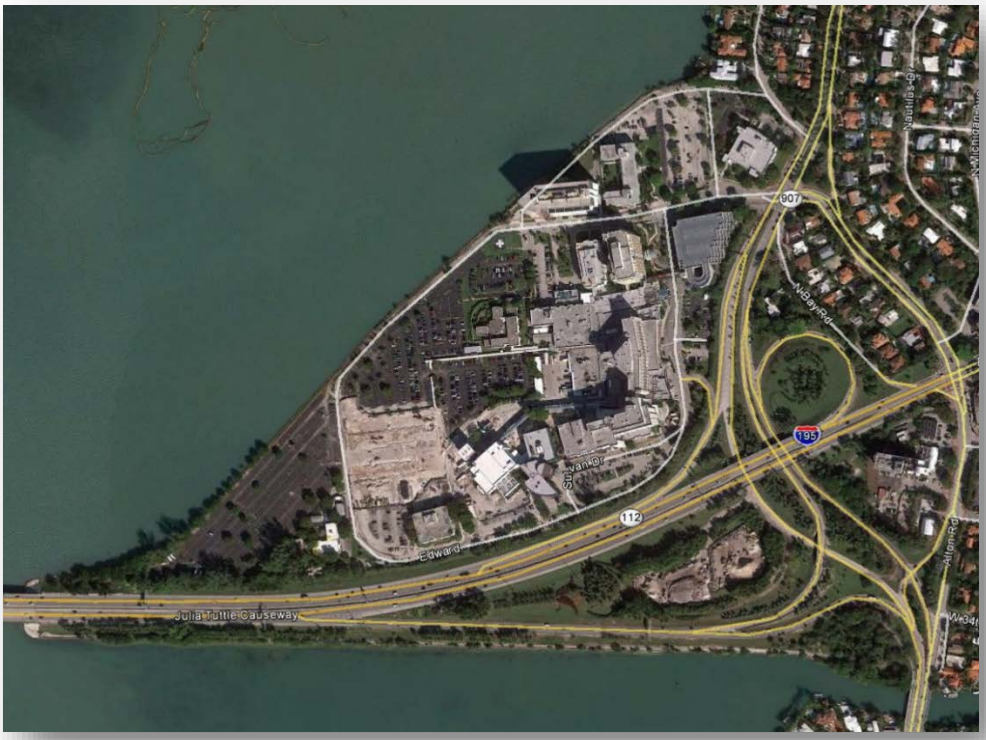
MOUNT SINAI MEDICAL CENTER, CONTINUING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT



July 2017

US Army Corps of Engineers ®
Jacksonville District

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US Army Corps of Engineers
JACKSONVILLE DISTRICT

DRAFT FINDING OF NO SIGNIFICANT IMPACT

MOUNT SINAI MEDICAL CENTER
CONTINUING AUTHORITIES PROGRAM
SECTION 14 PROJECT
MIAMI-DADE COUNTY, FLORIDA

The U.S. Army Corps of Engineers, Jacksonville District (Corps), has prepared an environmental assessment in accordance with the National Environmental Policy Act of 1969, as amended, and the White House's Council on Environmental Quality regulations to assess environmental effects of replacing a seawall at the Mount Sinai Medical Center under Section 14 of the Continuing Authorities Program. The Corps assessed the effects of the following actions in the Integrated Feasibility Study and Environmental Assessment (IFS/EA) dated May 2017 for the Mount Sinai Medical Center in Miami Beach, Miami-Dade, Florida. The Recommended Plan consists of the following:

- Installation of 3,070 linear feet of sheetpile (25-feet long PZC-13 steel sheetpile) driven to a depth of 16 feet in the 3,200 foot long footprint of the existing seawall.
- Use of a vibration or impact hammer to drive the sheetpile no more than 3 feet waterward of the existing seawall with a concrete cap elevation of 4.0 feet, North American Vertical Datum of 1988 (NAVD88). The three foot offset is necessary for workers to reconnect any drainage system or utilities between the new and existing seawall. The three feet offset will be filled with stone.
- A 300 foot long T-wall will tie into the sheetpile and continue landward to the 3.5 foot contour to prevent flanking of the seawall.
- A 1.5 foot concrete lift added to the 130 foot section of existing seawall constructed in 1990 to reach an overall crest elevation of 4.0 feet NAVD88.

In addition to the No Action Alternative, eight structural alternatives were evaluated, including the Recommended Plan. The other alternatives consisted of structural measures to reinforce, elevate, fully or partially replace the existing seawall. Relocation was also evaluated in comparison with the Recommended Plan. Six structural alternatives were eliminated from detailed evaluation due to cost and the need per U.S. Army Engineering Regulation 1105-2-100 Appendix F, Section III, F-23 to select the least cost alternative.

I have reviewed the IFS/EA for the Recommended Plan. This Finding incorporates by reference all discussions and conclusions contained in the IFS/EA enclosed hereto. Based on the information analyzed

in the IFS/EA, which reflects pertinent information obtained from agencies having jurisdiction by law and/or special expertise, I conclude that the Recommended Plan will not significantly affect the quality of the human environment and does not require an Environmental Impact Statement. Reasons for this conclusion are in summary:

a. The Recommended Plan is in compliance with the Endangered Species Act of 1973, as amended. On November 15, 2016, the U.S. Fish and Wildlife Service concurred with the Corps' determination that the Recommended Plan "may affect, but it not likely to affect" listed species under their jurisdiction. National Marine Fisheries Service (NMFS) concurred with the Corps' determination that the project "may affect, but it not likely to adversely affect" sea turtle species and smalltooth sawfish. However, NMFS issued a Biological Opinion (biop) dated June 13, 2017, which provided terms and conditions to lessen the impacts to listed sea turtles and smalltooth sawfish from noise. USACE shall incorporate the terms and conditions into the construction plans and specifications. Additionally, NMFS has determined that the project may adversely affect Johnson's seagrass designated critical habitat and the biop included the adverse effect associated with the project. .
b. This project is the maintenance of an existing bulkhead and as a result does not require an Environmental Resource Permit from the Florida Department of Environmental Protection (FDEP), however an exemption will be obtained during the plans and specifications portion of the project. The Corps coordinated a consistency determination pursuant to the Coastal Zone Management Act through circulation of the IFS/EA via public notice dated September 29, 2016. The FDEP determined via letter dated December 7, 2016 that "the state has no objections to allocation of federal funds for the subject project and, therefore, the funding award is consistent with the Florida Coastal Management Program."
c. The Recommended Plan has been coordinated with the Florida State Historic Preservation Officer and the appropriate federally recognized Tribes in accordance with the National Historic Preservation Act and consideration given under the National Environmental Policy Act. On September 26, 2016 the Florida State Historic Preservation Officer determined that the replacement of the seawall at Mount Sinai Medical Center will have no effect on historic properties eligible or potentially eligible for listing in the National Register of Historic Places.
d. The Corps concluded consultation with NMFS under the Essential Fish Habitat provisions of the Magnuson Stevens Act. NMFS Habitat Conservation Division provided six conservation recommendations on December 1, 2016 and January 9, 2017 with the Corps providing responses December 27, 2016 and February 2, 2017, concluding consultation.
e. Benefits to the public will be to replace a seawall that protects the perimeter road that provides access to the Emergency Room, as well as other hospital facilities that support the only hospital on Miami Beach. This ensures continued access to the hospital by the public of Miami Beach.

All practicable means to avoid and minimize adverse environmental effects have been incorporated into the Recommended Plan. Measures will be in place during construction to eliminate, reduce, or avoid adverse impacts below the threshold of significance to fish and wildlife resources including the following:

- A Protected Species Observer shall be present on the project during all construction activities and shall ensure that if any protected species (marine mammals, sea turtles, smalltooth sawfish) enter the buffer area, the project shall cease in-water operations until

either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal;

- A two ringed bubble curtain will be required through project construction;
- Water quality shall be protected by adherence to the State of Florida water quality criteria for Biscayne Bay Aquatic Preserve; and
- For all construction methods, the Corps will utilize a shutdown zone which will always be a minimum of 15 meters (50 feet) around the work area with a dedicated/qualified Endangered Species/Marine Mammal Observer. For impact pile driving, which generates impulsive sound, a larger 100 meters (330 foot) shutdown zone shall be implemented for marine mammals only; the standard 50 meter shutdown zone will continue to be applied for all other protected species.

In view of the above and the attached IFS/EA, and after consideration of public and agency comments received on the project, I conclude that the Recommended Plan would not result in a significant effect on the quality of the human environment. This Finding of No Significant Impact incorporates by reference all discussions and conclusions contained in the IFS/EA enclosed herewith. A copy of these documents will be made available to the public at the following website: http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx.

Jason A. Kirk, P.E.
Colonel. U.S. Army
District Commander

22 SEP 2017
Date

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USING THIS DOCUMENT

Report Reference Materials: To ease navigation through the report, prompts are provided throughout the document, alerting the reader to reference additional sections or graphics. In this report, these prompts can be identified by this blue box format.

Additionally, informational foldout REF-1 is provided at the end of the report to be used while reading the document to serve as a reference map with key points and landmarks.

Detailed tables of contents are provided by chapter in the main report, as well as an index at the end of the report.

TABLE OF CONTENTS

Main Report

Executive Summary.....ES-1
EA: Summary

1 Introduction.....1-1
EA: Purpose of and Need for Action

2 Existing and Future Without-Project Conditions.....2-1
EA: Existing and Future Without-Project Conditions

3 Plan Formulation.....3-1
EA: Alternatives Including Proposed Action

4 The Recommended Plan.....4-1
EA: Alternatives Including Proposed Action

5 Environmental Compliance.....5-1
EA: Scoping, Public Involvement, Compliance with Environmental Regulations

6 Recommendations.....6-1

Appendices

APPENDIX A – ENGINEERING
APPENDIX B – COST ENGINEERING AND RISK ANALYSIS
APPENDIX C – PERTINENT CORRESPONDENCE
APPENDIX D – ENVIRONMENTAL
D-1 – 404 b1 Evaluation

D-2 – CZMA Determination
D-3 – Environmental Surveys
APPENDIX E – REAL ESTATE PLAN

Table of Contents

1 INTRODUCTION* 1-1

1.1 STUDY AUTHORITY* 1-1

1.2 STUDY SPONSOR 1-1

1.3 LOCATION OF STUDY AREA AND VULNERABLE FACILITIES 1-2

1.4 STUDY PURPOSE AND NEED 1-2

1.5 PRIOR STUDIES 1-9

1.6 DECISION TO BE MADE 1-9

1.7 SCOPING AND ISSUES 1-9

1.8 PERMITS, LICENSE, AND ENTITLEMENTS 1-9

2. EXISTING AND FUTURE WITHOUT-PROJECT CONDITIONS 2-1

2.1. PHYSICAL ENVIRONMENT 2-1
2.1.1. EROSION 2-1
2.1.2. CLIMATE 2-7

2.2. NATURAL ENVIRONMENT (AFFECTED ENVIRONMENT) 2-11

2.3. GENERAL ENVIRONMENTAL SETTING 2-11
2.3.1. VEGETATION 2-12

2.4. THREATENED AND ENDANGERED SPECIES 2-17
2.4.1. SEA TURTLES 2-17
2.4.2. MANATEES 2-17
2.4.3. JOHNSON'S SEAGRASS 2-19
2.4.4. AMERICAN CROCODILE 2-20
2.4.5. SMALLTOOTH SAWFISH 2-21
2.4.6. SCLERACTINIAN CORALS 2-21

2.5. FISH AND WILDLIFE RESOURCES 2-24
2.5.1. BOTTLENOSE DOLPHINS 2-24

2.5.2. FISHES 2-25
2.5.3. MIGRATORY BIRDS 2-25
2.5.4. ESSENTIAL FISH HABITAT 2-26
2.5.5. INVASIVE SPECIES 2-26
2.5.6. COASTAL BARRIER RESOURCES 2-28
2.5.7. AIR QUALITY 2-28
2.5.8. WATER QUALITY 2-28
2.5.9. NOISE 2-29
2.5.10. CULTURAL RESOURCES 2-30
2.5.11. AESTHETIC AND RECREATION RESOURCES 2-31
2.5.12. HAZARDOUS AND TOXIC MATERIALS 2-32

3. PLAN FORMULATION 3-1

3.1. PROBLEMS AND OPPORTUNITIES 3-1
3.1.1. PROBLEMS 3-1
3.1.2. OPPORTUNITIES 3-1

3.2 CONSTRAINTS 3-2
3.2.1. PLANNING CONSTRAINTS 3-2

3.3. OBJECTIVES 3-2
3.3.1. PLANNING OBJECTIVES 3-2
3.3.2. FEDERAL ENVIRONMENTAL OBJECTIVES 3-3

3.4. SUMMARY OF MANAGEMENT MEASURES AND RELOCATION 3-3
3.4.1 NON-STRUCTURAL (NS) 3-3
3.4.2 STRUCTURAL (S) 3-3
3.4.3. PRELIMINARY SCREENING 3-4
3.4.4. SECONDARY SCREENING 3-6
3.4.5. MEASURES CARRIED FORWARD 3-8
3.4.6. RELOCATION 3-8

3.5. ALTERNATIVE DEVELOPMENT 3-10
3.5.1. DESIGN ELEVATION DETERMINATION (STRUCTURE CREST AND VERTICAL ROAD RELOCATION) 3-10
3.5.2. ALTERNATIVE 1 3-10
3.5.3. ALTERNATIVE 2 3-11

3.6. ENVIRONMENTAL EFFECTS OF ALTERNATIVES 3-12
3.6.1. GENERAL ENVIRONMENTAL EFFECTS 3-12
3.6.2. VEGETATION 3-13
3.6.3. THREATENED AND ENDANGERED SPECIES 3-15
3.6.4. FISH AND WILDLIFE RESOURCES 3-23
3.6.5. ESSENTIAL FISH HABITAT ASSESSMENT 3-28
3.6.6. HISTORIC PROPERTIES 3-28
3.6.7. SOCIO-ECONOMIC 3-29
3.6.8. AESTHETICS 3-29
3.6.9. RECREATION 3-29

3.6.10. WATER QUALITY 3-29
3.6.11. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE 3-30
3.6.12. AIR QUALITY 3-31
3.6.13. NOISE 3-31
3.6.14. PUBLIC SAFETY 3-32
3.6.15. ENERGY REQUIREMENTS AND CONSERVATION 3-33
3.6.16. NATURAL OR DEPLETABLE RESOURCES 3-33
3.6.17. REUSE AND CONSERVATION POTENTIAL 3-33
3.6.18. SCIENTIFIC RESOURCES 3-33
3.6.19. NATIVE AMERICANS 3-33
3.6.20. URBAN QUALITY 3-33
3.6.21. DRINKING WATER 3-33
3.6.22. INVASIVE SPECIES 3-33
3.6.23. CUMULATIVE IMPACTS 3-33
3.6.24. POTENTIALLY AFFECTED RESOURCES 3-34
3.6.25. RESOURCES NOT LIKELY TO BE CUMULATIVELY AFFECTED 3-35
3.6.26. CUMULATIVE EFFECTS ASSESSMENT CONCLUSION 3-36

3.7. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES 3-37
3.7.1. IRRETRIEVABLE 3-37
3.7.2. IRREVERSIBLE 3-37

3.8. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS 3-37

3.9. COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES 3-37

3.10. CONFLICTS AND CONTROVERSY 3-37

3.11. UNCERTAIN, UNIQUE, OR UNKNOWN RISKS 3-37

3.12. PRECEDENT AND PRINCIPLE FOR FUTURE ACTIONS 3-38

3.13. SCREENING OF FINAL ALTERNATIVES VS RELOCATION 3-38
3.13.1. COST COMPARISON 3-39

3.14. IMPACT AVOIDANCE AND MINIMIZATION 3-40

4. RECOMMENDED PLAN 4-1

4.1. DESIGN AND CONSTRUCTION CONSIDERATIONS 4-1
4.1.1. GENERAL DESCRIPTION 4-1
4.1.2. ENVIRONMENTAL OPERATING PRINCIPLES 4-2
4.1.3. PLAN IMPLEMENTATION REQUIREMENTS 4-2

4.2. DETAILED COST ESTIMATE AND COST SHARING 4-3

4.3. SEA LEVEL CHANGE CONSIDERATIONS 4-4

4.4. RESIDUAL RISK 4-4

5. ENVIRONMENTAL COMPLIANCE 5-1

5.1. SCOPING 5-1

5.2. AGENCY COORDINATION 5-1

5.3. LIST OF RECIPIENTS 5-1

5.4. COMMENTS RECEIVED AND RESPONSE 5-1

5.5. ENVIRONMENTAL COMMITMENTS 5-1
5.5.1. PROTECTION OF MANATEES DURING ALL IN-WATER CONSTRUCTION ACTIVITIES 5-1
5.5.2. PROTECTION OF ALL MARINE MAMMALS (MANATEES AND DOLPHINS) DURING SEAWALL CONSTRUCTION ACTIVITIES 5-1
5.5.3. PROTECTION OF SEA TURTLES AND SMALLTOOTH SAWFISH 5-2

5.6. COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS 5-2
5.6.1. NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 5-2
5.6.2. ENDANGERED SPECIES ACT OF 1973 5-2
5.6.3. FISH AND WILDLIFE COORDINATION ACT OF 1958 5-2
5.6.4. NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA) 5-2
5.6.5. CLEAN WATER ACT OF 1972 5-3
5.6.6. CLEAN AIR ACT OF 1972 5-3
5.6.7. FARMLAND PROTECTION POLICY ACT OF 1981 5-3
5.6.8. WILD AND SCENIC RIVER ACT OF 1968 5-3
5.6.9. MARINE MAMMAL PROTECTION ACT OF 1972 5-3
5.6.10. ESTUARY PROTECTION ACT OF 1968 5-4
5.6.11. SUBMERGED LANDS ACT OF 1953 5-4
5.6.12. COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990 5-4
5.6.13. RIVERS AND HARBORS ACT OF 1899 5-4
5.6.14. ANADROMOUS FISH CONSERVATION ACT 5-4
5.6.15. MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT 5-4
5.6.16. MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT 5-4
5.6.17. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT 5-4
5.6.18. UNIFORM RELOCATION ASSISTANCE AND REAL PROPERTY ACQUISITION POLICIES ACT OF 1970 5
5.6.19. E.O. 11990, PROTECTION OF WETLANDS 5-5
5.6.20. E.O. 11988, FLOOD PLAIN MANAGEMENT 5-5
5.6.21. E.O. 12898, ENVIRONMENTAL JUSTICE 5-5
5.6.22. E.O. 13089, CORAL REEF PROTECTION 5-6
5.6.23. E.O. 13112, INVASIVE SPECIES 5-6
5.6.24. E.O. 13186, MIGRATORY BIRDS. 5-6
5.6.25. E.O. 13045, DISPARATE RISKS INVOLVING CHILDREN 5-6

6. RECOMMENDATIONS 6-1

6.1 DRAFT ITEMS OF LOCAL COOPERATION 6-1

6.2 DISCLAIMER 6-4

MOUNT SINAI MEDICAL CENTER
CAP – SECTION 14 DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT
CITY OF MIAMI BEACH, FLORIDA

EXECUTIVE SUMMARY

Please refer to informational foldout REF-1 located on the back page of this report.

PURPOSE AND NEED

This study was conducted under the authority of Section 14 of the Flood Control Act of 1946, as amended, which authorizes the study, design, and construction of small projects for streambank and shoreline erosion protection of public works and non-profit public services. Section 14 is designed to implement projects to protect public facilities and facilities owned by non-profit organizations used to provide public services that are open to all on equal terms. These facilities must have been properly maintained but be in imminent threat of damage or failure by natural erosion processes on stream banks and shorelines, and are essential and important enough to merit Federal participation in their protection.

The Mount Sinai Medical Center is a major medical institution that serves not only the citizens of the City of Miami Beach, but offers a wide array of services to hundreds of thousands of people in the greater Miami metropolitan area (Miami Herald, 2016). The medical center is the only hospital facility on a barrier island and maintains emergency services and shelter for critically ill patients during disasters. The center is also an Essential Services facility and a disaster coordination point. The facility is unable to fully evacuate all patients during disasters and must shelter in place, as well as provide critical support to the population remaining on the island and other facilities with emergency needs.

Currently, during extreme high tide events, the bayside seawall (approximately 3,500 feet long) is overtopped by tides and waves. Overtopping and resulting inundation drives erosion and subsidence of land behind the wall threatening vulnerable facilities including a perimeter road and parking facilities which are critical to the center's operations. Continued erosion will result in failure of portions, or all, of the existing seawall. Such failure would impact the perimeter road and vulnerable parking, negatively affecting the daily operations of the medical center, limiting access to the Emergency Department, hospital facilities, and potentially causing life risk.

ALTERNATIVE PLANS AND THE RECOMMENDED PLAN

Plan Formulation

A description of the alternatives, their performance in terms of benefits and costs, and the methods used for screening are provided in the sub-sections that follow.

Management Measures

Management measures considered include:

Non-Structural (NS)

NS-1: No Action

*Other measures that would typically be considered non-structural are considered under "Relocation."

Structural (S)

S-1: Adding elevation to existing seawall (lift, sandbags, stone, wood, or other material).

S-2: Revetment on waterside of existing seawall to existing elevation.

S-3: Revetment on waterside and on top of existing seawall to higher elevation.

S-4: Sheetpile (vinyl, steel, or other material) placement on the waterside of the existing seawall to existing elevation.

S-5: Sheetpile (vinyl, steel, or other material) placement on waterside of existing seawall to higher elevation.

S-6: Sheetpile (vinyl, steel, or other material) placement on landside of existing seawall at existing elevation with erosion prevention measure placed on land behind seawall.

S-7: Sheetpile (vinyl, steel, or other material) placement on landside of existing seawall to higher elevation.

S-8: Erosion prevention material placed on land behind seawall.

Figure ES-1 shows a graphic depiction of structural measures.

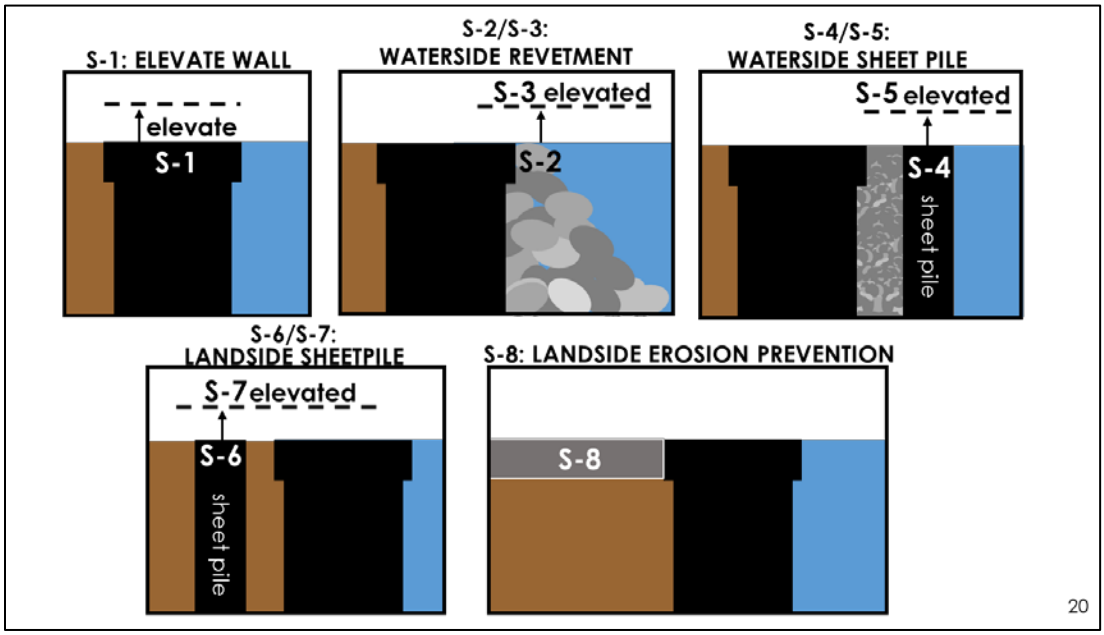

Figure ES-1: Graphic depiction of structural measures considered.

Alternative Development, Relocation, and the Recommended Plan

Per ER 1105-2-100 Appendix F, Section III, F-23, alternatives are compared to determine the least cost alternative. The least cost alternative plan is considered to be justified if the total cost of the proposed alternative is less than the cost to relocate the threatened facilities. Therefore, relocation is not considered a "measure" or "alternative" but rather a basis for cost comparison.

Adding elevation to the existing seawall (S-1), sheetpile placement on the waterside of the existing seawall to higher elevation (S-5), and No Action (NS-1) were the measures carried forward for alternative development and comparison with Relocation. Comparison of each alternative to the No Action Alternative is a requirement of the National Environmental Policy Act (NEPA). S-1 and S-5 were scaled and combined to formulate two alternatives; Alternative 1 and Alternative 2.

The barrier island on which the Mount Sinai Medical Center is located is very densely developed, and real estate prices are some of the highest in the nation. Opportunities to relocate vulnerable facilities are limited. Relocation options considered included:

- Vertical relocation of the perimeter road on piles.
- Vertical relocation of the perimeter road on an elevated berm.
- Offsite parking within walking distance of hospital facilities.
- Offsite parking (in existing or new construction) with shuttle service to hospital facilities.
- Parking constructed onsite.

The selected relocation option consists of vertical relocation of the vulnerable portion of the perimeter road on an elevated berm. Relocation also includes relocation of vulnerable parking to a new parking garage constructed on the medical center property.

Per ER 1105-2-100 Appendix F, Section III, F-23**, the least cost alternative plan is considered to be justified if the total costs of the proposed alternative are less than the costs to relocate the threatened facility.** The costs of Alternative 1, Alternative 2, and Relocation are shown in Table ES-1. Both alternative costs are less than relocation. Alternative 2 is preferable to No Action and is the least cost alternative plan. Alternative 2 is therefore considered to be justified and is the Recommended Plan.

Table ES-1: Cost comparison.

CONSTRUCTION COST ONLY
Planning Level Estimates 20Jul16

	Item	Number of Units	Units	Cost
Relocation	parking garage	250	parking spaces	$5,500,000
	sheet pile	1000	lf	$1,345,000
	elevated road	1310	lf	$707,400
			Total =	**$7,552,400**
Alternative 1	Item	Number of Units	Units	Cost
	sheet pile	3200	lf	$4,304,000
	T-wall	300	lf	$91,500
			Total =	**$4,395,500**
Alternative 2	Item	Number of Units	Units	Cost
	sheet pile	3070	lf	$4,129,200
	1.5 ft concrete lift	130	lf	$9,800
	T-wall	300	lf	$91,500
			Total =	**$4,230,500**

Table ES-2: Certified Construction Cost only*.

Walla Walla Certified Estimate
08May17

	Item	Number of Units	Units	Cost
Alternative 2	sheet pile	3070	lf	$4,740,000
	1.5 ft concrete lift	130	lf	$16,000
	T-wall	300	lf	$87,000
			Total =	**$4,843,000**

*No Construction Management, EDC, S&A , S&I and Administrative (RE)

The Recommended Plan (Alternative 2) includes installation of 3,070 linear feet of sheetpile (25-ft long PZC-13 steel sheetpile) driven to a depth of 16 feet in the 3,500 foot long footprint of the existing seawall. The sheetpile will be driven by vibration or impact hammer approximately three feet waterward of the existing seawall with a concrete cap elevation of 4.0 feet (North American Vertical Datum (NAVD88)). The three foot offset is necessary for workers to reconnect any drainage system or utilities between the new and existing walls. The three foot offset will be filled with stone. At the northeast end of the driven sheetpile, a 300 foot long T-wall will tie-in to the sheetpile and continue landward to the 3.5 foot contour to prevent flanking of the seawall. Sheetpile will not be driven in front of the 130 foot section of seawall constructed in 2009. This section has been deemed structurally sound enough to add a 1.5 foot concrete lift to the top of the existing wall to reach an overall crest elevation of 4.0 feet NAVD88. **Figure ES-2** depicts the Recommended Plan in plan view.

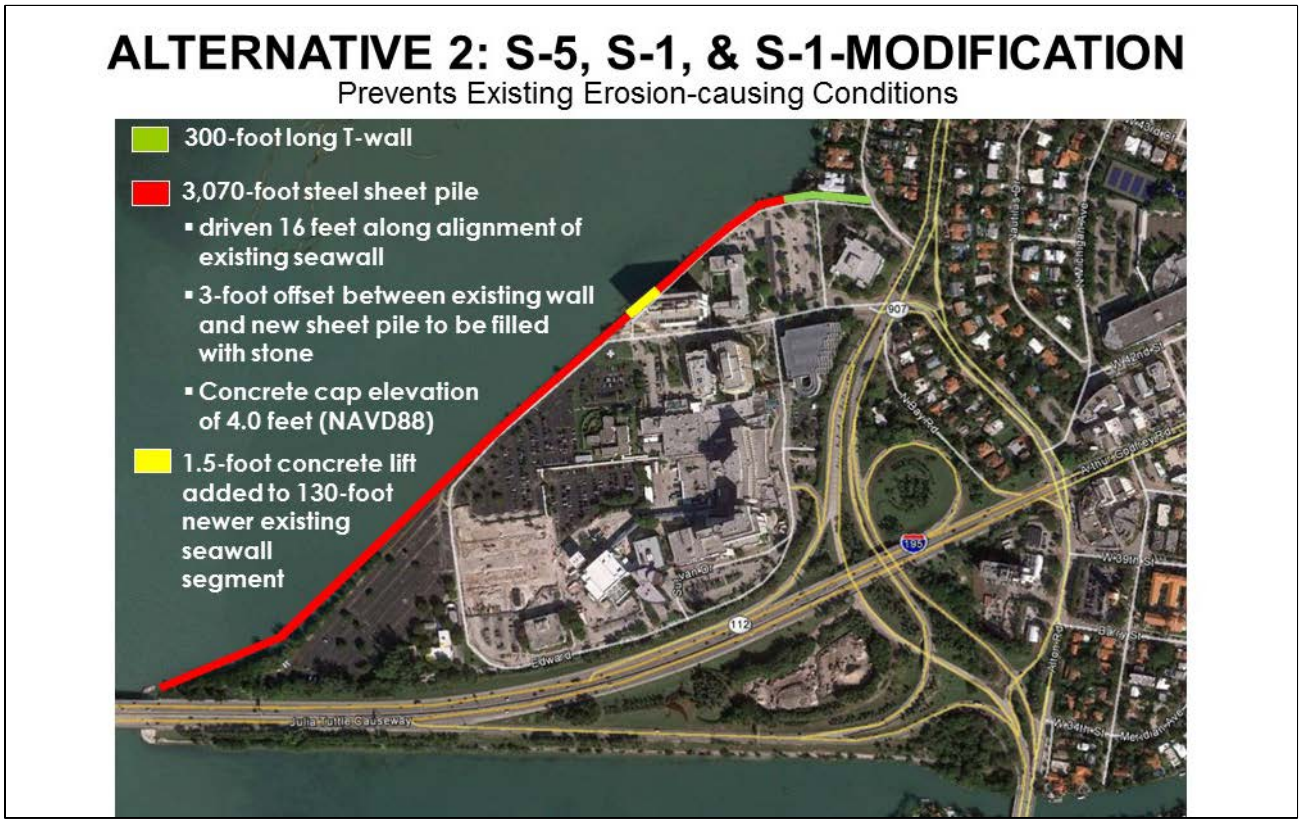

Figure ES-2: Recommended Plan.

Sea Level Change (SLC)

The project area, and the City of Miami Beach as a whole, are vulnerable to sea level change. However, given the emergency nature and funding constraints of the CAP Section 14 authority, future sea level change was not a key factor for alternative development. Alternative development focused on preventing current erosion causing conditions. However, future sea level change was considered, per guidance, in order to recommend an alternative that prevents current erosion causing conditions and is able to be adapted to future sea level change by the sponsor if necessary. The Recommended Plan will increase the current crest elevation by 1.5 feet to prevent overtopping of the wall, as currently seen with the existing structure. As sea levels change, extreme high tide events will begin to overtop the Recommended Plan. At that time, the Recommended Plan could be adapted by the sponsor by construction of a concrete elevation lift, similar to that being done on the 130 feet of existing wall, to raise the crest elevation further. Any investigation, design, and construction of such adaptations would be the responsibility of the sponsor.

ENVIRONMENTAL CONSIDERATIONS

Environmental considerations for this project include compliance with NEPA, species listed as threatened or endangered under the Endangered Species Act, as well as associated designated critical habitat, habitats designated as essential fish habitat under the Magnuson Stevens Fisheries Conservation and Management Act, water quality under the Clean Water Act, and historic and cultural resources protected under the National Historic Preservation Act. A detailed list of all environmental laws, regulations, and

executive orders applicable to this action and compliance with those requirements is included in Section 5.6 of this report.

COST ESTIMATE AND IMPLEMENTATION

Planning level costs used construction costs only and did not include construction management (S&I or S&A), engineering during construction, or administrative costs. The certified costs for construction for the Recommended Plan is $4,843,000 (Table ES-1). Federal costs total 65% of the Recommended Plan, or $4,095,000. Non-federal costs total 35%, or $2,205,000. The expected construction duration is 18 months.

The current cost estimate for the Recommended Plan is $6,300,000. This cost is more developed than the planning level costs shown in Table ES-2.

NON-FEDERAL SPONSOR AND CONGRESSIONAL REPRESENTATION

The study was requested by the City of Miami Beach, the local non-federal sponsor, in a letter dated January 13, 2014. The project also has strong congressional support as indicated in a letter dated February 24, 2014 from Congresswoman Debbie Wasserman Schultz. The City supports the Recommended Plan to protect the medical center from further damage and prevent potential failures at the facility.

Congressional representation for the area includes the following:
Honorable Representative Debbie Wasserman Schultz

10100 Pines Boulevard
Pembroke Pines, FL 33026
(954) 437-3936
19200 West Country Club Drive, 3rd Floor
Aventura, FL 33180
(305) 936-5724

COORDINATION WITH AGENCIES AND THE PUBLIC

A notice of availability for the EA and Finding of No Significant Impact (FONSI) was mailed to Federal and State agencies, tribal representatives, and members of the general public. A complete mailing list is available upon request. The EA and Draft FONSI was also posted on the Corps' internet website at the following address: http://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents/

The proposed project was coordinated with the following agencies: U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency (EPA), Florida State Clearinghouse, Florida State Historic Preservation Officer (SHPO), Florida Fish and Wildlife Conservation Commission (FFWCC), and the Florida Department of Environmental Protection (DEP). The draft NEPA document, integrated within this report, was coordinated with the public during a 60-day comment period from 26 September 2016 through 29 November 2016. Comments received on the report have been incorporated and the comments are included in Appendix E.

RISK CONSEQUENCE RATING

Without action, erosion will continue and extreme high tide events will continue to overtop the existing seawall, driving erosion and the ultimate failure of portions, or all, of the wall. Such failure will impact the perimeter road and vulnerable parking and negatively affect daily operations of the medical center, limiting access to hospital facilities, and potentially causing life risk. Furthermore, if seawall failures occurred during events necessitating activation of emergency disaster services, the center's function as an Essential Services facility and disaster coordination point could be severely impacted. These would constitute adverse impacts to facilities critical to public health, safety, security, and welfare that could occur within the next two to four years. These considerations elevate the Safety Risk Ranking in the Risk Consequence Matrix to a rank of 2 as shown in Table ES-3.

Table ES-3: Risk Consequence Matrix

SAFETY MATRIX RANKING		Consequences Category				
		Category A	Category B	Category C	Category D	Category E
Risk Level	Level A (0 to 2 years)	1	3	5	7	12
	Level B (2 to 4 years)	2	4	6	8	12
	Level C (4 to 6 years)	3	5	7	9	12
	Level D (6 to 8 years)	4	6	8	10	12
	Level E (Over 8 years)	5	7	9	11	12

This rank is based on the following: An undesirable event is anything which causes adverse consequences. In this case, the undesirable event is failure, either partial or total, of the existing seawall due to erosion. "Risk Level" is an estimate of the time, starting from the present, when an undesirable event is considered most likely to occur based on best professional judgment. Small portions of the seawall are currently failing; given this, and the poor condition of the wall in general, it is likely that failure could occur within the next 2-4 years, signifying Risk Level B.

Severity of impact from the event decreases from the highest severity in Category A to the lowest severity in Category E. Projects are assigned to the highest severity category for which one or more criteria in the category apply to the project consequences. Category A means that at least one of the following is expected if the undesirable event occurs.

- Adversely impacts transportation routes with Average Daily Traffic (ADT) over 50,000.
- Adversely impacts an affected population over 50,000.
- Adversely impacts an affected disadvantaged population over 20,000.
- Losses with an estimated relocation or replacement cost over $3,000,000.
- Adverse impacts to facilities critical to public health, safety, security, or welfare.
- Adverse impacts to facilities designated as having national cultural importance.

- Adverse impacts to facilities critical to interstate commerce.
- Loss of life is considered likely if no action is taken.

The severity of impact resulting from the failure of the existing seawall would meet four of the criteria under Category A:

1. Adversely impacts an affected population over 50,000:
   The 2014 population of Miami Beach is 125,000 residents; higher than the 50,000 population threshold. Furthermore, Miami Beach is a highly touristed area, and population increases with tourism multiple times per year.
2. Losses with an estimated relocation or replacement cost over $3,000,000:
   As will be described later in this report, the estimated relocation cost of threatened facilities is greater than $3,000,000.
3. Adverse impacts to facilities critical to public health, safety, security, or welfare:
   If the existing seawall fails, the perimeter road and existing parking will be impacted. Normal operations or emergency operations of the medical facility will be impacted and several of these criteria will be met. The Mount Sinai Medical Center is the only hospital facility on the barrier island and maintains emergency services, shelter for electric and oxygen dependent persons, and care for critically ill patients during disasters. The center is also an Essential Services facility and a disaster coordination point. The primary service area of the center sees 5,000,000 annual visitors and has 125,000 permanent residents. Yearly, there are 22,000 inpatient admissions and 181,000 outpatient admissions. There are 178+ emergency care visits and 7+ births per day. The facility is unable to fully evacuate all patients during disasters and must shelter in place, as well as provide critical support to the population remaining on the island and other facilities with emergency needs. Such impacts would also constitute "adverse impacts" to facilities critical to public health, safety, security, and welfare.
4. Loss of life is considered likely if no action is taken.
   Furthermore, loss of life could be considered likely depending on the severity of the impact and timing with respect to medical service needs.

RESIDUAL RISK

Even with implementation of the Recommended Plan, residual risk remains. The Recommended Plan addresses current erosion-causing conditions driven by overtopping of the bayside seawall as an emergency repair. It is not designed to prevent erosion resulting from extreme high tide events beyond those that have been experienced or that will occur as a result of sea level change. Residual risk remains that extreme high tide events in the future could overtop the new seawall and that the Mount Sinai property could be inundated by other current and future events, such as heavy rainfall, which the Recommended Plan is not designed to address.

1 INTRODUCTION*

Please refer to informational foldout REF-1, located on the back page of this report, throughout this report.

1.1 STUDY AUTHORITY*

This study was conducted under the authority of Section 14 of the Flood Control Act of 1946, as amended, which authorizes the study, design, and construction of small projects for streambank and shoreline erosion protection of public works and non-profit public services.

Section 14 is designed to implement projects to protect public facilities and facilities owned by non-profit organizations used to provide public services that are open to all on equal terms. These facilities must have been properly maintained, but be in imminent threat of damage or failure by natural erosion processes on stream banks and shorelines, and are essential and important enough to merit Federal participation in their protection.

The Mount Sinai Medical Center is a private non-profit hospital and is considered an eligible facility under Section 14, according to ER 1105-2-100, Appendix F, page F-30. The center's facilities have been properly maintained, but are in imminent threat of damage by natural erosion processes on the shoreline. Additional information on this program can be found in USACE 2000, Planning Guidance Notebook, Appendix F.

The feasibility study was carried out in a manner consistent with the USACE Environmental Operating Principles (EOPs). The principles are consistent with NEPA, the Army's Environmental Strategy with its four pillars (prevention, compliance, restoration, and conservation), and other environmental statutes that govern USACE activities. Finally, the implementation framework proposed as part of the study seeks to work collaboratively; fully engaging individuals, agencies, and local groups in identifying, planning, and implementing shoreline protection efforts.

1.2 STUDY SPONSOR

The study was requested by the City of Miami Beach, the local non-federal sponsor, in a letter dated January 13, 2014. The project has strong congressional support, as indicated in a letter, dated February 24, 2014, from Congresswoman Debbie Wasserman Schultz. The City supports the Recommended Plan to protect the medical center from further damage and to prevent potential failures at the facility.

Congressional representation for the area includes the following:

Honorable Representative Debbie Wasserman Schultz

10100 Pines Boulevard		19200 West Country Club Drive, 3rd Floor
Pembroke Pines, FL 33026	or	Aventura, FL 33180
(954) 437-3936		(305) 936-5724

1.3 LOCATION OF STUDY AREA AND VULNERABLE FACILITIES

The project vicinity is located in the City of Miami Beach, Florida, on a barrier island bordered to the east by the Atlantic Ocean and to the west by Biscayne Bay. The project area is the property of Mount Sinai Medical Center, located directly north of Julia Tuttle Causeway and extending approximately 0.57 miles along the bayside of the island. The area vulnerable to erosion is outlined in **Figure 1-1**. Within this area, vulnerable facilities include approximately 2,100 feet of the perimeter road, helicopter pad and parking facilities (approximately 250 parking spaces) closest to Biscayne Bay.

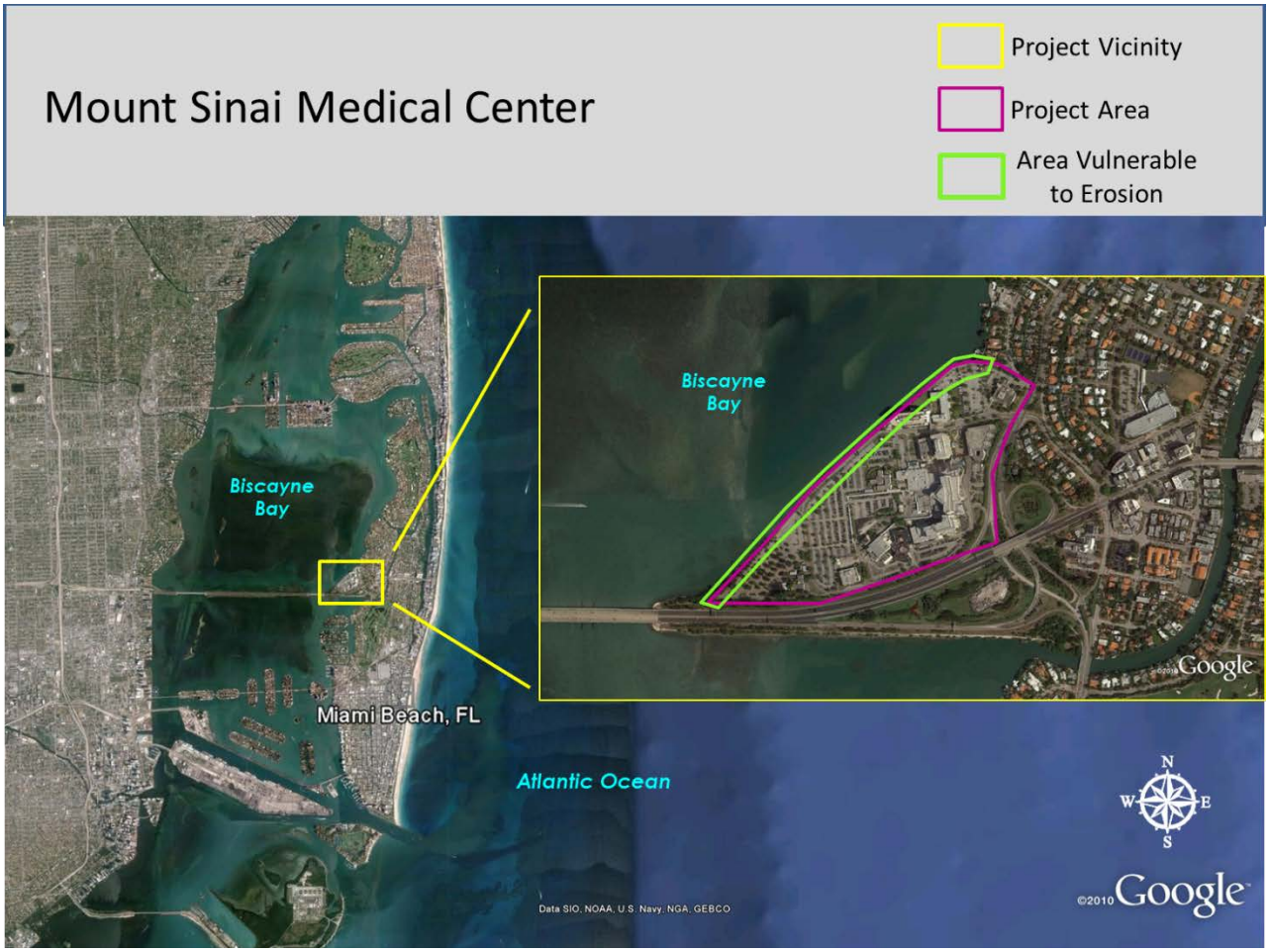

Figure 1-1: Mount Sinai vicinity and project area.

1.4 STUDY PURPOSE AND NEED

The Mount Sinai Medical Center is a major medical institution that serves not only the citizens of the City of Miami Beach, but offers a wide array of services to hundreds of thousands of people in the greater Miami metropolitan area. There are numerous buildings of various sizes on the campus, which is bordered on the west by Biscayne Bay (Antares Group 2014). **Figure 1-2** shows various buildings on the campus and an existing seawall bordering the property along Biscayne Bay.

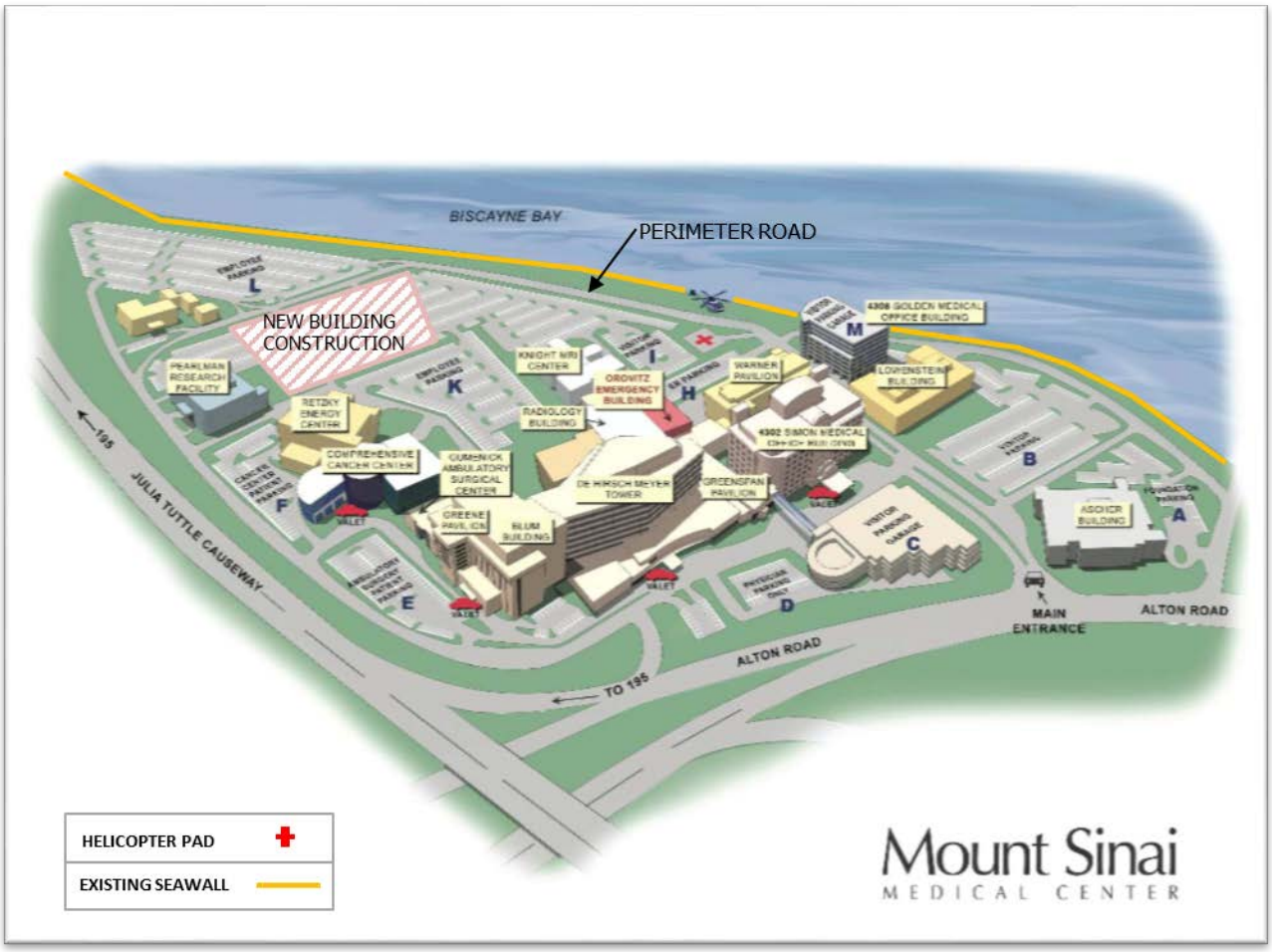

Figure 1-2: Site graphic of Mount Sinai Medical Center

The Mount Sinai Medical Center is the only hospital facility on the barrier island and maintains emergency services, shelter for electric and oxygen dependent persons, and care for critically ill patients during disasters. The center is also an Essential Services facility and a disaster coordination point. The facility is unable to fully evacuate all patients during disasters and must shelter in place, as well as provide critical support to the population remaining on the island and other facilities with emergency needs.

Currently, during extreme high tide events, the bayside seawall, approximately 3,500 feet long, is overtopped by tides and waves (**Figure 1-3 - Figure 1-6**). Overtopping, and the resulting inundation, drives erosion (**Figure 1-4**) of land behind the wall threatening vulnerable facilities including a perimeter road and parking facilities, which are critical to the center's operations. Continued erosion will result in failure of portions, or all, of the existing seawall which is currently in a degraded state (**Figure 1-7**). Such failure would impact the perimeter road and vulnerable parking, negatively affecting daily operations of the medical center, limiting access to hospital facilities, and potentially causing a risk to life.

The existing perimeter road, its location and configuration, are essential to maintaining hospital and emergency operation functions. The existing perimeter road encircles the mid-hospital property and traverses a significant portion of waterfront as shown in REF-1. Maintaining this configuration is essential for day-to-day hospital operations, as well as the hospital's function as a disaster staging area. The current road configuration provides first responders with quick, efficient access to the emergency room and

helipad, and provides correct dimensions for fire rescue apparatus. The current configuration along the seawall serves to separate pedestrian and vehicular traffic, which provides for a safer environment for pedestrians and minimizes traffic congestion.

All existing parking is necessary to medical center operations. The primary service area of the center sees 5,000,000 annual visitors and has 125,000 permanent residents. Yearly, there are 22,000 inpatient admissions and 181,000 outpatient admissions.

Figure 1-3: Biscayne Bay elevated to the top of the seawall during a July 2013 extreme high tide event. Standing water behind the wall, covering the perimeter road, resulted from overtopping of the seawall.

Figure 1-4: Segment of seawall showing waves overtopping wall and land subsidence causing potholes along perimeter road landward of seawall.

Figure 1-5: Inundation and waves breaking over the seawall carried seaweed behind the wall during an October 7, 2014 extreme high tide event.

Figure 1-6: Inundation and waves breaking over the seawall carried seaweed behind the wall during an October 7, 2014 extreme high tide event. Ponding water indicates land subsidence under the road.

Figure 1-7: Rusting rebar and cracking throughout the seawall (2014).

1.5 PRIOR STUDIES

Estimates of Flood Damages to Sea Wall, Facilities and Operations at the Mount Sinai Medical Center, Miami Beach, Florida, (Antares Group 2014). The purpose of this assessment was to provide a preliminary indication of potential damages to the Mount Sinai Medical Facility and to project potential additional risk based on sea level change.

1.6 DECISION TO BE MADE

Determine if a feasible alternative, from engineering and environmental perspectives, can be implemented to protect vulnerable facilities in place, or if relocating the vulnerable facilities would be more cost effective.

1.7 SCOPING AND ISSUES

The following environmental issues were identified as relevant to the proposed action and as appropriate for evaluation:

a. Vegetation
b. Threatened and Endangered Species
c. Scleractinian Corals
d. Fish and Wildlife Resources
e. Essential Fish Habitat
f. Coastal Barrier Resources
g. Water Quality
h. Hazardous and Toxic Materials
i. Air Quality
j. Noise
k. Historic Properties
l. Invasive Species
m. Aesthetic Resources
n. Recreation Resources

1.8 PERMITS, LICENSE, AND ENTITLEMENTS

The USACE will request verification of the exemption from the state's water quality standards under Section 401 of the Clean Water Act and Chapter 373.406 of Florida Statute from the Florida Department of Protection (FDEP) to cover the proposed action. Verification of the exemption will also constitute state concurrence that the project is consistent with the Florida Coastal Zone Management Program.

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2. EXISTING AND FUTURE WITHOUT-PROJECTCONDITIONS

2.1. PHYSICAL ENVIRONMENT

2.1.1. EROSION

EXISTING CONDITIONS

The existing seawall is approximately 3,500 feet long and was constructed in multiple phases to prevent erosion of the Mount Sinai Medical Center property. The northern segment was constructed first, in 1959. Approximately 400 feet of the original northern segment wall remains; this portion is in the poorest condition. (See **Figure 2-1** and **Figure 2-2**).

Figure 2-1: Northern segment of existing seawall.

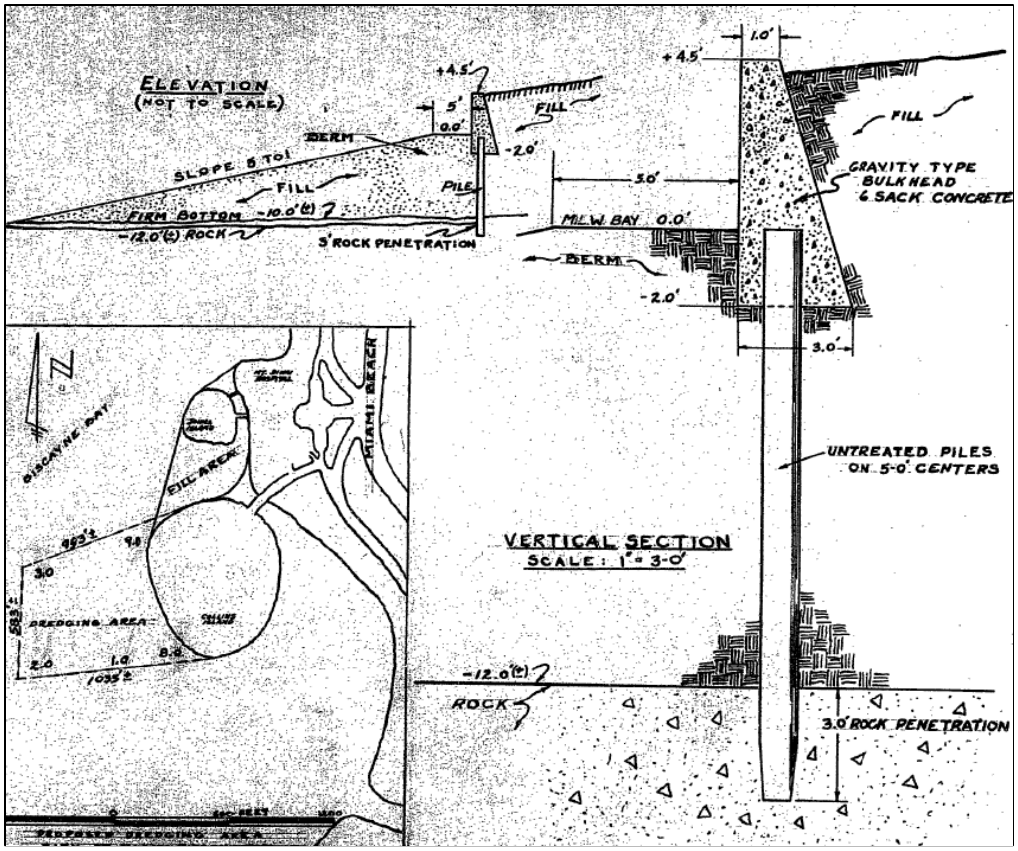


Figure 2-2: Design drawing of northern segment. Constructed circa 1959.

In 1967, dredged fill was placed adjacent to the Mount Sinai property to expand the upland. A new seawall was constructed to protect the newly created land from erosion (**Figure 2-3**). This segment is approximately 2,600 feet.

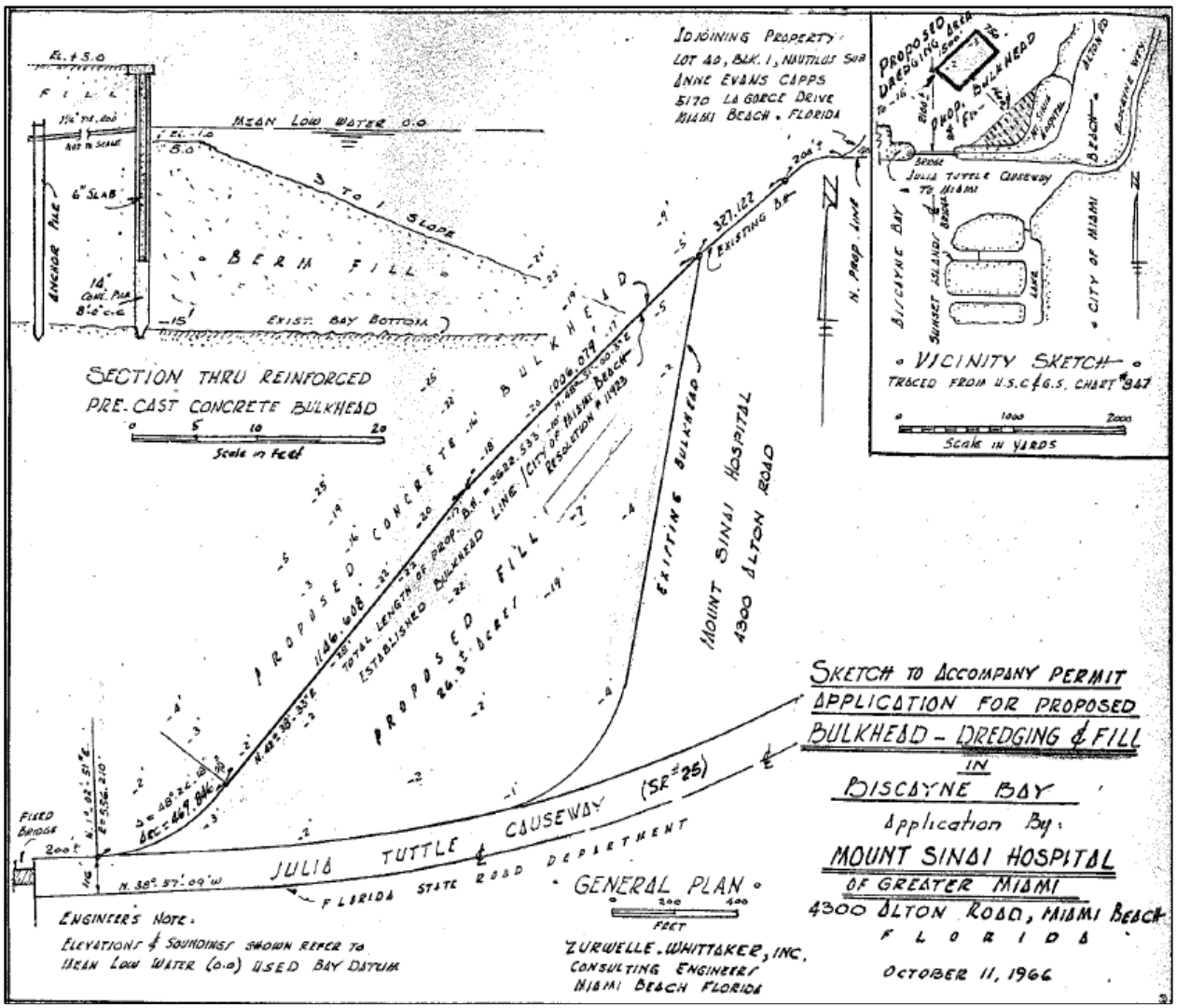


Figure 2-3: Design drawing for segment constructed in 1967.

In 2009, 130 feet of this segment of seawall was improved (**Figure 2-4**). Combined, all segments of the existing seawall total approximately 3,500 feet, with a crest elevation of approximately 2.5 feet NAVD88.

Figure 2-4: The newest segment of seawall; 130 feet constructed in 2009 and tying into the 1967 segment.

The majority of the seawall, except for the 130 feet constructed in 2009, is in a failing condition, evidenced by the cracking and spalling of concrete, exposed rusting steel reinforcement condition, and land subsidence landward of the wall indicating the loss of soil beneath through and or over the existing wall.

Most of the primary medical facilities and buildings are located away from Biscayne Bay on higher ground, with the exception of the Golden and Lowenstein buildings, which were constructed in close proximity to the seawall. A two-lane paved perimeter road and parking facilities extend along most of the length of the existing seawall. A grassy area from 8 to 15 feet wide extends along much of the area between the seawall and the perimeter road and parking facilities. Some trees, and other vegetation, exist along this grassy area. There is evidence of steel tiebacks for the seawall and possibly some underground utilities in this area. Areas of scouring damage are evident at many locations adjacent to the seawall, a result of overtopping and/or wave action. In some areas gravel has been placed in the scour holes to restore surface elevations and prevent further damage.

Critical facilities vulnerable to erosion include the portion of the perimeter road which runs adjacent to the seawall, approximately 1,000 feet of the perimeter road, and parking facilities adjacent to the seawall on the north and south ends of the medical center property. Existing condition segments of the seawall with critical infrastructure are shown in **Figure 2-5**.

Currently, during extreme high tide events, the seawall is overtopped resulting in inundation of the perimeter road and parking area. Overtopping is a major driver in the erosion of land behind the seawall which fronts the perimeter road and parking facilities. Overtopping allows soil to migrate through cracks

in the compromised portion of seawall and be carried over the wall as water recedes. Depth of the current seawall concrete piles are assumed to be three feet below the existing bay bottom. Although unverified, this limited depth may allow material to erode at the toe of the seawall. Given these conditions, the existing seawall is in imminent threat of damage by natural erosion processes. Loss of portions of the seawall will result in sudden, extreme erosion impacting existing critical facilities. These factors complicate and compromise hospital operations. A depiction of this erosion process is shown in **Figure 2-** and **Figure 2-**.

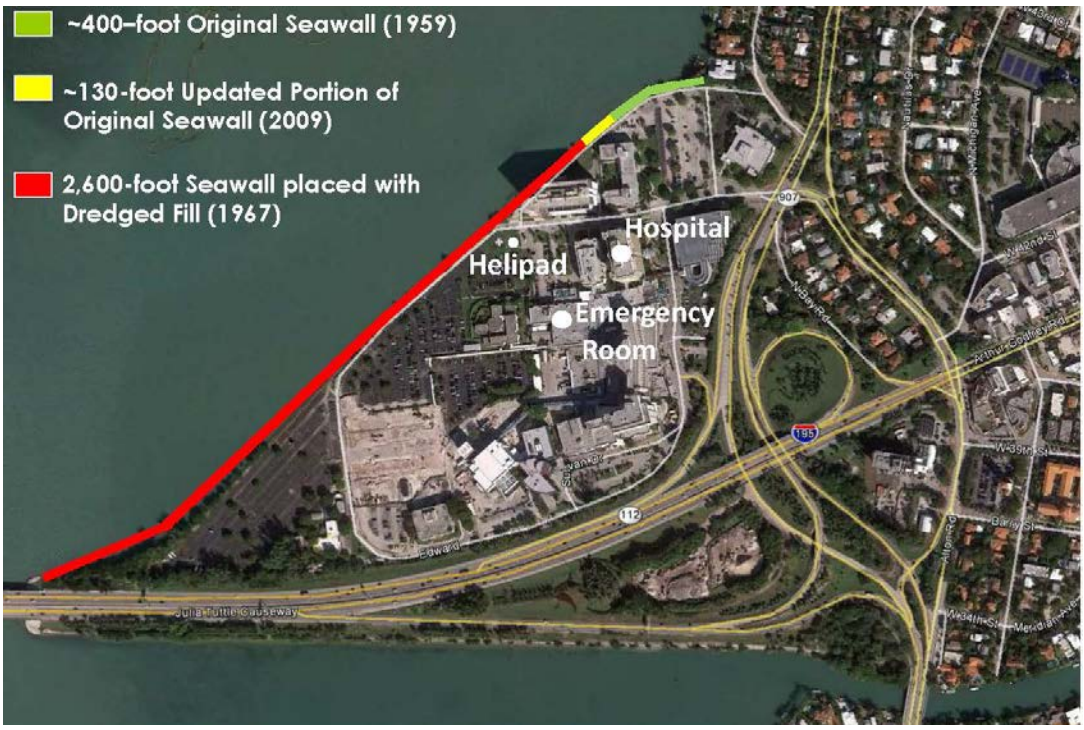


Figure 2-5: Existing Condition Seawall Segments with Critical Infrastructure.

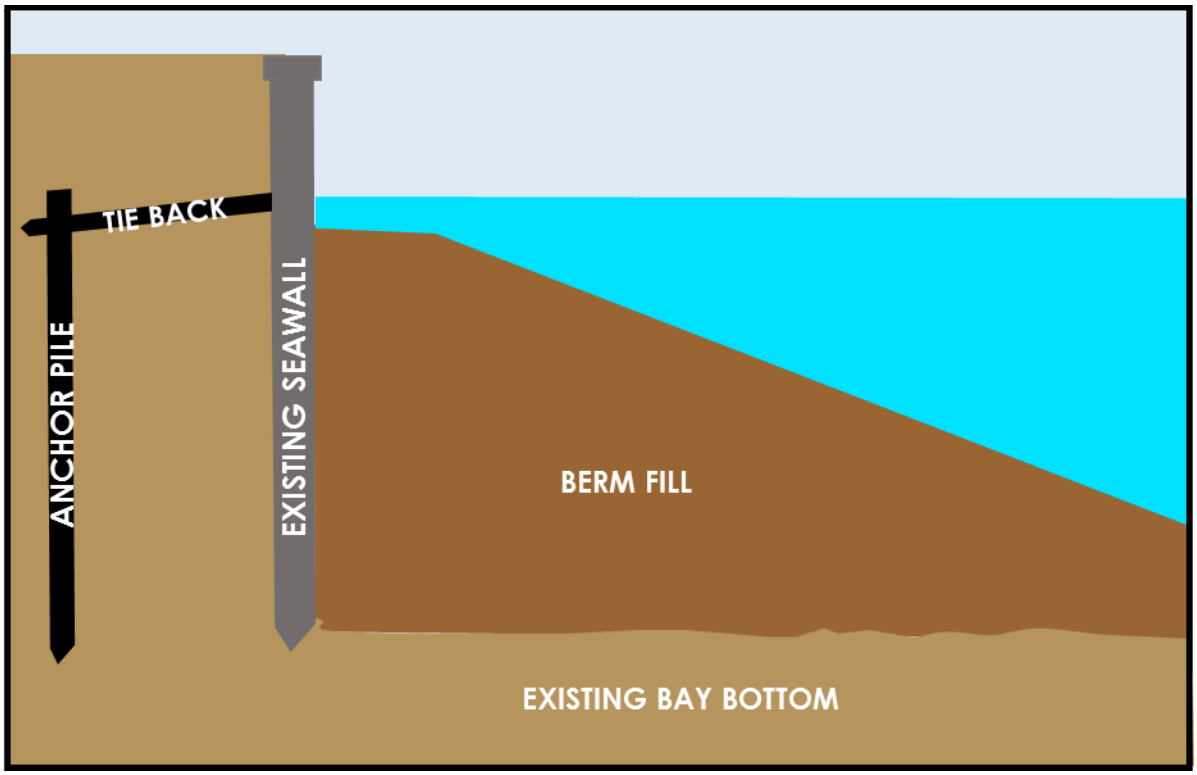


Figure 2-6: Seawall configuration for the majority of the existing seawall (1967 design).

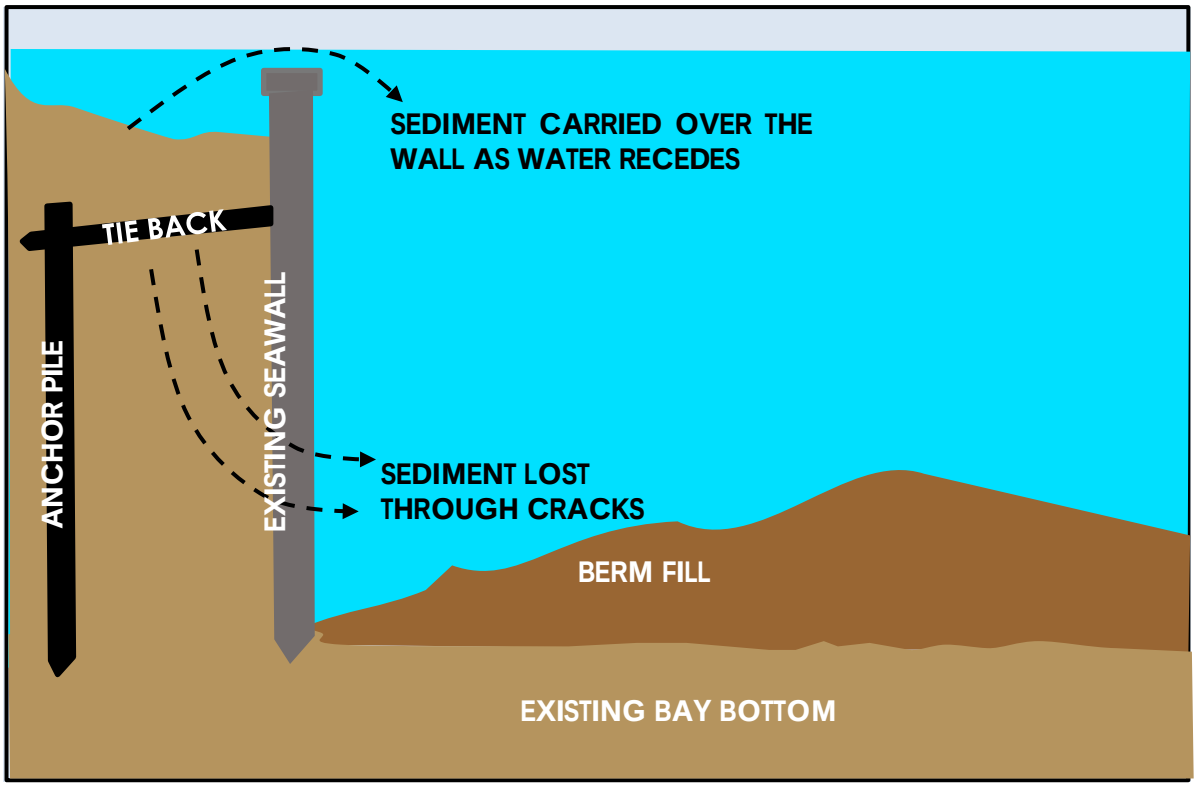


Figure 2-7: Erosion modes for the existing seawall: overtopping of the seawall crest resulting in sediment eroded over and through the existing seawall.

Erosion causes the subsidence of land behind the seawall. After extreme high tide events, standing water remains in subsided areas on the landward side of the seawall, complicating and compromising hospital operations and patient health (life risk). These complications would be exacerbated during disaster events, e.g. storms or hurricanes, where conditions would be worsened both by the natural event and by the increased use of hospital facilities as an emergency care facility and a disaster staging area.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Continued erosion will result in failure of portions, or all, of the existing seawall. Such failure would impact the perimeter road and vulnerable parking areas negatively affecting the daily operations of the medical center, limiting access to hospital facilities, and potentially causing a risk to life. Extreme high tide events, a major driver of erosion, occur multiple times per year and are expected to increase as sea level changes.

2.1.2. CLIMATE

EXISTING CONDITIONS

2.1.2.1. WATER LEVELS AND TIDES

All water levels and land surface elevations in this report will be referenced to North American Vertical Datum of 1988 (NAVD88), unless otherwise specified. References to other datums will be provided as necessary. The nearest tidal gage to the Mount Sinai Medical Center is Biscayne Creek, NOAA # 8723089. This is the only gage located in this area of Biscayne Bay. Other NOAA gages are located on the other side of one or more causeways; causeways restrict tidal flow and those gages are therefore not fully relevant to this project site. However NOAA # 8723089 only collected 2 years' worth of data in the early 1970's. The Virginia Key gage (8723214) has the longest period of record of all the local gages; it was installed in 1994 and remains operational today.

The highest water level on record was examined at both gages. At Biscayne Creek, the maximum level was +1.24 feet NAVD88, but this low value may be due to the relatively short (<2 year) period of record, in addition to the causeway effects. The Virginia Key gage recorded a maximum value of +2.79 feet NAVD88. This water level would overtop most of the length of the existing seawall and could lead to the level of flooding currently observed at the facility.

Anecdotal and photographic evidence provided by the medical center shows that water levels presently overtop the existing seawall by up to one foot during the annual "king tide" events, which are the most extreme high tide events, other than those that could be created by tropical and extra-tropical storms. The level of overtopping will increase over time in response to sea level change, but at this time evidence suggests that water levels rise to approximately one foot over the existing seawall elevation.

2.1.2.2. SURGE

Surge levels are provided by Federal Emergency Management Agency's (FEMA) 2009 Flood Insurance Study (FIS).

Table 2-1: Surge levels, from FEMA 2009 FIS.

Return Frequency (years)	Surge Elevation (ft, NGVD29)	Surge Elevation (ft, NAVD88)
10	5.4	3.8
50	6.7	5.1
100	7.2	5.6
500	8.1	6.5

Table 2-2: Surge levels, from FEMA 2009 FIS.

2.1.2.3 SEA LEVEL CHANGE

Relative local sea levels have risen gradually throughout the study area during the entire period of record. The longest water-level record in the City of Miami Beach area was measured by NOAA gage #8723170 (**Figure 2-**). Recorded water levels from this gage span 50 years, extending from 1931 to 1981. During this period the average annual rate of relative sea level change was 0.008 inches per year, +/- 0.001 in/yr. Note that the gage used to establish the tidal datum used throughout this study (Biscayne Creek, station #8723089) was not used in this computation of sea level change rates due to its short period of record.

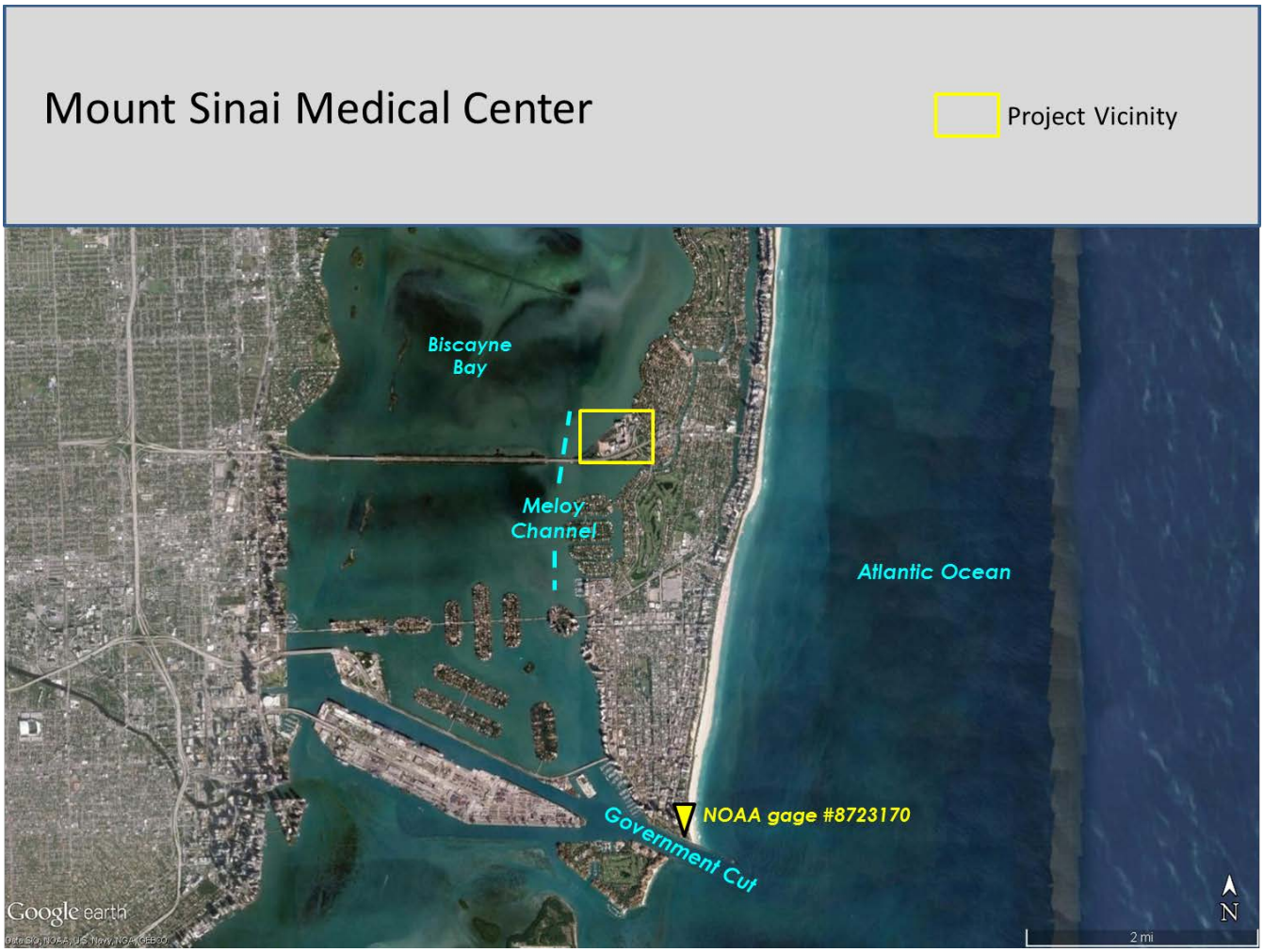


Figure 2-8: General setting.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Water levels and surge will continue to increase in the future as sea levels change. It is generally accepted that sea level will continue to rise and that the rate of rise may accelerate due to climatic changes. The U.S. Army Corps of Engineers (USACE) provides guidance on the calculation of sea level change and on its application to the design process. USACE Engineering Regulation (ER) 1100-2-8162 was issued in December 2013 to establish procedures for projecting sea level change into the future based on global sea level change rates, the local historic sea level change rate, base year of project analysis, and number of years in the period of analysis. This ER requires that three scenarios be examined, which result in low, intermediate, and high predictions of sea level change. The low value is based on an extrapolation of the local historic sea level change. The intermediate and high values are based on the National Research Council (NRC) sea level change predictive Curves I and III, respectively. The three rates of sea level change predicted for the project area over 100 years, from year 2018, the planned base year of construction of any Recommended Plan, are shown in **Figure 2-9**, with detail on their calculation provided in the Engineering Appendix. As shown in the figure, sea levels could change from between 0.75 to nearly 6.5 feet over the next 100 years.

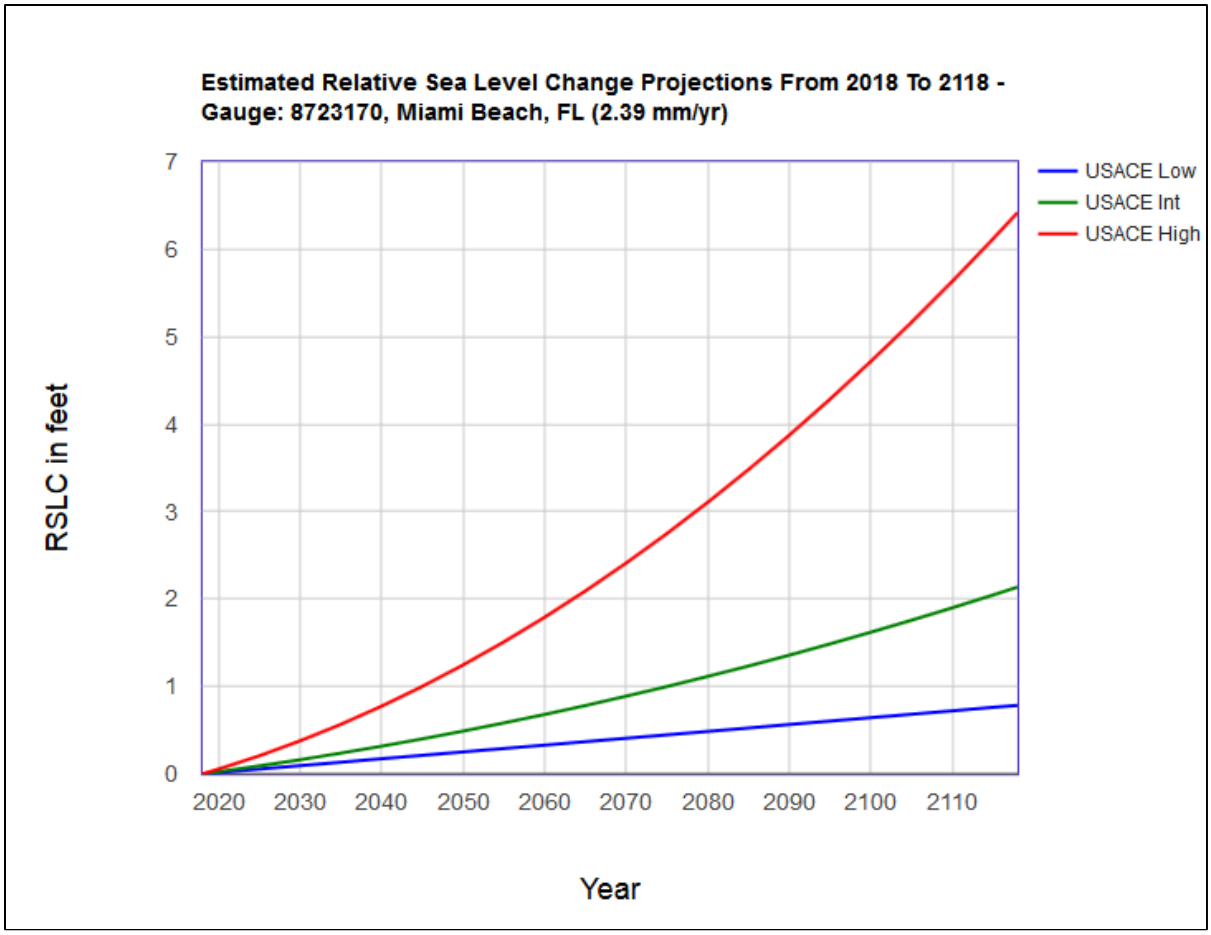


Figure 2-9: Predicted relative sea level change in Miami Beach by the year 2118.

The project area, and the City of Miami Beach as a whole, are vulnerable to sea level change. Alternative development focused on preventing current erosion causing conditions. However, future sea level change was considered, per guidance, in order to recommend an alternative that prevents current erosion causing conditions and is able to be adapted to future sea level change by the sponsor if necessary.

A 2014 risk assessment was completed for the Mount Sinai Medical Center by the Antares Group. The purpose of the assessment was to provide a preliminary indication of future damages to infrastructure and operations. Future damages include damage to structures, loss of facility function, content damages, displacement, and loss of life as a result of erosion and inundation. The assessment used a combination of pre-existing materials provided by the medical center and open sources and the Federal Emergency Management Agency (FEMA) BCAR 4.8 software platform to calculate damages. All loss figures are over a 50 year time horizon and are discounted to present value using the FEMA standard 7% discount rate.

Sea Level Rise (SLR) will exacerbate erosion and inundation caused by high tide events in the future. The Antares Group projected SLR for flood hazard data using the USACE SLR calculator (http://corpsclimate.us/ccaceslcurves.cfm) and averaged the projected increase in water surface elevations for the period 2010 to 2060. The projection uses the USACE **intermediate** SLR rate for the area. Several damage estimates were given in the assessment: damage to the seawall and related infrastructure (including asphalt road, concrete curb, and fill), and damage to facilities and operations. The assessment found that approximately $4,000,000 in damages to the seawall and related infrastructure are possible

over a 50 year time horizon if sea level change accelerates to the USACE **intermediate** SLR scenario. In addition to these damages, an additional $296,000,000 in damages and loss of function to Mount Sinai facilities and operations was predicted to occur. Recommending an alternative that can be adapted as sea level rises will be important to reduce the risk of such potential future damages.

2.2. NATURAL ENVIRONMENT (AFFECTED ENVIRONMENT)

The Affected Environment section succinctly describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section describes only those environmental resources that are relevant to the decision to be made. It does not describe the entire existing environment, but only those environmental resources that would affect, or that would be affected, by the alternatives if they were implemented. This section, in conjunction with the description of the "no-action" alternative forms the baseline conditions for determining the environmental impacts of the proposed action and reasonable alternatives.

2.3. GENERAL ENVIRONMENTAL SETTING

EXISTING CONDITIONS

The Mount Sinai Medical Center is located to the east of the Meloy Channel shown in the red dashed line in **Figure 2-10**, on the north-east side of Biscayne Bay, a shallow subtropical lagoon that extends from the City of North Miami (Miami-Dade County, Florida) south to the northern end of Key Largo, at the juncture of Miami-Dade and Monroe Counties. Biscayne Bay is bordered on the west by the mainland of peninsular Florida and on the east by both the Atlantic Ocean and a series of barrier islands consisting of sand and carbonate deposits over limestone bedrock (Hoffmeister 1974).

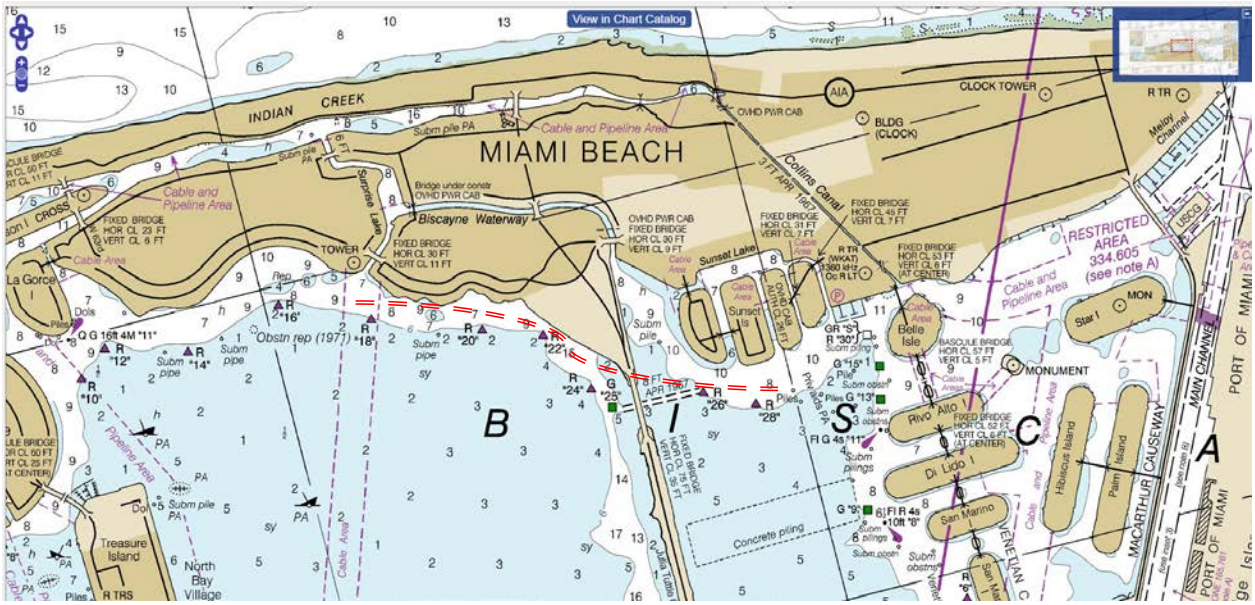


Figure 2-10: The location of Meloy Channel on the backside of Miami Beach (noted with the red-dashed line).

Tides within the Miami area are semi-diurnal, having two high and two low tides each day. The mean range at Miami Beach is 2.5 feet; 3.0 feet in spring. The lowest tide is 1.4 feet below mean low water (USACE 1989). Maximum tidal current velocities through Government Cut (**Figure 2-**) are approximately

5.5 feet per second on average tide, but occasional velocities of approximately 6.2 feet per second have been recorded during spring tide (USACE 1989).

The Biscayne Bay area, including the Mount Sinai Medical Center, is located within State of Florida Class III waters. Class III is the standard designation covering most of the open marine waters of the state. Biscayne Bay is also classified as Outstanding Florida Waters (OFW) under Section 62-302.700 of the Florida Administrative Code and is commonly referred to as the Biscayne Bay Aquatic Preserve. The OFW designation carries with it the requirement that ambient water quality cannot be degraded below its existing level.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The future without-project conditions are similar to the existing conditions described above. However, tide levels will increase proportionally with sea level rise.

2.3.1. VEGETATION

EXISTING CONDITIONS

2.3.1.1. SEAGRASS SURVEY

A seagrass survey was conducted by Coastal Eco-Group, Inc. (CEG) over eight days between May 2 and June 2, 2016. Seventy transects were established in 50-foot increments along the 3,500-foot length of the seawall, starting at the base of the seawall and extending waterward to a maximum distance of 400 feet (**Figure 2-11**).

The highly-used navigable waters of Meloy Channel are located within the boundaries of the survey areas between Transects 10 and 35. Due to safety concerns with diving in, and adjacent to, these waters, CEG coordinated with the USACE to discuss shortening the transect lengths in this area where the red day markers are closest to the seawall. Several of the original 400-foot length transects extended waterward of the channel red day marker. USACE approved shortening these transects for diver safety by as much as 150 feet to provide a larger buffer from vessel activity.

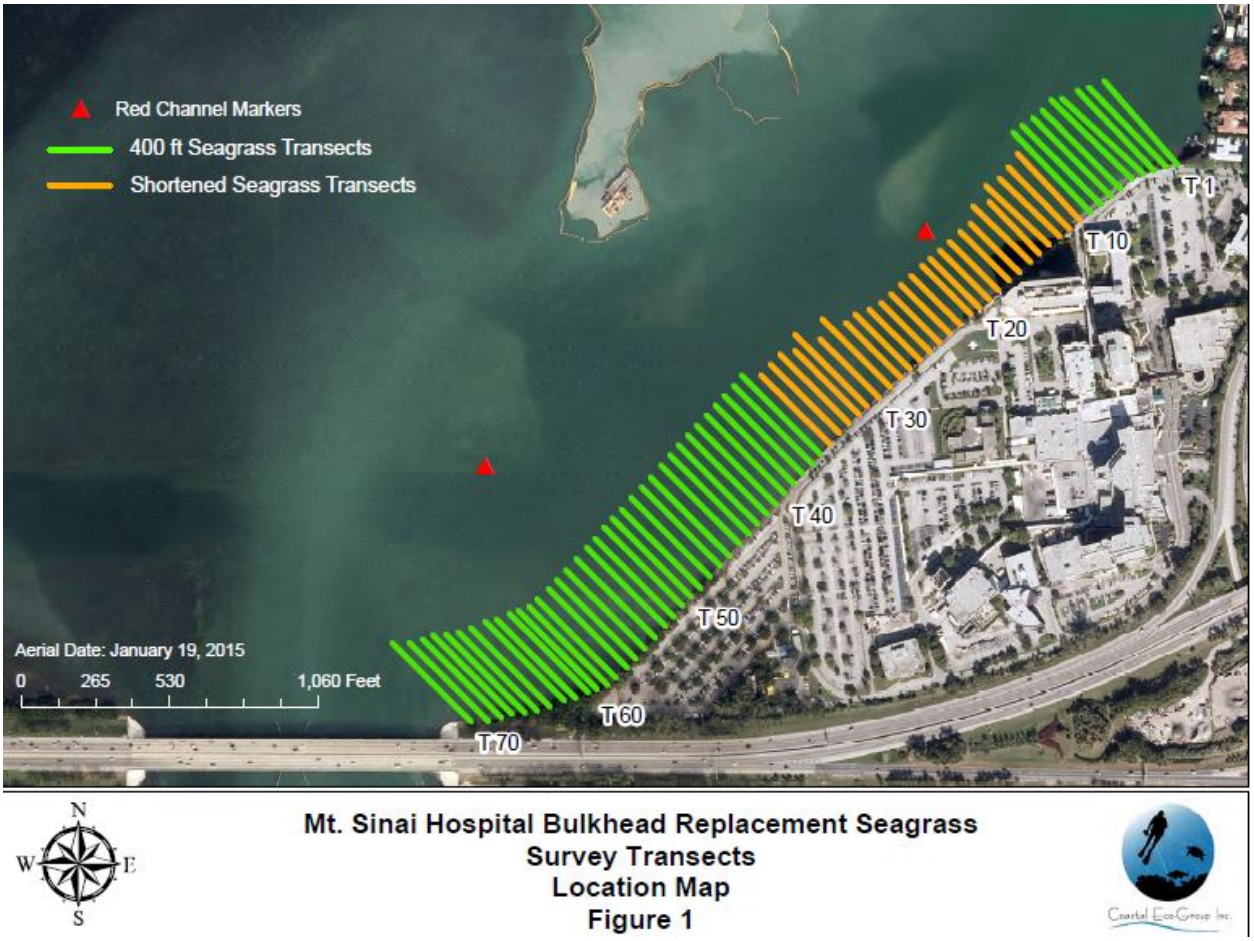


Figure 2-11: Seagrass Survey Transect Locations

A total of 17.04 acres of seagrass habitat and 9.11 acres of unvegetated bottom were mapped within the survey area (**Figure 2-12**). The seagrass bed is dominated by *Halophila decipiens*, *Halodule wrightii*, and *Syringodium filiforme*; *Thalassia testudinum* occurs in sporadic, dense patches, primarily in the northern and southern extents of the bed. A mixed species seagrass bed dominates the nearshore and increases in extent at the south end of the survey area; this mixed species bed accounts for 10.16 acres of seagrass habitat in the study area. The mixed species bed transitions to 6.75 acres of *H. decipiens* in the offshore portion of the study area. Monospecific *H. wrightii* and *T. testudium* patches only accounted for between 0.10 and 0.03 acres of the total seagrass habitat, respectively. There was a strong relationship between substrate type and distribution of the seagrass bed. Muck was the dominant substrate throughout the central segment of the survey area where seagrass was generally not present (refer to **Figure 2-**). Threatened *Halophila johnsonii* was not observed during the survey. The nearshore bed edge ranged from 0 to 26 ft. waterward of the seawall. The area between the seawall and the seagrass bed edge was dominated by rubble; sand was the dominant substrate at the bed edge. During low tides, approximately 825 feet of the area directly in front of the seawall is exposed to the air, preventing submerged aquatic vegetation from colonizing the area. This is the northernmost 250 feet and the southernmost 575 feet (based on the seagrass surveys conducted for the project). A copy of the survey is included in Appendix D-4.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The existing seawall is deteriorating and has the potential to collapse in areas, resulting in the destabilization of the shoreline where sediment and debris may impact the adjacent seagrass beds.

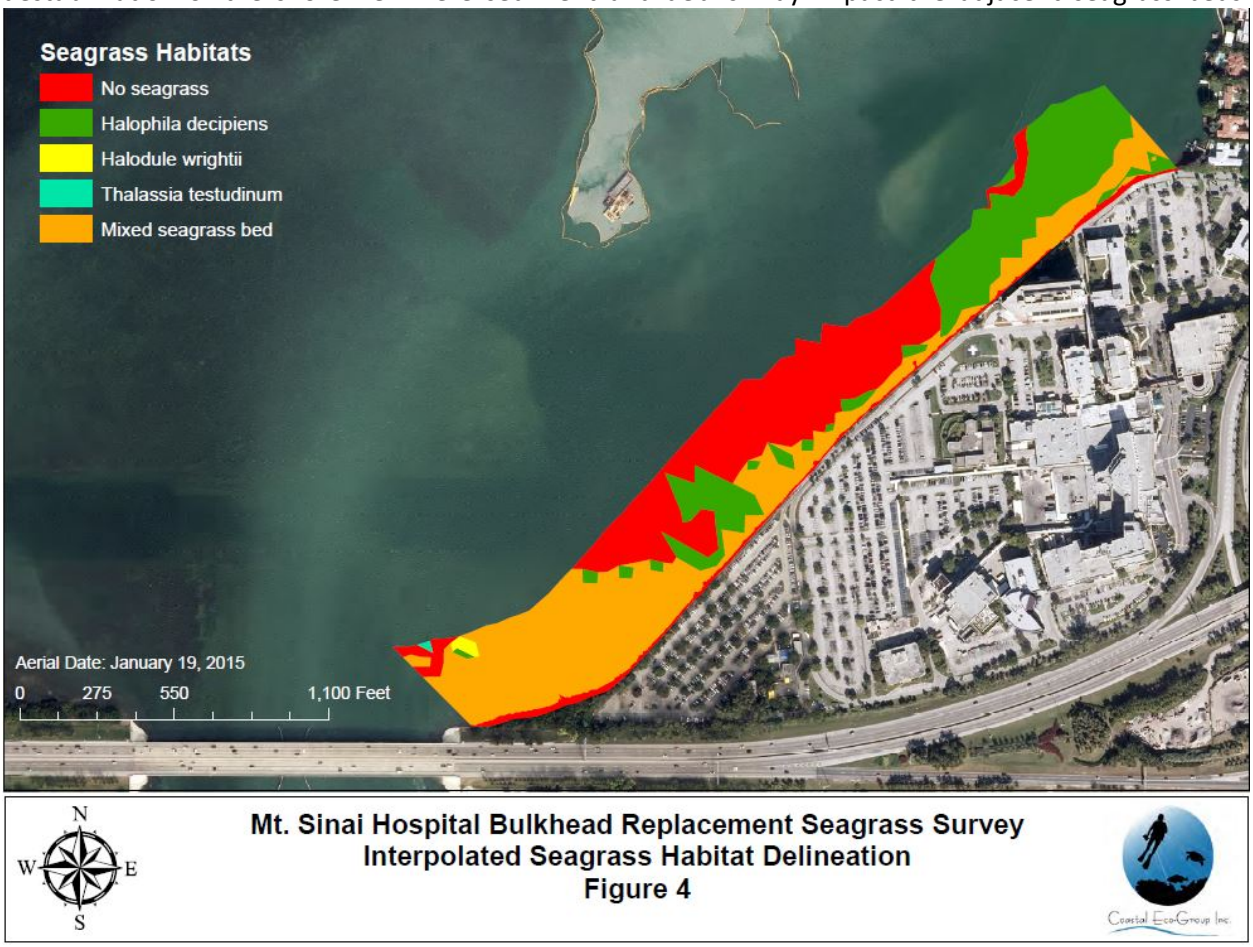


Figure 2-12: Mount Sinai Hospital seagrass survey.

2.3.1.2. TREE SURVEY

A tree survey was conducted on May 2 and 3, 2016, behind the existing seawall. The survey focused on the trees concentrated on the northern and southern sections of the property behind and adjacent to the seawall. The tree survey defined four distinct areas of trees that were identified (**Figure 2-13**).

Figure 2-13: Tree Survey at Mount Sinai Medical Center

The survey identified 11 different tree species (**Table 2-3**) and a total of 68 trees were surveyed along the seawall. Area 1, located on the northern end of the property, consisted mostly of Seagrape. Within this area many of the trees abutted the seawall and were leaning, or had fallen into the bay, due to shoreline erosion. The second area, Area No. 2, consisted of six different species: Seagrape, Black Mangrove, Washington Fan Palm, Pitch Apple, Black Olive, and Silver Buttonwood. The trees and shrubs present in this area were planned landscape plantings. The third section, Area No. 3, contained a mostly mature set of trees, including mostly Black Olive and Australian pine, along with one Seagrape. The fourth, and last, section of trees were situated on the shore of the bay and extended out to the Julia Tuttle Causeway. The trees here were overgrown, with a lot of undergrowth and trash from the bay that had washed up on the shore and base of the trees. Area 4 had the largest tree canopy and the largest trees. Trees were found growing on both sides of the seawall.

Table 2-3: Tree survey by species.

TREE ID	COMMON NAME	SCIENTIFIC NAME	Comments
1	Brazilian pepper	*Schinus terebinthifolius*	FLEPPC Category 1 invasive exotic
2	Golden Dewdrop	*Duranta erecta L.*	Non-native
3	Seagrape	*Coccoloba uvifera*	
4	Seagrape	*Coccoloba uvifera*	
5	Seagrape	*Coccoloba uvifera*	
6	Seagrape	*Coccoloba uvifera*	
7	Seagrape	*Coccoloba uvifera*	
8	Seagrape	*Coccoloba uvifera*	
9	Seagrape	*Coccoloba uvifera*	
10	Seagrape	*Coccoloba uvifera*	
11	Seagrape	*Coccoloba uvifera*	
12	Seagrape	*Coccoloba uvifera*	
13	Black mangrove	*Avicennia germinans*	
14	Seagrape	*Coccoloba uvifera*	
15	Washington Fan Palm	*Washingtonia robusta*	Possible *Livistona spp* however both are non-native
16	Washington Fan Palm	*Washingtonia robusta*	Possible *Livistona spp* however both are non-native
17	Washington Fan Palm	*Washingtonia robusta*	Possible *Livistona spp* however both are non-native
18	Seagrape	*Coccoloba uvifera*	
19	Washington Fan Palm	*Washingtonia robusta*	Possible *Livistona spp* however both are non-native
20	Washington Fan Palm	*Washingtonia robusta*	Possible *Livistona spp* however both are non-native
21	Seagrape	*Coccoloba uvifera*	
22	Seagrape	*Coccoloba uvifera*	
23	Seagrape	*Coccoloba uvifera*	
24	Seagrape	*Coccoloba uvifera*	
25	pitch apple	*Clusia rosea*	
26	Black Olive	*Terminalia buceras*	Non-native
27	Seagrape	*Coccoloba uvifera*	
28	Seagrape	*Coccoloba uvifera*	
29	Black Olive	*Terminalia buceras*	Non-native
30	Silver Buttonwood	*Conocarpus erectus var. sericeus*	
31	Black Olive	*Terminalia buceras*	Non-native
32	Black Olive	*Terminalia buceras*	Non-native
33	Black Olive	*Terminalia buceras*	Non-native
34	Black Olive	*Terminalia buceras*	Non-native
35	Black Olive	*Terminalia buceras*	Tree 35 - 45
36	Black Olive	*Terminalia buceras*	Tree 36 - 46
37	Black Olive	*Terminalia buceras*	Non-native
38	Black Olive	*Terminalia buceras*	Non-native
39	Black Olive	*Terminalia buceras*	Non-native
40	Black Olive	*Terminalia buceras*	Non-native
41	Black Olive	*Terminalia buceras*	Non-native
42	Seagrape	*Coccoloba uvifera*	
43	Black Olive	*Terminalia buceras*	Non-native
44	Black Olive	*Terminalia buceras*	Non-native
45	Black Olive	*Terminalia buceras*	Non-native
46	Black Olive	*Terminalia buceras*	Non-native
47	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic
48	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic
49	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic
50	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic
51	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic
52	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic
53	Seagrape	*Coccoloba uvifera*	
54	Seagrape	*Coccoloba uvifera*	
55	Seagrape	*Coccoloba uvifera*	
56	Seagrape	*Coccoloba uvifera*	
57	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic
58	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic
59	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic
60	Strangler fig	*Ficus aurea*	
61	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic
62	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic
63	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic
64	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic
65	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic
66	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic

Trees and underbrush found in Area 1 (Tree Nos. 1-11), at the northern most end of the seawall, are densely packed. The seawall at this location has suffered significant damage and deterioration. Trees found in Area 2 (Tree Nos. 12-30) represent landscaping plantings that are maintained and were part of the overall facility landscaping along sidewalks and benches. Trees found in Area 3 (Tree Nos. 31-50) were mostly trees planted as part of landscaping and are spaced apart from each other. Most of these trees are approximately 10 feet from the seawall. Trees found in Area 4 (Tree Nos. 51-68) are densely packed with underbrush and debris floated in by tides and storm events. A copy of the survey is included in Appendix D-4.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

If the existing seawall, or portions of the wall should collapse, then some vegetation may be impacted, including loss of the trees into the adjacent bay waters.

2.4. THREATENED AND ENDANGERED SPECIES

2.4.1. SEA TURTLES

EXISTING CONDITIONS

The City of Miami Beach is within the normal nesting range of three species of sea turtles; the loggerhead (*Caretta caretta*), the North Atlantic distinct population segment (DPS) of green sea turtle (*Chelonia mydas*) (80 FR 15272), and the leatherback (*Dermochelys coriacea*). The leatherback sea turtle is listed as endangered under the Endangered Species Act (ESA). The loggerhead sea turtle is listed as a threatened species. The North Atlantic DPS of the green sea turtle is currently proposed as a threatened species; previously all green sea turtles found in the U.S. were listed as endangered species. There are no records of sea turtles nesting within the boundaries of the interior of northern Biscayne Bay.

The waters offshore of the City of Miami Beach and Biscayne Bay are also used for foraging and shelter for the three species listed above, as well as the hawksbill sea turtle (*Eretmochelys imbricata*) and, possibly, Kemp's ridley sea turtle (*Lepidochelys kempii*), and Olive ridley sea turtle (*Lepidochelys oliveacea)* (DC&A 2001; Foley, *et al.* 2003). There is no designated critical habitat for sea turtles within the project area.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The existing seawall is deteriorating and has the potential to collapse in areas, resulting in the destabilization of the shoreline where sediment and debris may impact the adjacent seagrass beds. Loss of the existing wall would also adversely affect algae growing on the structure. The green sea turtle may access this area and forage on seagrass, as well as algae growing on the wall. .

2.4.2. MANATEES

EXISTING CONDITIONS

The Florida manatee (*Trichechus manatus latirostris)* is a subspecies of the West Indian manatee. *Trichechus manatus* has been listed as a protected mammal in Florida since 1893. Federal law, specifically the Marine Mammal Protection Act of 1972 (MMPA) and the ESA, protects manatees. 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. All of Biscayne Bay is designated critical habitat under the ESA (42 FR 47840, September 22, 1977).

Within Miami-Dade County there exists both permanent and transient populations of manatees. Surveys show that during the winter months when temperatures drop, manatees from north Florida and Miami-Dade County will migrate to the Florida Power and Light (FP&L) power plant at Port Everglades (USGS 2000). During the spring months when the water warms, manatees return to the counties to the north and south to forage and reproduce. Telemetry and aerial surveys confirm manatees are present within Miami-Dade County all year (Miami-Dade County 1999a, USGS 2000). The surveys also confirm that they frequent the waters in and adjacent to the study area, and near the Miami River and Intracoastal Waterway. All of the waters in Miami-Dade County are designated as critical habitat for the manatee under the ESA in 1976 (50 CFR 17.95(a)). Adjacent to the Mount Sinai Medical Center, manatee slow speed zones are enforced from November 15 - April 30 and 30 MPH from May 1 - November 14 (**Figure 2-14**).

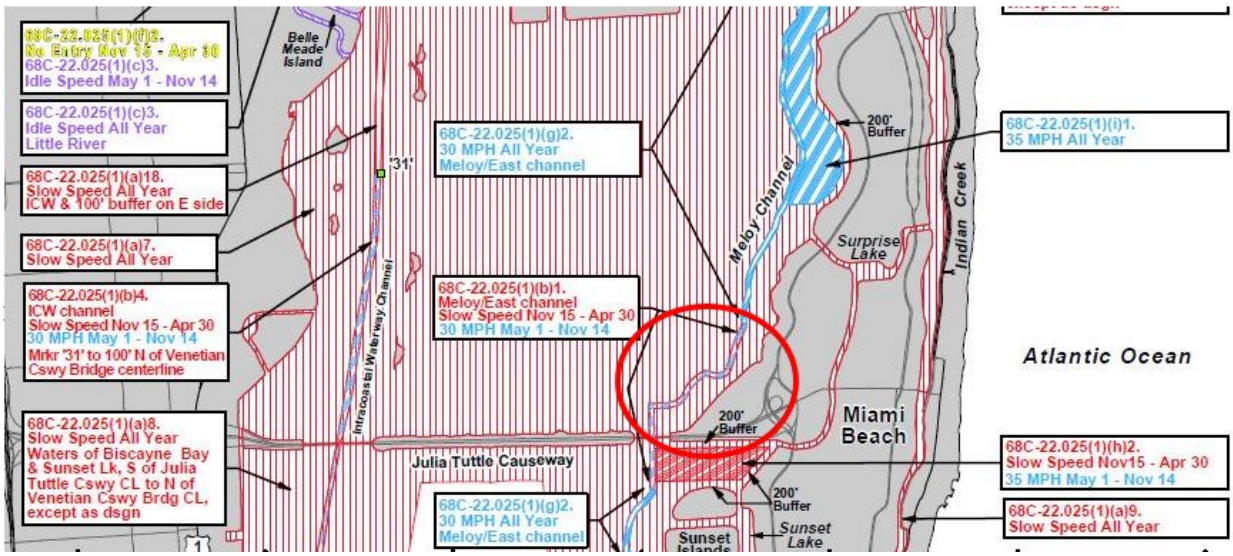


Figure 2-14: FWC Manatee Speed Zones near the Mount Sinai Center

Florida manatees have been documented feeding on seagrasses in the shallow waters west of the project area and within the recently completed Julia Tuttle seagrass restoration area which is adjacent to the southern border of the project area (**Figure 2-15**).

Figure 2-15: Manatee at Julia Tuttle Restoration Site Sept 2015

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The existing seawall is deteriorating and has the potential to collapse in areas resulting in the destabilization of the shoreline where sediment and debris may impact adjacent seagrass beds. Loss of the existing wall may also adversely affect algae growing on the wall. The manatee forages on seagrass as well as algae and, during high tide, may be able to access this area.

2.4.3. JOHNSON'S SEAGRASS

EXISTING CONDITIONS

Johnson's seagrass was listed as a threatened species by NMFS on September 14, 1998 (63 FR 49035) and a re-proposal to designate critical habitat pursuant to Section 4 of the ESA was published on December 2, 1998 (64 FR 64231). The final rule for critical habitat designation for Johnson's seagrass was published April 5, 2000 (65 FR 17786). The Primary Constituent Elements for Johnson's seagrass critical habitat are: clear water allowing for sunlight to penetrate, water quality or quantity, sediment types and sediment stability. Johnson's seagrass has one of the most limited geographic ranges of all seagrass species. It is only known to occur between Sebastian Inlet and northern Biscayne Bay on the east coast of Florida (Kenworthy 1997). Although Johnson's seagrass has been reported to occur in north Biscayne Bay, no Johnson's seagrass was encountered within the seagrass survey area.

The seawall is adjacent to Johnson's seagrass designated critical habitat unit "J" (**Figure 2-16**), however, the 20 feet directly in front of the seawall was previously disturbed in 1967 with the placement of the berm during seawall construction **(Figures 2-2 and 2-3**) and continues to be disturbed by wave energy is reflected from the face of the seawall, causing scour to occur at the base of the seawall. Seagrasses have colonized much of the berm material placed in front of the wall in 1967. Based on conversations with NMFS staff, because seagrass species other than Johnson's seagrass are found within three feet of the face of much of the seawall, these areas would support Johnson's seagrass and would be considered designated critical habitat (Tom Dolan, PhD. Pers comm. 04/05/2017). Approximately 825 feet of the sediment in front of the seawall face are exposed at low tide, meaning that the Primary Constituent

Elements necessary for Johnson's seagrass are not present within that 825 feet in front of the existing seawall.

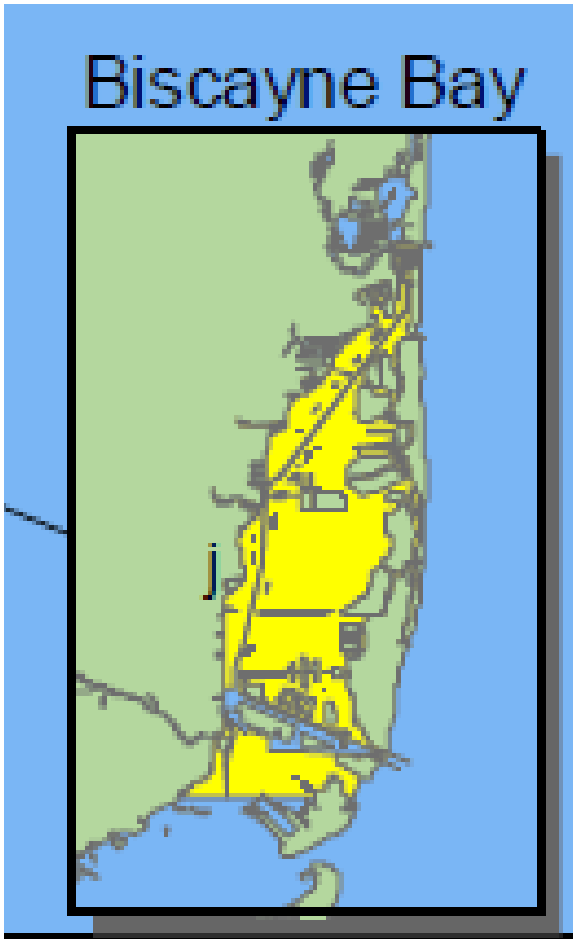


Figure 56: Unit J - Designated Johnson's seagrass Critical Habitat in Biscayne Bay.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The existing seawall is deteriorating and has the potential to collapse in areas, resulting in the destabilization of the shoreline where sediment and debris may impact Johnson's seagrass critical habitat.

2.4.4. AMERICAN CROCODILE

EXISTING CONDITIONS

The American crocodile is a state and federally listed threatened species. It is distributed along the coastal and estuarine shores of the extreme southern Florida peninsula. Crocodiles primarily nest south of the project area, from Florida Bay to Turkey Point, and on northern Key Largo. In Biscayne Bay they have been observed nesting as far north as Crandon Park, Bill Baggs State Recreation Area, and Snapper Creek (USFWS 1999; Mazzotti 2000) located more than six miles south of the project area. Nesting for the crocodile begins in March and extends until late April or early May until the eggs are laid. They build their nests in well-drained soil at sites adjacent to deep-water. Adult crocodiles feed at night on schooling fish in creeks, open water, and deep channels (FP&L 1987). Crocodiles are shy animals and prefer quiet, inland ponds, creeks, and protected coves. They also prefer natural, undisturbed areas for nesting, resting, and

feeding (USFWS 1999). Documentation of American crocodiles north of Miami-Dade County has increased over the last few years, with animals being reported in Broward and Palm Beach Counties. According to USFWS, the closest nest that has been documented near Mount Sinai Medical Center was on the north end of Virginia Key in 2015, approximately 6.5 miles south of the Mount Sinai Medical Center. There is no designated critical habitat for the American crocodile in the project area.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There will be no effect to American crocodile in the No Action alternative.

2.4.5. SMALLTOOTH SAWFISH

EXISTING CONDITIONS

On April 1, 2003, NMFS published a final rule (68 FR 15674) listing the DPS of smalltooth sawfish found in the U.S. as an endangered species under the ESA. Smalltooth sawfish, *Pristis pectinata* were once common in Florida as detailed by the "Smalltooth Sawfish Recovery Plan" (NMFS, 2009) and are very rarely reported in southeast Florida. Their core range extends along the Everglades coast from the Ten Thousand Islands to Florida Bay, with moderate occurrences in the Florida Keys and at the mouth of the Caloosahatchee River. Outside of these areas, sawfish are rarely encountered and appear to be relatively rare (Simpfendorfer 2006). It does not appear to be a coincidence that the core range of smalltooth sawfish corresponds to the section of Florida with the smallest amount of coastal habitat modification. Smalltooth sawfish inhabit the shallow coastal waters of tropical seas and estuaries throughout the world. They are usually found in shallow waters, less than 32 feet (10 m), very close to shore over muddy and sandy bottoms. NMFS released the final recovery plan for the smalltooth sawfish in January 2009 (NMFS, 2009), and designated critical habitat for the species in September 2009 (74 FR 45353). There is no designated critical habitat for smalltooth sawfish in the project area.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There will be no effect to smalltooth sawfish in the No Action alternative.

2.4.6. SCLERACTINIAN CORALS

EXISTING CONDITIONS

A survey for scleractinian corals was conducted on May 2, 2016, along the entire 3,500 linear foot seawall, from the base of the seawall to the mean low water mark. Transects to document encrusting organisms were located vertically along the seawall from the mean low water mark to the bay bottom. Scleractinian coral data collected included coral species, size, orientation, latitude, longitude, and height on the seawall wall. The total scleractinian coral transect survey area was 70 m^2 (**Figure 2-17**, **Figure 2-18**). A total of 11 scleractinian corals ≥ 1 cm were identified along the entire seawall. Coral colonies < 10 cm were identified as *Siderastrea siderea* or *S. siderea*. The colonies that were ≥ 10 cm included individuals of *Oculina diffusa*, *Oculina robusta*, and *S. siderea*. None of the corals found on the existing structure are listed under the ESA.

The 10 transects with scleractinian corals were generally located at the center portion of the existing seawall. **Table 2-4** provides the location, species, and size data for each scleractinian coral. Of the 11 coral colonies located on the existing seawall, six (55%) exceeded 10 cm in their greatest (longest) measured dimension. The total area of wall surface covered by all 11 corals is approximately 0.11 m^2. These species are commonly identified on the reefs and hardbottom communities of southeast Florida (Jaap 1984; Porter 1987), however, none of them are listed as threatened under the ESA.

Table 2-4: Location, species, and size data for each scleractinian coral located on the existing seawall.

Transect	Transect Length (m)	Water Depth (m)	Scleractinian Coral Species	Coral ID	Length (cm)	Width (cm)	Height (cm)	> 10 cm	% Live	Location on transect (cm)	Orientation (R/L)	Distance from transect line (cm)
T19	1.90	0.85	*Oculina diffusa*	A	15	13	7	Yes	100	20	West	16
T28	2.00	0.94	*Siderastrea siderea*	A	2	2	0.5	No	100	0.05	East	12
T29	1.90	0.90	*Siderastrea siderea*	A	11	8	1	Yes	100	15	East	25
T30	1.80	0.80	*Oculina diffusa*	A	16	10	16	Yes	100	30	East	32
T32	1.80	0.75	*Siderastrea siderea*	A	7	6	1	No	100	4	West	25
T33	1.80	0.80	*Oculina robusta*	A	17	14	9	Yes	100	20	West	5
T33	1.80	0.80	*Siderastrea* cf. *siderea*	B	6	5	0.5	No	100	25	East	30
T34	1.90	0.85	*Siderastrea siderea*	A	12	7	1	Yes	100	14	West	4
T36	1.80	0.75	*Oculina diffusa*	A	24	16	11	Yes	100	36	West	50
T38	1.55	0.50	*Siderastrea* cf. *siderea*	A	3	3	0.5	No	100	12	West	50
T39	1.68	0.72	*Siderastrea siderea*	A	4	3	0.5	No	100	0.5	East	18

Macroalgae, empty space, turf algae, and sponge cover, when combined, made up 80 to 100% of the total cover at the encrusting transect surveys. Other functional groups identified on the 10 encrusting transects were hydroid, tunicate, anemone, fanworm, barnacle, bivalve, and limpets.

The following data were collected for all scleractinian coral colonies ≥ 1 cm in diameter within 0.5 m on either side of the transect line (1-m wide belt).

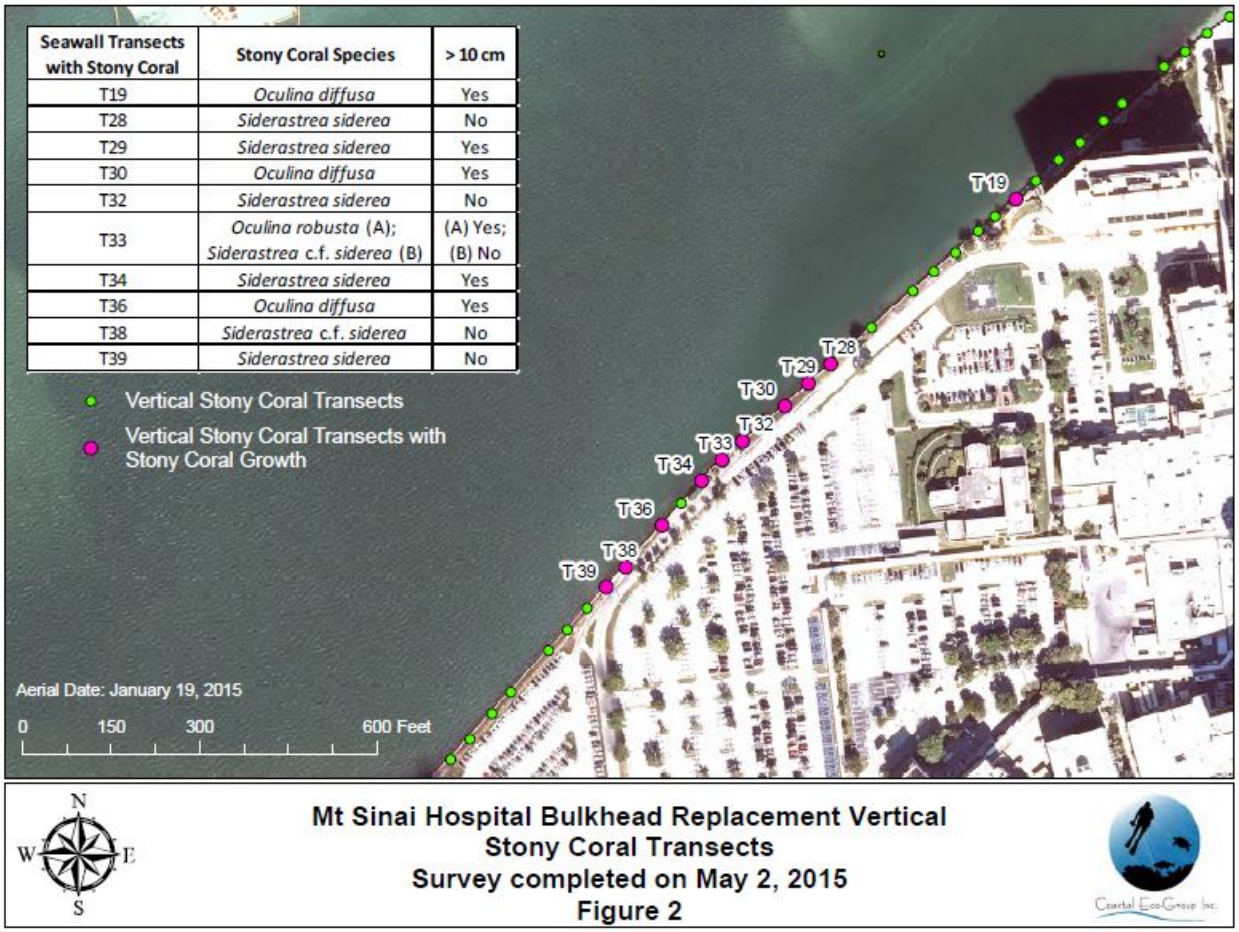
- Species, to the lowest taxonomic rank possible, including a note if the species is listed as threatened under the Endangered Species Act.
- Colony size, including length (longest axis), width (perpendicular to the longest axis), and height (in the direction of growth).
- Colony orientation (x,y,z).
- Overall health (i.e. presence of disease or bleaching).
- Percent live and dead tissue.
- General description of the original colony location (i.e. eastern Colonized Habitat shallow or segments) and depth.

All scleractinian coral colonies were documented with still digital photography. A representative landscape photograph of the encrusting organisms was also collected at each transect. To determine an estimated maximum number of corals that may be encrusting the seawall, the total length of the seawall being replaced (3,070 feet) was multiplied by the depth of the seawall below MLW – a maximum of 3 feet of water. This results is a total depth of the seawall below MLW is 9,210 ft^2.

A quantitative encrusting organism survey was conducted at 10 of the 70 transects to cover a total survey area of 70 m^2. Macroalgae, empty space, turf algae, and sponge cover, when combined, made up 80 to

100% of the total cover at the encrusting transect surveys. Other functional groups identified on the 10 encrusting transects were hydroid, scleractinian coral, tunicate, anemone, fanworm, barnacle, bivalve, and limpets (**Figure 2-**).

Converting the total seawall area to be replaced of 9,210 ft^2 to m^2 results in a total area below water is approximately 850 m^2. The 130 feet of the "1990" seawall are not being replaced and organisms living on that portion of the wall will not be relocated. Subtracting the original survey area from the total area below MLW results in a remaining area of 777.3 m^2. This is 11.1 times the previously surveyed area. Taking the 11.1 and multiplying it by the total number of corals found in the 70 m^2 survey area results in a potential total of 111 coral colonies. In the original survey, 55% of the colonies were larger than 10 cm in diameter. 111 colonies times 55% equals a total of 61 colonies greater than 10 cm in diameter with the potential to be located on the face of the seawall below MLW.



Seawall Transects with Stony Coral	Stony Coral Species	> 10 cm
T19	*Oculina diffusa*	Yes
T28	*Siderastrea siderea*	No
T29	*Siderastrea siderea*	Yes
T30	*Oculina diffusa*	Yes
T32	*Siderastrea siderea*	No
T33	*Oculina robusta* (A); *Siderastrea* c.f. *siderea* (B)	(A) Yes; (B) No
T34	*Siderastrea siderea*	Yes
T36	*Oculina diffusa*	Yes
T38	*Siderastrea* c.f. *siderea*	No
T39	*Siderastrea siderea*	No

Figure 2-17: Stony coral transects.

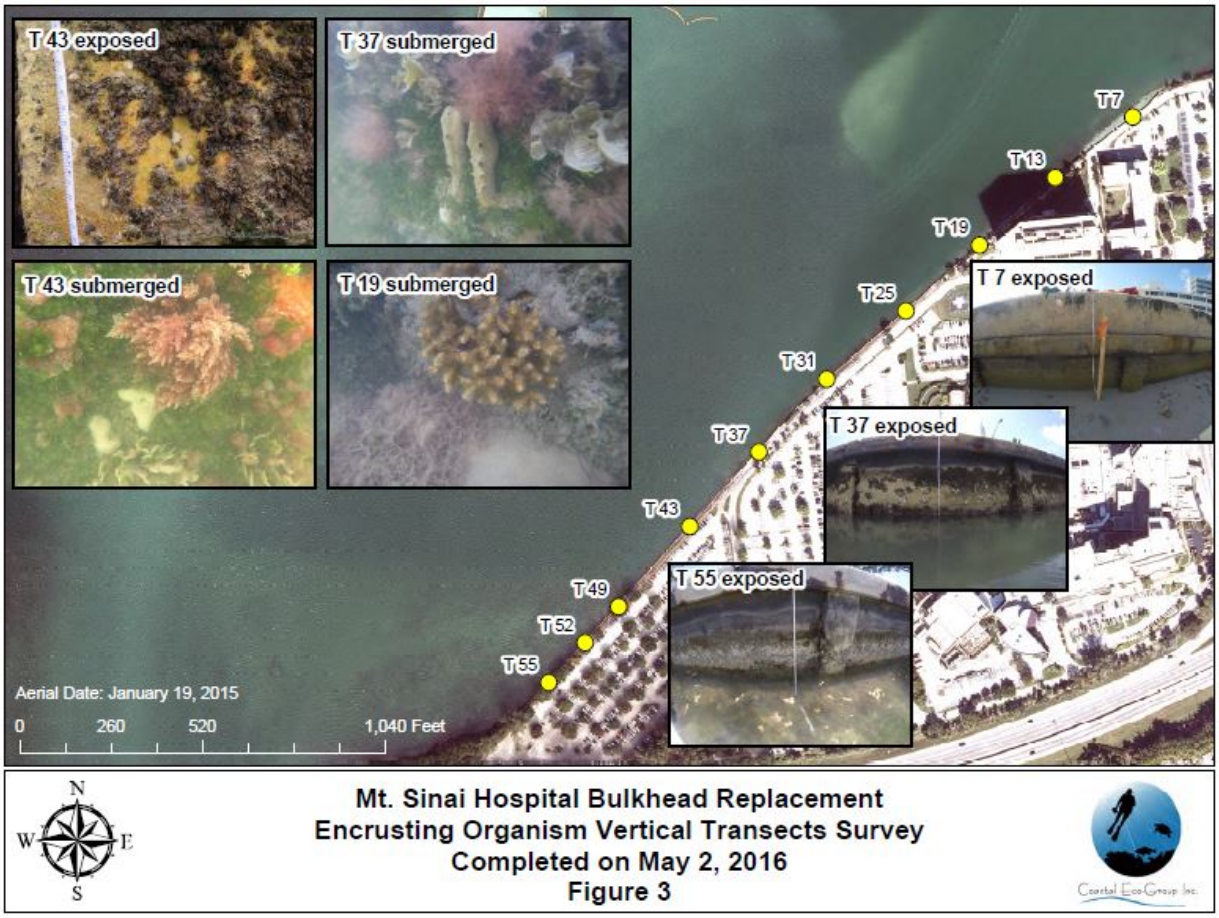


Figure 2-18: Encrusting organism transect survey

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The existing seawall is deteriorating and has the potential to collapse in areas which may impact encrusting organisms or scleractinian corals.

2.5. FISH AND WILDLIFE RESOURCES

2.5.1. BOTTLENOSE DOLPHINS

EXISTING CONDITIONS

The NMFS – Southeast Fisheries Science Center-Miami Laboratory (SEFSC) has identified numerous stocks of coastal bottlenose dolphins along the east coast of the United States. The stock of bottlenose dolphins most likely to be in the vicinity of Mount Sinai Medical facility is the Biscayne Bay stock. Incorporated by reference is the most recent stock assessment for the Biscayne Bay stock of bottlenose dolphin that was completed by NMFS in 2014 (Waring *et al*, 2014).

Based on Waring *et al (*2014), the minimum population that may be in northern Biscayne Bay; the closest vicinity to the Mount Sinai Medical facility, is 69 animals, based upon Litz's (2007) determination that 69 animals in Biscayne Bay have a northern home range (Haulover Inlet to Rickenbacker Causeway). The maximum population of animals that may be in Biscayne Bay is equal to the total number of uniquely

identified animals for the entire photo-ID study of Biscayne Bay, or 229 animals. The best population estimate for Biscayne Bay is also based on Waring *et al (*2014) - 157 animals – during a consistent survey effort put in place by SEFSC for the 2003-2007 photo-ID survey seasons.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There will be no effect to bottlenose dolphins in the No Action alternative.

2.5.2. FISHES

EXISTING CONDITIONS

Fish species are expected to be near the Mount Sinai seawall. This is a common occurrence in South Florida because fish are attracted to vertical structures. Fish species documented during surveys conducted in 2005 near seawalls at Port of Miami, located approximately three miles south of the project area are listed in **Table 2-5**. Similar fish species are expected to be present at the Mount Sinai seawall, due to the proximity of the project to Port of Miami.

Table 2-5: Fishes collected near seawalls at 2005 Port of Miami project.

Common Name	Scientific Name	Common Name	Scientific Name
Atlantic thread herring	Opisthonema oglinum	bandtail puffer	Sphoeroides spengleri
bigeye scad	Selar crumenopthalmus	black grouper	Mycteroperca bonaci
blackwing sea robin	Prionotus rubio	bluestriped grunt	Haemulon sciurus
Cardinalfish	Astropogon spp	dwarf sand perch	Diplectrum bivittatum
Filefish	Aluterus spp	French grunt	Haemulon flavolineatum
gag grouper	Mycteroperca microlepis	gray angelfish	Pomacanthus arcuatus
gray triggerfish	Balistes capriscus	Hogfish	Lachnolaimus maximus
lane snapper	Lutjanus synagris	Lookdown	Selene vomer
mangrove snapper	Lutjanus griseus	Mojarra	Eucinostomas spp
mutton snapper	Lutjanus analis	Porkfish	Anisotremus virginicus
pygmy filefish	Monocanthus setifer	queen angelfish	Holocanthus ciliaris
red grouper	Epinephelus morio	scrawled cowfish	Lactophrys quadricornis
silver jenny	Eucinostomas gula	spotfin mojarra	Eucinostomas argenteus
Tomtate	Haemulon aurolineatum	white grunt	Haemulon plumieri
yellow jack	Caranx bartholomaei	yellowfin mojarra	Gerres cinereus

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There will be no effect to fish in the No Action alternative.

2.5.3. MIGRATORY BIRDS

Migratory birds may fly through southeast Florida and may attempt to rest on the seawall or use the vegetation adjacent to this structure at Mount Sinai Medical Center.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The existing seawall is deteriorating and has the potential to collapse in areas, which may impact some vegetation occasionally utilized by birds.

2.5.4. ESSENTIAL FISH HABITAT

EXISTING CONDITIONS

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires Federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). This report with integrated EA is prepared in consistence with guidance provided by the NMFS Southeast Regional Office to USACE, Jacksonville District regarding coordinating EFH consultation requirements with NEPA (NMFS 1999). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, or growth to maturity" (SAFMC 1998).

The South Atlantic Fishery Management Council (SAFMC) designated corals, seagrasses, and unconsolidated sediments as EFH. Sand habitats are EFH for cobia (*Rachycentron canadum*), black seabass (*Centropristis striata*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculates*), spiny lobster, and pink shrimp (*Farfantepenaeus duorarum*). Coral and seagrass benefit fishery resources by providing food or shelter (SAFMC 1983). SAFMC also designated corals and seagrasses as a Habitat Area of Particular Concern (HAPC), which is a subset of EFH that is either rare, particularly susceptible to human-induced degradation, especially important ecologically, or located in an environmentally stressed area. In light of their designation as EFH-HAPC's and Executive Order 13089, NMFS applies greater scrutiny to projects affecting corals and seagrasses, as they are HAPCs, to ensure practicable measures to avoid and minimize adverse effects to these habitats are fully explored.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There may be an effect to Essential Fish Habitat if no action is taken. The existing seawall is deteriorating and has the potential to collapse in areas, resulting in erosion where sediment and debris may impact adjacent seagrass beds as well as encrusting organisms and scleractinian corals.

2.5.5. INVASIVE SPECIES

Florida has the second highest incidence of invasive species in the US. Three invasive marine animal species have been identified in the "Southern Florida" HUC code (30902) in the offshore areas per the USGS Non-Indigenous Aquatic Species Database (http://nas.er.usgs.gov/queries/default.aspx). Although this database does not list species in specific bays and estuaries in Florida, it is highly likely that the invasive species reported in offshore waters may also be inside of bay systems adjacent to offshore waters. With that potential, the following invasive species have been documented offshore of Miami-Dade County, and thus the potential exists for them to be found within Biscayne Bay.

- Lionfish – *Pterois volitans/miles*

The lionfish has been confirmed within the boundaries of Biscayne Bay with documented sightings within a few hundred feet of CGB Miami Beach (**Figure 2-19**).

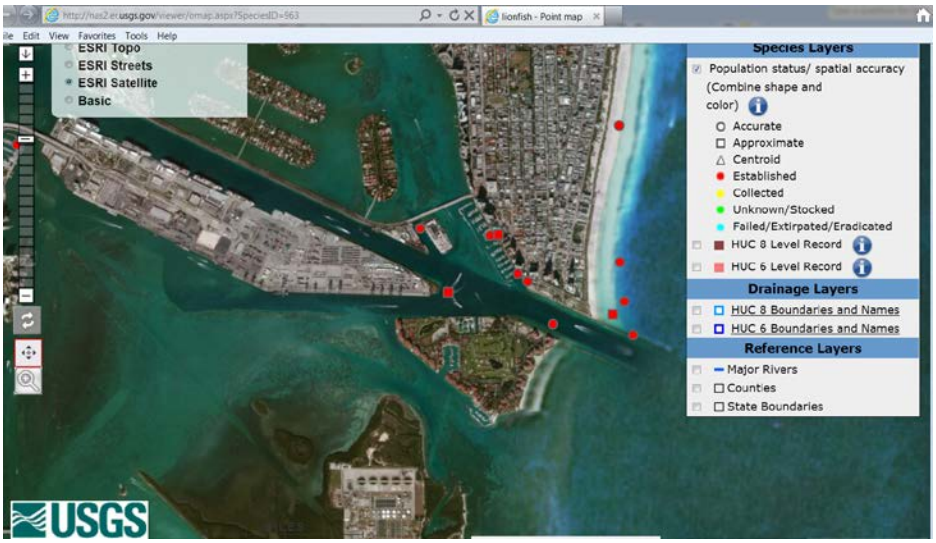


Figure 2-19 Reports of lionfish in SE Florida

- Asian Tiger Shrimp – *Penaeus monodon*

  Although the Asian tiger shrimp has not be reported in the database from Miami-Dade County, it is very likely to be present as it has been reported south in Monroe County and north in Broward and Palm Beach Counties (**Figure 2-20**).

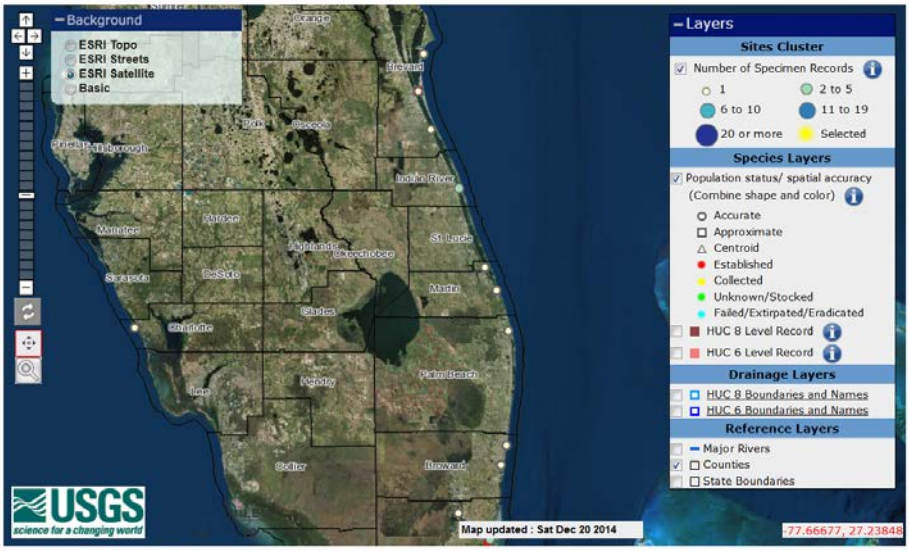


Figure 2-20 Reports of Asian Tiger Shrimp in SE Florida

- Fairy Basslet - *Gramma loreto*
  Although the fairy basslet has not been reported in the database from Miami-Dade County, it is very likely to be present as it has been reported south in Monroe County and north in Broward and Palm Beach Counties (**Figure 2-21**).

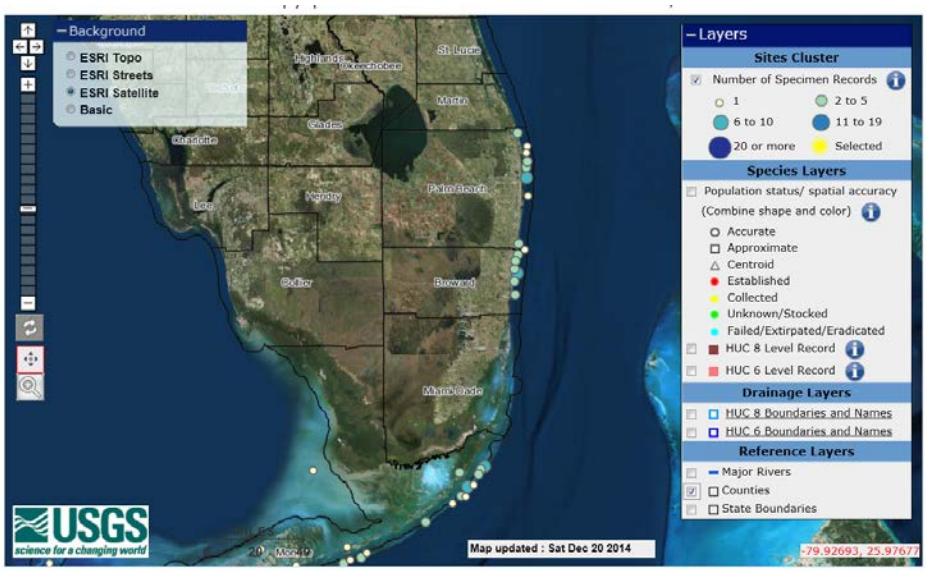


Figure 2-21 Reports of Fairy Basslet in SE Florida

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There will be no effect to invasive species in the No Action alternative.

2.5.6. COASTAL BARRIER RESOURCES

There are no designated Coastal Barrier Resource Act Units located in the project area that would be affected by this project.

2.5.7. AIR QUALITY

Air quality within the project area is good due to the presence of either on or offshore breezes. Miami-Dade County is in attainment with the Florida State Air Quality Implementation Plan for all parameters, except for the air pollutant ozone. The County is in attainment for all EPA designated air quality parameters.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There will be no effect to air quality in the No Action alternative.

2.5.8. WATER QUALITY

The Mount Sinai Medical Center is located within the Biscayne Bay Aquatic Preserve. The preserve, which includes all of the waters of Biscayne Bay south to Biscayne National Park, was established in 1980 under Ch. 18-18, F.A.C. and is considered to be State-Owned Submerged Land under the jurisdictional authority of FDEP. All aquatic preserves in Florida are designated OFW. New construction, or other marine activities, cannot result in a degradation of water quality outside of specially designated mixing zones (Miami-Dade County 1999).

Turbidity is the major limiting factor in coastal water quality in South Florida. Turbidity is measured in Nephelometric Turbidity Units (NTU), which is a measure of light-scatter by particulates within the water. This measurement does not address the characteristics of the suspended material that create turbid conditions. According to Dompe and Haynes (1993), the two major sources of turbidity in coastal areas are very fine organic particulate matter and sand-sized sediments that become re-suspended around the seabed from local waves and currents.

Turbidity values are generally lowest in the summer months and highest in the winter months, corresponding with winter storm events and the rainy season. During a one year study of the northern part of Biscayne bay, Stamates *et al.* (2013) noted turbidity ranged from a low of less than one NTU to a high of almost 25 NTUs (0.88 NTU – 24.87 NTU) with the 90th percentile being 1.78 NTUs. The study also found that turbidity in northern Biscayne Bay was primarily a function of phytoplankton blooms in the basin. Wanless *et al.* (1984) identified sources of turbidity in this part of Biscayne Bay included shallow bottoms, benthic diatoms, seagrasses and calcareous algae, and resuspension of flocculent bottom materials during winter storms.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The existing seawall is deteriorating and has the potential to collapse in areas resulting in erosion where sediment may impact local water quality.

2.5.9. NOISE

Ambient noise is comprised of sounds from natural and manmade sources. Natural sounds include wind, rain, thunder, water movement such as surf, and wildlife. Sound levels from these sources are typically low, but can be pronounced during violent weather events. Sounds from natural sources are generally not considered undesirable. Ambient background noise in urbanized areas typically varies from 60 to 70 dBA, but can be higher; suburban neighborhoods experience ambient noise levels of approximately 45 to 50 dBA (USEPA 1974). In urbanized areas such as the location of the Mount Sinai hospital, noise sources may include emergency vehicles, i.e. ambulance, as well as helicopters landing at the hospital, in addition to recreational vessels. Typical source levels for common industrial noise sources are given in Table 2-6 and Table 2-7. Maximum noise levels reach 99 dBA when multiple sources of noise are operating simultaneously, assuming an increase of 3 dB per doubling of sound intensity (WSDOT 2010a). These maximum noise levels are intermittent in nature and may occur sporadically on any given day with construction or other waterfront activity.

Table 2-6: Maximum Noise Levels at 50 feet for Common Construction Equipment.

Equipment Type	Maximum Noise Levels (dBA)
Impact pile driver	109
Vibratory pile driver	96
Scraper	90
Backhoe	90
Crane	81
Pumps	81
Generator	81
Front Loader	79
Air Compressor	78

Sources: WSDOT 2008; Illingworth & Rodkin 2012

Table 2-7: Noise sources associated with project.

Noise Source	Peak Frequency Range (Hz)	Underwater Source Level (re 1µPa)	Reference
Small vessels	250-6,000	151 dB rms at 1 m	Lesage et al 1999
Large vessels (underway)	20-1,500	170-180 dB rms at 1m	Richardson et al 1995
Tug docking barge	200-1,000	149 dB rms at 100m	Blackwell and Greene 2002
Vibratory driving of a 24-inch steel pipe pile	50-1,500	159 dB rms at 10m	Illingworth and Rodkin 2012
Impact driving of a 24-inch steel pipe pile	50-1,500	186 dB rms at 10m	WSDOT 2010b

dB = decibel; rms = root mean squared; m=meter

Underwater ambient noise is comprised of sounds produced by a number of natural and anthropogenic sources. Natural noise sources can include wind, waves, precipitation, and biological sources such as shrimp, fish, and cetaceans. These sources produce sound in a wide variety of frequency ranges (Urick 1983; Richardson *et al*. 1995) and can vary over both long (days to years) and short (seconds to hours) time scales. In shallow waters, precipitation may contribute up to 35 dB to the existing sound level, and increases in wind speed of 5 to 10 knots can cause a 5 dB increase in ambient ocean noise between 20 Hz and 100 kilohertz (kHz) (Urick 1983). High noise levels may also occur in nearshore areas during heavy surf, which may increase low frequency (200 Hz – 2 kHz) underwater noise levels by 20 dB or more within 200 yards of the surf zone (Wilson *et al*. 1985).

The underwater acoustic environment adjacent to the Mount Sinai Hospital is likely to be dominated by noise from day-to-day vessel transits past the seawall by recreational vessels transiting Meloy Channel. During the proposed action, normal vessel transits are expected to continue, and noise contributions from these sources would remain at current levels. Small ships and boats have been recorded with noise levels ranging up to 160-180 dB (OSPAR 2009).

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There will be no effect as a result of noise in the No Action alternative.

2.5.10. CULTURAL RESOURCES

EXISTING CONDITIONS

The earliest widely accepted date of occupation by the aboriginal inhabitants of Florida dates from around 12,000 years ago (Milanich 1994). This cultural period, called the Paleo-Indian period, lasted until about 10,000 YBP (years before present). Sea level was lower and the continental shelves were exposed in an area almost twice the width of the current size of the state. Few Paleo-Indian archeological sites are recorded in South Florida.

During the Archaic period (ca. 10,000 YBP - ca. 2500 YBP), a wider range of resources was exploited and may have led to a more sedentary existence. Sea level rose to its present position. Few Archaic period archeological sites, such as the Cutler Ridge site (~9300 YBP) in Miami, are recorded in South Florida. Known sites are clustered along the Atlantic coast and inland waterways.

Regional cultural traditions within Miami-Dade County, known as the Glades culture; historically known as the Tequesta, developed from the Archaic period in South Florida around 2,500 YBP. The Glades culture sequence (ca. 2500 YBP-A.D. 1513) produced a large number of sites, predominantly along the coasts, but also in the interior wetlands. Glades site types include shell and earth middens and low sand mounds.

During the early historic period, beginning with the first Spanish colonial period (A.D. 1513-1763), the Tequesta were the main tribal group that controlled southern Florida with a central village located on the Miami River. Their population was decimated by European-introduced diseases, warfare, enslavement, and migration out of Florida.

Present day coastal Miami-Dade County was virtually ignored by New World explorers like Ponce de Leon until the mid-seventeenth century when it became an important passage way for New World shipping. Many Spanish fleet ships wrecked in the vicinity. The *HMS Fowey*, a British war ship, sank in Biscayne Bay in 1748 on a reef now known as Fowey Rocks.

The Seminole and Miccosukee tribes migrated into this region of Florida in the 18th and 19th centuries from Georgia and Alabama to escape relocation attempts by the U.S. Army. American settlement in South Florida began in earnest in the late 19th century after Florida became a U.S. Territory in 1821. Settlers began moving into the Miami area by the 1830s. Fort Dade was constructed near Miami to protect settlers.

The City of Miami emerged in the late nineteenth century from Henry Flagler's Florida East Coast Railway that was constructed through the area. The Port of Miami boomed in the 1920s. In the 1940s, Miami served as a prominent training area for the U.S. Navy during World War II. By the 1950s, the population of the region had exploded and today Miami-Dade County's industry includes shipping, agriculture, commercial and sport fishing, and tourism.

The Miami-Dade property appraiser's records indicate that construction of the hospital complex begun in 1958. No impacts to the hospital buildings are anticipated. The northern section of the seawall was constructed circa May 1959, and the remaining extent (2,600 feet) of the seawall was constructed circa March 1967. The seawall was constructed following standardized construction design plans, and does not embody distinctive characteristics of a type, period, or method of construction. Consultation in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations in 36 CFR Part 800: Protection of Historic Properties, will be coordinated with the Florida SHPO regarding the project. No recorded submerged or terrestrial archaeological sites exist along the seawall. The entire project footprint has been previously disturbed by construction.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

There will be no effect to listed historic properties in the No Action alternative.

2.5.11. AESTHETIC AND RECREATION RESOURCES

Mount Sinai Hospital is located in the northeastern portion of Biscayne Bay adjacent to Meloy Channel. This area has high aesthetic value, with recreational and commercial vessels utilizing the Intracoastal Waterway and Meloy Channel.

The City of Miami Beach has public access and receives heavy use by swimmers and sunbathers. Adjacent to these beaches are many condominiums and hotels used by long term and short-term visitors and residents of the area. Other water related activities within the project area include on-shore and offshore fishing, snorkeling, scuba diving, windsurfing, and recreational boating. Most of the boating activity in the area originates from either Bakers Haulover Inlet or Government Cut. Both offshore fishing and diving utilize the natural and artificial reefs located within and adjacent to the project area. Commercial enterprises along the beach rent beach chairs, cushions, umbrellas, and jet skis. Food vendors can also be found along the beach areas. The revenue generated by beachgoers supports a strong Miami Beach business district in the project vicinity.

The project will have a negligible effect on aesthetics because the project site has an existing facility. Construction will obscure the view of the waterway; however this will be temporary and therefore negligible to the public interest.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Effects to aesthetics could be negative in the project area if the existing seawall, or portions of it, collapse. Collapse would result in steel and concrete debris in the water, as well as eroded land.

2.5.12. HAZARDOUS AND TOXIC MATERIALS

A search of the US Coast Guard oil spill database did not return any results for the project area. A search of the FDEP's "Map Direct Hazardous Waste Program" database identified Mount Sinai Hospital as a Hazardous Waste generator, however no known discharges of hazardous material from the hospital has been noted. A search of EPA's Superfund database did not return any National Priority List sites in the vicinity of the project area. The hospital was built in 1949 on the bayside of Miami Beach on dredged material from Biscayne Bay. . No testing has been conducted of any core borings collected behind the existing seawall. Based on this history, as well as the previously mentioned searches, there are no known hazardous or toxic materials (HTRW) within the project area.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

No changes to the status of hazardous and toxic materials are expected in the future without project condition.

3. PLAN FORMULATION

3.1. 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 purpose of this feasibility study is to develop an implementable and acceptable plan to change the future condition and address specific problems and opportunities in the study area. Problems and opportunities have been identified by the Project Delivery Team (PDT) in several ways, including coordination with the sponsor, site visits, and reports completed by private contractors.

3.1.1. PROBLEMS

Existing problems in the study area include:

- **Infrastructure is vulnerable to erosion. Further erosion will impact infrastructure key to hospital and emergency operation functions.**
  An existing seawall was constructed in several phases to prevent erosion of land. The existing seawall has been repaired in various locations, but the majority of the wall is in imminent threat of damage by natural erosion processes. Loss of portions of the seawall will result in sudden, extreme erosion impacting existing infrastructure.
- **The primary driver for current erosion problems is overtopping of the wall during extreme high tide events.**
  Overtopping allows material to migrate through cracks in the existing compromised seawall and be carried over the wall as the water recedes. Erosion also contributes to subsidence of land behind the wall. After extreme high tide events, standing water remains in subsided areas complicating and compromising hospital operations and patient health (life risk.) These complications would be exacerbated during disaster events (storms, hurricanes, etc.) where conditions would be worsened both by the natural event and by the increased use of hospital facilities as an emergency care facility and a disaster staging area.

3.1.2. OPPORTUNITIES

Opportunities are positive conditions in the study area that may result from implementation of a Federal project. Opportunities exist to:

- **Protect critical infrastructure vulnerable to erosion and maintain hospital and emergency operation functions.**
  Alternatives exist to prevent erosion and to protect critical infrastructure in place that may be more cost effective than relocating infrastructure. Critical infrastructure vulnerable to erosion includes the perimeter road and parking on the north and south ends of the hospital's waterfront.
- **Prevent current erosion drivers.**
  Such an alternative would prevent current erosion problems. It would not be designed to prevent all inundation of hospital property, but only the overtopping that occurs along the seawall and contributes to the overall erosion problem. Such an alternative would also include proper depth, or toe protection to prevent erosion at the seabed from impacting critical infrastructure.

3.2 CONSTRAINTS

3.2.1. PLANNING CONSTRAINTS

A constraint limits the extent of the planning process. It is a statement of things or situations the alternative plans should avoid. Constraints are designed to avoid undesirable changes between the without and with-project future conditions. The planning constraints relative to this study are:

- **Avoid conflict with Federal laws.**
- **Avoid or minimize environmental impacts.**
  If impacts cannot be avoided or minimized, they should be mitigated.
- **Avoid or minimize impacts to hospital operations during any alternative implementation.**
  This constraint would lead toward alternatives that would not impact hospital operations, especially emergency and disaster-related operations.
- **Avoid or minimize impacts to future hospital operations.**
  This constraint would lead toward alternatives that would not impact future hospital operations, especially emergency and disaster-related operations.

3.3. OBJECTIVES

3.3.1. PLANNING OBJECTIVES

The following study objectives have been developed based on problems, opportunities, goals, and Federal and state objectives and regulations.

- **Protect the hospital's perimeter road and parking from erosion caused by current conditions.**
  Any alternative will be designed to prevent current erosion-causing conditions and, due to the emergency nature of the work, is not intended to specifically provide protection against future sea level rise. However, alternatives can be formulated to be adapted to future sea level change.

- **Maintain footprint of existing perimeter road.**
  This objective is essential to the opportunity to maintain hospital and emergency operation functions. The existing perimeter road encircles the mid-hospital property and traverses a significant portion of waterfront as shown in REF-1. Maintaining this configuration is essential for day-to-day hospital operations, as well as the hospital's function as a disaster staging area.

- **Maintain amount of existing parking.**
  All existing parking is necessary to medical center operations. The Mount Sinai Medical Center is the only hospital facility on the barrier island and maintains emergency services, shelter for electric and oxygen dependent persons, and care for critically ill patients during disasters. The center is also an Essential Services facility and a disaster coordinating point. The primary service area of the center sees 5,000,000 annual visitors and has 125,000 permanent residents. Yearly, there are 22,000 inpatient admissions and 181,000 outpatient admissions. All parking facilities available on the hospital property are currently necessary to provide these services. Parking facilities on the bayside of the hospital property sit atop land abutted by a failing seawall and at risk of imminent damage. Loss of these facilities would negatively affect hospital operations, life safety, and the ability to provide essential public services.

3.3.2. FEDERAL ENVIRONMENTAL OBJECTIVES

USACE strives to balance the environmental and development needs of the nation in full compliance with the NEPA and other authorities provided by Congress and the Executive Branch. Therefore, 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 mitigated as required by Section 906(d) of WRDA 1986.

This report is an integrated feasibility study and environmental assessment. As with a separate NEPA document, it discusses and documents the environmental effects of the recommended plan and summarizes compliance with Federal statutes and regulations.

3.4. SUMMARY OF MANAGEMENT MEASURES AND RELOCATION

Management measures are specific structural or nonstructural actions that would take place at geographical locations within the project areas.

Management measures were selected to accomplish at least one of the planning objectives. Both structural (S) and nonstructural (NS) measures were identified.

Structural measures modify the behavior of damage drivers. In this case, structural measures would modify the drivers causing erosion. Nonstructural measures are those that modify the damage susceptibility of infrastructure. Typically, this would include measures such as flood proofing, elevating, or relocation of infrastructure.

Per ER 1105-2-100 Appendix F, Section III, F-23, alternatives are compared to determine the least cost alternative. The least cost alternative plan is considered to be justified if the total cost of the proposed alternative is less than the cost to relocate the threatened facilities. Therefore, relocation is not considered a “measure” or “alternative” but rather a basis for cost comparison.

3.4.1 NON-STRUCTURAL (NS)

NS-1: No Action
*Other measures that would typically be considered non-structural are considered under “Relocation.”

3.4.2 STRUCTURAL (S)

S-1: Adding elevation to the existing seawall (“lift” achieved by adding sandbags, stone, wood, or other material).
S-2: Revetment on waterside of the existing seawall to existing elevation.
S-3: Revetment on waterside and on top of the existing seawall to higher elevation.
S-4: Sheetpile (vinyl, steel, or other material) placement on the waterside of the existing seawall to existing elevation.
S-5: Sheetpile (vinyl, steel, or other material) placement on the waterside of the existing seawall to higher elevation.
S-6: Sheetpile (vinyl, steel, or other material) placement on landside of existing seawall to existing elevation with an erosion prevention measure placed on the land behind seawall.

S-7: Sheetpile (vinyl, steel, or other material) placement on the landside of the existing seawall to higher elevation.

S-8: Erosion prevention material placed on the land behind the seawall.

Figure 3-1 shows a graphic depiction of structural measures.

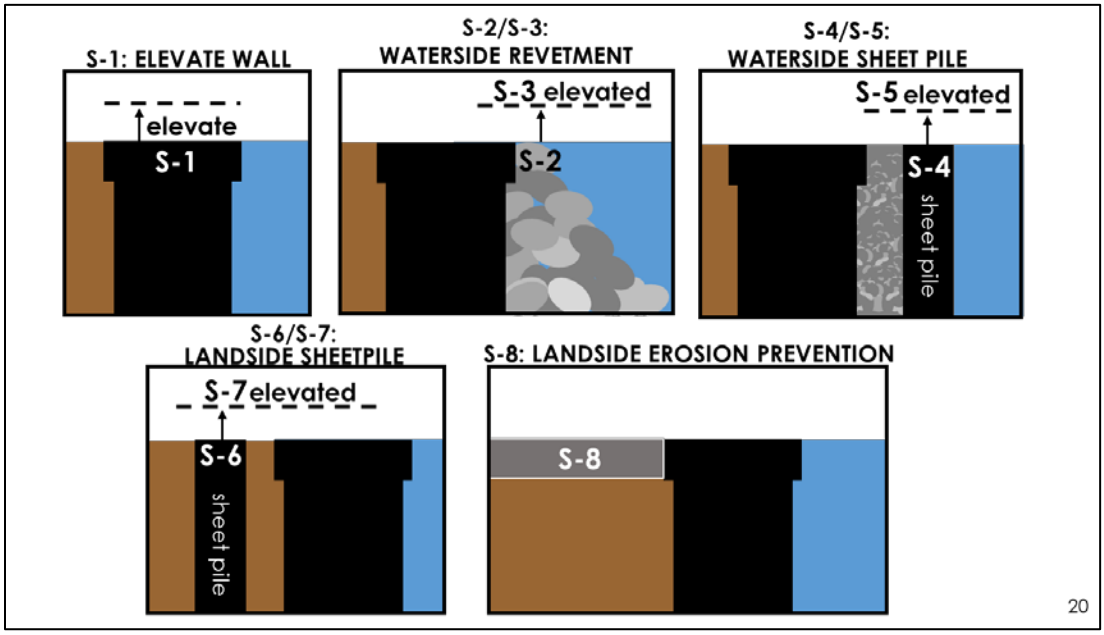


Figure 3-1: Graphic depiction of structural measures considered.

3.4.3. PRELIMINARY SCREENING

Table 3-1 shows the preliminary screening of the management measures against the study objectives and constraints. Each measure is rated as to how well it meets objectives and avoids constraints on a scale of zero to two. The sum of the ratings is then taken, and if a measure scores a minimum ranking of seven, it meets at least half of the project goals and is carried forward. If a measure is ranked less than seven, it is screened out.

The management measures were evaluated and rated in Table 3-1 for their potential to accomplish objectives given constraints: 0 = does not meet criteria, 1 = partially meets criteria, and 2 = fully meets criteria. If the total rating equals a number greater than 6, the measure partially meets, at least, half of the objectives given constraints and is carried forward for further analysis. If the total rating is equal to or less than 6, the measure is not considered further. The final total rating should not be inferred to be a ranking of measures against one another. A measure's rating is only an indication of how likely it is to meet objectives given constraints and therefore carried forward or not. S-6 was screened out as a result of this first screening.

Table 3-1: Management measure initial screening.

	Measures	Planning Objectives			Planning Constraints					
		Protect Critical Infrastructure Vulnerable to Erosion	Maintain Footprint of Existing Perimeter Road	Maintain Existing Parking	Avoid Conflict with Federal Laws	Avoid or Minimize Environmental Impacts	Avoid or Minimize Impacts to Hospital Operations During Any Alternative Implementation.	Avoid, or Minimize, Impacts to Future Hospital Operations	Total	Measure Carried Forward (Yes/No)
	Nonstructural Measures (NS)									
NS-1	No-Action	Continued potential for significant impacts to infrastructure.	Loss of footpring of existing perimeter road as existing seawall fails.	Existing parking will be reduced as existing seawall fails.	Consistent with federal law.	Potential loss of environmental rescources as existing seawall fails, causing erosion and covering of seafloor resources with soil and debris.	No impact for implementation.	Hospital operations will be impacted during exteme high tide events and will be impacted as existing seawall fails.		
		0	0	0	2	1	2	0	5	No-Action carried forward for baseline comparison.
	Structural Measures (S)									
S-1	Adding elevation to existing seawall (concrete lift, sandbags, stone, wood, or other material)	Would likely be least costly but requires dependence on structural integrity of existing seawall to support weight of added elevation. Does not alleviate erosion of fill through or under the existing seawall.	Maintains footprint of existing perimeter road until erosion through or under the existing seawall causes seawall failure or the seawall collapses under added weight.	Maintains existing parking until erosion through or under the existing seawall causes seawall failure or the seawall collapses under added weight. This would cause a loss of fill behind the seawall impacting existing parking.	Consistent with federal law.	Potential loss of environmental rescources as existing seawall fails, causing erosion and covering of seafloor resources with soil and debris.	Could be fastest alternative to implement.	Could minimize impacts to operations. However, as erosion continues through and under existing seawall operations would be affected as existing seawall fails.		
		0	1	1	2	1	1	1	7	Yes
S-2	Revetment on waterside of existing seawall to existing elevation.	Could support existing seawall and prevent failure. Would not prevent loss of material over existing seawall. Structure would need to be designed to be completely submerged during extreme high tide events.	Would not prevent extreme high tide events from inundating property. Structure may prevent most inundation induced erosion but some erosion could still occur landward of seawall, impacting the perimeter road.	Would not prevent extreme high tide events from inundating property. Structure may prevent most inundation induced erosion but some erosion could still occur landward of seawall, impacting existing parking.	Consistent with federal law.	Slope of waterside face would impact a large footprint of the seabed, impacting seagrass and other resoucres.	Construction would likely involve stone placement and have some impact on operations.	Would not prevent extreme high tide events from inundating property. Structure may prevent most inundation induced erosion but some erosion could still occur landward of seawall, impacting operations.		
		1	1	1	2	0	1	1	7	Yes
S-3	Revetment on waterside and on top of existing seawall to higher elevation.	Could support existing seawall and prevent failure. However, design still relies on existing seawall to partially support rock placed on top of it.	If existing seawall fails under added weight, erosion could still impact existing perimeter road.	If existing seawall fails under added weight, erosion could still impact existing parking.	Consistent with federal law.	Slope of waterside face would impact a large footprint of the seabed, impacting seagrass and other resoucres.	Construction would likely involve stone placement and have some impact on operations.	If existing seawall fails under added weight, significant impacts to operations could occur as structure is modified/repaired.		
		1	1	1	2	0	1	1	7	Yes
S-4	Sheetpile (vinyl, steel, or other material) placement on waterside of existing seawall at existing elevation.	Could prevent all current erosion problems. However, structure and materials would need to be designed to be completely submerged during extreme high tide events.	Should maintain footprint of existing perimeter road depending. However, structure would not prevent overtopping of seawall and any related issues.	Should maintain footprint of existing parking. However, structure would not prevent overtopping of seawall and any related issues.	Consistent with federal law.	Relatively small footprint due to vertical construction minimizing potential environmental impacts.	Construction would likely require both land and water access for pile driving and have some impact on operations.	Since measure would be inundated during extreme high tide events, future maintenance may be required impacting operations.		
		2	1	1	2	2	1	1	10	Yes
S-5	Sheetpile (vinyl, steel, or other material) placement on waterside of existing seawall to higher elevation.	Would prevent all current erosion problems.C24	Maintains footprint of existing perimeter road.	Maintains existing parking.	Consistent with federal law.	Relatively small footprint due to vertical construction minimizing potential environmental impacts.	Construction would likely require both land and water access for pile driving and have some impact on operations.	All current erosion problems are addressed and maintenance should be minimal, minimizing impacts to operations.		
		2	2	2	2	2	1	2	13	Yes
S-6	Sheetpile (vinyl, steel, or other material) placement on landside of existing seawall at existing elevation..	Could prevent all current erosion problems. However, structure and materials would need to be designed to be completely submerged during extreme high tide events.	Should maintain footprint of existing perimeter road depending on how far landward piles must be driven. However, structure would not prevent overtopping of seawall and any related issues.	Should maintain footprint of existing parking depending on how far landward piles must be driven. However, structure would not prevent overtopping of seawall and any related issues.	Consistent with federal law.	Driving sheetpile on landside of existing seawall raises serious concerns with existing seawall failure. Failure of wall may cause collapse and burial of environmental resources.	Construction behind wall could be complicated without complete as-builts of existing wall. Any tiebacks of existing wall would be severed as new sheetpile is driven. Impacts to hospital operations could be lengthy depending on complexity of	Without as-builts of the existing seawall, it is unknown what impacts to operations could be as a result of impacting existing drainage or utilities behind wall.		
		1	1	1	2	0	0	1	6	No
S-7	Sheetpile (vinyl, steel, or other material) placement on landside of existing seawall to higher elevation.	Would prevent all current erosion problems.	Should maintain footprint of existing perimeter road depending on how far landward piles must be driven.	Maintains existing parking.	Consistent with federal law.	Driving sheetpile on landside of existing seawall raises serious concerns with existing seawall failure. Failure of wall may cause collapse and burial of environmental resources.	Construction behind wall could be complicated without complete as-builts of existing wall. Any tiebacks of existing wall would be severed as new sheetpile is driven. Impacts to hospital operations could be lengthy depending on complexity of	Without as-builts of the existing seawall, it is unknown what impacts to operations could be as a result of impacting existing drainage or utilities behind wall.		
		2	1	2	2	0	0	1	8	Yes
S-8	Erosion prevention measure (fabric, rip-rap, or other material) constructed on land behind existing seawall.	Would prevent erosion of surface soil. Would not prevent loss of material through/under existing seawall. Would need to be designed to be completely submerged during extreme high tide events.	Should maintain footprint of existing perimeter road depending on erosion prevention measure placed behind seawall.	Would not prevent eventual collapse of portions, or all, of existing wall. Existing parking will be reduced as existing seawall fails.	Consistent with federal law.	Would be no environmental impacts to sea floor. Potential environmental impacts to resources along top of seawall.	Construction footprint would span area between perimeter road and existing seawall top and have some impact on operations.	Since measure would be inundated during extreme high tide events, future maintenance may be required impacting operations.		
		1	1	0	2	1	1	1	7	Yes

Measure carried forward for further analysis
Measure eliminated
2 - Fully meets objective/avoids constraint
1 - Partially meets objective/avoids constraint
0 - Does not meet objective/avoids constraint

3.4.4. SECONDARY SCREENING

The remaining measures were discussed in detail by the Project Development Team (PDT) to evaluate their merit for further consideration, as described in the following paragraphs.

NS-1: No Action

The No Action measure would consist of no participation by the Federal government in an alternative to protect vulnerable facilities. Under this measure, erosion would continue and extreme high tide events would continue to inundate the existing seawall, driving erosion, and ultimately the failure of portions, or all, of the wall. Such failure would impact the perimeter road and vulnerable parking, negatively affecting the daily operations of the medical center, limiting access to hospital facilities, and potentially causing life risk. Furthermore, if failures occurred during extreme events necessitating activation of emergency disaster services, the center's function as an Essential Services facility and disaster coordination point could be severely impacted.

S-1: Adding elevation to the existing seawall (lift, sandbags, stone, wood, or other material.)

As described in Table 3-1, this measure is likely the least costly and easiest to implement. However, due to visible deterioration, and existing sections where the seawall is failing, the structure cannot reliably support the additional weight of materials used to increase the seawall height. Furthermore, the measure would not prevent the erosion of material through the existing wall, and is unlikely to reduce the risk of failure. However, there is one span of the existing seawall where this measure could be implemented. The 130 ft. section of seawall in front of the Golden Medical office building (see **Figure** 1-2) was newly constructed in 2009 to an elevation equivalent to the remaining wall. This newer section can support increased height. This measure will be carried forward for the 130 ft. newly constructed seawall section.

S-2: Revetment on the **waterside** of the existing seawall to existing elevation.

This measure would be constructed of stone, likely granite or limestone. The footprint of a revetment would be significantly larger than a measure constructed vertically. The revetment footprint would cover a larger area of the seafloor, likely impacting more environmental resources than a measure such as sheetpile. Due to these reasons, this measure was screened out.

S-3: Revetment on the **waterside** and on top of the existing seawall to higher elevation.

Considerations are similar to S-2. While this measure would have added erosion prevention due to its higher crest elevation, the potential negative environmental impacts compared to other measures, such as sheetpile, led to screening it out.

S-4: Sheetpile (vinyl, steel, or other material) placement on **waterside** of existing seawall at existing elevation.

Depending on the material used, this measure could be cost prohibitive within the CAP project limit. The amount of construction that can be land based rather than water based will have a significant impact on cost. Sheetpile provides benefits over other measures due to its limited, or negligible, environmental impact, depending on the location of resources. This measure would not address erosion due to overtopping and would need to be combined with an erosion prevention structure (S-8) to prevent the erosion of land behind the seawall. Additionally, the measure would need to be constructed with the intent of being periodically submerged during extreme high tide events, likely increasing cost and the necessity for O&M. Due to these factors, the measure was screened out.

S-5: Sheetpile (vinyl, steel, or other material) placement on the **waterside** of the existing seawall to higher elevation.

Depending on the material used, this measure could be cost prohibitive within the CAP project limit. The amount of construction that can be land based rather than water based will have a significant impact on cost. Given the likely minimal cost increase to add elevation to the sheetpile, this measure is preferable to S-4 since it would not require an erosion prevention measure behind the wall and would prevent inundation of the structure, as well as erosion resulting from material being carried back over the wall as inundation waters recede. Given the effectiveness of the measure and minimal, or no, environmental impact, this measure is preferable to others and was carried forward.

S-7: Sheetpile (vinyl, steel, or other material) placement on the **landside** of the existing seawall to higher elevation.

This measure could minimize or eliminate environmental impacts to seafloor resources. Depending on the material used, this measure could be cost prohibitive within the CAP per project limit. The amount of construction that can be land based rather than water based will have a significant impact on cost. This measure would prevent inundation of the structure as well as erosion resulting from material being carried back over the wall as inundation waters recede. However driving piles on the landside of the existing seawall may have construction complications related to tiebacks and/or service lines buried behind the existing wall. Such features would need to be located prior to construction and removed/relocated. Due to these factors, this measure was eliminated.

S-8: Erosion prevention material on the land behind the seawall.

This measure would involve placement of small size rip-rap, fabric, or some other form of prevention material on the land behind the existing seawall. In order to fully address erosion issues, the measure would need to be used in combination with S-2 or S-4. This measure also has the potential to add weight, depending on the material used, to the landward side of the existing seawall. Additional load on the land behind the wall could increase likelihood of failure of portions of the existing wall. Using this measure in combination with others could complicate construction when the S-5 measure would address all erosion-causing conditions without added complication. Due to this consideration, this measure was eliminated.

Table 3-2 summarizes the secondary screening.

Table 3-2: Secondary screening of managment measures. NS-1 (No Action) is carried forward for baseline comparison.

Measure		Discussion	Carry Forward?
S-1	Add elevation to existing seawall.	Only applicable for 130 ft of newer existing wall.	Yes
S-2	Waterside revetment to existing elevation.	Large env. impact footprint. Footprint extends approx. 18' from wall. Seagrass begins 6' from wall. Does not fully address erosion.	No
S-3	Waterside revetment to higher elevation.	Large env. impact footprint compared to S-5. Footprint extends approx. 18' from wall. Seagrass begins 6' from wall.	No
S-4	Waterside sheet pile to existing elevation.	Does not fully address erosion and must be constructed to be submerged.	No
S-5	Waterside sheet pile to higher elevation.	Fully addresses erosion with likely minimal cost increase to S-4.	Yes
S-7	Landside sheet pile to higher elevation.	Potential construction complications: existing seawall tiebacks and service lines would need to be removed and relocated.	No
S-8	Erosion prevention material on land behind seawall.	Must be used in combination with S-2 or S-4 to fully address erosion resulting in added complication compared to increasing elevation. Added load on land behind seawall may cause seawall impacts/collapse.	No

3.4.5. MEASURES CARRIED FORWARD

Adding elevation to the existing seawall (S-1), sheetpile placement on the waterside of the existing seawall to higher crest elevation (S-5), and No Action (NS-1), were the measures carried forward for alternative development and comparison with Relocation.

3.4.6. RELOCATION

3.4.6.1. RELOCATION OF PERIMETER ROAD

The barrier island on which the Mount Sinai Medical Center is located is very densely developed. Real estate prices nearby are some of the highest in the nation. Opportunities to relocate the perimeter road do not exist. Onsite relocation would require the demolition of patient care buildings or operations infrastructure. Offsite relocation would be subject to costly real estate limitations, but also unfeasible due to the need to maintain the perimeter road in its current location and configuration which encircles the mid-hospital property and traverses a significant portion of waterfront. The current road configuration provides first responders with quick, efficient access to the emergency room and helipad, and provides correct dimensions for fire rescue apparatus. The current configuration along the seawall

serves to separate pedestrian and vehicular traffic, which provides for a safer environment for pedestrians and minimizes traffic congestion. Due to these factors, vertical relocation of the perimeter road is the only relocation measure available. Vertical relocation options considered include:

- Vertical relocation of the perimeter road on piles.
- Vertical relocation of the perimeter road on an elevated berm.

Vertically relocating the perimeter road on an elevated berm is more economical than elevating the road on piles. Therefore, vertical relocation on piles was screened out. Only the section of road adjacent to Biscayne Bay would require elevation (approximately 1,000 feet), with appropriate transitions to/from existing grade. Given the proximity of the road to the existing seawall in this section, elevating the road on a berm would create an additional load on the existing wall. Therefore some form of support would need to be constructed on the waterside of the existing seawall, to prevent the wall from collapse during or after construction.

3.4.6.2. RELOCATION OF VULNERABLE PARKING

All existing parking is essential, not only to provide services to the public for normal and emergency operations, but also for employee parking. The Mount Sinai Medical Center is the only hospital facility on the barrier island and maintains emergency services, shelter for electric and oxygen dependent persons, and care for critically ill patients during disasters. The center is also an Essential Services facility and a disaster coordination point. The primary service area of the center sees 5,000,000 annual visitors and has 125,000 permanent residents. Yearly, there are 22,000 inpatient admissions and 181,000 outpatient admissions. The hospital sees approximately 55,000 annual emergency room visits and has 3,700 employees. Approximately 75% of patients come from outside of the city so there is a large influx of vehicles, currently using 93% of the facility's parking capacity. Construction of new facilities (**Figure 1-2**) will remove a significant portion of the current surface parking lot, while at the same time increasing patient volume, and perhaps increasing the need for additional employees, thereby creating a deficit in available parking. To meet this demand, the hospital will be constructing their own onsite parking garage.

Parking relocation options considered:

- Offsite parking within walking distance of hospital facilities.
- Offsite parking, in existing or new construction, with shuttle service to hospital facilities.
- Parking constructed onsite.

The hospital evaluated the potential to develop offsite parking and found that the cost of procuring additional land would likely be prohibitive if it existed. Miami Dade County Property Appraiser lists the median price of vacant land as $234 per square foot ($7 million for 30,085 square feet). However, there is not any properly zoned vacant commercial land near Mount Sinai that is available to purchase.
Offsite parking with shuttle service was also assessed by the hospital. The closest parking garages are between 1 and 3 miles from the hospital with daily rates ranging from $8 - $20. Based on these rates, the cost to park 250 employees would range from $520,000-$1,250,000 annually, assuming that the necessary parking volume was available. Additional shuttle operational costs would be at least $300,000 a year. These costs were deemed prohibitive.

Based on these factors, it was determined that any vulnerable parking would be relocated to a new parking garage located on hospital property.

3.4.6.3. RELOCATION PLAN

The Relocation plan therefore consists of vertical relocation of the perimeter road adjacent to Biscayne Bay with constructed support for the portion of the existing seawall adjacent to the elevated road. Relocation also includes the relocation of vulnerable parking to a new parking garage constructed on the medical center property.

3.5. ALTERNATIVE DEVELOPMENT

Adding elevation to the existing seawall (S-1), sheetpile placement on the waterside of the existing seawall to higher elevation (S-5), and No Action (NS-1), were the measures carried forward for alternative development and comparison with Relocation. No Action is required to be assessed under NEPA and all alternatives must be compared to it. S-1 and S-5 were scaled and combined to formulate Alternative 1 and Alternative 2.

3.5.1. DESIGN ELEVATION DETERMINATION (STRUCTURE CREST AND VERTICAL ROAD RELOCATION)

A key design factor of Alternatives 1 and 2 is the crest elevation necessary to prevent current erosion-causing conditions. This same elevation will be used as the height to which the vulnerable portion of the perimeter road should be vertically relocated. The Engineering Appendix provides full details on determination of the design crest elevation. In summary:

- Height of existing seawall is approximately 2.5 feet (NAVD88)
- Extreme high tide events overtop the seawall by approximately 1 foot; gage measured still water level.
- An additional 0.5 feet should be added to prevent overtopping by waves along the bayside.
- Therefore a crest elevation increase of 1.5 feet should be added to the existing wall.
- This results in a design crest elevation of 4 feet (NAVD88).
- This increase is designed to prevent existing erosion-causing conditions, and does not account for future sea level rise.

3.5.2. ALTERNATIVE 1

Alternative 1 includes the S-5 steel sheet pile driven on the waterside of the entire alignment of the existing seawall to an elevation of 4.0 feet NAVD88. The total length of the new sheetpile would be 3,500 feet, driven to a depth of 16 feet, with no more than a three foot offset between it and the existing wall. The three foot offset is necessary for workers to reconnect any drainage system or utilities between the new and existing walls. The three foot offset will be filled with stone. At the northeast end of the driven sheetpile, a modification to S-1, adding elevation, will be added; a T-wall will tie-in and continue landward to the 3.5 foot contour to prevent flanking of the seawall. **Figure 3-2** depicts Alternative 1 in plan view. Construction is expected to take 266 calendar days. It is estimated that, based on an 8 hour work day, no more than 10 sheets can be driven each day. A two foot wide concrete cap will be placed on top of the seawall, resulting in a one foot overhang in front of the seawall, similar to what was constructed on the 2009 portion of the wall seen in Figure 2-4.

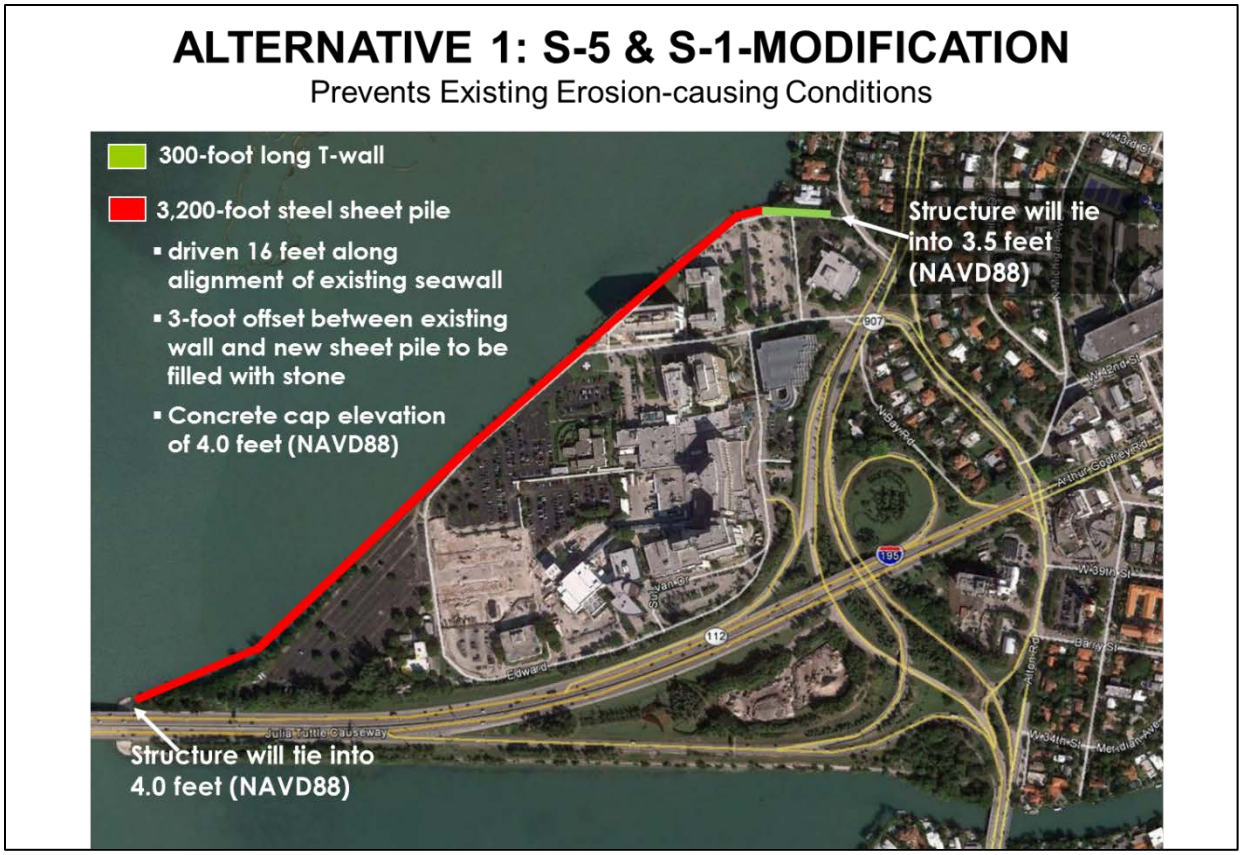


Figure 3-2: Alternative 1.

3.5.3. ALTERNATIVE 2

Alternative 2 is very similar to Alternative 1. However, it was determined that the 130 foot section of seawall constructed in 1990 was in an acceptable condition to support the weight of added concrete to increase its elevation. Therefore Alternative 2 will not drive sheetpile seaward of this 130 foot section of existing seawall and instead will add a 1.5 foot concrete lift on top of the existing seawall. **Figure 3-3** depicts Alternative 2 in plan view. Construction will take less than the 266 days required for Alternative 1. It is estimated that, based on an 8 hour work day, no more than 10 sheets can be driven each day. A two foot wide concrete cap will be placed on top of the seawall, resulting in a one foot overhang in front of the seawall, similar to what was constructed on the 2009 portion of the wall seen in Figure 2-4.

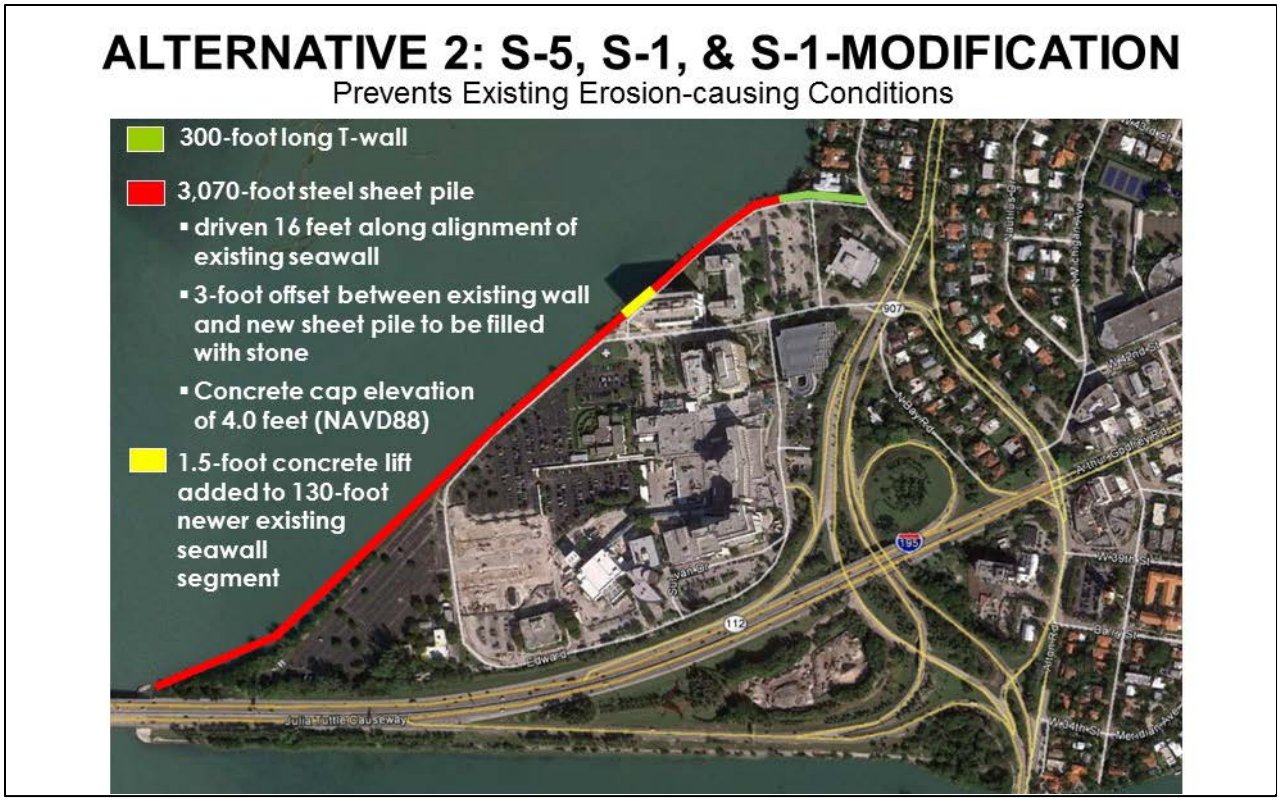


Figure 3-3: Alternative 2.

Per ER 1105-2-100 Appendix F, Section III, F-23**, the least cost alternative plan is considered to be justified if the total costs of the proposed alternative are less than the costs to relocate the threatened facility.**

3.6. ENVIRONMENTAL EFFECTS OF ALTERNATIVES

This section is the scientific and analytic basis for the comparisons of the alternatives: No Action, Alternative 1, and Alternative 2. The No Action Alternative was assessed for each of the criteria in Section 2. The following includes anticipated changes to the existing environment including direct, indirect, and cumulative effects.

3.6.1. GENERAL ENVIRONMENTAL EFFECTS

While USACE cannot specify which construction methodology may be used for the seawall construction, USACE places specific environmental conditions on specific construction methodologies. For the seawall construction, either vibratory or impact hammers will be used, and the impact assessment for pile driving associated with seawall construction is based on impact hammer driven piles, as these tend to result in the greatest pressure being released into the water. The vibratory pile driver or impact hammer would generate a lower level of sound or vibration through a series of lower impact blows. For the purposes of impact analysis, the construction timeframe is assumed to be 266 calendar days.

3.6.2. VEGETATION

3.6.2.1. ALTERNATIVE 1

Seagrass impacts associated with the construction of Alternative 1 were calculated by dividing each of the original 50 foot wide seagrass transects in two using ArcGIS software, so that each new transect was 25 feet in width and mapping the seagrasses within three feet of the existing seawall face. The coverage of this area (one foot, two feet or three feet) was multiplied by 25 feet to obtain a coverage of the area between the transects. The square footage for each of these areas was totaled and all of the areas summed together. In an effort to be conservative, where the grass was documented as being three feet from the seawall face, an impact of 25 square feet was assumed, which would be excessive given the location of the new seawall is within three feet of the current seawall (**Table 3-3**).

Table 3-3. Seagrass Impacts of Alternative 1 by Transect.

Transect Number	Distance of Bed Edge from Existing Seawall	Impacted Sq. Footage of Seagrass on Transect
1	0	75
1.5	0	75
2	3	25
2.5	2	25
3	2	25
3.5	1	50
12	1	50
13.5	2	25
14	3	25
14.5	1	50
16	3	25
17	2	25
17.5	2	25
18.5	1	50
19.5	0	75
20	3	25
20.5	2	25
22.5	0	75
24.5	1	50
25.5	1	50
26	3	25
27	3	25
27.5	1	50
28.5	1	50
29.5	3	25
31	0	75
31.5	0	75
33.5	3	25
34.5	3	25
35	3	25
36	1	50
37	2	25
37.5	1	50
38	2	25
38.5	0	75
39.5	3	25
40	1	50
41	2	25

42.5	1	50
42	3	25
42.5	1	50
43.5	2	25
45.5	3	25
46	3	25
47.5	3	25
49	3	25
51.5	2	25
52	3	25
52.5	3	25
1	1	50
54.5	2	25
56	3	25
56.5	3	25
Total Square Footage		**2,275**

The total square footage of 2,275 equals 0.052 acres (conversion 1 sq. foot equals 0.000023 acre (http://www.onlineconversion.com/area.htm). Using this conversion, USACE has determined that the Alternative 1 would result in minor impacts, 0.052 acres, to seagrass beds. Although this project would be constructed in accordance with Section 14 of the 1946 Flood Control Act, as amended - Streambank and Shoreline Erosion Protection of Public Works and Non-Profit Public Services, its construction will also be consistent with Nationwide Permit 3 (NWP), 33 CFR 320.4, and 40 CFR Part 230. Activities authorized by this NWP may result in the loss of small amounts of wetlands. Seagrass beds are considered to be a type of saltwater wetlands (NOAA 2004). USACE will require, and thus will be compliant with General Condition 23 of Nationwide Permits, that the proposed work avoid and minimize impacts to seagrass beds. Also in accordance with this condition, compensatory mitigation at a minimum one-for-one ratio will be required for all wetland (seagrass) losses resulting from the proposed work that exceed 0.10 acres. Additional seagrass surveys within the project footprint will be performed before and after construction, and this information would be coordinated with the appropriate regulatory agencies. Construction of the project is assumed to be from the shoreside for cost engineering purposes, however, if a contractor proposes to construct from the waterside, temporary impacts to seagrasses adjacent to the seawall may occur when the legs from a spud barge are placed on the bottom. Since the spuds and anchors do not change the depth of water, long term impacts to grass from spudding or anchoring are expected to be minimal as any crushed grasses should recover or recolonize the area after the spuds/anchors are removed. If a contractor proposes to build from the waterside, GPS locations of all anchors/spud down locations will be recorded and those areas surveyed for seagrass impacts after the anchor/spud operations are complete and the results included in the report on seagrass impacts associated with the project footprint. If total project seagrass impacts exceed 0.10 acres, then USACE will work with the agencies to determine the appropriate compensatory mitigation for seagrasses.

Trees and underbrush found in Area 1 (Tree Nos. 1-11) at the northern most end of the seawall, are densely packed and will likely be removed during demolition and reconstruction activities. The seawall at this location has suffered significant damage and deterioration. Trees found in Area 2 (Tree Nos. 12-30) represent landscaping plantings that are maintained and were part of the overall facility landscaping along sidewalks and benches. As such, landscape materials abut the seawall; consequently, any demolition and reconstruction efforts will destroy most of such plantings. Trees found in Area 3 (Tree Nos. 31-50) were mostly trees planted as part of landscaping and are spaced apart from each other. Most of these trees are approximately 10 feet from the seawall and, depending on demolition and construction methods, may

be saved. However, this will not be known until project design is completed. Trees found in Area 4 (Tree Nos. 51-68) are densely packed with underbrush and debris floated in by tides and storm events, and will likely be removed during demolition and reconstruction activities.

3.6.2.2. ALTERNATIVE 2

Effects would be similar to Alternative 1. However, as previously stated, the 130 foot section of seawall constructed in 2009 is in good enough condition to support the weight of added concrete to increase its elevation. Therefore, no sheet pile would be placed adjacent to this section of the wall, and seagrass impacts would not occur in 130 foot section of the existing wall, further reducing the total project impacts. Removal of the seagrass in front of the "2009" portion of the seawall removes transect #s 17, 17.5, 18, 18.5 and 19 for a total of 125 feet. Within these transects, three have seagrasses recorded within three feet of the seawall face – 17, 17.5 and 18.5 covering a total of 100 ft^2 of seagrass. Removing this from the total square footage calculated for Alternative 1 results in a total square footage to be impacted by Alternative 2 of 2,175 ft^2, which covers 0.050 acres. Alternative 2 would result in minimal impacts to seagrasses, .002 acres less than Alternative 2.

3.6.3. THREATENED AND ENDANGERED SPECIES

3.6.3.1. SEA TURTLES

3.6.3.1.1. Alternative 1

Sea turtles may be affected by being temporarily unable to use the site due to potential avoidance of construction activities and related noise, and physical exclusion from areas contained by turbidity curtains (if utilized), but these effects are insignificant and temporary. Disturbance from construction activities and related noise will be intermittent and only occur during the day for part of the construction period; turbidity curtains will only enclose small areas at any one time in the project area, will be removed upon project completion, and will not appreciably interfere with use of the area by listed species. Additional avoidance and minimization measures include adhering to the NMFS' "Sea Turtle and Smalltooth Sawfish Construction Conditions." Although seagrass and other soft bottom habitats will be impacted, USACE does not anticipate that the proposed project will have any adverse indirect effects on sea turtles in the vicinity of the action area. These habitats may be utilized by the species, however, loss of seagrass habitats is relatively small with respect to overall seagrass abundance throughout the area.

Replacement of the seawall will result in the temporary loss of foraging habitat that has encrusted the face of the existing structure. This impact is temporary, since the newly constructed seawall will recolonize with the same types of encrusting plants and organisms over time.

To determine effects thresholds, USACE assumed the use of impact pile drivers, as those are the loudest potential impact. Acoustic impact criteria and thresholds were developed in cooperation with NMFS for sea turtle exposures to various sound sources. The NMFS prepared an analysis for pile driving activities in the Florida Keys (NMFS 2014) developing threshold values for onset of injury to sea turtles due to impact pile driving is 206 dB re 1 µPa sound pressure level root mean square (RMS) or 187 dB for a single pile driver pulse (Sound Exposure Level (sSEL)), whichever is larger. Noise levels that result in changes in behavior is 160 dB (RMS). This criteria was developed in cooperation with NMFS and is not based on experimental evidence of injuries caused to sea turtles by pile driving sound. In the absence of reliable in-water density data for sea turtles, this criterion is useful for qualitatively assessing activities that impart sound to water.

Sound levels from vibratory pile driving are not expected to reach the 194 dB re 1 µPa sound pressure level root mean square threshold (

Table 3-).

Table 3-4: Sea Turtle Source Levels for Pile Driving

Hammer	Pile type	Source Level (Noise Generates by Activity)	Behavior change (RMS [dB re 1µPa])	Injury (peak pressure)	Impact Radius (Behavior)
Vibratory	24" steel sheet pile	192 dB (peak pressure) 178 dB (sSEL)	160	206	16m (52 ft.)
Impact	24" steel sheet pile	220 dB (peak pressure) 194 dB (sSEL)	160	206	9m (30 ft.)

NMFS 2014

Because of this, no injuries associated with the sound produced by pile driving are anticipated for any species of sea turtle; however this does not preclude behavioral effects. As a precautionary measure against possible behavioral effects, should an impact hammer be used to drive in the sheet pile, a bubble curtain consisting of two rings shall be deployed around the area where the piles are being driven each day. In addition, the number of sheets to be driven in one day will be limited to 10 sheets per day. The NMFS utilized their 2014 Biop for Regional General Permit SAJ-82 for their analysis for this project specific biop.

NMFS determined:

> Based on our noise calculations, installation of metal sheet piles (such as cofferdams or metal seawall sheet piles) by vibratory hammer will not result in any form of injurious noise effects. Yet, this installation method could result in behavioral effects at radii of 52 ft. (16 m) for sea turtles and 243 ft. (74 m) for ESA-listed fishes. Given the mobility of sea turtles and ESA-listed fish species, we expect them to move away from noise disturbances. If an individual chooses to remain within the behavioral response zone it could be exposed to behavioral noise impacts during pile installation. Since installation will occur intermittently (throughout the day and between days), we anticipate any effects will be insignificant. These species will be able to resume normal activities during quiet periods between pile installations and at night. Therefore, installation of metal sheet piles by vibratory hammer will not result in any injurious noise effect and we anticipate any behavioral effects will be insignificant.

USACE agrees with this determination and will utilize a 50 safety radius for vibratory installation for sea turtles, which is equal to the planned protective radius for marine mammals, and is two feet smaller than the required distance for sea turtles, thus more protective of sea turtles. The radius will be noted visually

by placement of a buoy 50-feet waterward of each day's construction area. Any animal that crosses this line will result in a shutdown of work until the animal leaves the area of its own volition.

If construction is completed with vibratory hammer, due to the 50 foot safety radius around the seawall construction activities, and the determination that sound levels associated with vibratory hammer are not expected to reach the impactive levels previously set by NMFS, USACE believes that construction of the proposed work may affect, but is not likely to adversely affect, the threatened and endangered sea turtles as defined by the ESA, as NMFS determined in 2014 (NMFS 2014). However, if an impact hammer is used, the potential for behavioral effects occurs outside of the 50 foot safety radius. To reduce the potential for adverse effects to sea turtles, a bubble curtain will be employed to further reduce noise to less impactive levels. The bubble curtain will meet the specifications for pile driving found in the Florida Statewide Programmatic Biological Opinion (SER-2013-12540) dated December 4, 2015, Appendix C: SWPBO Noise Effects Matrix and BMPs (NMFS 2015).

3.6.3.1.2. Alternative 2

Effects for the partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall as described above, however, construction would not take as long.

3.6.3.2. MANATEES

3.6.3.2.1. Alternative 1

Utilization of pile driving to replace the sheet pile seawall may have an effect on manatees in the area. Both the pressure and noise associated with pile driving can impact marine mammals.

The two tables below were recreated from USN 2013 (
Table 3-,

Table 3-). They detail representative pile driving sound pressure levels measured from 24" wide steel sheet piles. Sources are indicated by footnotes in the relevant tables.

Table 3-5: Underwater sound pressure levels during vibratory installation based on in situ monitored construction activities.

Project and Location	Pile Size and Type	Water Depth	Range to Pile	RMS	Peak	Sediment
Berth 23 Port of Oakland, CA[c]	24 inch steel sheet pile	6.1m	10m	163	177	Unknown
Berth 30 Port of Oakland, CA[c]	24 inch steel sheet pile	4.9m	10m	162	175	Unknown
Berth 35/37 Port of Oakland, CA[c]	24 inch steel sheet pile	6.1m	10m	163	177	Unknown
Sound levels expressed as dB re 1 µPa rms and dB re 1 µPa peak for RMS and Peak SPL measurements, respectively.						

Sources: a – Illingworth & Rodkin 2012; b- Washington Department of Transportation 2010; c- California Department of Transportation 2009; d – Washington Department of Transportation 2010a

Table 3-6: Underwater sound pressure levels during impact installation based on in situ monitored construction activities.

Project and Location	Pile Size and Type	Water Depth	RMS	Peak	SEL	Sediment
Friday Harbor Ferry Terminal, WA[a]	24-inch steel sheet pile	12.8m	170	183	180	Sandy silt / clay
		13.4m	186	205	179	
		14.3m	186	204	179	
		10m	194	210	185	Sandy silt / rock
		10m	195	215	187	
		10m	193	212	184	
Typical values, CALTRANS compendium summary table[b]	24-inch steel sheet pile	15m	194	207	178	Unknown
Berth 23 Port of Oakland[b]	24-inch steel sheet pile	12 to 14m	189	205	179	Unknown
Sound levels expressed as dB re 1 µPa rms and dB re 1 µPa peak for RMS and Peak SPL measurements, respectively.						

Sources: [a]WSDOT 2005; [b]CALTRANS 2009

USFWS has not set levels defining harassment of manatees under the MMPA. However, under the MMPA, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering."

In Finneran 2016, the peak and longer term sound levels that result in either TTS or a permanent threshold shift (PTS), which is an injurious impact to an animal were determined for sirenians, the group that manatees belong to. Specifically, Finneran determined that for a PTS to occur in a manatee associated with an impactive noise like pile driving, sound level exposure must exceed 226 dB peak or 190dB over a longer term.

Behavioral harassment (Level B) is considered to have occurred when manatees are exposed to impulsive noise from impact pile driving at or above 220 dB peak or 175 dB over a longer term., and for non-impulsive noise from vibratory pile driving at or above 186 dB, but below injurious thresholds (Finneran 2016).

Sound levels from vibratory pile driving are not expected to reach the 175 dB sound pressure level; therefore, based on the data from Finneran (2016), no injuries to manatees from sound associated with vibratory pile driving are anticipated. However, should manatees be near the project vicinity during pile driving operations, direct impacts could include alteration of behavior and autecology. For example, daily movements and/or seasonal migrations of manatees may be impeded or altered.

As a precautionary measure against possible behavioral effects, USACE will utilize a shutdown zone which will always be a minimum of 15 meters (50 feet). For impact pile driving which generates impulsive sound,

a larger 100 meter (330 foot) shutdown zone shall be implemented for marine mammals only; the standard shutdown zone will continue to be applied for all other protected species. A protected species observer will be present on the project to ensure that if a protected species approaches or enters a shutdown zone during any in-water work, activity will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal. Based on this information, and the proposed construction techniques, it was determined that seawall construction using vibratory or impact pile driving may affect, but is not likely to adversely affect, the endangered Florida manatee and will not adversely modify designated critical habitat. The USFWS concurred with this determination on November 15, 2016. This concurrence is included in Appendix C.

3.6.3.2.2. Alternative 2

Effects for partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall as described above.

3.6.3.3. JOHNSON'S SEAGRASS AND DESIGNATED CRITICAL HABITAT

3.6.3.3.1. Alternative 1

Alternative 1 will not affect Johnson's seagrass as none was documented in the seagrass survey conducted in the project area. The project will remove a maximum of 7,125 square feet of designated critical habitat for Johnson's seagrass from Unit J. To determine this value, multiply the total distance of the seawall (3,500 feet – 825 exposed at low tide) 2,375 feet by the maximum waterward extent of the replacement seawall, three feet. This equals a total of 7,125 sq. feet).

The estimated total area of Johnson's seagrass critical habitat given in 67 FR 13098 is 22,574 acres. A specific value for Unit J is not provided in the notice. 7,125 sq. feet is 0.15 acres. Placement of the new seawall in front of the existing seawall will permanently remove 0.00071 percent (0.15/22,574) of the total area of designated critical habitat. This is not a significant impact to designated critical habitat for Johnson's seagrass and will not adversely modify designated critical habitat for the species.

3.6.3.3.2. Alternative 2

Alternative 2 will not affect Johnson's seagrass as none was documented in the seagrass survey conducted in the project area. The project will remove a maximum of 6,735 square feet (of designated critical habitat for Johnson's seagrass from Unit J. To determine this value, multiply the total distance of the seawall being replaced (3,070 feet – 825 exposed at low tide) 2,245 feet by the maximum waterward extent of the replacement seawall, three feet. This equals a total of 6,735 sq. feet).

The estimated total area of Johnson's seagrass critical habitat given in 67 FR 13098 is 22,574 acres. A specific value for Unit J is not provided in the notice, and was not available from NMFS when requested to determine the impacts specific to Unit J. 6,735 sq. feet is 0.16 acres. Placement of the new seawall in front of the existing seawall will permanently remove 0.00066 percent (0.16/22,574) of the total area of designated critical habitat for Johnson's seagrass. This is not a significant impact to designated critical habitat for Johnson's seagrass and will not adversely modify designated critical habitat for the species.

3.6.3.4. AMERICAN CROCODILE

3.6.3.4.1. Alternative 1

As with sea turtles, noise and pressure effects on crocodiles have been poorly studied. As such, in the absence of species-specific (or in this case, order-specific) data, USACE is using assumptions regarding effects on sea turtles as proxies for the American crocodile, given their common reptilian morphology and physiology, and for dolphins, given the similarity in body size between adult dolphins and crocodiles. If these comparisons are valid, direct impacts to crocodiles could include injury or death associated with physical damage from pressure-related injuries.

Behavioral effects may occur within the 52-foot radius previously discussed for sea turtles, though the degree of risk is uncertain. Crocodilians are known for complex communication behaviors, sometimes involving the use of sounds transmitted below the range of frequencies audible to humans. As such, their ears may be susceptible to low-frequency noise. Damage to sensitive ear structures and tissues, though externally covered by a thick flap of skin/scale, could result. If there is any temporary or permanent hearing loss, individuals may not behave normally, but the degree to which this would affect foraging, reproductive success, and other functions is unknown.

There is no known use of the project area by American crocodiles, however, they may transit past the project area. Crocodiles may be affected by construction activities and related noise, and physical exclusion from areas contained by turbidity curtains (if utilized), and are very likely to avoid the project area. These effects are insignificant and temporary. Disturbance from construction activities and related noise will be intermittent and only occur during the day for part of the construction period; turbidity curtains will only enclose small areas at any one time in the project area, will be removed upon project completion, and will not appreciably interfere with use of the area by listed species.

USACE plans to protect crocodiles in the same manner as manatees and other listed and protected species in the action area. Based on the protective measures proposed for this project, the impacts to crocodiles associated with seawall construction should be minimal. Based on this information, and the proposed construction techniques, it was determined that the proposed work using vibratory or impact pile driving may affect, but is not likely to adversely affect the threatened American crocodile. The USFWS concurred with this determination on November 15, 2016. This concurrence is included in Appendix C.

3.6.3.4.2. Alternative 2

Effects for the partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall described above.

3.6.3.5. SMALLTOOTH SAWFISH

3.6.3.5.1. Alternative 1

Smalltooth sawfish may be affected by being temporarily unable to use the site due to potential avoidance of construction activities and related noise, and physical exclusion from areas contained by turbidity curtains (if utilized), but these effects are insignificant and temporary. Disturbance from construction activities and related noise will be intermittent and only occur during the day for part of the construction period; turbidity curtains will only enclose small areas at any one time in the project area, will be removed upon project completion, and will not appreciably interfere with use of the area by listed species.

Additional avoidance and minimization measures include adhering to the NMFS' "Sea Turtle and Smalltooth Sawfish Construction Conditions". Although seagrass and other soft bottom habitats will be impacted, USACE does not anticipate that the proposed project will have any adverse indirect effects on smalltooth sawfish in the vicinity of the action area. These habitats may be utilized by the species,

however, loss of seagrass habitats is relatively small with respect to overall seagrass abundance throughout northern Biscayne Bay. Additionally, softbottom areas are also plentiful in and near the action area, and impacts to them would not limit resource use by sawfish, especially since the population density of individuals in the area is extremely low.

In their 2014 Biological Opinion for SAJ-82, NMFS determined:

> Based on our noise calculations, installation of metal sheet piles (such as cofferdams or metal seawall sheet piles) by vibratory hammer will not result in any form of injurious noise effects. Yet, this installation method could result in behavioral effects at radii of 52 ft. (16 m) for sea turtles and 243 ft. (74 m) for ESA-listed fishes. Given the mobility of sea turtles and ESA-listed fish species, we expect them to move away from noise disturbances. If an individual chooses to remain within the behavioral response zone it could be exposed to behavioral noise impacts during pile installation. Since installation will occur intermittently (throughout the day and between days), we anticipate any effects will be insignificant. These species will be able to resume normal activities during quiet periods between pile installations and at night. Therefore, installation of metal sheet piles by vibratory hammer will not result in any injurious noise effect and we anticipate any behavioral effects will be insignificant.

USACE agrees with this determination and will utilize a 50 foot shutdown radius for vibratory or impact hammer installation for smalltooth sawfish, which is equal to the planned protective radius for marine mammals, and is two feet smaller than the required distance for sea turtles. The radius will be noted visually by placement of a buoy 50-feet waterward of each day's construction area. Any animal that crosses this line will result in a shutdown of work until the animal leaves the area of its own volition.

If construction is completed with vibratory hammer, due to the 50 foot safety radius around the seawall construction activities, and the determination that sound levels associated with vibratory hammer are not expected to reach the impactive levels previously set by NMFS, USACE believes that construction of the proposed work may affect, but is not likely to adversely affect, the endangered smalltooth sawfish.

However, if an impact hammer is used, the potential for behavioral effects occurs outside of the 50 foot safety radius. To reduce the potential for adverse effects to smalltooth sawfish, a bubble curtain will be employed to further reduce noise to less impactive levels. The bubble curtain will meet the specifications for pile driving found in the Florida Statewide Programmatic Biological Opinion (SER-2013-12540) dated December 4, 2015, Appendix C: SWPBO Noise Effects Matrix and BMPs (NMFS 2015).

3.6.3.5.2. Alternative 2

Effects for the partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall as described above.

3.6.3.6. SCLERACTINIAN CORALS

3.6.3.6.1. Alternative 1

The replacement of existing seawall will not affect any ESA listed coral species because no listed coral species were documented on the seawall during the 2016 survey. Therefore it was determined that there will be no effect to any listed corals species.

3.6.3.6.2. Alternative 2

Effects for the partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall as described above.

3.6.4. FISH AND WILDLIFE RESOURCES

3.6.4.1. BOTTLENOSE DOLPHINS

3.6.4.1.1. Alternative 1

Utilization of pile driving to replace the sheet pile seawall may have an effect on bottlenose dolphins in the area. Both the pressure and noise associated with pile driving can impact marine mammals.

NMFS has defined levels of harassment for marine mammals under the MMPA. Level A harassment is defined as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering." Current NMFS practice regarding exposure of bottlenose dolphins to pile driving noise is that "mid-frequency" cetaceans, like dolphins exposed to peak impulsive sounds at or above 185 dB (NMFS, 2016) are considered to have been taken by Level A (i.e. injurious) harassment.

Behavioral harassment (Level B) is considered to have occurred when mid-frequency marine mammals like dolphins are exposed to impulsive noise from impact pile driving at or above 170 dB and for non-impulsive noise from vibratory pile driving at or above 178 dB, but below injurious thresholds (Finneran 2016).

Table 3- details representative pile driving sound pressure levels measured from 24" wide steel sheet piles.

Sound levels from vibratory pile driving are not expected to reach the 170 dB re 1 µPa sound pressure level root mean square threshold; therefore no injuries to dolphins from sound associated with vibratory pile driving are anticipated. However, should dolphins be near the project vicinity during pile driving operations, direct impacts could include alteration of behavior and autecology. For example, daily movements and/or the seasonal migrations of dolphins may be impeded or altered.

USACE accessed the NMFS-SEFSC Photo-ID survey data from 1990-2004 covering 12 years of survey in the bay via the OBIS-Seamap database (http://seamap.env.duke.edu/) and downloaded the Google Earth overlay of the data (**Figure 3-4**). Based on the NOAA data, it is clear that sighting levels across throughout Biscayne Bay are not equal, and that the areas of Biscayne Bay in front of the hospital have moderate sighting densities (10-20 dolphins per survey). This means that there is a moderate potential for dolphins to be in the waters adjacent to the seawall replacement area.

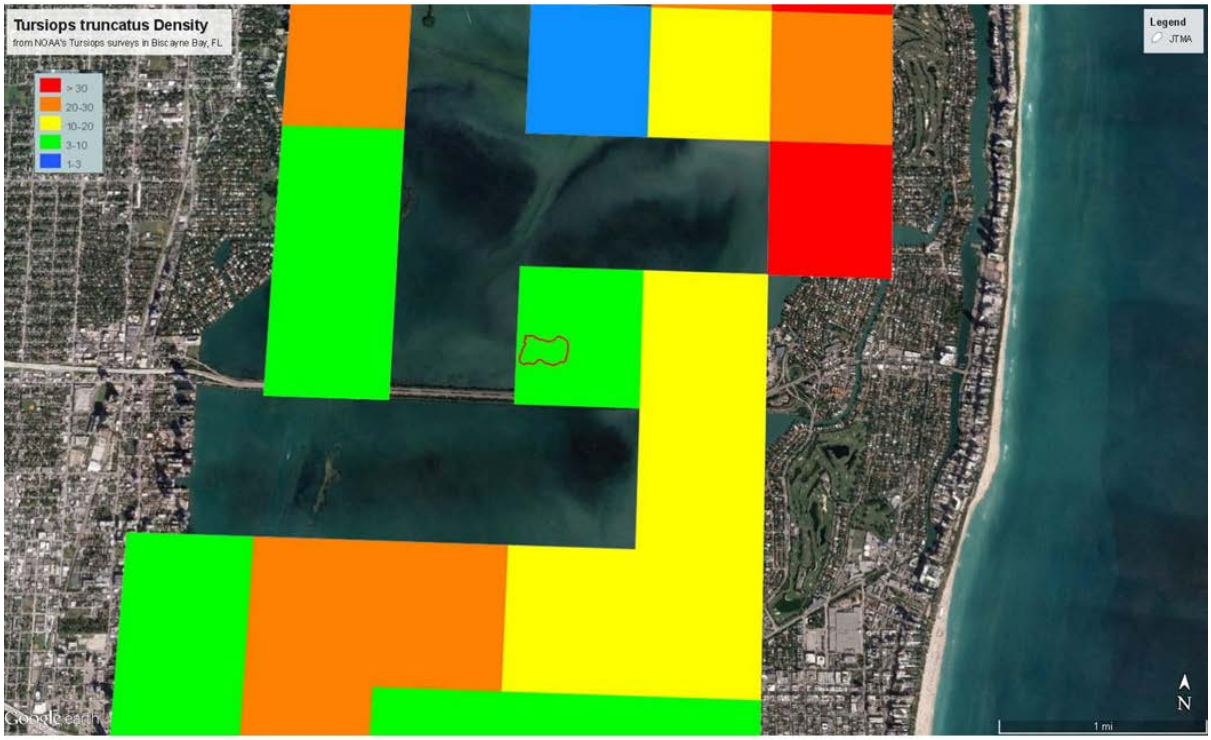


Figure 3-4. NOAA Southeast Fisheries Science Center, South Florida Bottlenose Dolphin Photo-identification Cooperative – Dolphin sightings

As a precautionary measure against possible behavioral effects, USACE will utilize a shutdown zone, which will always be a minimum of 15 meters (50 feet). For impact pile driving, which generates impulsive sound, a larger 100 meter (330 foot) shutdown zone shall be implemented for marine mammals only; the standard shutdown zone will continue to be applied for all other protected species. If a bottlenose dolphin approaches or enters a shutdown zone during any in-water work, activity will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal.

3.6.4.1.2. Alternative 2

Effects for the partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall as described above.

3.6.4.2. FISHES

3.6.4.2.1. Alternative 1

The proposed action includes the replacement of the existing seawall and associated disturbance of the water column. Highly mobile juvenile or adult fish would be able to move quickly away from the disturbance. However, fish associated with attached macroalgae and sedentary invertebrates on the existing seawall will be displaced until the community is reestablished on the new seawall; attached macroalgae EFH are expected to quickly recolonize the seawall (<1 year). The small area of unconsolidated substrate EFH (e.g. subtidal flats) which surround the existing seawall will be minimally disturbed in the replacement of the vertical structures.

Individual fish near the seawall replacement work area may also experience sound intensities that could affect their behavior or damage their hearing ability. There is an in-depth discussion of underwater noise from pile driving and the modeling methodology in the marine mammals section. Since many fish use their swim bladders for buoyancy, they are susceptible to rapid expansion/decompression due to peak pressure waves from underwater noises (Hastings and Popper 2005). The onset of injury threshold resulting from this rapid expansion/decompression is supported by data presented on selected species in FHWG (2008). Whereas behavioral disturbance criteria for fish are not supported with data, NMFS and USFWS generally use 150 dB rms as the threshold for ESA-listed species. Criteria for behavioral impacts and onset of injury are provided in **Table 3-**.

The criteria suggest only the most limited mortality of fish, and only when they are very close to an intense sound source (FHWG 2008). There is no population-level impact on unregulated fish anticipated from the sound intensities modeled and only minimum and temporary adverse impacts on water column EFH for all managed species inhabiting the water column. The ESA listed smalltooth sawfish may be affected by the sound intensities, but are not likely to be adversely impacted by them.

Table 3-7: Criteria for fish behavioral disturbance and onset of injury from the sound produced by vibratory and impact hammers.

Pile Type	Driving Method	Threshold	Distance (m)[1]	Area (km^2)
Steel (sheet and king piles)	Vibratory	Behavioral (all):150 dB re 1 µPa rms	73.6	0.011
	Impact (contingency)	Injury (all): 206 dB re 1 µPa rms	8.6	0.00058
		Injury (≥ 2g): 187 dB re 1 μPa^2sec SEL	21.6	0.0019
		Injury (< 2g): 183 dB re 1 μPa^2sec SEL	39.9	0.0045
		Behavioral (all):150 dB re 1 µPa rms	3,981	1.37
Polymeric fender piles	Vibratory	Behavioral (all): 150 dB re 1 µPa rms	15.8	0.001

Note: no injury criteria for fish for vibratory driving; all sound levels expressed in dB re 1 µPa rms. dB=decibel; rms=root-mean-square; µPa=microPascal; Practical spreading loss (15 log, or 4.5 dB per doubling of distance) used for calculations; [1]Sound pressure levels used for calculations are given in Tables 3-12 and 3-13.

The primary cause of injury and mortality to aquatic organisms from pile driving for seawall replacement in aquatic environments appears to be damage associated with the rupture and hemorrhage of air-filled internal organs, in particular, the swim bladder (Wright and Hopky 1998; Keevin and Hempen 1997), which, in many pelagic fishes, plays a role in buoyancy. Demersal species, such as flounder, typically do not have swim bladders and are frequently less susceptible to pressure impacts. Less information is available, but it is generally reported that there is minimal injury and mortality from pressure to mollusks, shellfish, and crustaceans, which do not have gas-filled organs similar to the swim bladder in fish (Wright and Hopky 1998). Although the structure of the swim bladder and the mechanism for adjusting gas volume vary among species, generally the process for release of gas from the swim bladder is too slow to compensate for the rapid fluctuations in hydrostatic pressure associated with the pressure shock wave associated with pile driving. This and other physiological considerations are discussed below (Hempen *et al.* 2005):

> "The primary cause of damage in finfish exposed to a pressure shock wave appears to be the outward rupture of the swim bladder as a result of the expansive effect of the negative hydrostatic pressure associated with the reflected air-water surface wave. While the organ may tolerate the compressive portion of the shock wave, the rapid drop to negative hydrostatic gage pressure and expansion of the gas that cannot otherwise be released, causes the rupture of the organ. Vibration, expansion, and rupture of the swim bladder can also cause secondary damage and hemorrhage due to impact with other internal organs in close proximity to the swim bladder. Other organs typically exhibiting damage include the kidney, liver, spleen, and sinus venosus (a structure in the heart). Extensive tearing of tissue has been observed in species where the swim bladder is closely attached to the visceral cavity. Close attachment to the dorsal cavity wall was typically associated with extensive damage to the kidney. Species with thick-walled swim bladders and cylindrical body shape (e.g., oyster toad fish and catfish) appear to be more resistant to pressure waves than species with laterally compressed bodies such as herring and menhaden (Linton *et al.* 1985, as cited in Keevin and Hempen 1997). Smaller individuals of a species are generally more sensitive than larger fish. Early-stage larvae do not have swim bladders and are more resistant than older larvae after development of the swim bladder. The extent of injury and

mortality decreases with distance from the detonation, as the magnitude of the pressure drop declines due to dissipation of the blast impulse (*I*) and energy flux density (*Ef*) with distance. In a review of a number of studies of primarily open water blasting, Keevin and Hempen (1997) concluded that *I* was the best predictor of potential damage for shallow depths (less than 3 m), while *Ef* was the best predictor for deeper conditions."

3.6.4.2.2. Alternative 2

Effects for the partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall as described above.

3.6.4.3. CORALS AND ASSOCIATED SPECIES

3.6.4.3.1. Alternative 1

Based on the survey conducted on the existing seawall, replacement of the entire seawall, a maximum of 111 coral colonies from four different species would be impacted by the seawall replacement. The survey of the complete seawall identified six colonies equal to, or greater than, 10 cm in diameter, making them candidates for relocation, which represents 55% of the colonies mapped during the seawall survey. As previously explained in Section 2.4.6, 55% of 111 colonies is 61 colonies greater than 10 cm in diameter. Any corals relocated off of the seawall may be offered to non-federal parties for education and research purposes and/or may be relocated to a previously permitted relocation site managed by either Miami-Dade County DERM. This will leave up to fifty-two colonies calculated based on the June 2016 survey which are less than 10 cm in diameter (too small to ensure successful relocation) which may remain on the seawall at the time of construction. There is no guarantee that these smaller corals will be relocated, and for the purposes of analysis are assumed to be lost from the ecosystem until sufficient time passes for corals of similar size and species composition to colonize the new seawall once replacement is complete. Permanent loss of the 111 colonies will not significantly impact the population levels of the four species of coral, as the colonies are already isolated from the breeding populations offshore of southeast Florida due to their location on a manmade structure inside of Biscayne Bay. Over time, larvae of corals may be flushed back into the Bay, or may come from other manmade structures within the bay that are encrusted with similar organisms and allow for settlement on the new seawall face.

Prior to initiation of any construction activities, USACE will require the contractor to relocate any colonies greater than 10 cm located on the seawall to an artificial reef location within Biscayne Bay that is maintained by Miami-Dade County DERM. The 10 cm size was chosen in consultation with coral relocation experts (Dr. Keith Spring, CSA *pers comm*.) who conveyed that corals smaller than 10 cm are often flatter and more easily broken during relocation efforts. The collections and relocations will be made by coral experts and trained professionals.

3.6.4.3.2. Alternative 2

With the partial replacement of the seawall, only 10 individual coral colonies would be impacted. There is one colony that would not be impacted because it is located within the 130 linear feet of seawall where only a 1.5 foot concrete lift would be added and no sheetpile would be constructed in front of the newer existing seawall. This one colony (*O. diffusa*) is greater than 10 cm in diameter, therefore only a total of five colonies would be relocated with this alternative. Population level impacts would be similar to Alternative 1.

3.6.4.4. MIGRATORY BIRDS

3.6.4.4.1. Alternative 1

Migratory birds are currently able to rest on the seawall at the Mount Sinai Medical Facility Center. As a result, birds may be temporarily unable to utilize the seawall as a resting area during construction.

3.6.4.4.2. Alternative 2

Effects for the partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall as described above.

3.6.5. ESSENTIAL FISH HABITAT ASSESSMENT

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.

3.6.5.1. ALTERNATIVE 1

The replacement of the existing 3,500 linear feet of seawall will result in the permanent impact of 9,600 SF (0.22 acres) of substrate comprised of sand, muck, and rubble, and replacement of a manmade structure covered in various encrusting plants and organisms detailed in the survey found in Appendix D-3. A subset of this contains approximately 0.05 acres of mixed seagrass. The project proposes 100% land-based construction. Temporary indirect impacts to the seagrass beds adjacent to the seawall could also occur due to scouring and turbidity. Although these impacts would be temporary, and the seagrass habitat would be expected to repopulate once construction is complete, if scouring occurs, the contractor should regrade the impacted area to pre-project levels to allow the reestablishment of the seagrass community.

3.6.5.2. ALTERNATIVE 2

Effects would be similar to Alternative 1. However, the portion of the 130 linear feet seawall where only a 1.5 foot concrete lift would be added and no sheet pile would be constructed, in front of the newer existing seawall, is the same location where seagrass was observed within 3 feet of the base of the existing seawall and had the potential to be impacted. Temporary impacts to adjacent seagrass beds due to in-water construction would be the same as with the preferred alternative.

3.6.6. HISTORIC PROPERTIES

All project alternatives, including the no action alternative, are based within the Mount Sinai Medical Facility Center. The hospital complex was constructed beginning in 1958 through dredge and fill. No impacts to the hospital buildings are anticipated. The northern section of the seawall was constructed circa May 1959, and the remaining extent, 2,600 feet, of the seawall was constructed circa March 1967. The seawall was constructed following standardized construction design plans, and does not embody distinctive characteristics of a type, period, or method of construction. Consultation in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations in 36 CFR Part 800: Protection of Historic Properties, will be coordinated with the Florida State Historic Preservation Officer (SHPO) regarding the project. No recorded submerged or terrestrial archaeological sites exist along the seawall. The entire project footprint has been previously disturbed by construction.

3.6.6.1. ALTERNATIVE 1

No impacts to the hospital buildings are anticipated. The northern section of the seawall was constructed circa May 1959, and the remaining extent, 2,600 feet, of the seawall was constructed circa March 1967. The seawall was constructed following standardized construction design plans, and does not embody distinctive characteristics of a type, period, or method of construction. Consultation in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations in 36 CFR Part 800: Protection of Historic Properties, will be coordinated with the Florida SHPO regarding the project. No recorded submerged or terrestrial archaeological sites exist along the seawall. The entire project footprint has been previously disturbed by construction.

3.6.6.2. ALTERNATIVE 2

Effects for the partial replacement of the seawall at the facility will be similar in nature to the effects for replacement of the entire seawall as described above.

3.6.7. SOCIO-ECONOMIC

All action alternatives are not expected to affect socio-economic conditions in the vicinity of the Mount Sinai Medical Facility Center. The project is taking place along the existing seawall and should not hamper any other activities which would result in socio-economic impacts to others.

3.6.8. AESTHETICS

All action alternatives are not expected to affect aesthetics in the vicinity of the Mount Sinai Medical Facility Center. The project is within an existing developed area that contains a hardened shoreline. Construction will obscure the view of the waterway; however this will be temporary and therefore have a negligible effect on the public interest.

3.6.9. RECREATION

All action alternatives are not expected to affect aesthetics in the vicinity of the Mount Sinai Medical Facility Center and Meloy Channel. The area will remain open for boating and other recreational activities in the vicinity of the Mount Sinai Medical Facility Center.

3.6.10. WATER QUALITY

All action alternatives would have similar impacts to water quality due to construction activities. The project is exempt under Florida water quality permit requirements as it is the replacement of an existing seawall under Florida Statute 373.406. The Corps will complete the exemption verification during the Plans and Specs development phase of the project. USACE completed a 404b1 evaluation (Appendix D-1) and state water quality standards will be met during construction.

Replacement of the seawall shall be consistent with Nationwide Permit #3, which states:

> (a) The repair, rehabilitation, or replacement of any previously authorized, currently serviceable structure, or fill, or of any currently serviceable structure or fill authorized by 33 CFR 330.3, provided that the structure or fill is not to be put to uses differing from those uses specified or contemplated for it in the original permit or the most recently authorized modification. Minor deviations in the structure's configuration or filled area, including those due to changes in materials, construction techniques, requirements of other regulatory agencies, or current construction codes or safety standards that are necessary to make the repair, rehabilitation, or replacement are authorized. Any stream channel modification is limited to the minimum necessary for the repair, rehabilitation, or replacement of the

structure or fill; such modifications, including the removal of material from the stream channel, must be immediately adjacent to the project or within the boundaries of the structure or fill. This NWP also authorizes the repair, rehabilitation, or replacement of those structures or fills destroyed or damaged by storms, floods, fire or other discrete events, provided the repair, rehabilitation, or replacement is commenced, or is under contract to commence, within two years of the date of their destruction or damage. In cases of catastrophic events, such as hurricanes or tornadoes, this two-year limit may be waived by the district engineer, provided the permittee can demonstrate funding, contract, or other similar delays.

Section 33 CFR 330.3 states:

330.3 Activities occurring before certain dates. The following activities were permitted by NWPs issued on July 19, 1977, and, unless the activities are modified, they do not require further permitting: (b) Structures or work completed before December 18, 1968, or in waterbodies over which the DE had not asserted jurisdiction at the time the activity occurred, provided in both instances, there is no interference with navigation. Activities completed shoreward of applicable Federal Harbor lines before May 27, 1970 do not require specific authorization. (Section 10).

Florida Statute Chapter 373

373.406 Exemptions.—The following exemptions shall apply:
(6) Any district or the department may exempt from regulation under this part those activities that the district or department determines will have only minimal or insignificant individual or cumulative adverse impacts on the water resources of the district. The district and the department are authorized to determine, on a case-by-case basis, whether a specific activity comes within this exemption. Requests to qualify for this exemption shall be submitted in writing to the district or department, and such activities shall not be commenced without a written determination from the district or department confirming that the activity qualifies for the exemption.

As original construction of the seawall that will be replaced by this project was in the 1950s, they are consistent with the requirements for Nationwide Permit #3 under Section 33 CFR 330.3.

Both alternatives will cause temporary increases in turbidity where the seawall is being placed. The State of Florida water quality regulations require that water quality standards not be violated during construction. The standards state that turbidity outside the mixing zone shall not exceed 29 NTU's above background. Various protective measures and monitoring programs will be conducted during construction to ensure compliance with state water quality standards. Should turbidity exceed state water quality standards during construction, as determined by monitoring, the contractor will be required to cease operations until conditions return to normal.

3.6.11. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The proposed action, replacement of the seawall, is not expected to affect the status of hazardous, toxic, and radioactive waste in the vicinity of the Mount Sinai Medical Facility Center.

3.6.12. AIR QUALITY

Pursuant to the General Conformity Rule of the Federal Clean Air Act (CAA), as promulgated by the EPA, a Federal agency must make a General Conformity Determination for all Federal actions in non-attainment or maintenance areas where the total of direct and indirect emissions of a non-attainment pollutant or its precursors exceed levels established by the regulations. All action alternatives may result in small, localized, temporary increases in concentrations of nitrogen dioxide (NO_2), SO_2, CO, VOC, and PM. Emissions associated with the dredge plant would be the largest contribution to the inventory. However, the total increases are relatively minor in context of the existing point and nonpoint and mobile source emissions in Miami-Dade County. Projected emissions from the proposed action would not adversely impact air quality given the relatively low level of emissions and the likelihood of prevailing offshore winds. Short term impacts from dredge emissions, and other construction equipment associated with the Preferred Alternatives, would not significantly impact air quality. No air quality permits would be required. The proposed action, replacement of the seawall, is not expected to affect the status of air quality in the vicinity of the Mount Sinai Medical Facility Center.

3.6.13. AIRBORNE NOISE

3.6.13.1. ALTERNATIVE 1

The effects of noise in the marine environment, and to protected species, has been previously discussed and are incorporated by reference. The remaining analysis will discuss the potential effects of airborne noise.

The proposed action would result in a temporary increase in airborne noise levels in the project area. Estimated source levels for airborne noise from pile driving are given in **Table 3-**; source levels were selected from published literature. Because there are no available airborne sound pressure level measurements from steel sheet, data from 24 inch diameter steel pipe piles was used to estimate the airborne sound source levels.

Table 3-8: Estimated Source Levels for Airborne Pile Driving Noise.

Driving Method	Source Level
Vibratory	96 dBA at 15m (50 ft.)
Impact	100 dBA at 11m (36 ft.)

Note m=meter
dBA = A-weighted decibel scale
ft. = feet

The source level selected for impact driving does not represent the maximum measured level for a 24 inch pipe pile (109 dBA; Illingworth & Rodkin 2012), which was obtained during short-term driving of a single pile in rocky sediment during the Navy Test Pile Program in Bangor, Washington in 2011. The selected source level shown in **Table 3-** was obtained during driving of a 24 inch pipe pile for a bridge replacement in Washington (WSDOT 2010). Because softer sediments, such as those found in the area surrounding Mount Sinai Medical Facility Center, reduce the amount of force needed to drive a pile to desired depth, in turn reducing noise from pile reverberation (Kinsler *et al*. 1999), the non-maximal source level estimate selected is a reasonable assumption for airborne noise levels from pile driving at the Mount Sinai Medical Facility Center.

Estimates of airborne noise propagation from pile driving were based on the assumption that airborne construction noise behaves as a point-source, propagating in a spherical manner, with a 6 dB decrease in sound pressure level per doubling of distance (WSDOT 2008). The hardsite conditions proposed by WSDOT (2008) apply to both the over-water and over-land, mostly paved or hard surfaces, portions of the in-air project area. Noise associated with vibratory pile driving is expected to attenuate to 65 dB within 0.34 miles (550 meters) of the source; impact pile driving noise is expected to attenuate to 65 dB at 0.40 miles (650 meters). During both impact and vibratory pile driving, airborne noise levels are expected to exceed 84 dB (the threshold for hearing protection) within 246 feet (75 meters) of the incident pile. These estimates assume a free flowing medium (e.g. over water) without obstructions, which is a reasonable assumption for the majority of the project area. Vegetation, and buildings within the land areas of the proposed action, may obstruct sound transmission in the project area; however, this model did not include possible attenuation from land-based obstructions, e.g. vegetation and buildings. The ranges given are therefore a conservative estimate of the affected area.

3.6.13.2. ALTERNATIVE 2

Effects for replacement of the seawall at the facility will be similar in nature to the effects above, but will take place only within a portion of the facility.

3.6.14. PUBLIC SAFETY

3.6.14.1. SEAWALL REPLACEMENT (ALTERNATIVES 1 AND 2)

Implementation of both alternatives will allow the Mount Sinai Medical Center to continue to stabilize the shoreline. The threatened facilities are key to disaster emergency operations, not only as a hospital facility, but also as a disaster staging area, or for other EOS operation facilities.

The shoreline that protects these facilities is at risk of erosion through seawall failure that could impact the perimeter road and parking. Furthermore, the seawall is overtopped by extreme high tide events multiple times per year, resulting in inundation as the primary driver for the current erosion problems. Land subsidence behind the wall, combined with low crest elevation, results in overtopping and standing water. These factors complicate and compromise operations and patient health. Overtopping allows

material through cracks, and be carried over the wall as the water recedes; all of which could impact public safety.

3.6.15. ENERGY REQUIREMENTS AND CONSERVATION

The energy requirements for construction activity would be confined to labor, transportation, and other construction equipment.

3.6.16. NATURAL OR DEPLETABLE RESOURCES

The gasoline and diesel fuel used by the construction equipment is considered a depletable resource.

3.6.17. REUSE AND CONSERVATION POTENTIAL

The proposed action would not directly present any reuse or conservation potential.

3.6.18. SCIENTIFIC RESOURCES

The proposed action would not have any impact on scientific resources.

3.6.19. NATIVE AMERICANS

No Native American communities or any tribal lands exist within the project areas. The project will not adversely impact Native Americans or any tribal lands.

3.6.20. URBAN QUALITY

The replacement of the seawall at Mount Sinai Hospital is not expected to have any effect on the Urban Quality of Miami Beach.

3.6.21. DRINKING WATER

The replace of the seawall along the shoreline at Mount Sinai Hospital is not expected to have any effect on drinking water for Miami Beach or Miami-Dade County.

3.6.22. INVASIVE SPECIES

The replacement of the seawall at Mount Sinai Hospital is not expected to have any effects on invasive species in the vicinity of the project areas. Protective measures to prevent spread of invasive species will be incorporated into the project specifications (e.g. cleaning of equipment, etc.).

3.6.23. CUMULATIVE IMPACTS

Cumulative impacts are the impact on the environment which results 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 (40 CFR 1508.7).

An inherent part of the cumulative effects analysis is the uncertainty surrounding actions that have not yet been fully developed. The CEQ (1997) regulations provide for the inclusion of uncertainties in the EA analysis, and state that "(w)hen an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking" (40 CFR Part 1502.22). The CEQ regulations do not say that the analysis cannot be performed if the information is lacking. Consequently, the analysis contained in this section includes what could be reasonably anticipated to occur given the uncertainty

created by the lack of detailed investigations to support all cause and effect linkages that may be associated with the Proposed Action.

The geographic areas used for the scope of this analysis vary for each affected resource. For example, air quality is generally evaluated on a county by county basis by USEPA, so the cumulative effects for air quality would be evaluated by this bounding area. Marine resources, however, are affected only within the waters of central Biscayne Bay. Relevant past, current, and future projects have been included in the cumulative impact analysis. However, the uncertainty of future trends, and lack of detailed planning documents for the various alternative locations, allows for only a general evaluation of future trends.

The proposed action would result in long-term benefits, which should outweigh any short-term environmental losses. The cumulative impact of maintaining the Mount Sinai Medical Center's seawall allows for the continued shoreline stabilization of the threatened facility. Cumulative impacts to EFH and ESA listed species for this project would be minimal. Turbidity and disturbance associated with the seawall replacement will be temporary and no long term impacts are anticipated.

Past Actions in the area of Mount Sinai Hospital.

The Mount Sinai Medical Center is located on the eastern side of Biscayne Bay, north of Government Cut and the Port of Miami, and west of Miami Beach, in a very developed urban environment. The hospital complex was constructed beginning in 1958 from dredged and fill material. The northern section of the seawall was constructed in the late 1950s, and the remaining extent, 2,600 feet, of the seawall was constructed in the late 1960s. In 2011, a DA permit was issued, authorizing the replacement of "130 linear feet of failed concrete pile and panel bulkhead at the same location with a new concrete pile and panel structure. The work will also include shoreline stabilization via placement of 22.7 cubic yards of lime rock boulders adjacent to a new 130 linear foot bulkhead."

The areas of Miami Beach are significantly developed, and the native mangrove ecosystem, which was located along the shores of Biscayne Bay, has been entirely removed from the vicinity of Mount Sinai Hospital. Dredge and fill activities in the vicinity of the hospital include the construction of the Julia Tuttle Causeway in 1959 that impacted seagrass beds west of the hospital.

Present Actions.

As residential development continues to increase, the shoreline in the watershed has become hardened with vertical seawalls to stabilize the upland properties. In addition, docks for personal watercraft, and minor maintenance dredging are likely to occur to maintain navigation. High levels of nutrients enter bay waters from storm runoff of fertilizer from homes surrounding the bay. This has decreased water clarity in the bay and is expected to continue for the foreseeable future. Recently backfilling of some of the dredged holes north of the Julia Tuttle Causeway has been completed in an attempt to restore shallow water seagrass habitat.

Future Actions.

It is expected that the medical facility will continue to operate and that the adjacent waterway will continue to be maintained and utilized.

3.6.24. POTENTIALLY AFFECTED RESOURCES

The analysis of impacts must focus on specific resources or impact areas. The resources and areas that were identified at risk for the potential of impacts include marine resources such as seagrasses, corals,

and associated hardbottom species that have encrusted on the existing seawall, as well as manatees, swimming sea turtles, smalltooth sawfish, and bottlenose dolphins, which may transit through the adjacent waterway.

3.6.24.1. CORALS AND ASSOCIATED ENCRUSTING ORGANISMS ON THE EXISTING SEAWALL

Corals which have encrusted manmade structures within Biscayne Bay are lost to the reef system offshore of the county, and the temporary loss of these corals from the existing seawall (corals are expected to recolonize the new seawall) is not expected to have a cumulative effect on corals and associated organisms in Miami-Dade County.

3.6.24.2. SEAGRASSES BEING IMPACTED THROUGH CONSTRUCTION OF NEW SEAWALL

Seagrass has been documented within the project area. Direct impacts to seagrass would be minor; less than 0.05 acres. It is expected that if grasses are indirectly impacted through in-water construction by scouring or turbidity, they will be able to recolonize. The total aerial coverage of seagrass in Biscayne Bay is estimated to be 159,363 acres (Yarbo, 2013). Based on this assessment, no permanent impact on seagrass is expected within Biscayne Bay.

3.6.25. RESOURCES NOT LIKELY TO BE CUMULATIVELY AFFECTED

Based on current available information, there are some resources that are not likely to experience measurable cumulative effects, although this EA has addressed the specific effects of the proposed project in accordance with NEPA. Also, as additional information became available, or as a result of public or agency comments received, the need for cumulative impact analysis for these resources has been addressed. The resource areas, and the basis for not including a cumulative impact analysis for these areas at this time, are as follows:

- *Land Use*. The project would result in a relatively small change in land use, and there are no additional reasonably foreseeable projects other than those included in this analysis.

- *Geology and Sediments*. The overall effect to the sandy bottom of Meloy Channel by the loss of 0.21 acres of benthic habitat will be minimal.

- *Threatened or Endangered Species*. Impacts to listed species were evaluated under the Endangered Species Act and for all species in the project area. For all such species but sea turtles and smalltooth sawfish, the project "may affect, but is not likely to adversely affect" them. There will be no affect to listed corals or Johnson's seagrass. Besides the potential affects to listed sea turtles and smalltooth sawfish and very small impact to Johnson's seagrass critical habitat, no additional incremental cumulative effects on threatened or endangered species are anticipated.

- *Other Fish and Wildlife*. Impacts to non-listed fish and wildlife are minimal and are not expected to result in a significant cumulative effect. Some of the coral colonies will be relocated from the seawall prior to construction, thus reducing impacts to the reproductive population, and construction of the new seawall will result in a new area for juvenile corals to settle onto the seawall.

- *Water Quality*. Water quality impacts would only be temporary due to construction activities, and there are no additional reasonably foreseeable projects other than those included in this analysis.

- *Hazardous, Radioactive, and Toxic Wastes*. The project would not result in a release of any hazardous, toxic, or radioactive waste, and there are no additional reasonably foreseeable projects other than those included in this analysis.

- *Air Quality*. Any impacts to air quality would result from construction of the replacement seawall and would be temporary. The total increase in air pollutants would be relatively minor to the existing point- and mobile-source emissions in Miami-Dade County. Miami-Dade County is in a designated attainment area and a conformity statement would not be required. No foreseeable future actions leading to an increase in emissions would result from this project.

- *Noise*. Noise impacts would be temporary as a result of construction activities, and the project will result in only a minor incremental impact due to noise. As a result, a minor increase in cumulative impact is expected.

- *Aesthetic Resources*. Only temporary adverse effects to aesthetic resources would occur during construction; therefore, there would be no adverse cumulative effect to aesthetic resources resulting from this project.

- *Recreation*. Only temporary adverse effects to recreation would occur during construction; therefore, there would be no adverse cumulative effect to recreation resulting from this project.

- *Cultural and Historic Resources*. It is anticipated that no cultural or historic resources would be affected by the project. Therefore, no cumulative effect on these resources would result from this project.

- *Native American Resources*. The project would have no effect and would not influence any foreseeable future actions that could adversely affect Native American tribes.

- *Environmental Justice*. The project would have no effect and would not influence any foreseeable future actions that could adversely affect minority and low-income populations.

- *Invasive Species.* The project would have no effect on invasive species and would not influence any foreseeable actions that could incrementally increase the impacts of invasive species in Biscayne Bay.

3.6.26. CUMULATIVE EFFECTS ASSESSMENT CONCLUSION

Due to efforts to avoid and minimize the environmental impact of the proposed action within the project area and its vicinity, and due to avoidance and minimization actions that will be carried out for the proposed project and those that are likely to be required for any future actions, USACE anticipates that any cumulative impacts associated with replacement of the seawall at the Mount Sinai Medical Center will be negligible.

3.7. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

3.7.1. 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 road construction. Replacement of the existing seawall would result in the permanent loss of any stony corals less than 10 cm in size, and all other encrusting organisms on the seawall, which is also considered a loss of Essential Fish Habitat. These affects would be temporary as the new seawall would recolonize over time, based on the level of colonization of the current seawall. The permanent loss of seagrass within the direct footprint of the project would also occur. There will also be the loss of tree species behind the existing seawall, including invasive, exotic Brazilian pepper and Australian pine, which is a benefit to the project area.

3.7.2. 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 energy and fuel used during construction would also be an irreversible commitment of resources.

3.8. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

There may be a temporary, unavoidable reduction in water clarity and increased turbidity during construction operations. This would be limited to the immediate areas of the proposed dredging and seawall construction. This impact would be temporary and should disappear shortly after construction completion.

Those species that are not able to escape the dredging or seawall construction are expected to recolonize after project completion. Construction of the new seawall will result in unavoidable impacts to hardbottom species which have colonized the existing seawall that are not relocated prior to construction. This will be due to placement of the new sheet pile in front of the existing seawall and filling between the new and existing seawall. Relocation of stony corals will minimize these impacts. There will be unavoidable loss of the infaunal community in the area of the new seawall placement.

3.9. COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES

The preferred alternative is consistent with the state's Coastal Zone Management plan and with Federal, State, and local laws, plans, and objectives.

3.10. CONFLICTS AND CONTROVERSY

During the required permitting and consultation processes, no significant conflicts or controversy associated with the proposed project were expressed by any resource or permitting agency.

3.11. UNCERTAIN, UNIQUE, OR UNKNOWN RISKS

Repairing and replacing an existing seawall in order to stabilize the shoreline is a long-established practice in Florida. The construction method for the seawall is to place the new seawall in front of the old one,

thus encapsulating the existing seawall, and potentially having minimal fill material released into the surrounding environment. There are no additional uncertain, unique, or unknown risks associated with this project. The uncertain and unknown risks associated with sea level change will affect the Mount Sinai Medical Center over the next 50 years. The long term impacts of sea level change are unknown.

3.12. PRECEDENT AND PRINCIPLE FOR FUTURE ACTIONS

The proposed action would not set any precedent or principle for future actions. USACE will obtain all necessary permits and authorizations prior to all future seawall replacement activities, as well as conduct required NEPA analysis and subsequent consultations under Federal and state law.

3.13. SCREENING OF FINAL ALTERNATIVES VS RELOCATION

Per ER 1105-2-100 Appendix F, Section III, F-23**, the least cost alternative plan is considered to be justified if the total costs of the proposed alternative are less than the costs to relocate the threatened facility.**

In order to determine if either Alternatives 1 or 2 are justified, their costs must be compared to the costs to relocate the threatened facilities. As stated earlier, relocation consists of the vertical relocation of the perimeter road adjacent to Biscayne Bay, with constructed support for the portion of the existing seawall adjacent to the elevated road. This would require 2,100 feet of the perimeter road to be raised on a berm to an elevation of 4 feet NAVD88. 1,000 feet of sheetpile would be driven on the seaward side of the existing seawall to stabilize the wall section under additional load from the raised road. Relocation also includes the movement of approximately 250 vulnerable parking spaces to a new parking garage constructed on the medical center property. **Figure 3-4** depicts the relocation option in plan view.

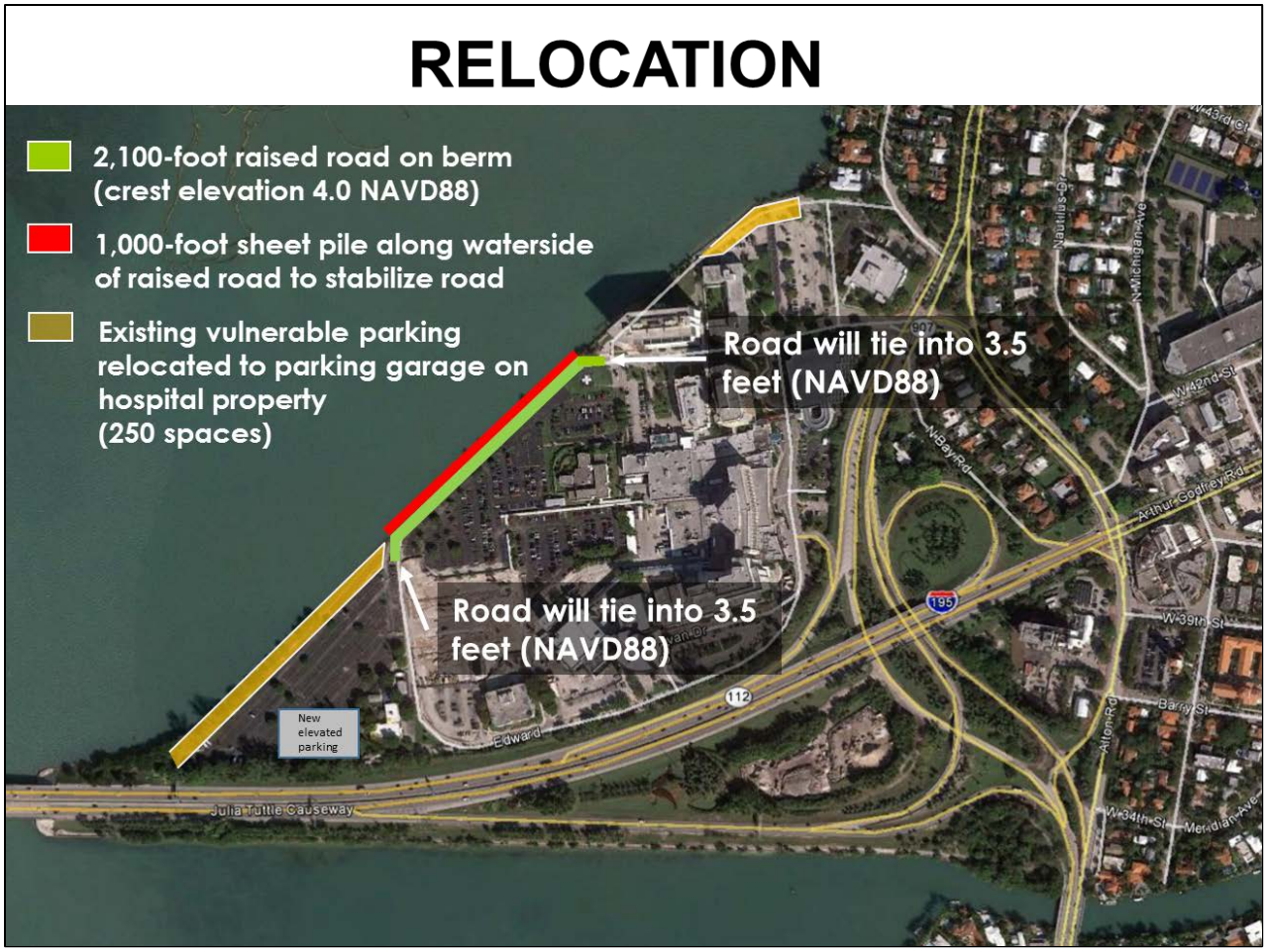


Figure 3-4: Relocation plan.

3.13.1. COST COMPARISON

Planning level costs of Alternative 1, Alternative 2, and Relocation are shown in

Table 3-. Both alternative costs are less than relocation. Alternative 2 is preferable to No Action and is the least cost alternative plan. Alternative 2 is therefore considered to be justified and is the Recommended Plan. Details on cost estimates are given in the Cost Engineering Appendix.

Table 3-9: Cost comparison (FY17 Price Levels. Planning Level Costs).

CONSTRUCTION COST ONLY

Planning Level Estimates 20Jul16

	Item	Number of Units	Units	Cost
Relocation	parking garage	250	parking spaces	$5,500,000
	sheet pile	1000	lf	$1,345,000
	elevated road	1310	lf	$707,400
			Total =	**$7,552,400**
Alternative 1	**Item**	**Number of Units**	**Units**	**Cost**
	sheet pile	3200	lf	$4,304,000
	T-wall	300	lf	$91,500
			Total =	**$4,395,500**
Alternative 2	**Item**	**Number of Units**	**Units**	**Cost**
	sheet pile	3070	lf	$4,129,200
	1.5 ft concrete lift	130	lf	$9,800
	T-wall	300	lf	$91,500
			Total =	**$4,230,500**

3.14. IMPACT AVOIDANCE AND MINIMIZATION

Mitigation includes those measures and features that avoid, minimize, and/or compensate for environmental impacts. For the seawall replacement, mitigation includes endangered species protection by compliance with USACE/FWS standard manatee construction protocols, and compliance with the NMFS sea turtle and smalltooth sawfish construction protocols, avoidance and minimization of impacts to seagrass, voluntary relocation of scleractinian corals greater than 10 cm in diameter from the seawall to an alternative location, and monitoring for marine mammal presence during seawall construction operations, with appropriate shutdown criteria should dolphins or manatees approach within 100 m (330 feet) of the construction area. This determination is in compliance with 403.813, Florida Statutes, and 404(f) of the Clean Water Act.

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4. RECOMMENDED PLAN

4.1. DESIGN AND CONSTRUCTION CONSIDERATIONS

4.1.1. GENERAL DESCRIPTION

The Recommended Plan (Alternative 2) includes installation of 3,070 linear feet of sheetpile; 25-foot long PZC-13 steel sheetpile, driven to a depth of 16 feet along the 3,500 foot long existing footprint of the seawall. The cantilevered sheetpile will be driven approximately 3 feet seaward of the existing seawall with a concrete cap elevation of 4.0 feet (NAVD88). The three foot offset is necessary for workers to reconnect any drainage system or utilities between the new and existing walls. The three foot offset will be filled with stone. At the northeast end of the driven sheetpile, a T-wall will tie-in to the sheetpile and continue landward to the 3.5 foot contour to prevent flanking of the seawall. Since this location is inland and removed from the direct effects of waves, an elevation of 3.5 feet is adequate to prevent flanking. Sheetpile will not be driven in front of the 130 foot section of seawall constructed in 2009. This section has been deemed structurally sound enough to add a 1.5 foot concrete lift to the top of the existing wall to reach an overall crest elevation of 4.0 feet NAVD88. **Figure 4-1** depicts the Recommended Plan in plan view.

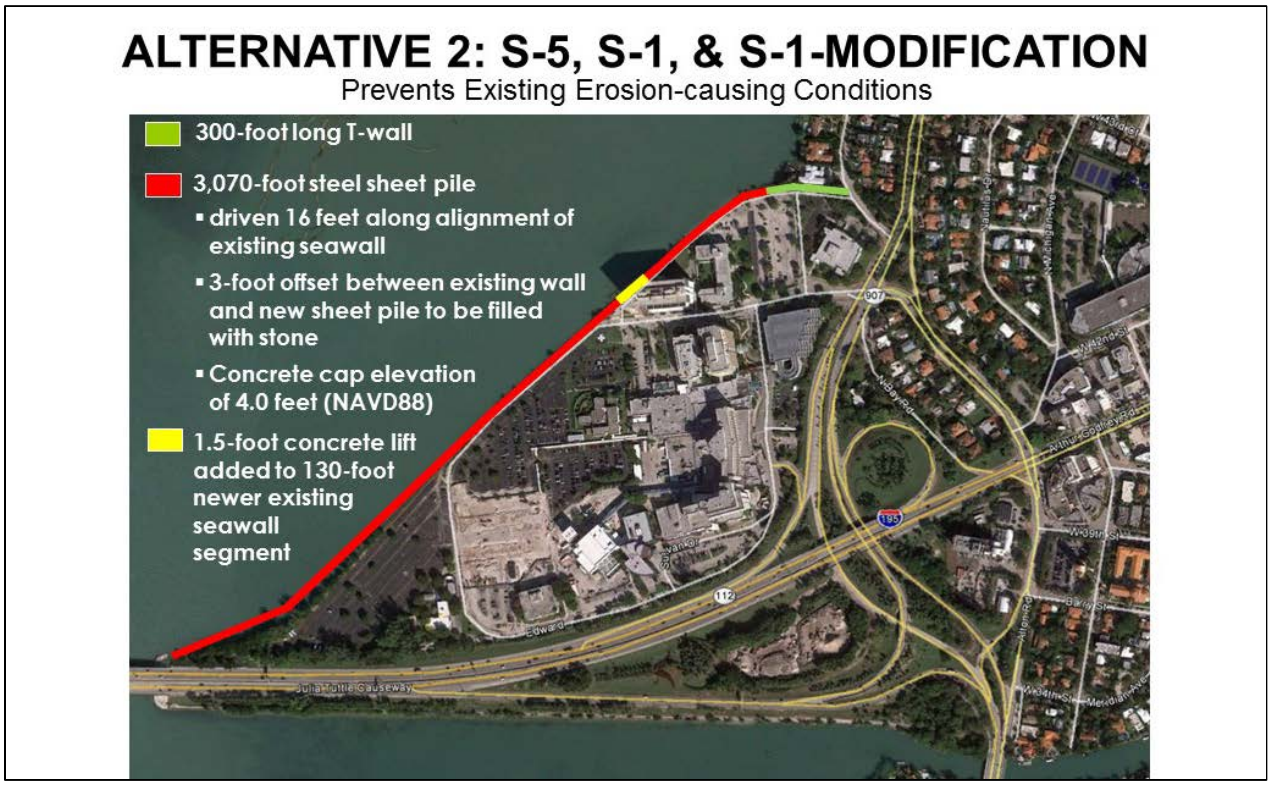

Figure 4-1: Recommended Plan.

4.1.2. ENVIRONMENTAL OPERATING PRINCIPLES

The feasibility study was carried out in a manner consistent with the USACE Environmental Operating Principles (EOPs). The principles are consistent with NEPA, the Army's Environmental Strategy with its four pillars (prevention, compliance, restoration, and conservation), and other environmental statutes that govern USACE activities. USACE Environmental Operating Principles were considered throughout plan formulation, as reflected in the selection of an alternative which minimizes environmental impacts while meeting all project objectives to the maximum extent practicable.

4.1.3. PLAN IMPLEMENTATION REQUIREMENTS

NON-FEDERAL RESPONSIBILITIES

The non-federal sponsor for the project is the City of Miami Beach. The non-federal project sponsor will provide an up-front cash contribution for the construction costs of the proposed project. The non-federal sponsor shall provide lands, easements, and rights-of-way, and bear a portion of the administrative costs associated with land requirements. The non-federal project sponsor will be responsible for all costs related to 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. The City of Miami Beach is enrolled in, and in compliance with, the NFIP. No LERRD credit will be sought for this because "the lands, easements or rights-of-way are part of the tract of land that includes the facility or structure being protected." "In such cases, the non-Federal sponsor will not receive credit for the value of LERRD it provides that are part of the tract of land on which the facility or structure to be protected is located, if such tract of land is owned by either the non-Federal sponsor or the owner of the facility or structure on the date that the PCA is executed." per ER 1105-2-100 Appendix F, Section III, F-23, part e.

FEDERAL RESPONSIBILITIES

USACE is responsible for budgeting for the Federal share of future Federal construction projects. Federal funding is subject to the 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 obtain water quality exemption, continue coordination with the state and federal agencies, and construct the project. Cost sharing of PED and construction are subject to the availability of appropriations.

WORK-IN-KIND

No work-in-kind is anticipated at this time.

PROJECT PARTNERSHIP AGREEMENT

The Project Partnership Agreement (PPA) remains to be developed.

SPONSOR'S VIEWS

The sponsor is in full support of the recommended plan and does not wish to pursue a Locally Preferred Plan.

REAL ESTATE REQUIREMENTS

Twenty-five percent of construction is proposed to take place from the water and seventy-five percent from land. Construction of 3,070 linear feet of sheet pile wall will occur along the northwest shoreline of Mount Sinai Medical Center within the existing 3,500 foot long existing footprint of the seawall. The sheet pile wall will tie into a 300-foot T-wall along the northern edge of Mount Sinai Medical Center property line. The non-federal sponsor will certify that lands are available via the flood protection levee easement for construction and operations and maintenance of both the sheet pile wall and the T-wall. A staging area of approximately 0.95 acre of lands has been identified. The non-federal sponsor will certify the availability of the staging area via a temporary work area easement. Access will be provided via pubic access roads. Access to the staging area will not require exclusive use of the identified access route. The non-federal sponsor will certify the availability of access via a temporary road easement. Construction is estimated to take approximately 18 months. The Real Estate Appendix provides additional detail.

4.2. DETAILED COST ESTIMATE AND COST SHARING

A detailed cost estimate is provided in the Cost Engineering Appendix. These costs are more developed and will vary from those shown in Chapter 2, which were planning level costs. **Table 4-1** shows a cost summary, and

Mt. Sinai CAP Section 14 Summary of Project Cost Sharing (FY17 Price Levels)					
Item	Federal Cost Share	Federal Cost	Non-federal Cost Share	Non-federal Cost	Project First Cost
Implementation Cost Share	65.0%	$4,095,000	35.0%	$2,205,000	$6,300,000
Non-federal RE Adminsitration*		$55,250		$29,750	
Non-federal Cash Contribution or IKC				$1,860,250	
5% Non-federal Cash Contribution				$315,000	
* Includes non-federal admin costs only NOTE: Dollar values are rounded					

details the Federal and non-federal cost apportionment. Cost sharing based on guidance from ER 1105-2-100, Appendix F, page F-30 which states, "The non-Federal sponsor will provide a minimum of 35 percent, but not to exceed 50 percent, of total project costs, to include a contribution of funds equal to 5 percent of total project costs in accordance with the terms of the Project Partnership Agreement to be executed".

Table 4-1: Recommended Plan cost summary (FY17 price levels)

Mt. Sinai CAP Section 14 Summary of Project Cost (FY17 Price Levels)	
Item	Project First Cost
Construction	$5,208,000
PED	$637,000
Construction Management	$370,000
Real Estate	$85,000
TOTAL	$6,300,000
* costs include contingency	

Table 4-2: Cost Sharing of the Recommended Plan (FY17 price levels)

Mt. Sinai CAP Section 14 Summary of Project Cost Sharing (FY17 Price Levels)					
Item	Federal Cost Share	Federal Cost	Non-federal Cost Share	Non-federal Cost	Project First Cost
Implementation Cost Share	65.0%	$4,095,000	35.0%	$2,205,000	$6,300,000
Non-federal RE Adminsitration*		$55,250		$29,750	
Non-federal Cash Contribution or IKC				$1,860,250	
5% Non-federal Cash Contribution				$315,000	
* Includes non-federal admin costs only NOTE: Dollar values are rounded					

4.3. SEA LEVEL CHANGE CONSIDERATIONS

The project area, and the City of Miami Beach as a whole, are vulnerable to sea level rise. However, given the emergency nature and funding constraints of the CAP Section 14 authority, future sea level change was not a key factor for alternative development. Alternative development focused on preventing current erosion-causing conditions. However, future sea level change was considered, per guidance, in order to recommend an alternative that prevents current erosion-causing conditions and is able to be adapted to future sea level change by the sponsor if necessary. The Recommended Plan includes a concrete cap at elevation 4.0 NAVD88 on the driven sheetpile and a concrete lift along the 130 feet of seawall constructed in 2009. As sea levels rise, extreme high tide events will begin to overtop the Recommended Plan. At that time, the Recommended Plan could be adapted by the sponsor by construction of a concrete elevation lift. Any investigation, design, and construction of such adaptations would be the responsibility of the sponsor.

4.4. RESIDUAL RISK

Even with implementation of the Recommended Plan, residual risk remains. The Recommended Plan addresses current erosion-causing conditions driven by overtopping of the bayside seawall as an emergency replacement. It is not designed to prevent erosion resulting from extreme high tide events

beyond those that have been experienced or that will occur as a result of sea level rise. Residual risk remains that extreme high tide events in the future could overtop the new seawall and that the Mount Sinai property could be inundated by other current and future events such as rainfall, which the Recommended Plan is not designed to address.

5. ENVIRONMENTAL COMPLIANCE

5.1. SCOPING

Consistent with USACE NEPA regulations and guidance, a Notice of Availability of the draft EA/FONSI was issued to the public on 26 September 2016, opening a 60-day period for public for review and comment. A list of recipients can be provided upon required and the document is also available via the Jacksonville District environmental documents website: http://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents/

5.2. AGENCY COORDINATION

The proposed project was coordinated with the following agencies: USFWS, NMFS, EPA, Florida State Clearinghouse, Florida SHPO, FFWCC, and the FLDEP. All agency coordination letters are included in Appendix C.

5.3. LIST OF RECIPIENTS

A mailing list of agencies and organizations for the Study/FONSI is included Appendix C. The complete list of recipients is on file with USACE.

5.4. COMMENTS RECEIVED AND RESPONSE

Comments on the Study/FONSI and USACE responses are summarized within the signed FONSI and details are included in Appendix C.

5.5. ENVIRONMENTAL COMMITMENTS

USACE, and its contractors commit to avoiding, minimizing, or mitigating for adverse effects during construction activities by including the following commitments in the contract specifications:

5.5.1. PROTECTION OF MANATEES DURING ALL IN-WATER CONSTRUCTION ACTIVITIES

USACE shall incorporate the standard manatee protection construction conditions into the plans and specifications for this project.

5.5.2. PROTECTION OF ALL MARINE MAMMALS (MANATEES AND DOLPHINS) DURING SEAWALL CONSTRUCTION ACTIVITIES

USACE will utilize a shutdown zone which will always be a minimum of 15 meters (50 feet) around the work area with a dedicated/qualified Endangered Species/Marine Mammal Observer. For impact pile driving, which generates impulsive sound, a larger 100 meters (330 foot) shutdown zone shall be implemented for marine mammals only; the standard shutdown zone will continue to be applied for all other protected species. Also a two ringed bubble curtain will be required for impact pile driving. If a manatee or bottlenose dolphin approaches or enters a shutdown zone during any in-water work, a protected species observer shall halted all construction activities until either the animal has voluntarily

left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal.

5.5.3. PROTECTION OF SEA TURTLES AND SMALLTOOTH SAWFISH

USACE will incorporate NMFS' "Sea Turtle and Smalltooth Sawfish Construction Conditions" into the plans and specifications for this project. USACE will utilize a shutdown zone, which will always be a minimum of 15 meters (50 feet) around the work area, with a dedicated/qualified Endangered Species/Marine Mammal Observer. If a sea turtle or smalltooth sawfish is observed approaching or entering a shutdown zone during any in-water work, a protected species observer shall halted all construction activities until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal. Impact pile driving will require the use of a two ringed bubble curtain sounding the construction area to reduce the noise potentially entering the water.

5.6. COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

5.6.1. NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Environmental information on the project has been compiled and this integrated report has been prepared. A Notice of Availability for the integrated report/FONSI was coordinated with interested stakeholders for review and comment. The project is in compliance with the National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321, *et seq*. P.L. 91-190.

5.6.2. ENDANGERED SPECIES ACT OF 1973

Pursuant to Section 7 of the Act, consultation was conducted with the NMFS and USFWS. This project was fully coordinated under the Endangered Species Act and will, therefore, is in full compliance with the Act. A biological assessment was sent to both the USFWS and NMFS October 19, 2016 requesting that both USFWS and NMFS concur with a finding that the proposed project at Mount Sinai "may affect, but will not adversely affect" listed species under each of the agencies jurisdictions. USFWS concurred with this determination on November 15, 2016. NMFS requested additional information from USACE on November 30, 2016 and the additional information was sent to NMFS on December 6, 2016. A biop was issued by NMFS on June 14, 2017 for effects to Johnson's seagrass critical habitat, as well as a concurrence on the effects for sea turtles and smalltooth sawfish. Consultation documents for this EA are located in Appendix C.

5.6.3. FISH AND WILDLIFE COORDINATION ACT OF 1958

This project has been coordinated with the USFWS through the NEPA and ESA processes and is in compliance with this Act.

5.6.4. NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)

Consultation with the Florida SHPO was initiated 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. This project is in compliance with the Archeological Resources Protection Act (96-95), the Abandoned Shipwreck Act of 1987 (PL 100-298; 43 U.S.C. 2101-2106), 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 Florida Department of State, SHPO reviewed the project and by letter dated September 26, 2016 found that

"proposed project is unlikely to adversely affect historic properties." A copy of this letter is included in Appendix C.

5.6.5. CLEAN WATER ACT OF 1972

The USACE will request verification of the exemption from the state's water quality standards under Section 401 of the Clean Water Act and Chapter 373.406 of Florida Statute from the Florida Department of Protection (FDEP) to cover the proposed action. Verification of the exemption will also constitute state concurrence that the project is consistent with the Florida Coastal Zone Management Program. All state water quality standards will be met. The project is in compliance with this Act. A Section 404 (b)(1) evaluation is included in this report as Appendix D-1.

5.6.6. CLEAN AIR ACT OF 1972

The project area is in attainment and no air quality permits are required for this project.

5.6.7. 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 D-2. This consistency determination was conveyed to the FLDEP on September 30, 2016 with a request for concurrence. On December 7, 2016, FLDEP issued a letter providing comments on the EA and stated that final consistency would be issued at the time of issuance of an Environmental Resource Permit (ERP). The letter received from FLDEP is included in Appendix B. As previously discussed in Section 3.6.10, this project is exempt from permitting under the ERP program, as a result, also exempt from the Coastal Zone Management Plan per State Law: (380.23(7) Florida Statute):

Agencies shall not review for federal consistency purposes an application for a federally licensed or permitted activity if the activity is vested, exempted, or excepted under its own regulatory authority.

USACE was unaware of this state language at the time the request for concurrence was made. Based on this language, this project does not need a CZMA consistency determination from the State of Florida.

5.6.8. FARMLAND PROTECTION POLICY ACT OF 1981

No prime or unique farmland would be impacted by implementation of this project. This Act is not applicable.

5.6.9. 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.

5.6.10. MARINE MAMMAL PROTECTION ACT OF 1972

There is no anticipated take of any marine mammal during any activities associated with the project due to the monitoring of the area by a protected species observer and shutdown criteria included in the project specifications. Appropriate actions will be taken to avoid listed and protected marine mammal species effects during project construction. If a marine mammal is identified within the project boundaries, cease work requirements will be implemented until the animal leaves the project area of its own volition, preventing potential take of the animal under the MMPA. As a result of this, the project is in compliance with the Act.

5.6.11. ESTUARY PROTECTION ACT OF 1968

No designated estuary would be affected by project activities. This Act is not applicable.

5.6.12. SUBMERGED LANDS ACT OF 1953

The project would occur on the submerged lands of the State of Florida. The Federal government has Navigational Servitude under the Supremacy Clause of the U.S. Constitution and is not required to obtain a lease or authorization from the state to use state owned lands for projects that support navigation. By coordination of the project through the permit exemption process, the State was coordinated with under the CZMA process, and this project is in compliance with the Act.

5.6.13. COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

There are no designated coastal barrier resources in the project area that would be affected by this project. These Acts are not applicable.

5.6.14. RIVERS AND HARBORS ACT OF 1899

The proposed work would not obstruct the navigable waters of the United States. The proposed action was subject to public notice and other evaluations normally conducted for activities subject to the Act. The project is in full compliance.

5.6.15. ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species would not be affected. The project was coordinated with the NMFS and is in compliance with the Act.

5.6.16. MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

Migratory birds would be affected by project activities by temporary displacement due to project construction. The project is in compliance with these Acts.

5.6.17. MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

Replacement of the seawall at the Mount Sinai Medical Center is in compliance with the Marine Protection, Research, and Sanctuaries Act.

5.6.18. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

An Essential Fish Habitat (EFH) Assessment is included within this integrated report and was coordinated with the NMFS. USACE submitted an EFH assessment to NMFS on October 28, 2016. NMFS responded with conservation recommendations on December 1, 2016. NMFS provided six conservation recommendations, and USACE accepted four of them, to include coral relocation and seagrass mitigation. For those actions that were not accepted, USACE provided scientific justifications for the reason that the recommendations were rejected. Specifically, although USACE agreed to relocate corals greater than 10cm in diameter from the seawall to an artificial reef in Biscayne Bay, USACE declined to prepare a coral

relocation and monitoring plan for NMFS review and approval with coral survival and long-term monitoring requirements. Additionally, NMFS recommended additional compensatory mitigation for corals left on the seawall after relocation efforts. Since the corals were not ESA listed and the new seawall will provide habitat for new corals to colonize, no additional compensatory mitigation for these corals was included. NMFS recommended that the Corps require compensatory mitigation for unavoidable impacts to seagrass habitat associated with construction equipment spudding down, if construction occurred from the water. USACE committed to require the contractor to record GPS locations for each spud or anchor in seagrass beds, and after the spuds/anchors are removed for a survey to be conducted to determine the condition of the grass. If impacts to seagrass exceed 0.10 acres, USACE will work with the agencies to determine appropriate compensatory mitigation. USACE completed EFH consultation with NMFS by letter dated February 2, 2017. Copies of the correspondence are located in Appendix C.

5.6.19. UNIFORM RELOCATION ASSISTANCE AND REAL PROPERTY ACQUISITION POLICIES ACT OF 1970

The project does not involve real property acquisition and/or displacement of property owners or tenants. The Act is not applicable to this project.

5.6.20. E.O. 11990, PROTECTION OF WETLANDS

A very small impact to seagrass beds are expected with the project. The preferred alternative results in the permanent removal of 0.050 acres of seagrasses associated with the construction of the new seawall. This project is in compliance with the goals of this Executive Order (EO).

5.6.21. E.O. 11988, FLOOD PLAIN MANAGEMENT

The project has been evaluated in accordance with this EO. The project is in compliance.

5.6.22. E.O. 12898, ENVIRONMENTAL JUSTICE

This environmental justice assessment recognizes the issues addressed in the Environmental Justice Guidance under NEPA (CEQ 1997), and uses USEPA Guidance for Incorporating Environmental Justice Concerns in USEPA's NEPA Compliance Analyses (USEPA 1998) as a guide.

An environmental justice assessment requires an analysis of whether minority and low-income populations (i.e. "the populations of concern") would be affected by a proposed Federal action and whether they would experience adverse impacts from the proposed action at any of the site alternatives. If there are adverse impacts, the severity and proportionality of these impacts on populations of concern must be assessed in comparison to the larger non-minority or non-low-income populations. At issue is whether such adverse impacts fall disproportionately on minority and/or low-income members of the community and, if so, whether they meet the threshold of "disproportionately high and adverse." If disproportionately high and adverse effects are evident, then USEPA guidance advises that it should trigger consideration of alternatives and mitigation actions in coordination with extensive community outreach efforts (USEPA 1998).

The proposed action will not result in adverse human health or environmental affects which would disproportionally impact a particular minority or low-income population. The action will take place on and adjacent to a property of the Mount Sinai Medical Center. Properties located north of the hospital on Meloy Channel are a high dollar value private marina and private homes. Low-income populations and

minority populations are not disproportionately located within the region of influence of the proposed action. The proposed activity would not (a) exclude persons from participation in, (b) deny persons the benefits of, or (c) subject persons to discrimination because of their race, color, or national origin, nor would the proposed action adversely impact "subsistence consumption of fish and wildlife." Therefore, the project is in compliance with this EO.

5.6.23. E.O. 13089, CORAL REEF PROTECTION

This EO may apply to coastal projects, especially those which might directly or indirectly impact coral reefs. Although the project has corals growing on the seawall, the seawall is not considered as a coral reef under the EO, and the EO is not applicable to the project. However, USACE plans to relocate any scleractinian corals greater than 10 cm in size to an alternative location and make any remaining corals and other encrusting organisms to educational organizations like the Miami Science Museum or local universities.

5.6.24. E.O. 13112, INVASIVE SPECIES

The replacement of the seawall Mount Sinai Hospital is expected to have beneficial effects on invasive species associated with the removal of exotic invasive Brazilian pepper and Australian pines in the vicinity of the project area.

5.6.25. E.O. 13186, MIGRATORY BIRDS.

This EO requires, among other things, a Memorandum of Understanding (MOU) between the Federal Agency and the USWFS concerning migratory birds. Neither the Department of Defense MOU nor the USACE Draft MOU clearly address migratory birds on lands not owned or controlled by USACE. 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. Measures to avoid the destruction of migratory birds and their eggs or hatchlings will be implemented, where applicable.

5.6.26. E.O. 13045, DISPARATE RISKS INVOLVING CHILDREN

This EO mandates that each Federal agency make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

As the proposed action does not affect children disproportionately from other members of the population, the proposed action would not increase environmental health or safety risks to children.

6. 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 emergency shoreline protection within the study area that can be developed with the framework of the formulation concepts. Implementation of the Recommended Plan for the Mount Sinai CAP Section 14 Project is recommended at this time, with such modification as the Commander, South Atlantic Division, U.S. Army Corps of Engineers (SAD), deems advisable at his discretion.

The Recommended Plan is described in the previous chapters. The plan will address current erosion issues at the Mount Sinai Medical Facility, providing emergency erosion protection to the only hospital facility on the barrier island, which also operates as an Essential Services facility and a disaster coordinating point.

6.1 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 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 a minimum of 35 percent, but not to exceed 50 percent, of total project costs, to include a contribution of funds equal to 5 percent of total project costs in accordance with the terms of the Project Partnership Agreement to be executed;

b. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material, perform or ensure performance of all relocations, and construct improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material that the Government determines to be required or to be necessary for construction, operation, and maintenance of the Project.

c. 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;

d. 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;

e. Hold and save the United States free from all damages arising from the construction, 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;

f. 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;

g. 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 construction, 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;

h. 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 construction, operation, or maintenance of the project;

i. 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;

j. 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 construction, 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;

k. 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.*);

l. 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;

m. Participate in, and comply with, applicable Federal floodplain management and flood insurance programs;

n. 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;

o. 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;

p. 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 PPA, and implement the plan no later than one year after project construction is complete.

6.2 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 CAP Section 14 project for the Mount Sinai Medical facility 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.

Jason A. Kirk
Colonel, U.S. Army
District Engineer

Reference Maps

Erosion Drivers and Effects

- The primary driver for current erosion is the overtopping of the seawall during extreme high tide events.
- Overtopping, and the resulting inundation, drives erosion of material over/through the existing seawall and the subsidence of land behind the wall threatens vulnerable facilities, including a perimeter road and parking facilities.

Critical Facilities Vulnerable to Erosion

- Mount Sinai is the only major medical facility in the City of Miami Beach.
- It serves as a "shelter in place" for the local population during disasters.
- Emergency Staging Area during disaster events.
- Perimeter road and parking are essential to hospital operations.

REF-1: Foldout map.

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APPENDIX A
ENGINEERING APPENDIX

MOUNT SINAI MEDICAL CENTER, CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

May 2017

US Army Corps of Engineers ®
Jacksonville District

Table of Contents

1.0 Purpose 4
2.1 Project Background 4
2.2 Location 4
2.3 Existing Conditions 5
2.4 Proposed Alternatives 6
2.5 Recommended Plan 8
3.1 Geotechnical 10
3.2 History of Existing Sea Wall 10
3.3 Historical Boring Data 11
3.4 Geology 12
3.4.1 Regional Geology 12
3.5 Project Specific Geotechnical Data 12
3.5.1 Site-Specific Subsurface Conditions (Materials Encountered) 12
3.5.2 Boring procedures notes 15
3.5.3 Geotechnical Engineering data 16
3.5.4 Laboratory testing 16
3.6 Prelimanry Geotechnical Analyses 19
3.6.1 Geotechnical Results - Engineering Parameters 19
3.6.2 Recommendations 22
4.1 Coastal Report 22
4.2 Site Conditions 22
4.3 Description of Problem. 23
4.4 Water Levels. 23
4.4.1 Tides 23
4.4.2 Datum Conversions 25
4.4.3 Surge 25

4.4.4 Sea Level Rise 25
4.4.5 Calculation of SLR Rates 26
4.4.6 Bathymetric/Topographic Data 28

ATTACHMENTS

- Attachment A - Geotechnical Addendum
- Attachment B - Structural Addendum
- Attachment C – Vertical Road Relocation

1.0 Purpose

The purpose of this engineering appendix is to discuss possible solutions to the seawall repair and overtopping conditions at Mount Sinai Medical Center, located in Miami Beach, Florida. This project was authorized under Section 14 of the Continuing Authorities Program (CAP). This appendix will include project background, geotechnical evaluations, coastal analysis, cost analysis, initial designs, and recommendations.

2.1 Project Background

2.2 Location

The project area is located in the City of Miami Beach, Florida, on a barrier island bordered to the east by the Atlantic Ocean and to the west by Biscayne Bay. The study area is the property of Mount Sinai Medical Center, located directly north of Julia Tuttle Causeway and extending approximately 0.57 miles along the bayside of the island, as shown in Figure 2.1.

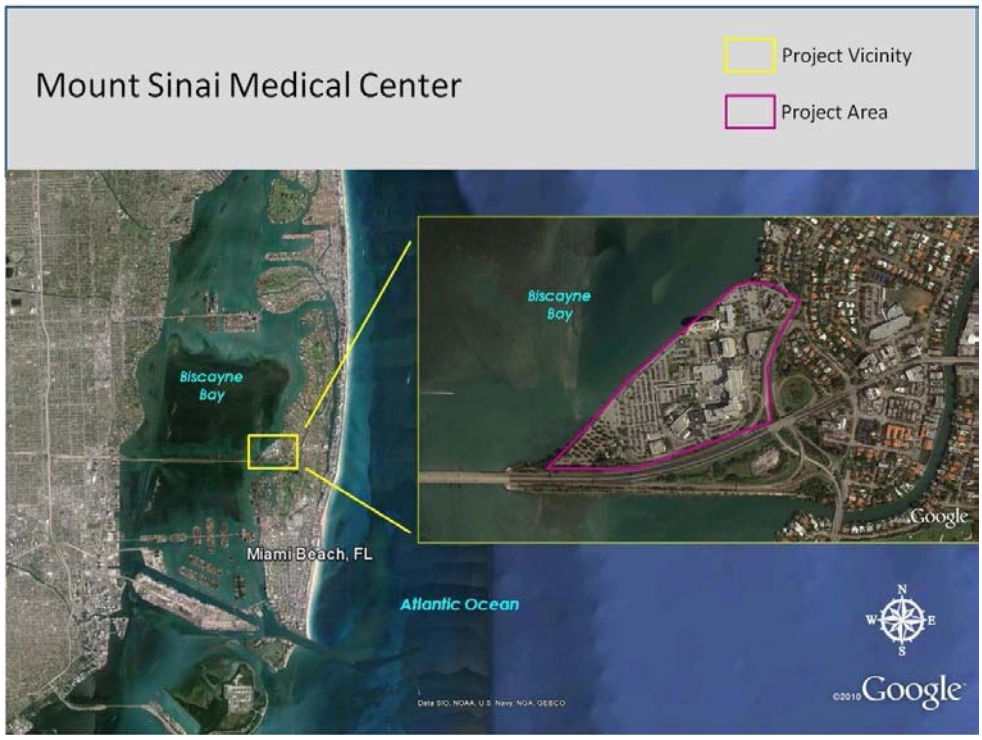

Figure 2.1 Project Location

2.3 Existing Conditions

The existing improvements within the project area includes a parking lot, a perimeter road, and a perimeter seawall surrounding the seaward edge of the property. Mount Sinai Medical Center (MSMC) is the only hospital facility on the barrier island, making it a vital facility to the community as well as a critical staging area during disasters. A report entitled *Bulkhead Assessment, Mount Sinai Medical Complex, Miami Beach, Florida (2009, Bureau Veratis, Inc.)* found the existing seawall to be roughly 50 years old. The report indicated that portions of the seawall were in critical condition and would require immediate replacement. This facility is a private non-profit hospital and is considered eligible for this CAP Section 14 Emergency Streambank and Shoreline Erosion study in accordance with ER 1105-2-100 Planning Guidance Notebook published 22 April 2000.

The existing condition of the seawall is at risk of failure. Portions of the seawall have partially deteriorated from exposure (See Figure 2.2), and the supporting bank has eroded away due to rainfall, wave overtopping, loose geotechnical conditions, and tidal Inundation. The current state of the seawall is prone to inundation during extreme storm and high tide events. Inundation is the main driver of erosion, causing material to be transported through the existing seawall, leaving utilities, parking, roads and other critical facilities directly landward vulnerable to flooding and erosion. Overtopping is expected to increase with the current rate of sea level rise (See Figure 2.3 below). Most of the primary medical facilities of the MSMC are located away from the bayfront on higher ground with the exception of the Golden and Lowenstein buildings, which are located in close proximity to the seawall. A limited repair to the seawall was performed in front of these two buildings in 2009. A two-lane paved road and parking facilities extend along most of the remaining length of the existing seawall. A grassy area from 8 to 15 feet wide extends along much of the area between the seawall and the road/parking lot. Trees and other vegetation exist along this grassy area, and there is evidence of steel tiebacks and possibly some underground utilities in this area. Areas of scouring damage are evident at many locations adjacent to the seawall, as a result of overtopping and/or wave action. In some areas gravel has been placed in the scour holes to restore surface elevations and prevent further damage.

Figure 2.2 Overtopping Conditions

Figure 2.3 Deteriorated Seawall

2.4 Proposed Alternatives

The main report describes objectives and constraints for the project. An evaluation of the current conditions led to a design of two alternatives and a relocation option to prevent erosion during critical tide events.

Alternative 1 includes the placement of sheet pile seawall along the seaward edge of the property with a T-wall constructed along the northern edge of the property line (See Figure 2.4). The sheet pile seawall will be designed at elevation EI 4.0 (NAVD88) and would be placed 3 feet in front (seaward) of the existing seawall. Material would be placed between the existing seawall and the new sheet pile wall to reduce the load on the existing wall. The structure will transition from a sheet pile seawall to a T-wall on the north end. The T-wall will tie into EI 3.5 feet (NAVD88) landward on the north end. On the southern end, the sheet pile seawall will directly tie into the Julia Tuttle Causeway embankment at 4.0 feet (NAVD88) and will require an easement from the FDOT. The sheet pile will be partially coated with coal tar epoxy to prevent corrosion. The design of the seawall is anticipating a 50-year design life. Information on the design of the sheet pile seawall can be found within Attachment B. No easement is required for the T-wall at the northern end of the medical center.

Alternative 2 would include a 300 foot T-wall constructed along the northern edge of the property line. A sheet pile seawall will be placed along the seaward edge of the property and the addition of a 1.5-foot concrete lift added to 130-foot newer existing seawall segment. (See Figure 2.5)

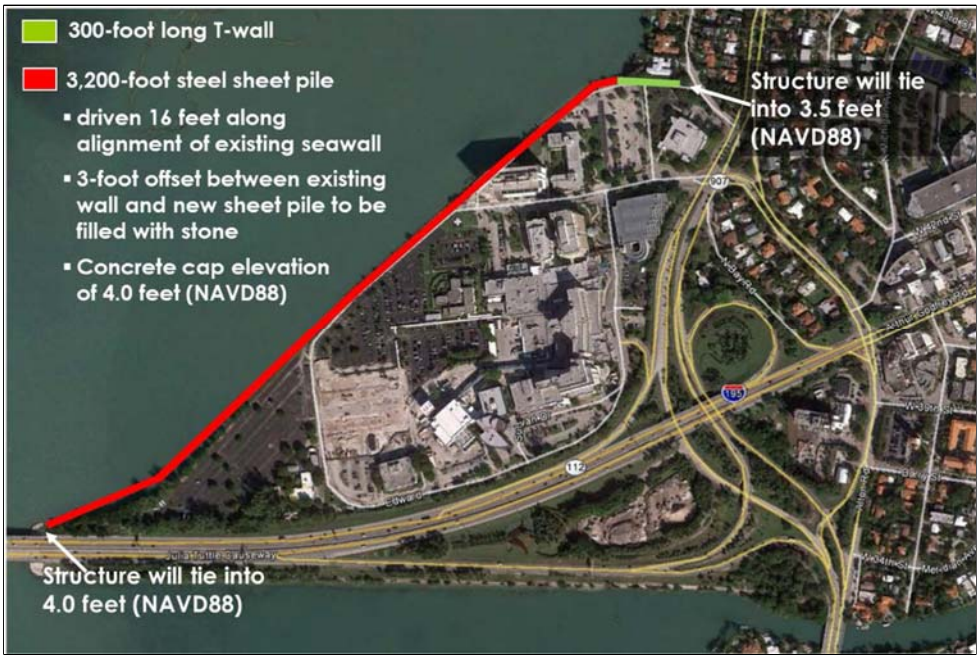

Figure 2.4 Alternative 1 (Sheet Pile Wall with T-Wall)

Figure 2.5 Alternative 2 (Sheet Pile with T-wall and Concrete lift)

Relocation was considered in conjunction with the alternatives proposed above. The Relocation plan therefore consists of vertical relocation of the perimeter road adjacent to Biscayne Bay with constructed support for the portion of the existing seawall adjacent to the elevated road. Relocation also includes relocation of vulnerable parking to a new parking garage constructed on the medical center property.

2.5 Recommended Plan

Analyzing the proposed alternatives led to Alternative 2 (See Figure 2.5) to be the most feasible plan of action. The plan includes the construction of a 300-foot long T-wall along the northern edge of the property, a 1.5-foot concrete lift added to 130-foot newer existing seawall segment and the construction of a sheet pile seawall along the entire seaward edge of the property excluding the 130-foot newer existing segment. This alternative was selected per ER 1105-2-100 Appendix F, Section lll, F-23, “the least cost alternative plan is considered to be justified if the total cost of the proposed alternative is less than the cost to relocate the threatened facility”.

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3.1 Geotechnical

3.2 History of Existing Sea Wall

The general plans for Bulkhead – Dredging & Fill, dated 1966, indicate that Mount Sinai Hospital expanded its facilities during that time period, with part of that effort including construction of the existing seawall, as shown in Figure 3.1. The 1960's wall expanded a pre-existing (pre-1966) bulkhead by about 500 feet, from 2,622 feet to the current 3,200 foot long wall. This project was established by the City of Miami Beach Resolution # 11923.

The post-1966 added section of wall was composed of 14 inch diameter precast concrete piles, spaced 8 feet center to center, with a 6-inch thick concrete panel between them. The wall was anchored to wood piles through 1-1/4 inch metal rods. The concrete piles were driven to elevation -15 feet (1966 Mean Low Water or MLW), which was approximately equivalent to the top of a limestone layer.

Based on existing data from Bulkhead – Dredging & Fill (1966), the bayfront area of Mount Sinai was filled and raised from elevation -15 feet MLW to -2 feet or -3 MLW. The area was raised with fill from a nearby borrow source located within the bay, as shown in Figure 3.1.

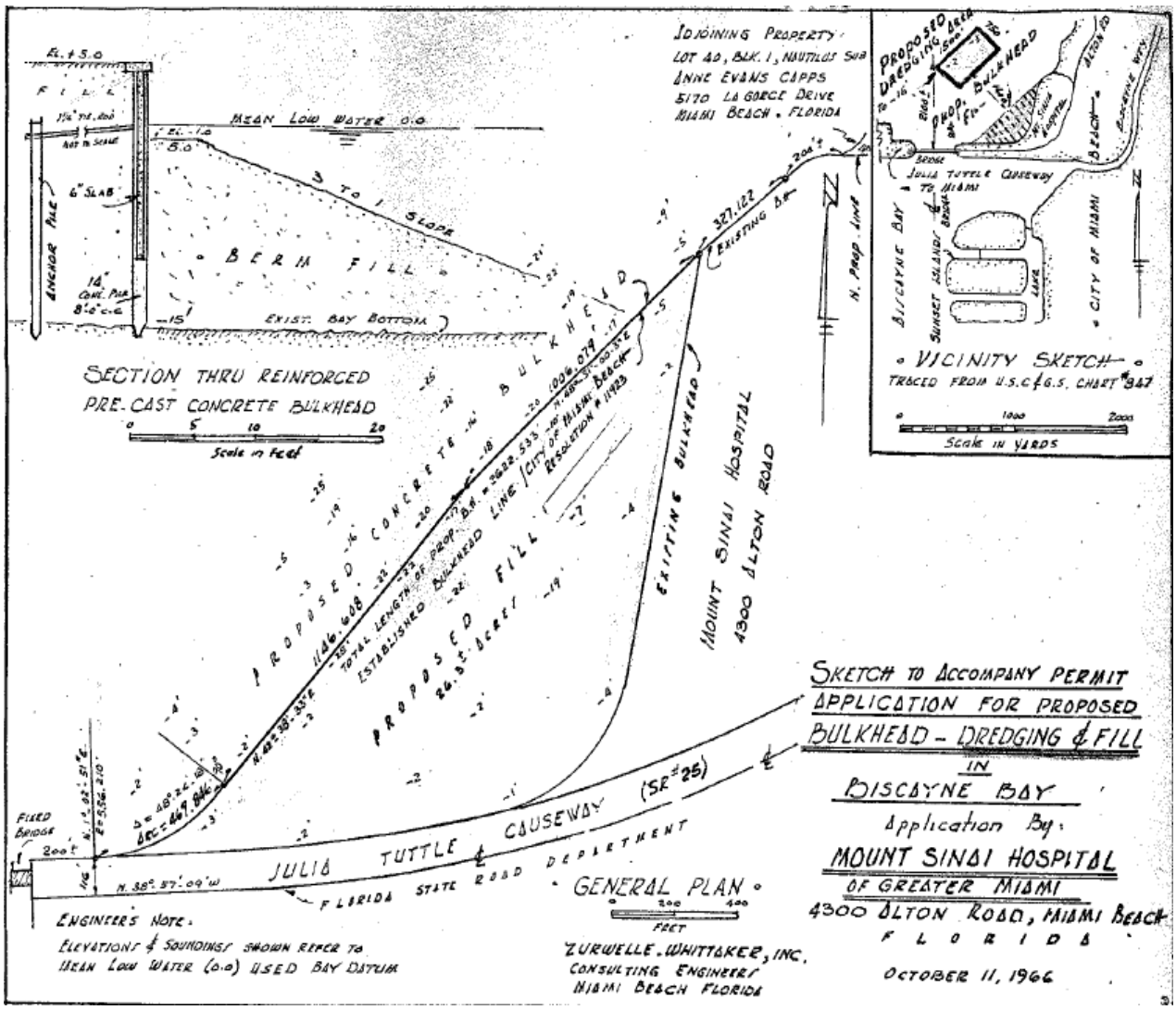


Figure 3.1 Copy of 1966 permit drawing for new bulkhead, dredging and filling.

3.3 Historical Boring Data

The only historical boring data presented herein was from a development of a building inside the Mount Sinai area. The Standard Penetration Test (SPT) borings, B-1 and B-2, were performed by Vertical V-Southeast, Inc. and NV5, Inc. (Vertical V-Southeast became New Vertical 5 or NV5), as part of a geotechnical exploration and evaluation for the project titled Warner Building Entrance Canopy, in 2012. The borings (B-1 and B-2) were located within the footprint of a canopy structure project, the objective B-1 and B-2 is to observe the nature, relative compactness and variability of the soil, rock and immediate groundwater levels underlying the project site. The geotechnical report indicates that a limestone layer, approximately 8 feet to 15 feet thick, was typically found

starting at depth of 21 feet and 23 feet. The boring location and the soil condition in borings encountered B-1 and B-2 are included in Addendum A.

3.4 Geology

3.4.1 Regional Geology

The landforms of the coastal area of Miami Dade County include barrier islands, lagoons, estuaries, and coastal ridges. The project site is a barrier island located along Eastern Biscayne Bay and north of Key Biscayne, on the Atlantic coast of Miami Dade County. Holocene sands that make up the island are underlain by the limestone units of the Miami Limestone Formation. The Miami Limestone consists of two facies, an oolitic facies and a bryozoan facies. The oolitic facies consists of white to orangish gray, poorly to moderately indurated, sandy, oolitic limestone (grainstone) with scattered concentrations of fossils. The bryozoan facies consists of white to orangish gray, poorly to well indurated, sandy, fossiliferous limestone (grainstone and packstone). Beds of quartz sand are also present as unindurated sediments and indurated limey sandstones. Broken shell is present in most samples.

3.5 Project Specific Geotechnical Data

3.5.1 Site-Specific Subsurface Conditions (Materials Encountered)

Project specific geotechnical data was obtained via three SPT borings, MSMC-CB15-01, MSMC-CB15-02 and MSMC-CB15-03 performed at the approximate locations shown on the site plan in Figure 3.2. Boring coordinate's data is shown in Table 3.1. USACE Mobile District's (SAM) drill unit performed drilling of borings. Borings were drilled from the existing ground surface to depths ranging between 30 feet and. 34.5 feet. See Figure 3.3 for the Boring Log Profile Fence. The boring logs are included in the Attachment A – Geotechnical Addendum, of this report.

Table 3.1 Available USACE Boring Data.

Designation	State Plane, FL-East, NAD83		Project Location
	X	Y	
MSMC-CB15-01	539750	939212	Northern Area of Seawall
MSMC-CB15-02	538922	938259	Middle Area of Seawall
MSMC-CB15-03	537910	937331	Southern Area of Seawall

As shown in Figure 3.1, the circa 1966 structure was built into the bay, where site conditions, varied. The figure indicates that toward the center of the alignment of the wall, the bay bottom was approximately at elevation -22 feet. (MLW), rising to both the northeastern & southwestern ends to elevations -5 feet. and -3 feet., respectively. The depressed area toward the center would have required a significant amount of fill to bring it to the final grade, the fill consisting of excavated material from the nearby borrow pit shown in Figure 3.1. It appeared that the materials encountered at ground surface at the boring locations consist of fill material overlying sands, silty-sands, lean clays and silts. Silt and clay N-Value's ranged from 1 to 5 blow per foot (bpf). Sand or silty-sand N-Value's ranged from 2 to 52 bpf. The sand, silty-sand, and silt typically contained a trace of shell and rock fragments. The sands, silty-sands, clays, and silts are underlain by a greenish gray to white oolitic limestone of the Miami Formation. The oolitic limestone was encountered at all boring locations between elevations of -11.8 feet to -23.7 feet NAVD88. The oolitic limestone is described as porous to pitted and contains various percentages of interbedded sand, silt, and fossils and was easily sampled using the SPT method with the rock broken by the spoon advancement. The oolitic limestone matrix (rock fragments recovered) consisted mostly of fine-grained sand size quartz (grainstone), was highly to moderately weathered, and ranged in strength from soft to moderately hard. Sand or silty sand was generally encountered beneath the oolitic limestone. In boring MSMC-CB15-02, a weakly cemented sandstone was encountered below the limestone at elevation -33 feet NAVD88. In boring MSMC-CB15-01, three feet of limestone was cored from a depth of -25.3 to -28.3 feet NAD88. The cored limestone is described as pitted, moderately fractured, very fine mostly quartz sand, indurated (packstone) and soft and can easily be scratched by knife. An Unconfined Compressive Strength (ASTM C-617) test yielded a value of 191 psi on a tested sample selected from the drilled core.

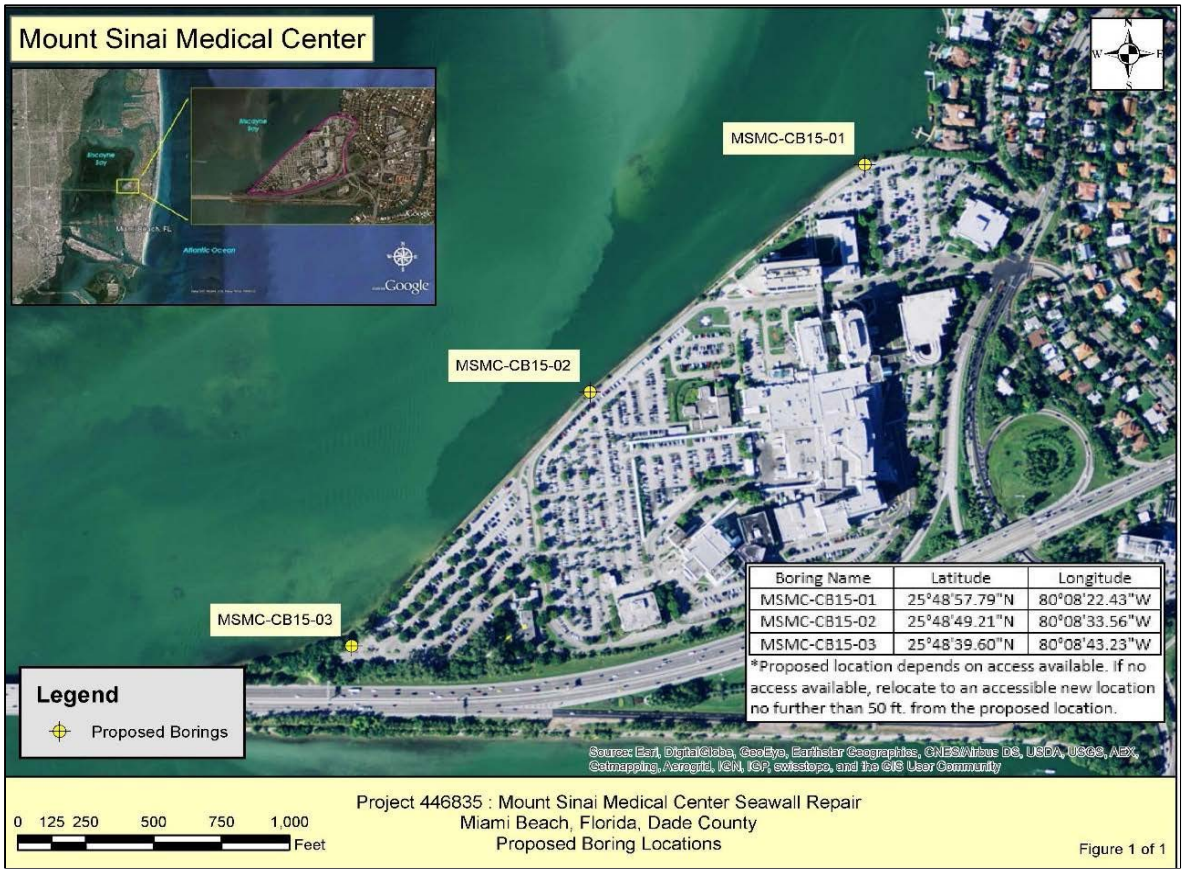


Figure 3.2 Boring Log locations Mount Sinai Seawall Repair

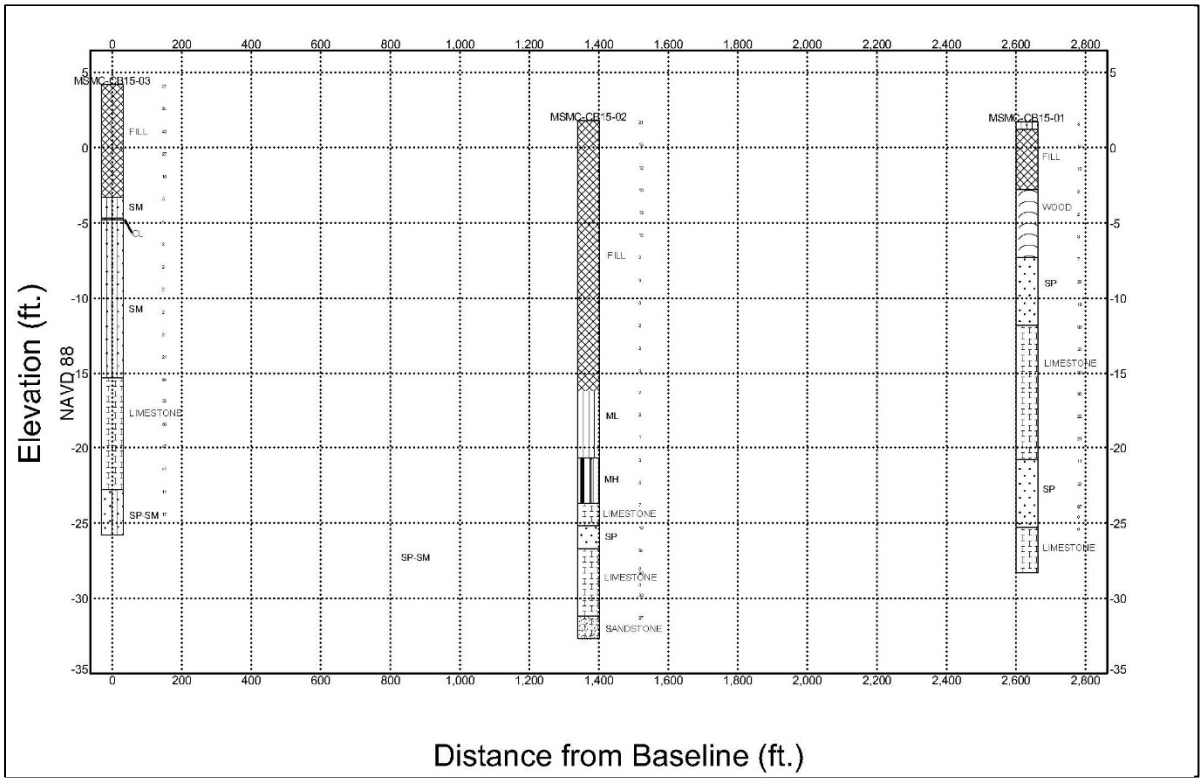


Figure 3.3 Borings Log Profile Fence

The subsurface conditions shown on the boring logs represent the conditions at the boring locations. Subsurface variations between borings should be anticipated. The Unified Soil Classification shown on the borings logs is based on visual classifications and laboratory testing. The limestone encountered corresponds to a rock formation that typically offers high resistance to excavation, hence, special equipment and breaking tools may be required to excavate this limestone. The limestone is also difficult to dewater due to its high porosity and permeability. Limestone content provided for non-limestone material (e.g. SAND w/ little limestone fragments) is descriptive of the materials within the retrieved SPT sampler. The cohesionless/granular soils encountered during this investigation may cave during excavation or drilling, thus stabilization measures may be required.

3.5.2 Boring procedures notes

Borings MSMC-CB15-01 through MSMC-CB-03 were sampled using the Standard Penetration Test (SPT) procedure consisting of a 140 lb. hammer and a 30-inch drop using a 2.0-foot split spoon (1 3/8-inch I.D. and 2-inch O.D.) until refusal was encountered or until the spoon was advanced 18 inches. Refusal is defined as a total of 50 blows of the hammer within any 6-inch increment, a total of 100 blows of the hammer within any 1-foot increment, or no observed advancement of the

sampler after 10 successive blows of the hammer. When refusal was encountered, the borings were continued with a 4-inch x 5 1/2-inch diameter core barrel.

3.5.3 Geotechnical Engineering data

According to the previous section, the simplified soil profile of the project is defined by the soil conditions in boring MSMC-CB15-02, since the soil conditions at this boring were considered to be the least favorable from a geotechnical perspective.

Layer I: Fill – This layer consists of mostly fine gravel and coarse-grained sand-sized quartz and was encountered from elevation 1.8 to -5.7 (NAVD88). The fill is medium dense with SPT N-values between 13 and 21 bpf.

Layer II: Fill – This layer consists of gray, poorly graded sand, with some gravel and was encountered from elevation -5.7 to -16.2 (NAVD88). The SPT N-values varies from 2 to 12 bpf. The classification of the layer has been changed based on existing data from a project in 1966.

Layer III: ML\MH – This layer consists primarily of gray, inorganic sandy silt of varying plasticity and sand content with few organics, typically less than 5%, with SPT N values between 1 and 5 bpf. This layer was encountered from -16.2 to -23.7 (NAVD88).

Layer IV: SP – This layer consists of primarily gray, poorly graded sand, with SPT N-values between 7 and 10 bpf. This layer was encountered from -23.7 to -26.7 (NAVD88).

Layer V: Limestone – This layer consist of grey sandy, sparsely fossiliferous moderately hard, limestone, with SPT N-values between 64 and 88 bpf. This layer was encountered from -26.7 to -32.7 (NAVD88).

3.5.4 Laboratory testing

Laboratory testing was performed on the soil and rock samples recovered from the three USACE borings to determine material classification and engineering properties. Laboratory physical testing consisted primarily of determination of the following:

Water Content – ASTM D2216

Organic Content – ASTM D2974 Method C

Sieve Analysis – ASTM D422

Classification of Soils – Standard Practice for Classification of Soils for Engineering Purposes (United Soil Classification System) ASTM D2487

1. Atterberg Limits Multi Point – ASTM D4318.
2. Unconfined Compression Strength (Rock) – Unconfined Compression Tests of Rock Cores, ASTM D2938.

The physical laboratory test results are summarized in Table 3.2 and the interpretation of these results are included in the following sections.

Table 3.2 Summary of laboratory testing

Boring Designation	Sample Number	Soil Classification (USCS)	Limit Liquid, LL (%)	Plastic Index, PI (%)	Organic Content, OC (%)	Visual Shell (%)	Water content, W_n (%)	Munsell Color	Approximately Fines content (%)
MSMC-CB15-01	2	SP-SM		-	3.7		17.0	10YR 7/3	9
MSMC-CB15-01	7	SP		-	-	-	42.7	5YR 3/1	4
MSMC-CB15-01	8	SP		-	-	-	20.7	5YR 3/1	3
MSMC-CB15-01	11	SM		-	-	-	23.6	10YR 6/3	19
MSMC-CB15-01	15	SP-SM		-	-	-	19.6	10YR 7/2	7.5
MSMC-CB15-02	3	(SP-SM)g		-	-	-	18.9		6
MSMC-CB15-02	8	(SP)g		-	-	-	18.1	10YR 6/1	5
MSMC-CB15-02	14	ML	NP	NP	3.1		47.6	10Y 5/1	50
MSMC-CB15-02	16	MH	60	24	5.9	2	44.6	N 5	86
MSMC-CB15-02	22	SP-SM		-	-	13	13.7	N 7	8
MSMC-CB15-03	3	SP-SM		-	-	-	11.3	10YR 7/3	9
MSMC-CB15-03	7	SM	NP	NP	2.6		39.9	10Y 5/2	34.5
MSMC-CB15-03	11	SM		-	-	-	42.0	10Y 5/1	17.5
MSMC-CB15-03	15	GP-GM		-	-	-	28.4	N 9	15
MSMC-CB15-03	20	SP-SM		-	0.3		20.3	10YR 7/1	5
USCS: Unified Soil Classification System;									

3.6 Preliminary Geotechnical

3.6.1 Geotechnical Results - Engineering Parameters

The following soil parameters provide for the lateral design of a steel sheet pile wall. It is noted that the short-term and long-term condition should both be analyzed, and the most critical condition used for design purposes. The parameters provided for limestone strata assume that the intact rock has been pulverized into a sandy gravel, whether by the sheetpile installation, or by chisel-beam or other pre-cutting methods before sheet installation.

The following parameters have been developed using the soil conditions from SPT boring MSMC-CB15-02. In order to develop the table below, an average of the N-values were performed for simplicity of calculations, in addition, some engineering judgment were implement for considerations of the internal friction angle and cohesion of the soil.

Table 3.3 Soil Parameters (Undrained Condition or Q-Case)

Mount Sinai (Undrained condition)										
Elevation Range (NAVD 88)	Soil Classification[1]	Saturated Unit Weight (γ_{sat}) (lb/ft^3)	Moist Unit Weight (γ_{moist}) (lb/ft^3)	Effective unit Weight (γ') (lb/ft^3)	Angle of Internal Friction (ϕ)	At Rest Earth Pressure coefficient K_o	At Active Earth Pressure coefficient K_a	At Passive Earth Pressure coefficient K_p	Cohesion Undrained (psf)	Soil Steel Interface Wall Friction Angle (Delta)
1.8 to -5.7	Fill	120	115	57.6	30	0.50	0.33	3	0	16
-5.7 to 16.2	Fill	110	106	47.6	30	0.52	0.35	2.9	0	16
-16.2 to -23.7	ML/MH	105	100	42.6	0	1	1	1	250	0
-23.7 to -26.7	SP	115	110	52.6	31	0.48	0.32	3.12	0	17
-26.7 to -32.7	Limestone	132	126	69.6	34	0.44	0.28	3.54	0	18
(1) USCS :Unified Soil Classification System										

Table 3.4 Soil Parameters (Drained Condition or S-Case)

Mount Sinai (Drained condition)										
Elevation (NAVD 88)	Soil Classification[(1)]	Saturated Unit Weight (γ_{sat}) (lb/ft^3)	Moist Unit Weight (γ_{moist}) (lb/ft^3)	Effective unit Weight (γ') (lb/ft^3)	Angle of Internal Friction (ϕ)	At Rest Earth Pressure coefficient K_o	At Active Earth Pressure coefficient K_a	At Passive Earth Pressure coefficient K_p	Cohesion Drained (psf)	Soil Steel Interface Wall Friction Angle (Delta)
1.8 to -5.7	Fill	120	115	57.6	30	0.50	0.33	3	0	16
-5.7 to 16.2	Fill	110	106	47.6	29	0.52	0.35	2.9	0	16
-16.2 to -23.7	ML/MH	105	100	47.6	26	0.56	0.39	2.56	0	14
-23.7 to -26.7	SP	115	110	52.6	31	0.48	0.32	3.12	0	17
-26.7 to -32.7	Limestone	132	126	69.6	34	0.44	0.28	3.54	0	18
(1) USCS: Unified Soil Classification System										

3.6.2 Recommendations

Additional geotechnical analyses and design work is required to verify the preliminary subsurface conditions and their strength properties to further develop structural features of the Recommended Plan using project-specific geotechnical data. Additional geotechnical investigation, analyses and design work include:

Additional SPT borings logs to refine site characterization.

Refine CWALSHT analysis for internal stability, based on additional data.

Global slope stability analyses of the seawall using GeoSlope software or similar stability analysis.

Lateral analysis of sheetpile seawall using the L-pile software.

Documentation

Preparation of construction level plans and specification.

4.1 Coastal Report

4.2 Site Conditions

Biscayne Bay is approximately 2.25 miles wide at this location, so the seawall is subject to wind-generated waves. However, a large shallow seagrass-covered shoal area is located directly offshore of the MSMC, covering a large amount of the surface area of the bay in this region. This shoal tends to greatly dissipate wave formation and propagation under normal water level conditions, but during periods of elevated water levels damaging wind-generated waves may still pass over this shoal with little effect. In addition to wind-generated waves, boat wakes are an additional design consideration. A boat channel is offset approximately 200 feet seaward of the seawall, and frequent use of this channel by large and/or high-speed vessels has been observed on numerous occasions. The transit of these vessels subjects the seawall to frequent boat wakes that can overtop the seawall as well.

The upper region of Biscayne Bay fronting the MSMC is connected to the Atlantic Ocean at Bakers Haulover Inlet, Government Cut/Miami Harbor, and the Intracoastal Waterway near downtown Miami. The upper bay is therefore readily influenced by water-level fluctuations in the open Atlantic Ocean caused by tides, storm surges, and sea level rise. The presence of numerous man-made islands and causeways constricts tidal flow and may tend to dampen short-period water level fluctuations to some degree, but longer period events can still directly affect water levels at MSMC.

4.3 Description of Problem

An existing seawall was constructed in several phases to prevent erosion of land. The existing seawall has been repaired in various locations but the majority of the wall is in imminent threat of damage by natural erosion processes. Loss of portions of the seawall will result in sudden, extreme erosion impacting existing infrastructure. The primary driver for current erosion problems is overtopping of the wall during extreme high tide events. Overtopping allows material to migrate through cracks in the existing compromised seawall and be carried over the wall as the water recedes. Erosion also contributes to subsidence of land behind the wall. After extreme high tide events, standing water remains in subsided areas complicating and compromising hospital operations and patient health (life risk.) These complications would be exacerbated during disaster events (storms, hurricanes, etc.) where conditions would be worsened by the natural event and increased use of hospital facilities as both an emergency care facility and a disaster staging area.

The primary cause of this erosion generated by subsequent periodic flooding is the low crest elevation of the existing seawall and the adjacent terrain. The crest elevation of the existing structure is at approximately 2.0 to 2.5 feet NAVD88 and average elevations along the adjacent roadway and parking lot are about 2.5 to 3.5 feet NAVD88. Although possibly adequate to prevent most overtopping when it was constructed in the 1960's, applying the historic rate of sea level rise of 0.09 in/yr (+2.3 mm/yr) results in present-day water levels that are about 4 to 5 inches higher than at the time of seawall construction. Given the relatively low elevation of the seawall even at the time of construction, this increased average water surface elevation results in greater overtopping during high tides and storm events.

4.4 Water Levels

All water levels and land surface elevations in this report will be referenced to North American Vertical Datum of 1988 (NAVD88), unless otherwise specified. References to other datums will be provided as necessary.

4.4.1 Tides

Tidal datums are provided for several gages throughout the region. The closest gages to the project site were located at Biscayne Creek (Station # 8723089), located 4.7 miles NNE of MSMC, and the Biscayne Bay gage (Station #8723165), located near downtown Miami, approximately 3.5 miles SW of the MSMC. These gages have periods of record of 29 and 22 months, respectively.

The longest-recording gage in the area is located at Virginia Key (Station 8723214). This gage was installed in January 1994 and remains operational to this day. The resulting period of record is therefore nearly 22 years. This gage is located 5.7 miles south of the MSMC at the confluence of Biscayne Bay and the Atlantic Ocean.

Tidal datums from each of the three references tidal stations are summarized in Table 4.1 below. These three gages span much of the extent of the tidally influenced portions of northern and central Biscayne Bay. As readily seen in this table, the tidal characteristics are relatively similar in spite of the variety of locations.

	Biscayne Creek	Biscayne Bay	Virginia Key
Datum	#8723089	#8723165	#8723214
Highest Obs.	1.24	1.51	2.79
MHHW	0.24	0.26	0.22
MHW	0.18	0.2	0.16
NAVD88	0	0	0
MTL	-0.9	-0.89	-0.85
MSL	-0.91	-0.89	-0.87
DTL	-0.93	-0.92	-0.88
MLW	-1.98	-1.98	-1.86
MLLW	-2.11	-2.11	-1.97
Lowest Obs.	-2.92	-3.24	-3.28

Table 4.1 Tidal datums near the project area. NOAA Stations # 8723089, 8723165, and 8723214.

Although the differences between these gages are relatively small, these tidal datums will provide the foundation for the water level analysis that follows. Selection of representative tidal conditions at the MSMC site is therefore important. The Biscayne Bay and Virginia Key gages are both located in, or adjacent to, tidal inlets and therefore do not experience the level tidal dampening that could be expected deeper inside the bay. Of the three gages, only Biscayne Creek was located well within the confined area of Biscayne Bay, and thus experienced similar tidal forcing characteristics as are presently experienced at the MSMC site. Use of the Biscayne Creek gage (station # 8723089) is based on a 2.5-year record, and due to its location should more accurately represent tidal conditions at the project site. Tidal datums from this gage will therefore be used in project formulation and design with the exception of highest observed water level which will be conservatively obtained from the Virginia Key gage due to the longer record at that location.

The highest water level on record was examined at Biscayne Creek and Virginia Key gauges. At Biscayne Creek the maximum level was +1.24 feet NAVD88, but this low value may be due to the relatively short (<2 year) period of record in addition to the causeway effects. The Virginia Key gage recorded a maximum value of +2.79 feet NAVD88. This water level would overtop most of the length of the MSMC seawall and could lead to the level of flooding that is currently observed at the facility.

4.4.2 Datum Conversions

Two primary vertical survey datums have been used: NAVD88 as described above, and the older National Geodetic Vertical Datum of 1929 (NGVD29). NGVD29 has been superseded by NAVD88, but is typically the reference datum for older elevation data. The conversion between these two datums varies by geographic location, but throughout this project area NGVD29 lies 1.56 feet below NAVD88. This conversion value will be used throughout the report.

Other common elevations of interest are mean lower low water and mean higher high water, which define the limits of the spring tidal range. These values are particularly important in defining the locations of tidally influenced water levels used in this report. Using the values shown for Station 8723089, MLLW lies at -2.11 feet NAVD88, and MHHW lies at 0.24 feet NAVD88.

4.4.3 Surge

Surge levels are provided by FEMA's 2009 Flood Insurance Study (FIS). These values were originally referenced to the National Geodetic Vertical Datum of 1929 (NGVD29), but are converted to NAVD88 in Table 2 in order to be consistent with other vertical measurements.

Return Frequency (years)	Surge Elevation (ft, NGVD29)	Surge Elevation (ft, NAVD88)
10	5.4	3.8
50	6.7	5.1
100	7.2	5.6
500	8.1	6.5

Table 4.2 Surge levels, from FEMA 2009 FIS.

4.4.4 Sea Level Rise

General Information. Eustatic sea level change is defined as a global change in the water surface elevations of the world's oceans. The total relative sea level change is the combination of eustatic sea level change and changes in local land surface elevations. The eustatic sea level has varied widely over geologic time, and evidence suggests that sea levels in the past have been both much higher - and much lower - than present levels. Sea level rise is an important issue for future project consideration, however due to the emergency nature of this project, funding limitations, and the

objective of preventing current erosion the Recommended Plan considers current day extreme water levels. Future sea level rise was considered, in order to recommend an alternative that can be adapted to future sea level change by the sponsor if necessary.

4.4.5 Calculation of SLR Rates

Sea levels have been rising gradually throughout the study area during the entire period of record. The longest water-level record in the Miami Beach area was measured by NOAA gage #8723170. Recorded water levels from this gage span 50 years, extending from 1931 to 1981. During this period the average annual rate of sea level rise was 0.094 in (2.39 mm) per year, +/- 0.017 in/yr (0.43 mm/yr). Note that the gage used to establish the tidal datum used throughout this study (Biscayne Creek, station #8723089) was not used in this computation of sea level change rates due to its short period of record.

It is generally accepted that sea level will continue to rise and that the rate of rise may accelerate due to climatic changes. The Corps of Engineers provides guidance on the calculation of sea level rise and on its application to the design process. The Corps of Engineers' Engineering Regulation (ER) 1100-2-8162 was issued in December 2013 to establish procedures for projecting sea level rise into the future based on global sea level change rates, local historic sea level change rate, base year of project analysis, and number of years in the period of analysis. This ER requires that three scenarios be examined, which result in low, intermediate, and high predictions of sea level rise. The low value is based on an extrapolation of the local historic sea level rise rate. The intermediate and high values are based on the National Research Council (NRC) sea level rise predictive Curves I and III, respectively.

All three curves are based on the following basic equation for prediction of eustatic sea level rise due to ongoing glacial melting and thermal expansion of ocean water:

$$E(t) = 0.0017t + bt2$$

In this equation E(t) is the eustatic sea level rise (in meters); t is the time of the projection into the future using 1992 as a baseline year. 1992 is used as the baseline because it is the midpoint of the previous tidal epoch (1983-2001). The value b is a coefficient that varies for each of the three NRC curves (note that only curves I and III are used in this analysis). The coefficient b is equal to 2.71E-5 for Curve I; 7.00E-5 for Curve II, and 1.13E-4 for Curve III. This equation assumes a global mean sea level change rate of +0.067 in/yr (1.7 mm/yr). The local sea level change rate for this location includes land subsidence and is +0.094 in/yr (2.39 mm/yr). These parameters were used to calculate the three sea level rise prediction curves as required in ER 1100-2-8162. In Figure 4.1 the extrapolated historic rate is represented by the green line; the NRC Curves I and III predicted rates are represented by the blue and red lines, respectively. These three curves correspond to the low,

intermediate, and high predictions of sea level rise required by ER 1100-2-8162, referenced to the base year of 1992.

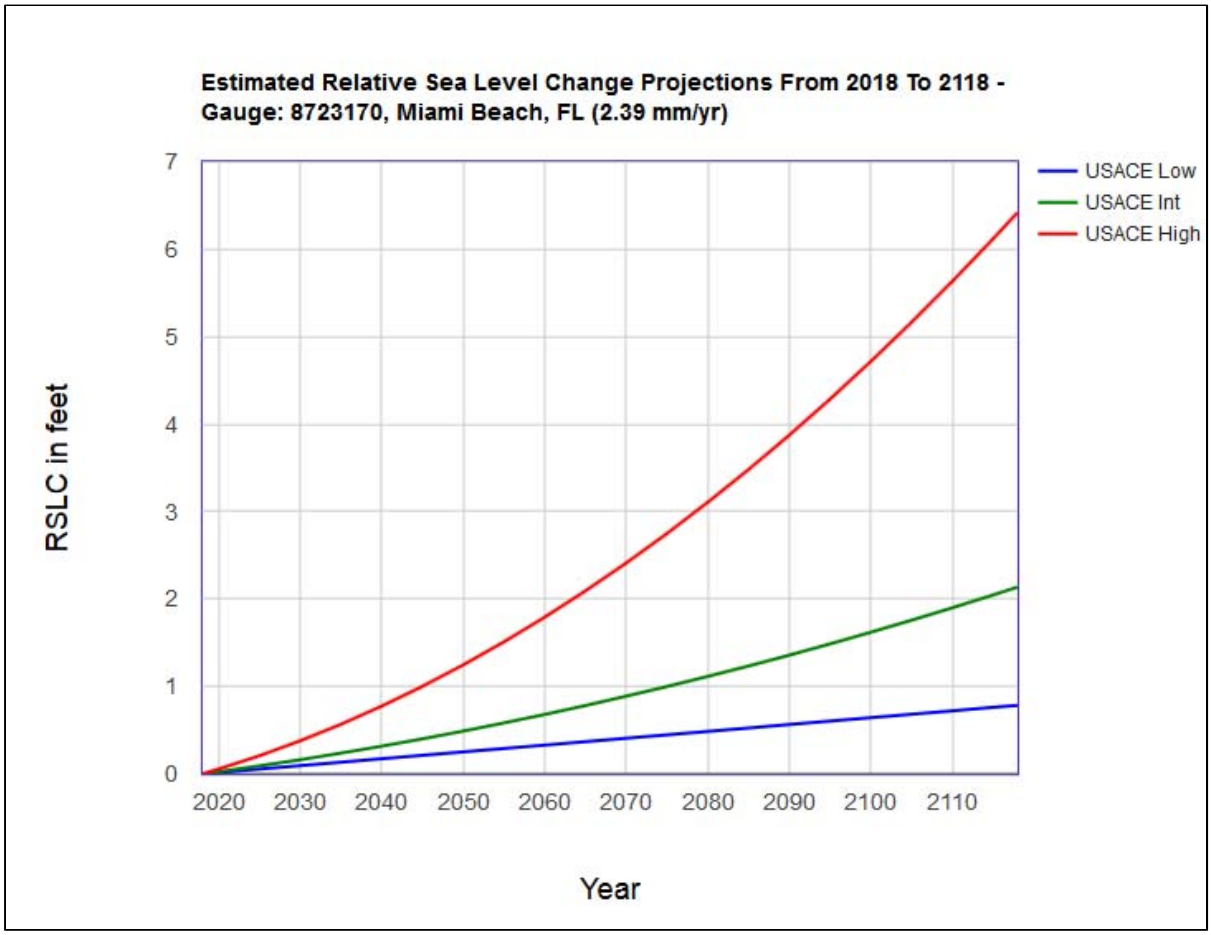


Figure 4.1 Summary of predicted relative sea level rise in Miami Beach by the year 2118.

In accordance with the methodology established in ER1100-2-8162, the year 1992 was chosen as the base year for calculations of sea level change rates for the Miami Beach area. The difference between the base year (1992) and the present (2018) is 26 years, and based on the calculations of RSLC values presented in Figure 4.1, water levels at year 2018 vary from +0.20 to +0.45 feet over the value in 1992. Since the increase in water levels as measured from the present time (2018) is of greater interest in project design than water levels measured from 1992, the values from Figure 4.1 were normalized to 2018 water levels. Table 4.3 presents these values, referenced to the year 2018. The RSLC values provided in Table 4.3 are projected over a 100-year interval, to the year 2118. The 50-year (2068) and 100-year (2118) projections are highlighted in gray.

Estimated Relative Sea Level Change in Feet from 2018 To 2118 Mt. Sinai Medical Center CAP (14) 8723170, Miami Beach, FL NOAA's Published Rate: 0.00784 feet/yr											
SLR Curve	2018	2028	2038	2048	2058	2068	2078	2088	2098	2108	2118
USACE-Low	0	0.08	0.16	0.24	0.31	0.39	0.47	0.55	0.63	0.71	0.78
USACE-Intermediate	0	0.13	0.28	0.45	0.64	0.85	1.07	1.31	1.57	1.84	2.14
USACE-High	0	0.31	0.69	1.15	1.68	2.28	2.96	3.72	4.54	5.44	6.42

Table 4.3 Sea level rise rates referenced to 2018 levels.

4.3.6 Bathymetric/Topographic Data

In general, two recent surveys were used for most of the design formulation for this project. Older surveys were utilized to provide historical trends, as-built project conditions for original construction, and other relevant information. The two primary surveys used in this study were performed in 2007 and 2015, and are described below.

A large-scale Lidar (Light Detection and Ranging) survey was performed in 2007 by FDEM (FL Division of Emergency Management. This survey covered the entire barrier island region, including the full extent of the MSMC. This survey produced elevation data at approximately 4-foot intervals across the entire MSMC property, and was used to define elevations for planning and design purposes. Excess elevation data beyond the boundaries of the study area were truncated in the interest of reducing file size and processing time; the limits of the truncated survey are shown in Figure 4.2.

Figure 4.2: 2007 Lidar Survey Boundary

A more limited, but project-specific profile survey was commissioned by Corps of Engineers following approval of the Federal Interest Determination (FID) in 2015. This survey was performed in order to define elevations along the waterfront in greater detail for project design purposes. The contractor was Whidden Surveying & Mapping, Inc., and field work was performed on 10 July 2015. The survey consisted of eight profiles crossing the shoreline, and two upland transects to define elevations along the north and south boundaries of the MSMC property. These profiles and transect lines are shown in Figure 4.2.

Comparisons of these two surveys were performed to determine the consistency of the elevation data which was gathered using two very different survey techniques. Both surveys were in very close agreement in areas where they overlapped, with maximum elevation differences on the order of a few inches or less. This provided a high level of confidence in both site condition surveys. In general, ground-surface elevations throughout the MSMC facility are very low and flat. The crest

of the existing seawall varies from about 2 to 2.5 feet NAVD88. Ground elevations landward of the seawall vary from about 2 to 4 feet in most areas. Elevations along both transects are equally low, ranging from the waterline up to maximum elevations of about 4 feet NAVD even at the farthest upland extent of the transects. This creates a potential problem with anchoring any erosion control structures into higher ground to protect against flanking. Initial indications are that any measures will have to wrap around most of the perimeter of the MSMC property to adequately protect the facility against elevated water levels and resulting erosion.

Example 1: FEMA BFE. Using the FEMA base flood elevation (BFE - 1 percent annual chance of exceedance) of 5.6 feet (with no allowance for wave overtopping or sea level rise), the existing bayfront seawall would require raising by up to 3.6 feet. Examination of the transect survey data shows that no surface elevations of +5.6 feet NAVD88 exist along either alignment, so this structure would be vulnerable to flanking. The flood-prevention structure could be anchored into the Julia Tuttle causeway embankment along the south side, but proper real estate easements would likely be required. No suitably high elevations exist along the northern MSMC property boundary to prevent flanking, and much of the MSMC would have to be encircled by flood control structures to prevent erosion by the 100-year event.

Based on elevations provided by the 2007 Lidar survey, the added distance required to anchor the south end of the protective structure into the +5.6-feet elevation contour is 55 feet. This wing wall would extend from the southern terminus of the seawall, southward to the +5.6-feet elevation contour along the Julia Tuttle Causeway embankment. The length of the wing wall required to prevent flanking around the north end of the seawall is much longer, due to extensive areas of low existing ground elevations in that area. To extend from the northern terminus of the existing seawall landward to the +5.6-feet contour would require an additional 1,150 feet of structure. The alignment of this structure would extend eastward along the northern perimeter of the MSMC property, then parallel to Alton Road, past the main entrance to the facility, and anchoring into the +5.6-feet contour in front of the south end of the existing parking garage. This wing wall extends along developed and/or constricted areas, and extends across the main entrance into the MSMC facility.

Example 2: FEMA+1. This alternative uses the FEMA base flood (1 percent chance of exceedance) elevation of 5.6 feet of elevation, plus a 1-foot allowance for wave overtopping and sea level rise effects. This alternative was suggested for future protective structures constructed throughout the northeast US in response to Hurricane Sandy. Using FEMA+1 the design flood-control structure elevation becomes 5.6 feet + 1.0 feet = 6.6 feet NAVD88. This alternative would require raising the existing seawall by up to 4.6 feet. The same problem exists with the lack of sufficiently high upland elevations to anchor the flanks of the structure into. As with the “FEMA BFE” option, the resulting structure would have to encircle most of the MSMC in order to prevent flanking.

The alignments of the wing walls required to properly anchor the reconstructed seawall into the +6.6-foot contour would be the same as for the previous option. The lengths of each wing wall would increase however, since they tie into slightly higher elevations. The total length of the south wing wall would be 60 feet, while the north wing wall length would increase to about 1,350 feet. As with the "FEMA BFE" option, this wing wall extends along developed and/or constricted areas, and extends across the main entrance into the MSMC facility.

Example 3: FEMA+3. This alternative uses the FEMA base flood (1 percent chance of exceedance) elevation of 5.6 feet of elevation, plus a 3-foot allowance for wave overtopping and sea level rise effects. This alternative is consistent with the City of Miami Beach's requirement for construction of flood control measures. Using FEMA+3 the design flood-control structure elevation becomes 5.6 feet + 3.0 feet = 8.6 feet NAVD88. This alternative would require raising the existing seawall by up to 6.6 feet above its present crest elevation. The problem created by the lack of sufficiently high upland elevations in which to anchor the flanks of the structure is exacerbated with this alternative.

Analysis of the 2007 Lidar survey shows that there are no ground elevations around the perimeter of the MSMC that are high enough to anchor wing walls into, to prevent flanking of the seawall. The protective structure would therefore have to encircle the entire facility. Such a structure would extend from one end of the seawall, around the outermost perimeter of the facility, and tie onto the other end of the seawall. The total length of such a structure (in addition to the 2,950-feet length of the seawall) is 4,100 feet. Much of this alignment extends along the Tuttle Causeway and Alton Road. This structure would also extend across both entrances to the MSMC facility.

Example 4: Local Observations. Anecdotal and photographic evidence provided by MSMC shows that water levels presently overtop the existing seawall by a foot or less during the annual "king tide" events that cause the inundation/erosion that is the basis for this study. The level of overtopping will certainly increase over time due to sea level rise, but at this time there is no evidence to suggest that water levels rise to more than a foot over the existing seawall elevation. Taking the upper limit of the existing seawall heights to be +2.5 feet NAVD88, this results in a maximum design water level during "king tide" events of +3.5 feet NAVD88. Based upon photo documentation provided by MSMC and the maximum recorded water level of +2.79 NAVD88 at the Virginia Key gage, it is rational to assume that a crest elevation of +3.5 will provide robust if not complete protection against the high water events which are resulting in the documented erosion along the MSMC bayfront.

A 3.5-feet elevation is coincident with the maximum existing ground elevations along the northern perimeter of the MSMC property, and would allow the structure to be tied into existing ground within a relatively short distance (about 50 feet) of the bayfront, versus some the higher design elevations that required much longer tieback lengths – some nearly encircling the entire MSMC facility. Based on the Virginia Key gage data, a crest elevation of +3.5 feet would prevent flooding

from the maximum measured water level event at that gage, would address the level of flooding observed at MSMC during "king tide" events, and would tie in more easily to the existing topography than previous alternatives and therefore would be more constructible.

The majority of the proposed structure lies along the exposed bayfront of MSMC and is subject to overtopping from wind-generated waves and from boat wakes. In order to minimize overtopping and protect against erosion an additional 0.5 feet can be added to the design crest elevation of the protective structure in order to reduce the amount of overtopping due to wave action. This would result in a crest elevation of +4.0 feet NAVD88. Since wind-generated waves and boat wakes will not propagate inland to the tie-in point, the structure can terminate at the +3.5-feet elevation contour at the northern end.

Attachment A – (Geotechnical Addendum)

Vertical V- Southeast, Inc.
308 N.W. 170th Street
North Miami Beach, Florida 33169
Telephone: 786 248 3180
Fax: 786 248 3190

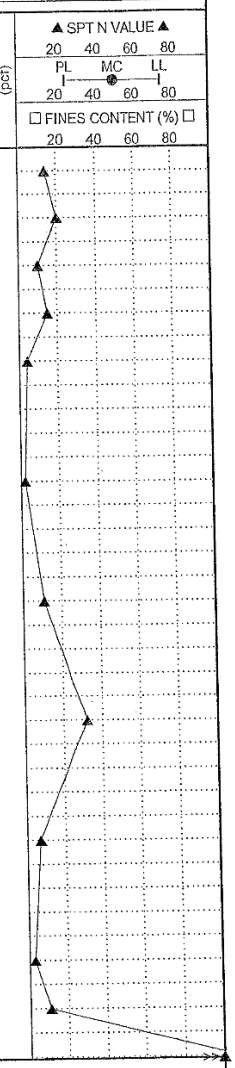
BORING NUMBER B-1
PAGE 1 OF 1

CLIENT Grycon, LLC
PROJECT NUMBER 145862
DATE STARTED 9/7/12 COMPLETED 9/7/12
DRILLING CONTRACTOR F.G.D. INC
DRILLING METHOD 2 7/8-inch Tricone and Bentonite Solution
LOGGED BY G. Miranda CHECKED BY M. Delgado
NOTES Drill Equipment CME-45

PROJECT NAME Warner Building Entrance Canopy
PROJECT LOCATION 4300 Alton Rd. Miami Beach, Florida
GROUND ELEVATION HOLE SIZE 2 7/8- inches
GROUND WATER LEVELS:
AT TIME OF DRILLING 7.00 ft
AT END OF DRILLING ---
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	ASPHALT					
	Light brown fine to medium grained SAND, some limestone fragments	SPT 1	33	18-6-8-6 (14)		
2		SPT 2	58	12-12-8-7 (20)		
4		SPT 3	67	6-6-4-5 (10)		
6		SPT 4	50	8-7-8-5 (15)		
8	Color change: Light gray	SPT 5	33	4-3-1-1 (4)		
10						
12						
14		SPT 6	25	2-1-1-1 (2)		
16	Darkt brown fine to medium grained SAND with muck					
18		SPT 7	50	2-5-6-6 (11)		
20						
22						
24	Tan sandy LIMESTONE	SPT 8	100	10-15-17-17 (32)		
26						
28	Light gray fine to medium grained SAND, some limestone fragments	SPT 9	42	2-3-4-4 (7)		
30	Brown fine to medium grained SAND					
32						
34		SPT 10	33	2-1-2-2 (3)		
36		SPT 11	50	5-5-6-6 (11)		
38	Light gray LIMESTONE	SPT 12	100	50/1"		

Bottom of borehole at 38.1 feet.



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NV5
Vertical V- Southeast, Inc.
308 N.W. 170th Street
North Miami Beach, Florida 33169
Telephone: 786 248 3180
Fax 786 248 3190

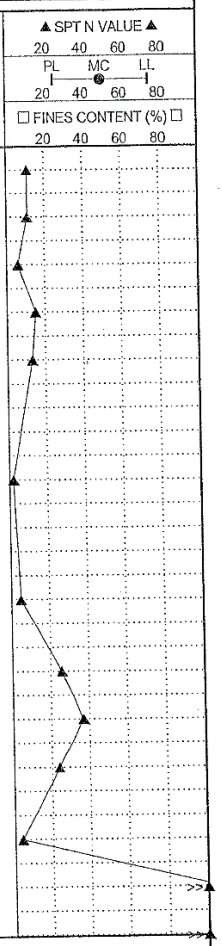
BORING NUMBER B-2

PAGE 1 OF 1

CLIENT Grycon, LLC
PROJECT NUMBER 145862
DATE STARTED 9/7/12 COMPLETED 9/7/12
DRILLING CONTRACTOR F.G.D. INC
DRILLING METHOD 2 7/8-inch Tricone and Bentonite Solution
LOGGED BY G. Miranda CHECKED BY M. Delgado
NOTES Drill Equipment CME-45

PROJECT NAME Warner Building Entrance Canopy
PROJECT LOCATION 4300 Alton Rd. Miami Beach, Florida
GROUND ELEVATION HOLE SIZE 2 7/8- inches
GROUND WATER LEVELS:
AT TIME OF DRILLING 7.00 ft
AT END OF DRILLING ---
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		ASPHALT					
		Light brown fine to medium grained SAND, some limestone fragments	SPT 1	33	9-6-5-6 (11)		
2		Color change: Tan	SPT 2	75	12-6-5-5 (11)		
4		Color change: Light gray	SPT 3	33	4-3-3-4 (6)		
6		Color change: Tan	SPT 4	42	6-7-8-8 (15)		
8		Light gray fine to medium grained SAND with limestone fragments	SPT 5	46	6-6-7-4 (13)		
10		Light gray silty SAND, some limestone fragments					
12							
14			SPT 6	21	2-1-1-1 (2)		
16		Darkt brown fine to medium grained SAND with muck					
18			SPT 7	50	2-2-3-7 (5)		
20							
22		Tan sandy LIMESTONE	SPT 8	100	5-10-16-20 (26)		
24			SPT 9	100	8-17-20-20 (37)		
26			SPT 10	50	10-18-6-4 (24)		
28		Light gray fine to medium grained SAND, some limestone fragments	SPT 11	58	2-2-2-41 (4)		
30							
32		Light gray LIMESTONE	SPT 12	100	50/1"		
		Bottom of borehole at 33.0 feet.	SPT 13	100	50/1"		



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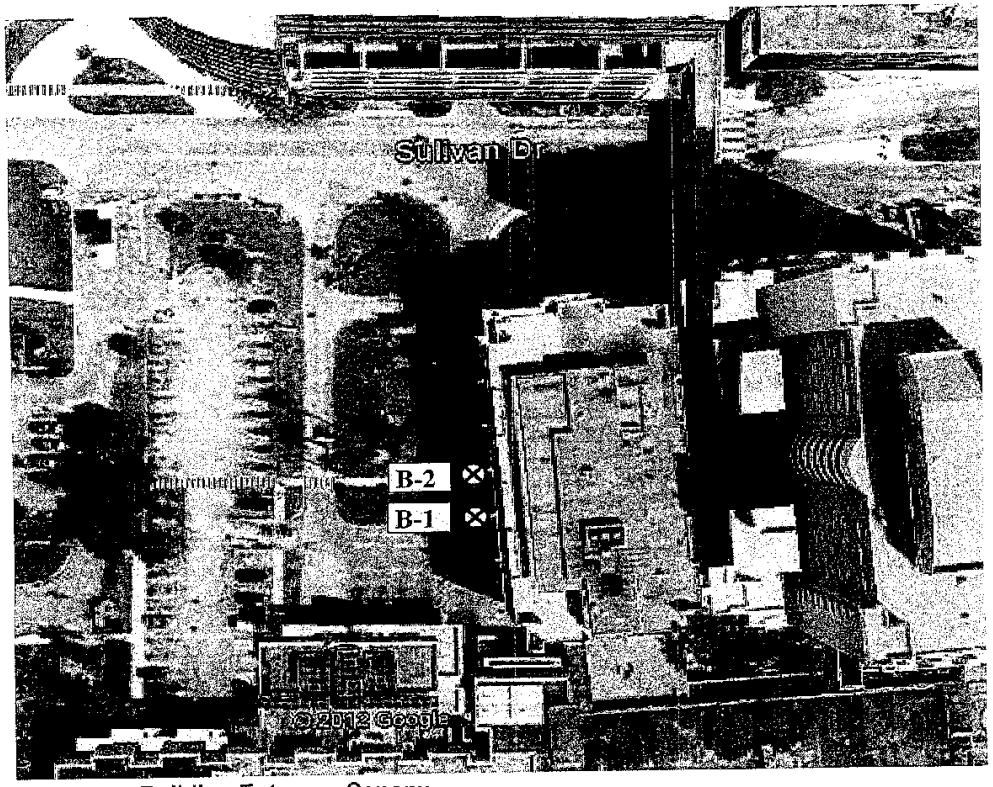


Projet: Warner Building Entrance Canopy
Location: 4300 Alton Rd. Miami Beach, Florida
Vertical-V Project No. 145862

⊗ Approximate Boring Test Location (not to scale)

NV5

Boring Designation MSMC-CB15-01

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

1. PROJECT MSMC; Seawall Geotechnical Investigation; Miami Beach, FL Northern Area of Seawall	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 MSMC-CB15-01 / LOCATION COORDINATES X = 939,212 Y = 539,750	11. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500 ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY Corps of Engineers - CESAM / CONTRACTOR FILE NO.	12. TOTAL SAMPLES / DISTURBED 18 / UNDISTURBED (UD) 0
4. NAME OF DRILLER Charlie Brown	13. TOTAL NUMBER CORE BOXES 0
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED / DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER -1.3 Ft.
	15. DATE BORING / STARTED 09-15-15 / COMPLETED 09-15-15
6. THICKNESS OF OVERBURDEN N/A	16. ELEVATION TOP OF BORING 1.7 Ft.
7. DEPTH DRILLED INTO ROCK N/A	17. TOTAL RECOVERY FOR BORING 61 %
8. TOTAL DEPTH OF BORING 30.0 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR Laura Roebuck, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
1.7	0.0						1.7		
1.2	0.5		SAND, silty, mostly fine-grained sand-sized quartz, top soil, 10YR 3/2 very dark grayish brown (SM)	40	1		SPT Sampler	3 3 2	5
			FILL, mostly fine to medium-grained sand-sized quartz, little silt, little fine gravel-sized rock fragments, 10YR 7/3 very pale brown				0.2		
			At El. 0.2 Ft., some silt, 10YR 4/2 dark grayish brown	27	2		SPT Sampler	4 8 6	14
-1.3	3.0						-1.3		
			FILL, mostly coarse gravel-sized rock fragments, little silt	27	3		SPT Sampler	3 5 5	10
-2.8	4.5						-2.8		
			WOOD, mostly organic matter, few fine-grained sand-sized quartz, few silt, organic odor, 2.5YR 4/4 reddish brown	67	4		SPT Sampler	1 1 1	2
							-4.3		
			At El. -4.3 Ft., trace shell fragments, trace fine gravel-sized rock fragments	100	5		SPT Sampler	1 1 1	2
							-5.8		
			At El. -5.8 Ft., discontinue fine gravel-sized rock fragments	73	6		SPT Sampler	1 1 2	3
-7.3	9.0						-7.3		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, some shell fragments, little silt, trace organic matter, organic odor, 5YR 3/1 very dark gray (SP)	53	7		SPT Sampler	1 2 5	7
							-8.8		
			At El. -8.8 Ft., discontinue organic matter, wet, 5B 3/1 very dark bluish gray	53	8		SPT Sampler	4 11 18	29
							-10.3		
			At El. -10.3 Ft., 5BG 4/1 dark greenish gray	67	9		SPT Sampler	6 9 10	19
-11.8	13.5						-11.8		
			LIMESTONE, sandy, sparsely fossiliferous, soft, highly weathered, porous, shelly sand filled pores, broken due to drill action, Coralline, 10YR 6/3 pale brown	67	10		SPT Sampler	8 17 22	39
							-13.3		

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation MSMC-CB15-01

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 3 SHEETS
PROJECT MSMC; Seawall Geotechnical Investigation; Miami Beach, FL	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL NAVD88
LOCATION COORDINATES X = 939,212 Y = 539,750	ELEVATION TOP OF BORING 1.7 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
		Highly Weathered		80	11		SPT Sampler -14.8	18 24 26	50
				80	12		SPT Sampler -16.3	11 17 19	36
-17.8	19.5			73	13		SPT Sampler -17.8	17 20 16	36
			LIMESTONE, 10YR 8/2 very pale brown	47	14		SPT Sampler -19.3	7 12 10	22
-20.8	22.5		At El. -19.3 Ft., medium grained, mostly quartz grains, 10YR 7/2 light gray	53	15		SPT Sampler -20.8	6 10 11	21
-22.3	24.0		SAND, poorly-graded, trace silt, trace shell fragments, trace fine gravel-sized rock fragments, 7.5YR 7/2 pinkish gray (SP)	67	16		SPT Sampler -22.3	6 7 4	11
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little silt, trace fine gravel-sized rock fragments, 10Y 5/1 greenish gray (SP)	53	17		SPT Sampler -23.8	7 18 34	52
				57	18		SPT Sampler -24.5	37 67/0.2'	
-25.3	27.0						Advanced Boring w/ fishtail bit -25.3		
-28.3	30.0		LIMESTONE, soft, mod. weathered, very fine grained, mostly quartz grains, moderately fractured, pitted, Coralline, 10YR 5/2 grayish brown	67		RQD 60	4 x 5-1/2" Diamond Impregnated Bit DFR = 100 % -28.3		

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. Borehole tremie grouted with portland cement and water.

4. Laboratory Testing Results

SAMPLE SAMPLE LABORATORY

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Abbreviations:

SAJ FORM 1836-A
JUN 02

Boring Designation MSMC-CB15-01

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 3 OF 3 SHEETS
PROJECT MSMC; Seawall Geotechnical Investigation; Miami Beach, FL	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL NAVD88
LOCATION COORDINATES X = 939,212 Y = 539,750	ELEVATION TOP OF BORING 1.7 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR CORE	REMARKS	BLOWS/ 0.5 FT.	N-VALUE

ID	DEPTH	CLASSIFICATION
2	1.5/3.0	SP-SM*
7	9.0/10.5	SP*
8	10.5/12.0	SP*
11	15.0/16.5	SM*
15	21.0/22.5	SP-SM*

* Lab classification based on gradation curve. Sample Number 11 was tested on limestone rock fragments and soil in this sample. Test results for Sample Number 11 indicate a Silty Sand (SM) with some gravel and is not an accurate description of the porous and pitted limestone encountered.

5. Additional Laboratory Testing

2 Moisture Content
4 Moisture Content
4 Percent Organic
7 Moisture Content
7 Percent Organic
8 Moisture Content
11 Moisture Content
15 Moisture Content

6. Rock Testing

SAMPLE ID	SAMPLE DEPTH	LABORATORY TEST
1	27.0/27.6	UCS

35
40
45
50
55

SAJ FORM 1836-A
JUN 02

Boring Designation MSMC-CB15-02

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

1. PROJECT MSMC; Seawall Geotechnical Investigation; Miami Beach, FL Middle Area of Seawall	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 MSMC-CB15-02 / LOCATION COORDINATES X = 938,259 Y = 538,922	11. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500 ☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY Corps of Engineers - CESAM / CONTRACTOR FILE NO.	12. TOTAL SAMPLES / DISTURBED 23 / UNDISTURBED (UD) 0
4. NAME OF DRILLER Charlie Brown	13. TOTAL NUMBER CORE BOXES 0
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED / DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER -0.1 Ft.
	15. DATE BORING / STARTED 09-16-15 / COMPLETED 09-17-15
6. THICKNESS OF OVERBURDEN N/A	16. ELEVATION TOP OF BORING 1.8 Ft.
7. DEPTH DRILLED INTO ROCK N/A	17. TOTAL RECOVERY FOR BORING 34 %
8. TOTAL DEPTH OF BORING 34.5 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR Laura Roebuck, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
1.8	0.0						1.8		
			FILL, mostly fine gravel-sized rock fragments, some fine to coarse-grained sand-sized quartz, trace shell fragments, dry	47	1		SPT Sampler	3, 8, 13	21
0.3	1.5						0.3		
			FILL, mostly fine to coarse-grained sand-sized quartz, some coarse gravel-sized rock fragments, wet ▼	47	2		SPT Sampler	8, 8, 7	15
							-1.2		
				60	3		SPT Sampler	4, 6, 6	12
							-2.7		
			At El. -2.7 Ft., little shell fragments, 10YR 6/1 gray	47	4		SPT Sampler	5, 6, 7	13
							-4.2		
			At El. -4.2 Ft., some fine to medium-grained sand-sized quartz, trace silt, 10YR 5/1 gray	53	5		SPT Sampler	6, 6, 7	13
							-5.7		
			At El. -5.7 Ft., mostly fine to medium-grained sand-sized quartz, some fine gravel-sized rock fragments, 10YR 6/1 gray	13	6		SPT Sampler	7, 6, 6	12
							-7.2		
				0	7		SPT Sampler	3, 1, 1	2
							-8.7		
			At El. -8.7 Ft., trace rock fragments, Low Recovery	27	8		SPT Sampler	3, 5, 4	9
							-10.2		
				0	9		SPT Sampler	6, 4, 2	6
							-11.7		
				0	10		SPT Sampler	3, 1, 1	2
-13.2	15.0						-13.2		

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation MSMC-CB15-02

DRILLING LOG (Cont. Sheet)	INSTALLATION: Jacksonville District		SHEET 2 OF 3 SHEETS
PROJECT: MSMC; Seawall Geotechnical Investigation; Miami Beach, FL	COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83	VERTICAL: NAVD88
LOCATION COORDINATES: X = 938,259 Y = 538,922	ELEVATION TOP OF BORING: 1.8 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			FILL, mostly gravel to cobble-sized limestone, some fine-grained sand-sized quartz, rock fill, 10YR 5/2 grayish brown	13	11		SPT Sampler	1, 1, 1	2
							-14.7		
				0	12		SPT Sampler	3, 2, 1	3
-16.2	18.0						-16.2		
			SILT, inorganic-L, mostly silt, little clay, little fine-grained sand-sized quartz, trace rock fragments, trace organic odor, 2.5Y 6/1 gray (ML)	27	13		SPT Sampler	2, 1, 1	2
							-17.7		
			At El. -17.7 Ft., trace fine-grained sand-sized quartz, stratified in very thin layers, 10Y 5/1 greenish gray	80	14		SPT Sampler	1, 1, 1	2
							-19.2		
			At El. -19.2 Ft., some clay, little fine-grained sand-sized quartz	80	15		SPT Sampler	1, WH, 1	1
-20.7	22.5						-20.7		
			SILT, inorganic-H, little fine-grained sand-sized quartz, trace rock fragments, organic odor, N 5/ gray (MH)	80	16		SPT Sampler	2, 1, 2	3
							-22.2		
				0	17		SPT Sampler	2, 3, 2	5
-23.7	25.5						-23.7		
		Mod. Wea.	LIMESTONE, sandy, sparsely fossiliferous, moderately hard, moderately weathered, fine grained, mostly quartz grains, vuggy, shelly sand filled vugs, broken due to drill action, Corraline, 10Y 5/1 greenish gray	27	18		SPT Sampler	3, 3, 4	7
-25.2	27.0						-25.2		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, little silt, little clay, trace shell fragments, trace shell up to 1/4", 10Y 4/1 dark greenish gray (SP)	7	19		SPT Sampler	2, 4, 6	10
-26.7	28.5						-26.7		
			LIMESTONE, sandy, sparsely fossiliferous, moderately hard, highly weathered, porous, shelly sand filled pores, broken due to drill action, Corraline, 10Y 6/1 greenish gray	33	20		SPT Sampler	3, 14, 50/0.2'	64+
							-27.9		
							-28.2 Advanced Boring		
				0	21		SPT Sampler	25, 90/0.3'	
							-29.0		
							Advanced Boring		
-29.7	31.5	Highly Weathered					-29.7		
			LIMESTONE, dolomitic, N 7/ light gray	67	22		SPT Sampler	10, 42, 46	88
-31.2	33.0						-31.2		
			SANDSTONE, moderately hard, cemented sand filled pores, broken due to drill action, 10Y 6/1 greenish gray From El. -31.6 to -31.7 Ft., thin hard rock layer	53	23		SPT Sampler	40, 14, 13	27
-32.7	34.5						-32.7		
							140# hammer w/30" drop used with 2.0' split		

SAJ FORM 1836-A
JUN 02

Boring Designation MSMC-CB15-02

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 3 OF 3 SHEETS
PROJECT MSMC; Seawall Geotechnical Investigation; Miami Beach, FL	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD83 / VERTICAL NAVD88
LOCATION COORDINATES X = 938,259 Y = 538,922	ELEVATION TOP OF BORING 1.8 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			NOTES:				spoon (1-3/8" I.D. x 2" O.D.).		

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. Borehole tremie grouted with portland cement and water.

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
3	3.0/4.5	SP-SM*
8	10.5/12.0	SP*
14	19.5/21.0	ML
16	22.5/24.0	MH
22	31.5/33.0	SP-SM*

*Lab classification based on gradation curve. Sample Numbers 3 and 8 were tested on fill material encountered at these depths. Test result classifications indicate Silty Sand (SP-SM) and Sand (SP) but could also be classified as (SP-SM)g and (SP)g respectively. Sample Number 22 was tested on limestone rock samples and soil in this sample. Test results for Sample Number 22 indicate a Silty-Sand (SP-SM) and is not an accurate description of the porous and pitted limestone encounterd.

5. Additional Laboratory Testing

3 Moisture Content
8 Moisture Content
14 Moisture Content
14 Atterberg
14 Percent Organic
16 Moisture Content
16 Atterberg
16 Percent Organic
22 Moisture Content

35
40
45
50
55

SAJ FORM 1836-A
JUN 02

Boring Designation MSMC-CB15-03

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3 SHEETS
1. PROJECT MSMC; Seawall Geotechnical Investigation; Miami Beach, FL Southern Area of Seawall		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 MSMC-CB15-03	LOCATION COORDINATES X = 937,331 Y = 537,910	11. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500	☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY Corps of Engineers - CESAM	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED 20 / UNDISTURBED (UD) 0
4. NAME OF DRILLER Charlie Brown		13. TOTAL NUMBER CORE BOXES 0	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER -1.8 Ft.	
		15. DATE BORING	STARTED 09-15-15 / COMPLETED 09-15-15
6. THICKNESS OF OVERBURDEN N/A		16. ELEVATION TOP OF BORING 4.2 Ft.	
7. DEPTH DRILLED INTO ROCK N/A		17. TOTAL RECOVERY FOR BORING 62 %	
8. TOTAL DEPTH OF BORING 30.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR Laura Roebuck, Geologist	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
4.2	0.0						4.2		
			FILL, sandy, nonplastic, mostly fine to coarse-grained sand-sized quartz, some gravel up to 1", trace fine-grained sand-sized shell up to 3', dry, top soil (0 - .2 ft.), 2.5Y 6/1 gray	67	1		SPT Sampler	1, 11, 10	21
							2.7		
				80	2		SPT Sampler	20, 12, 12	24
							1.2		
			At El. 1.2 Ft., little shell fragments, moist, 10YR 7/2 light gray	80	3		SPT Sampler	19, 24, 18	42
							-0.3		
			At El. -0.3 Ft., mostly fine to medium-grained sand-sized quartz, little shell fragments, little gravel, trace silt, 2.5Y 5/1 gray	73	4		SPT Sampler	11, 14, 13	27
							-1.8		
			At El. -1.8 Ft., mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, wet, 5Y 6/1 gray	53	5		SPT Sampler	2, 5, 5	10
-3.3	7.5						-3.3		
			SAND, silty, mostly fine-grained sand-sized quartz, some silt, trace shell fragments, trace clay, 10Y 6/1 greenish gray (SM)	40	6		SPT Sampler	4, 4, 4	8
-4.7	8.9						-4.8		
-4.8	9.0		CLAY, lean, mostly clay, some fine-grained sand-sized quartz, 10Y 6/1 greenish gray (CL)						
			SAND, silty, mostly silt, some clay, little fine-grained sand-sized quartz, trace shell fragments, 10Y 5/2 dark greenish gray (SM)	53	7		SPT Sampler	2, 2, 2	4
-6.3	10.5						-6.3		
			SAND, silty, mostly fine-grained sand-sized quartz, some silt, little clay, trace shell fragments, N 5/ gray (SM)	73	8		SPT Sampler	1, 1, 1	2
							-7.8		
			At El. -7.8 Ft., mostly fine to medium-grained sand-sized quartz, some silt, little clay, little fine to medium-grained sand-sized shell fragments, 10Y 5/1 greenish gray	73	9		SPT Sampler	1, 1, 1	2
							-9.3		
				0	10		SPT Sampler	1, 1, 1	2
							-10.8		

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation MSMC-CB15-03

DRILLING LOG (Cont. Sheet)	INSTALLATION: Jacksonville District		SHEET 2 OF 3 SHEETS
PROJECT: MSMC; Seawall Geotechnical Investigation; Miami Beach, FL	COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD83	VERTICAL: NAVD88
LOCATION COORDINATES: X = 937,331 Y = 537,910	ELEVATION TOP OF BORING: 4.2 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			At El. -10.8 Ft., mostly fine-grained sand-sized quartz, some silt, little fine to coarse-grained sand-sized shell fragments, trace clay	73	11		SPT Sampler -12.3	1 1 1	2
				60	12		SPT Sampler -13.8	1 1 1	2
			At El. -13.8 Ft., some fine to coarse-grained sand-sized shell fragments, trace rock fragments up to 1-1/2", trace fine gravel-sized coral	60	13		SPT Sampler -15.3	3 10 11	21
-15.3	19.5								
		Highly Weathered	LIMESTONE, sandy, sparsely fossiliferous, soft, highly weathered, mostly quartz grains, porous, sand filled pores, broken due to drill action, Corraline, N 9/ white	73	14		SPT Sampler -16.8	22 38 26	64
				100	15		SPT Sampler -18.3	14 25 27	52
				87	16		SPT Sampler -19.8	20 26 30	56
			At El. -19.8 Ft.	67	17		SPT Sampler -21.3	21 26 21	47
-21.3	25.5		LIMESTONE						
				67	18		SPT Sampler -22.8	16 22 19	41
-22.8	27.0								
			SAND, poorly-graded with silt, mostly fine-grained sand-sized carbonate, some rock fragments up to 1", little silt (SP-SM)	27	19		SPT Sampler -24.3	6 6 5	11
			At El. -24.3 Ft., trace shell fragments, trace rock fragments up to 1", trace silt, 10YR 7/1 light gray	33	20		SPT Sampler -25.8	11 11 6	17
-25.8	30.0								

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. Borehole tremie grouted with portland cement and water.

4. Laboratory Testing Results

SAMPLE SAMPLE LABORATORY

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

SAJ FORM 1836-A
JUN 02

Boring Designation MSMC-CB15-03

DRILLING LOG (Cont. Sheet)	INSTALLATION		SHEET 3 OF 3 SHEETS
	Jacksonville District		
PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
MSMC; Seawall Geotechnical Investigation; Miami Beach, FL	State Plane, FLE (U.S. Ft.)	NAD83	NAVD88
LOCATION COORDINATES	ELEVATION TOP OF BORING		
X = 937,331 Y = 537,910	4.2 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR CD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE

ID	DEPTH	CLASSIFICATION
3	3.0/4.5	SP-SM*
7	9.0/10.5	SM
11	15.0/16.5	SM*
15	21.0/22.5	GP-GM*
20	28.5/30.0	SP-SM*

*Lab classification based on gradation curve. Sample Number 15 was tested on limestone rock fragments and soil in this sample. Test results for Sample Number 15 indicate a Sand-Gravel to Silty-Gravel (GP-GM) and is not an accurate description of the porous and pitted limestone encountered.

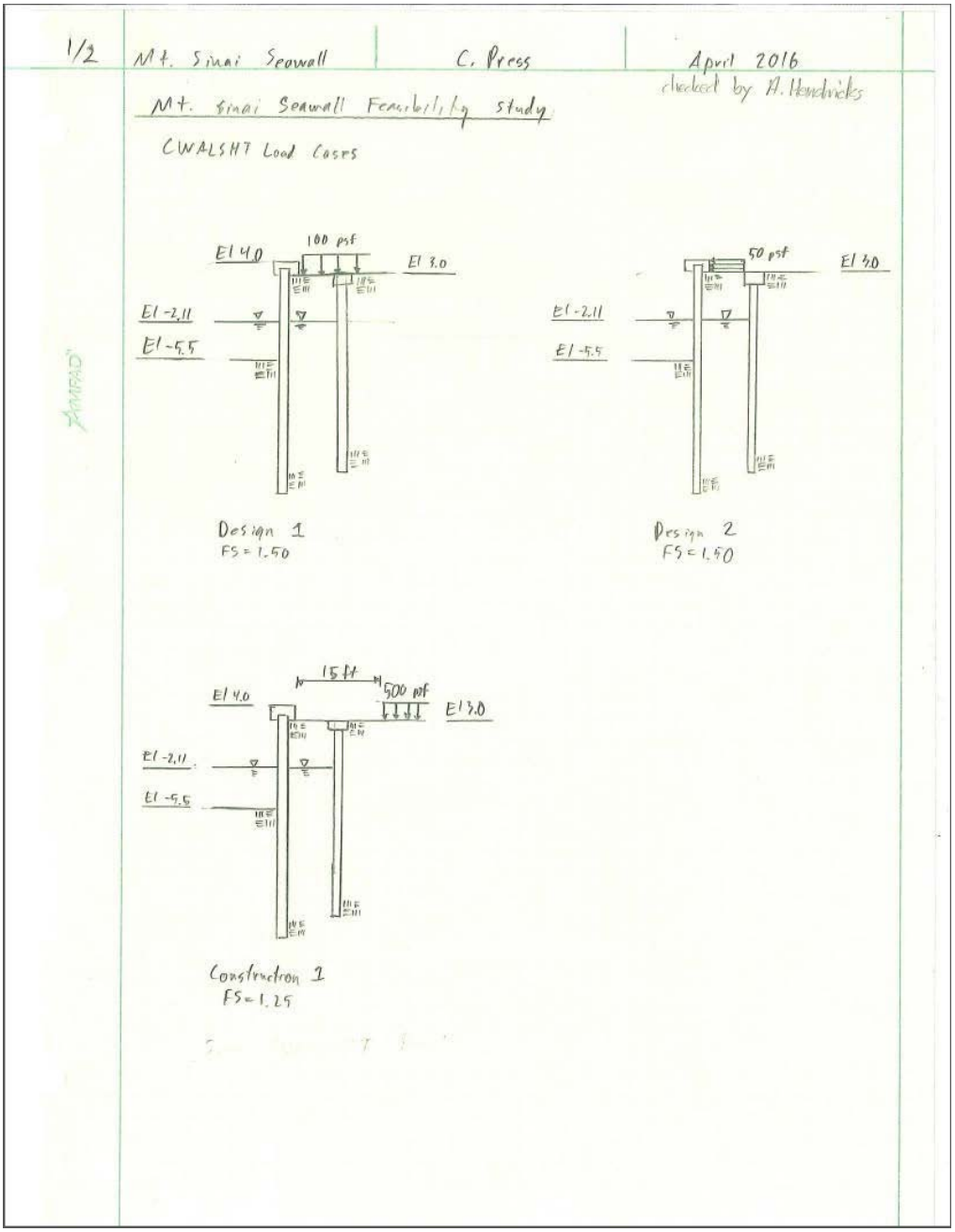
5. Additional Laboratory Testing

3	Moisture Content
7	Moisture Content
7	Atterberg
7	Percent Organic
11	Moisture Content
15	Moisture Content
20	Moisture Content
20	Percent Organic

35
40
45
50
55

SAJ FORM 1836-A
JUN 02

Attachment B – (Structural Addendum)



2/2	Mt Sinai Seawall	C. Press	April 2016

Checked by A. Hawkins

Design Life

Assume 50-yr design life

Max moment: 9,649 in-lb
$S_{x\text{-}req} = 4.6\ in^2$ } See CWALSHT Results

Corrosion Rates

2 sides

Sea water, temperate, high attack : 3.75 mm

Sea water, temperate, submerged : 1.75 mm

5.50 mm ≈ 0.22 in

Round 0.22 in up to 0.25 in of total section loss

See LB Foster Section Modulus Reduction sheet

PZC-13 with 0.25 in total section loss

$S_x = 11.49\ in^3 > 4.6\ in^2$ OK

Corrosion analysis is conservative for two reasons

1. Sheet pile will be partially coated with coal tar epoxy.
2. Location of maximum bending moment is not at the same elevation as location of high attack zones.

Mt. Sinai Seawall Feasibility Study
CWALSHT Results
Low Water: -2.11
PZC-13

Des by: CMP
Chk by: APH

		Load Case	Condition	FS	Tip El	Length	λ	Moment	Shear	Scaled Def	Steel Sx req	Steel Defl
Short Term	Design 1	Low Water	Usual	1.50	-20.55	24.1 ft	1.00	9,649 in-lb	3,824 lbs	1.67E+09 lb-in³	4.6 in³	0.4 in
	Design 2	Low Water	Usual	1.50	-19.3	22.8 ft	1.00	7,843 in-lb	3,361 lbs	1.25E+09 lb-in³	3.8 in³	0.3 in
	Construction	Low Water	Unusual	1.25	-17.44	20.9 ft	1.33	7,175 in-lb	3,242 lbs	1.10E+09 lb-in³	2.6 in³	0.2 in
Long Term	Design 1	Low Water	Unusual	1.50	-19.74	23.2 ft	1.00	9,721 in-lb	3,842 lbs	1.69E+09 lb-in³	4.7 in³	0.4 in
	Design 2	Low Water	Usual	1.50	-18.6	22.1 ft	1.00	7,896 in-lb	3,304 lbs	1.27E+09 lb-in³	3.8 in³	0.3 in
	Construction	Low Water	Usual	1.25	-16.63	20.1 ft	1.33	7,226 in-lb	3,206 lbs	1.11E+09 lb-in³	2.6 in³	0.3 in

LONG TERM

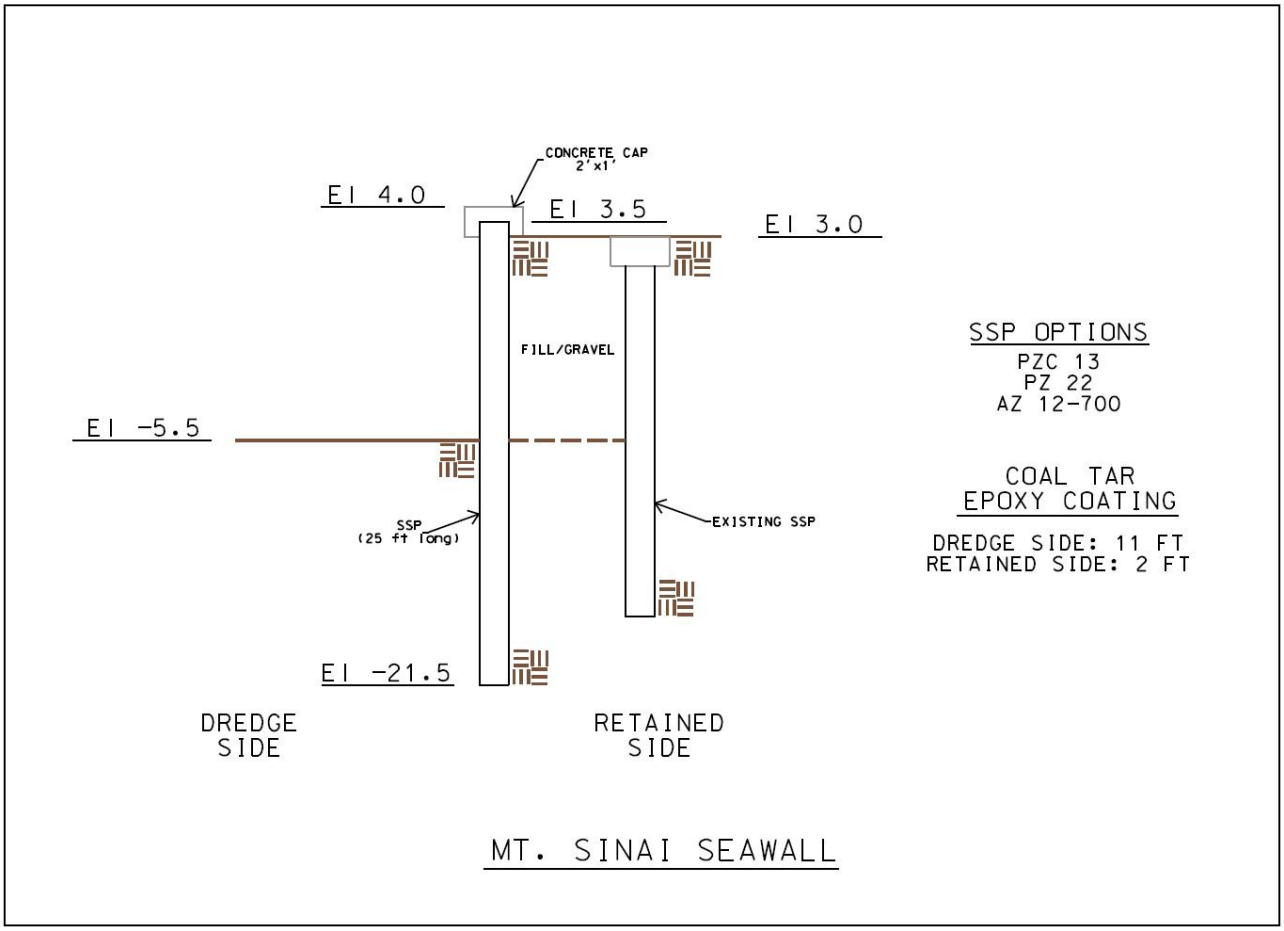
Table 4. Soil Parameters (Drained Condition)

Mount Sinai (Drained condition)										
Elevation (NAVD 88)	Soil Classification(1)	Saturated Unit Weight (γ_{sat}) (pcf)	Moist Unit Weight (γ_{moist}) (pcf)	Effective unit Weight (γ') (pcf)	Angle of Internal Friction (φ)	At Rest Earth Pressure coefficient K_o	At Active Earth Pressure coefficient K_a	At Passive Earth Pressure coefficient K_p	Cohesion Drained (psf)	Soil Steel Interface Wall Friction Angle (Delta)
1.8 to -5.7	Fill	120	115	57.6	30	0.50	0.33	3	0	16
-5.7 to -16.2	Fill	110	106	47.6	29	0.52	0.35	2.9	0	16
-16.2 to -23.7	ML/MH	110	105	47.6	26	0.56	0.39	2.56	0	14
-23.7 to -26.7	SP	115	110	52.6	31	0.48	0.32	3.12	0	17
-26.7 to -32.7	Limestone	132	126	69.6	34	0.44	0.28	3.54	0	18
(1) USCS: Unified Soil Classification System										

SHORT TERM

Table 3. Soil Parameters (Undrained Condition)

Mount Sinai (Undrained condition)										
Elevation Range (NAVD 88)	Soil Classification(1)	Saturated Unit Weight (γ_{sat}) (pcf)	Moist Unit Weight (γ_{moist}) (pcf)	Effective unit Weight (γ') (pcf)	Angle of Internal Friction (φ)	At Rest Earth Pressure coefficient K_o	At Active Earth Pressure coefficient K_a	At Passive Earth Pressure coefficient K_p	Cohesion Undrained (psf)	Soil Steel Interface Wall Friction Angle (Delta)
1.8 to -5.7	Fill	120	115	57.6	30	0.50	0.33	3	0	16
-5.7 to -16.2	Fill	110	106	47.6	30	0.52	0.35	2.9	0	16
-16.2 to -23.7	ML/MH	110	105	47.6	0	1	1	1	250	0
-23.7 to -26.7	SP	115	110	52.6	31	0.48	0.32	3.12	0	17
-26.7 to -32.7	Limestone	132	126	69.6	34	0.44	0.28	3.54	0	18
(1) USCS :Unified Soil Classification System										


CONCRETE CAP
2'x1'
El 4.0
El 3.5
El 3.0
FILL/GRAVEL
El -5.5
SSP
(25 ft long)
EXISTING SSP
El -21.5
DREDGE
SIDE
RETAINED
SIDE
SSP OPTIONS
PZC 13
PZ 22
AZ 12-700
COAL TAR
EPOXY COATING
DREDGE SIDE: 11 FT
RETAINED SIDE: 2 FT
MT. SINAI SEAWALL

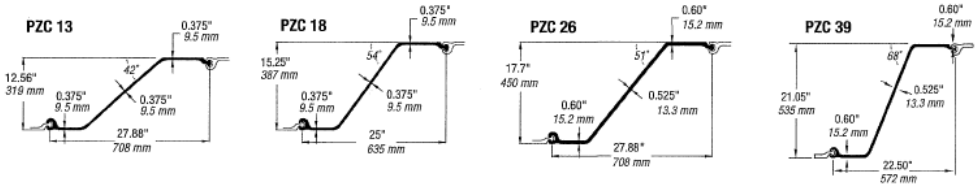
PZC SHEET PILING PROPERTIES

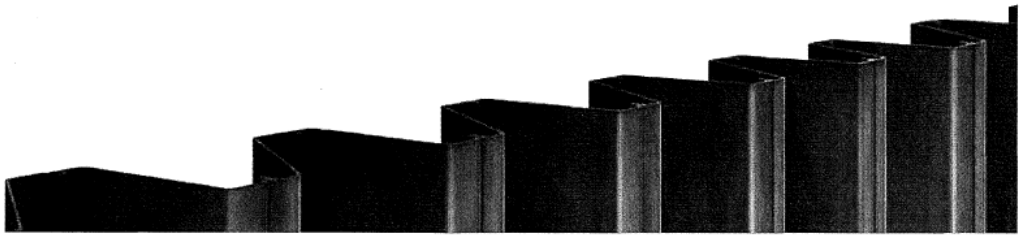
PZC sections are the "latest generation" of sheet piling profiles and were developed to be lighter, wider, and stronger than the older traditional PZ sections. PZC profiles are named for their strength in metric designations. For example, PZC 18 has a Section Modulus of 1,800 cm³/meter. **PZC profiles should always be the designer's first choice in order to provide the end user the most efficient retention wall with the most efficient ratio of section modulus to weight.**

					Per Single Section						Per Unit of Wall			
Section	Nominal Width in. (mm)	Wall Depth (Height) in. (mm)	Web Thickness in. (mm)	Flange Thickness in. (mm)	Area in.² (cm²)	Weight lbs/ft (kg/m)	Moment of Inertia in.⁴ (cm⁴)	Section Modulus in.³ (cm³)	Total Surface Area ft²/ft (m²/m)	Nominal Coating Area* ft²/ft (m²/m)	Area in.²/ft² (cm²/m)	Weight lbs/ft² (kg/m²)	Moment of Inertia in.⁴/ft (cm⁴/m)	Section Modulus in.³/ft (cm³/m)
PZC 13	27.88	12.56	0.375	0.375	14.82	50.4	353.0	56.2	6.10	5.60	6.38	21.7	152.0	24.2
	708	319	9.5	9.5	95.6	75.1	14,690	920	1.86	1.71	135.1	106.0	20,760	1,300
PZC 14	27.88	12.60	0.420	0.420	16.15	55.0	381.6	60.5	6.10	5.60	6.95	23.7	164.3	26.0
	708	320	10.7	10.7	104.2	81.8	15,890	990	1.86	1.71	147.2	115.5	22,440	1,400
PZC 18	25.00	15.25	0.375	0.375	14.82	50.4	532.2	69.8	6.10	5.60	7.12	24.2	255.5	33.5
	635	387	9.5	9.5	95.6	75.1	22,150	1,145	1.86	1.71	150.6	118.2	34,890	1,800
PZC 19	25.00	15.30	0.420	0.420	16.16	55.0	576.3	75.3	6.10	5.60	7.75	26.4	276.6	36.1
	635	388	10.7	10.7	104.2	81.8	23,990	1,235	1.86	1.71	164.1	128.8	37,780	1,945
PZC 25	27.88	17.66	0.485	0.560	20.40	69.4	938.7	106.3	6.65	6.15	8.78	29.9	404.1	45.7
	708	449	12.3	14.2	131.6	103.3	39,070	1,740	2.03	1.87	185.9	145.9	55,190	2,455
PZC 26	27.88	17.70	0.525	0.600	21.72	73.9	994.3	112.4	6.65	6.15	9.35	31.8	428.1	48.4
	708	450	13.3	15.2	140.1	110.0	41,390	1,840	2.03	1.87	197.9	155.4	58,460	2,600
PZC 28	27.88	17.75	0.570	0.645	23.22	79.0	1,057	119.1	6.65	6.15	10.00	34.0	455.1	51.3
	708	451	14.5	16.4	149.8	117.6	44,000	1,950	2.03	1.87	211.6	166.1	62,150	2,755
PZC 37	22.50	21.02	0.488	0.563	20.45	69.6	1,349	128.4	6.65	6.15	10.91	37.1	719.6	68.5
	572	534	12.4	14.3	132.0	103.6	56,160	2,100	2.03	1.87	230.9	181.2	98,270	3,680
PZC 39	22.50	21.05	0.525	0.600	21.76	74.0	1,429	135.6	6.65	6.15	11.61	39.5	762.1	72.3
	572	535	13.3	15.2	140.4	110.2	59,480	2,220	2.03	1.87	245.6	192.8	104,100	3,890
PZC 41	22.50	21.09	0.561	0.636	23.03	78.4	1,507	142.7	6.65	6.15	12.28	41.8	803.6	76.1
	572	536	14.2	16.2	148.6	116.6	62,720	2,340	2.03	1.87	260.0	204.1	109,700	4,090

*Both sides of sheet; excludes socket interior and ball of interlock.

All dimensions given are nominal. Actual flange and web thicknesses vary due to mill rolling practices; however, permitted variations for such dimensions are not addressed.





GERDAU AMERISTEEL

Eurocode 3:

Design of Steel Structures

Part 5: Piling

(ENV 1993-5)

Loss of Thickness

(mm)

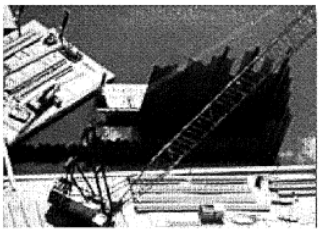
LBFoster
Piling

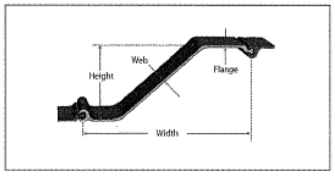
TABLE 1. Loss of Thickness Due to Corrosion for Steel Sheet Pilings (Ref 4) A

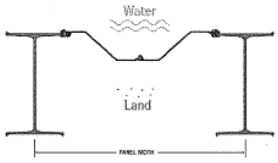
Soil, with or without groundwater:	DESIGN LIFE: 5 years	25 years	50 years	75 years	100 years
Undisturbed natural soils	0.00 mm	0.30 mm	0.60 mm	0.90 mm	1.20 mm
Polluted natural soils and industrial grounds	0.15 mm	0.75 mm	1.50 mm	2.25 mm	3.00 mm
Aggressive natural soils (swamp, marsh, peat...)	0.20 mm	1.00 mm	1.75 mm	2.50 mm	3.25 mm
Non-compacted and non-aggressive fills B (clay, schist, sand, silt...)	0.18 mm	0.70 mm	1.20 mm	1.70 mm	2.20 mm
Non-compacted and aggressive fills B (ashes, slag...)	0.50 mm	2.00 mm	3.25 mm	4.50 mm	5.75 mm
Water C:					
Common fresh water (river, ship canal-...) in the zone of high attack (water line)	0.15 mm	0.55 mm	0.90 mm	1.15 mm	1.40 mm
Very polluted fresh water (sewage, industrial effluent-,...) in the zone of high attack (water line)	0.30 mm	1.30 mm	2.30 mm	3.30 mm	4.30 mm
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0.55 mm	1.90 mm	3.75 mm	5.60 mm	7.50 mm
Sea water in temperate climate in the submerged zone or tidal zone	0.25 mm	0.90 mm	1.75 mm	2.60 mm	3.50 mm

A. Values are provided for general guidance only. Local knowledge may lead to the use of other values for design. The values given for 5 and 25 years are based on measurements, whereas other values are extrapolated.
B. In compacted fills, these corrosion losses should be divided by two.
C. The highest corrosion rate is usually found at the splash zone of marine environments or at the low water level in tidal waters. However, in most cases, the highest bending stresses occur in the submerged zone.

GERDAU AMERISTEEL







LBFoster
Piling

Summary of Calculated Section Modulus and Moment of Inertia for Thickness Reduction from 0.000" – 0.250"

Thickness Reduction (in.)	Section Modulus (in^3 / ft)				Moment of Inertia (in^4 / ft)			
	PZ27	PZC13	PZC18	PZC26	PZ27	PZC13	PZC18	PZC26
0.0000	31.80	24.17	33.50	48.38	187.3	151.9	255.5	428.1
0.0625	27.96	21.10	29.25	43.74	168.28	131.75	222.12	385.73
0.1250	24.07	17.96	24.89	39.08	144.12	111.79	188.23	343.42
0.1875	20.10	14.76	20.49	34.41	119.72	91.31	154.32	301.3
0.2500	16.10	11.49	16.05	29.74	95.39	70.72	120.38	259.48

* Reference: Richard Hartman, Ph.D., P.E.

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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                              BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:45:00

                              ****************
                              *  INPUT DATA  *
                              ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STABILITY; FS=1.50

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.50

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00   30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00   34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                   Page 1
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                                Des1_LW_Stab_ST.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS

         VII.A.--VERTICAL LINE LOADS
              NONE

         VII.B.--VERTICAL UNIFORM LOADS
                   LEFTSIDE     RIGHTSIDE
                     (PSF)        (PSF)
                      0.00        100.00

         VII.C.--VERTICAL STRIP LOADS
              NONE

         VII.D.--VERTICAL RAMP LOADS
              NONE

         VII.E.--VERTICAL TRIANGULAR LOADS
              NONE

         VII.F.--VERTICAL VARIABLE LOADS
              NONE

    VIII.--HORIZONTAL LOADS
         NONE
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                         BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:45:02

                         **************************
                         *   SOIL PRESSURES FOR   *
                         * CANTILEVER WALL DESIGN *
                         **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; SHORT TERM
      'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
      'STABILITY; FS=1.50

    II.--SOIL PRESSURES

         RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

                                   Page 2
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Des1_LW_Stab_ST.out

ELEV. (FT)	NET WATER (PSF)	<---LEFTSIDE---> PASSIVE (PSF)	ACTIVE (PSF)	<------NET------> (SOIL + WATER) ACTIVE (PSF)	PASSIVE (PSF)	<--RIGHTSIDE---> ACTIVE (PSF)	PASSIVE (PSF)
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0-	0.0	0.0	0.0	30.0	328.1	30.0	328.1
2.0	0.0	0.0	0.0	62.1	596.3	62.1	596.3
1.0	0.0	0.0	0.0	95.3	915.3	95.3	915.3
0.0	0.0	0.0	0.0	128.5	1234.2	128.5	1234.2
-1.0	0.0	0.0	0.0	161.7	1553.2	161.7	1553.2
-2.0	0.0	0.0	0.0	194.9	1872.2	194.9	1872.2
-2.1	0.0	0.0	0.0	197.7	1899.5	197.7	1899.5
-3.0	0.0	0.0	0.0	213.3	2049.2	213.3	2049.2
-4.0	0.0	0.0	0.0	229.9	2208.7	229.9	2208.7
-5.0	0.0	0.0	0.0	246.5	2368.2	246.5	2368.2
-5.5	0.0	0.0	0.0	254.8	2447.9	254.8	2447.9
-5.7	0.0	26.3	2.7	231.6	2475.4	258.0	2478.1
-6.0	0.0	65.9	6.9	196.4	2512.5	262.2	2519.3
-6.5	0.0	131.7	13.7	137.4	2571.5	269.1	2585.2
-7.0	0.0	197.6	20.6	78.3	2630.5	276.0	2651.1
-7.7	0.0	285.1	29.7	0.0	2708.8	285.1	2738.5
-8.0	0.0	329.4	34.3	-39.7	2748.5	289.7	2782.8
-9.0	0.0	461.1	48.0	-157.7	2866.6	303.4	2914.6
-10.0	0.0	592.9	61.7	-275.8	2984.6	317.1	3046.3
-11.0	0.0	724.6	75.4	-393.8	3102.6	330.8	3178.0
-12.0	0.0	856.3	89.1	-511.8	3220.7	344.5	3309.8
-13.0	0.0	988.1	102.9	-629.9	3338.7	358.2	3441.5
-14.0	0.0	1119.8	116.6	-747.9	3456.7	372.0	3573.3
-15.0	0.0	1251.6	130.3	-865.9	3574.7	385.7	3705.0
-16.0	0.0	1383.3	144.0	-983.9	3692.8	399.4	3836.8
-16.2	0.0	1058.4	81.8	-835.9	1815.3	222.5	1897.1
-16.6+	0.0	528.7	0.0	-445.4	1646.0	136.4	1646.0
-16.6-	0.0	635.0	0.0	-445.4	1646.0	136.4	1646.0
-17.0	0.0	546.3	0.0	-483.6	1430.8	62.7	1430.8
-17.5+	0.0	1003.5	0.0	-406.6	1621.0	405.1	1621.0
-17.5-	0.0	619.9	0.0	-406.6	1621.0	405.1	1621.0
-18.0	0.0	1003.5	77.4	-220.6	1753.4	782.9	1830.8
-19.0	0.0	1047.0	119.0	-207.5	1760.7	839.6	1879.7
-20.0	0.0	1088.6	161.4	-196.7	1773.1	891.9	1934.5
-21.0	0.0	1133.8	203.5	-191.9	1784.8	941.9	1988.3
-22.0	0.0	1181.2	248.4	-183.8	1792.9	997.4	2041.3
-23.0	0.0	1228.5	293.3	-177.1	1800.2	1051.4	2093.6
-23.7	0.0	5380.9	780.9	-739.0	17598.3	4641.9	18379.2
-24.0	0.0	6069.9	811.3	-1211.3	19839.8	4858.6	20651.1
-25.0	0.0	2535.5	244.5	-2047.1	4818.4	488.4	5062.9
-26.0	0.0	2690.2	258.1	-2181.7	4961.4	508.5	5219.5
-26.7	0.0	3948.0	308.9	-3099.6	8607.7	848.4	8916.5
-27.0	0.0	4197.0	309.8	-3328.4	9166.7	868.6	9476.5
-28.0	0.0	3413.6	254.9	-2947.2	6000.4	466.3	6255.3
-29.0	0.0	3630.2	270.9	-3147.1	6215.9	483.1	6486.8
-30.0	0.0	3854.9	292.4	-3354.7	6426.0	500.3	6718.4
-31.0	0.0	4083.0	314.1	-3559.4	6635.9	523.5	6950.0
-32.0	0.0	4311.4	330.4	-3765.0	6851.2	546.4	7181.7
-33.0	0.0	4540.2	346.8	-3976.8	7066.6	563.4	7413.4
-34.0	0.0	4769.3	364.5	-4188.9	7280.7	580.4	7645.2
-35.0	0.0	4998.7	385.9	-4401.4	7491.2	597.3	7877.0
-36.0	0.0	5228.4	406.1	-4614.2	7702.8	614.2	8108.9

Page 3

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                                Des1_LW_Stab_ST.out


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:45:02

                        ****************************
                        *  SUMMARY OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STABILITY; FS=1.50

   II.--SUMMARY

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

   WALL BOTTOM ELEV. (FT)      :      -20.55
         PENETRATION (FT)      :       15.05

   MAX. BEND. MOMENT (LB-FT)   :  1.3344E+04
         AT ELEVATION (FT)     :      -12.91

   MAX. SCALED DEFL. (LB-IN^3):  3.7133E+09
         AT ELEVATION (FT)     :        4.00

             NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                    ELLASTICITY IN PSI TIMES PILE MOMENT
                    OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                    IN INCHES.



PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:45:02

                        ****************************
                        * COMPLETE OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

     I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STABILITY; FS=1.50

    II.--RESULTS

                   BENDING                          SCALED          NET
    ELEVATION      MOMENT          SHEAR          DEFLECTION     PRESSURE
                                     Page 4
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Des1_LW_Stab_ST.out

(FT)	(LB-FT)	(LB)	(LB-IN^3)	(PSF)
4.00	0.0000E+00	0.	3.7133E+09	0.00
3.00+	-3.4925E-10	0.	3.4754E+09	0.00
3.00-	-4.8067E-10	0.	3.4754E+09	30.04
2.00	2.0358E+01	46.	3.2374E+09	62.07
1.00	1.0298E+02	125.	2.9996E+09	95.27
0.00	2.8088E+02	237.	2.7619E+09	128.48
-1.00	5.8725E+02	382.	2.5247E+09	161.68
-2.00	1.0553E+03	560.	2.2885E+09	194.88
-2.11	1.1181E+03	582.	2.2626E+09	197.72
-3.00	1.7160E+03	764.	2.0542E+09	213.30
-4.00	2.5899E+03	986.	1.8229E+09	229.91
-5.00	3.6937E+03	1224.	1.5961E+09	246.51
-5.50	4.3370E+03	1350.	1.4850E+09	254.81
-5.70	4.6118E+03	1398.	1.4410E+09	231.60
-6.00	5.0412E+03	1462.	1.3757E+09	196.37
-6.50	5.7945E+03	1546.	1.2687E+09	137.35
-7.00	6.5821E+03	1600.	1.1641E+09	78.34
-7.66	7.6554E+03	1626.	1.0297E+09	0.00
-8.00	8.2014E+03	1619.	9.6383E+08	-39.70
-9.00	9.7810E+03	1520.	7.7774E+08	-157.73
-10.00	1.1203E+04	1304.	6.0853E+08	-275.76
-11.00	1.2349E+04	969.	4.5864E+08	-393.79
-12.00	1.3101E+04	516.	3.3003E+08	-511.82
-13.00	1.3342E+04	-55.	2.2398E+08	-629.85
-14.00	1.2952E+04	-744.	1.4090E+08	-747.89
-15.00	1.1815E+04	-1551.	8.0094E+07	-865.92
-15.60	1.0730E+04	-2089.	5.3644E+07	-936.41
-16.00	9.8192E+03	-2421.	3.9579E+07	-715.62
-16.20	9.3213E+03	-2554.	3.3635E+07	-605.99
-16.63	8.1724E+03	-2764.	2.2971E+07	-369.85
-17.00	7.1313E+03	-2863.	1.5930E+07	-167.45
-17.48	5.7609E+03	-2881.	9.3011E+06	93.19
-18.00	4.2760E+03	-2756.	4.5791E+06	380.72
-19.00	1.8013E+03	-2102.	6.7203E+05	928.89
-20.00	2.5561E+02	-899.	1.1478E+04	1477.06
-20.55	0.0000E+00	0.	0.0000E+00	1779.56

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION	PRESSURE	PASSIVE	ACTIVE	ACTIVE	PASSIVE
(FT)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)
4.00	0.	0.	0.	0.	0.
3.00+	0.	0.	0.	0.	0.
3.00-	0.	0.	0.	30.	328.
2.00	0.	0.	0.	62.	596.
1.00	0.	0.	0.	95.	915.
0.00	0.	0.	0.	128.	1234.
-1.00	0.	0.	0.	162.	1553.
-2.00	0.	0.	0.	195.	1872.
-2.11	0.	0.	0.	198.	1899.
-3.00	0.	0.	0.	213.	2049.
-4.00	0.	0.	0.	230.	2209.
-5.00	0.	0.	0.	247.	2368.
-5.50	0.	0.	0.	255.	2448.
-5.70	0.	26.	3.	258.	2478.

Page 5

Des1_LW_Stab_ST.out

-6.00	0.	66.	7.	262.	2519.
-6.50	0.	132.	14.	269.	2585.
-7.00	0.	198.	21.	276.	2651.
-7.66	0.	285.	30.	285.	2739.
-8.00	0.	329.	34.	290.	2783.
-9.00	0.	461.	48.	303.	2915.
-10.00	0.	593.	62.	317.	3046.
-11.00	0.	725.	75.	331.	3178.
-12.00	0.	856.	89.	345.	3310.
-13.00	0.	988.	103.	358.	3442.
-14.00	0.	1120.	117.	372.	3573.
-15.00	0.	1252.	130.	386.	3705.
-15.60	0.	1330.	138.	394.	3784.
-16.00	0.	1383.	144.	399.	3837.
-16.20	0.	1058.	82.	222.	1897.
-16.63+	0.	529.	0.	136.	1646.
-16.63-	0.	635.	0.	136.	1646.
-17.00	0.	546.	0.	63.	1431.
-17.48+	0.	1004.	0.	405.	1621.
-17.48-	0.	620.	0.	405.	1621.
-18.00	0.	1004.	77.	783.	1831.
-19.00	0.	1047.	119.	840.	1880.
-20.00	0.	1089.	161.	892.	1934.
-20.55	0.	1134.	204.	942.	1988.
-22.00	0.	1181.	248.	997.	2041.

Page 6

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                                Des2_LW_Stab_ST.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                              BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:45:41

                              ****************
                              *  INPUT DATA  *
                              ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 2; HURRICANE
     'STABILITY; FS=1.50

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.50

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00   30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00   34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                   Page 1
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                                Des2_LW_Stab_ST.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS
         NONE

    VIII.--HORIZONTAL LOADS

         VIII.A.--HORIZONTAL LINE LOADS
                  NONE

         VIII.B.--HORIZONTAL DISTRIBUTED LOADS
              ELEVATION    DIST. LOAD
                 (FT)         (PSF)
                 4.00         50.00
                 3.00         50.00
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:45:43

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; SHORT TERM
      'USUAL CONDITION; DESIGN 2; HURRICANE
      'STABILITY; FS=1.50

    II.--SOIL PRESSURES

         RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         NET SOIL PRESSURES INCLUDE APPLIED HORIZONTAL DISTRIBUTED LOADS.

                                   <------NET------>
          NET    <---LEFTSIDE--->     (SOIL + WATER)     <--RIGHTSIDE--->
ELEV.    WATER   PASSIVE   ACTIVE    ACTIVE   PASSIVE    ACTIVE   PASSIVE
(FT)     (PSF)     (PSF)    (PSF)     (PSF)     (PSF)     (PSF)     (PSF)
  4.0     0.0       0.0      0.0      50.0      50.0       0.0       0.0
  3.0+    0.0       0.0      0.0      50.0      50.0       0.0       0.0
  3.0-    0.0       0.0      0.0       0.0       0.0       0.0       0.0
  2.0     0.0       0.0      0.0      33.2     319.0      33.2     319.0
  1.0     0.0       0.0      0.0      66.4     637.9      66.4     637.9
                                   Page 2
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Des2_LW_Stab_ST.out

0.0	0.0	0.0	0.0	99.6	956.9	99.6	956.9
-1.0	0.0	0.0	0.0	132.8	1275.9	132.8	1275.9
-2.0	0.0	0.0	0.0	166.0	1594.8	166.0	1594.8
-2.1	0.0	0.0	0.0	168.8	1622.1	168.8	1622.1
-3.0	0.0	0.0	0.0	184.4	1771.8	184.4	1771.8
-4.0	0.0	0.0	0.0	201.0	1931.3	201.0	1931.3
-5.0	0.0	0.0	0.0	217.6	2090.8	217.6	2090.8
-5.5	0.0	0.0	0.0	225.9	2170.5	225.9	2170.5
-5.7	0.0	26.3	2.7	202.7	2198.0	229.1	2200.8
-6.0	0.0	65.9	6.9	167.5	2235.1	233.4	2242.0
-6.5	0.0	131.7	13.7	108.5	2294.1	240.2	2307.8
-7.0	0.0	197.6	20.6	49.5	2353.1	247.1	2373.7
-7.4	0.0	252.8	26.3	0.0	2402.6	252.8	2428.9
-8.0	0.0	329.4	34.3	-68.6	2471.2	260.8	2505.5
-9.0	0.0	461.1	48.0	-186.6	2589.2	274.5	2637.2
-10.0	0.0	592.9	61.7	-304.6	2707.2	288.2	2768.9
-11.0	0.0	724.6	75.4	-422.7	2825.3	301.9	2900.7
-12.0	0.0	856.3	89.1	-540.7	2943.3	315.7	3032.4
-13.0	0.0	988.1	102.9	-658.7	3061.3	329.4	3164.2
-14.0	0.0	1119.8	116.6	-776.8	3179.4	343.1	3295.9
-15.0	0.0	1251.6	130.3	-894.8	3297.4	356.8	3427.7
-16.0	0.0	1383.3	144.0	-1012.8	3415.4	370.5	3559.4
-16.2	0.0	1058.4	81.8	-847.6	1751.7	210.8	1833.5
-16.6+	0.0	528.7	0.0	-453.2	1562.8	128.7	1562.8
-16.6-	0.0	635.0	0.0	-453.2	1562.8	128.7	1562.8
-17.0	0.0	546.3	0.0	-487.9	1330.8	58.3	1330.8
-17.5+	0.0	1003.5	0.0	-447.4	1527.8	364.3	1527.8
-17.5-	0.0	619.9	0.0	-447.4	1527.8	364.3	1527.8
-18.0	0.0	1003.5	77.4	-301.7	1667.8	701.8	1745.1
-19.0	0.0	1047.0	119.0	-290.2	1674.6	756.8	1793.6
-20.0	0.0	1088.6	161.4	-281.7	1685.7	806.9	1847.1
-21.0	0.0	1133.8	203.5	-275.9	1696.2	857.9	1899.7
-22.0	0.0	1181.2	248.4	-269.0	1703.3	912.2	1951.7
-23.0	0.0	1228.5	293.3	-265.5	1709.8	963.0	2003.1
-23.7	0.0	5380.9	780.9	-1205.0	16025.0	4175.8	16805.9
-24.0	0.0	6069.9	811.3	-1700.2	18074.7	4369.7	18886.0
-25.0	0.0	2535.5	244.5	-2076.9	4532.1	458.6	4776.6
-26.0	0.0	2690.2	258.1	-2211.2	4674.7	479.0	4932.8
-26.7	0.0	3948.0	308.9	-3160.5	8020.1	787.5	8329.0
-27.0	0.0	4197.0	309.8	-3391.8	8541.0	805.2	8850.8
-28.0	0.0	3413.6	254.9	-2969.9	5677.1	443.7	5932.0
-29.0	0.0	3630.2	270.9	-3169.8	5892.0	460.4	6162.9
-30.0	0.0	3854.9	292.4	-3377.9	6101.5	477.0	6393.9
-31.0	0.0	4083.0	314.1	-3585.2	6310.9	497.8	6625.0
-32.0	0.0	4311.4	330.4	-3790.5	6525.8	520.9	6856.2
-33.0	0.0	4540.2	346.8	-4000.1	6740.8	540.0	7087.5
-34.0	0.0	4769.3	364.5	-4212.3	6954.5	557.0	7318.9
-35.0	0.0	4998.7	385.9	-4424.8	7164.5	573.9	7550.4
-36.0	0.0	5228.4	406.1	-4637.6	7375.8	590.8	7781.9

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS

DATE: 28-JULY-2016 TIME: 9:45:43

Page 3

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                    Des2_LW_Stab_ST.out
                ****************************
                *  SUMMARY OF RESULTS FOR  *
                *  CANTILEVER WALL DESIGN  *
                ****************************

 I.--HEADING
  'MT. SINAI SEAWALL
  'LOW WATER; SHORT TERM
  'USUAL CONDITION; DESIGN 2; HURRICANE
  'STABILITY; FS=1.50

II.--SUMMARY

     RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

     LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

WALL BOTTOM ELEV. (FT)      :      -19.30
      PENETRATION (FT)      :       13.80

MAX. BEND. MOMENT (LB-FT)   :  1.0636E+04
      AT ELEVATION (FT)     :      -12.24

MAX. SCALED DEFL. (LB-IN^3):  2.6605E+09
      AT ELEVATION (FT)     :        4.00

          NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                 ELLASTICITY IN PSI TIMES PILE MOMENT
                 OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                 IN INCHES.
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                        BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:45:43

                ****************************
                * COMPLETE OF RESULTS FOR  *
                *  CANTILEVER WALL DESIGN  *
                ****************************

 I.--HEADING
  'MT. SINAI SEAWALL
  'LOW WATER; SHORT TERM
  'USUAL CONDITION; DESIGN 2; HURRICANE
  'STABILITY; FS=1.50

II.--RESULTS
```

ELEVATION (FT)	BENDING MOMENT (LB-FT)	SHEAR (LB)	SCALED DEFLECTION (LB-IN^3)	NET PRESSURE (PSF)
4.00	0.0000E+00	0.	2.6605E+09	50.00
3.00+	2.5000E+01	50.	2.4821E+09	50.00
3.00-	2.5000E+01	50.	2.4821E+09	0.00
2.00	8.0534E+01	67.	2.3037E+09	33.20
1.00	1.6927E+02	116.	2.1254E+09	66.40
0.00	3.2441E+02	199.	1.9474E+09	99.60
-1.00	5.7915E+02	316.	1.7701E+09	132.81
-2.00	9.6670E+02	465.	1.5937E+09	166.01

Page 4

Des2_LW_Stab_ST.out

-2.11	1.0189E+03	483.	1.5744E+09	168.85
-3.00	1.5180E+03	641.	1.4190E+09	184.43
-4.00	2.2537E+03	833.	1.2470E+09	201.03
-5.00	3.1903E+03	1043.	1.0789E+09	217.64
-5.50	3.7392E+03	1154.	9.9680E+08	225.94
-5.70	3.9743E+03	1196.	9.6441E+08	202.73
-6.00	4.3419E+03	1252.	9.1633E+08	167.50
-6.50	4.9864E+03	1321.	8.3774E+08	108.48
-7.00	5.6580E+03	1360.	7.6131E+08	49.47
-7.42	6.2310E+03	1371.	6.9911E+08	0.00
-8.00	7.0235E+03	1351.	6.1606E+08	-68.57
-9.00	8.3205E+03	1223.	4.8294E+08	-186.60
-10.00	9.4309E+03	978.	3.6417E+08	-304.63
-11.00	1.0237E+04	614.	2.6166E+08	-422.66
-12.00	1.0620E+04	132.	1.7677E+08	-540.69
-13.00	1.0462E+04	-467.	1.1016E+08	-658.73
-14.00	9.6458E+03	-1185.	6.1526E+07	-776.76
-14.78	8.4720E+03	-1829.	3.5148E+07	-869.07
-15.00	8.0539E+03	-2005.	2.9452E+07	-746.31
-16.00	5.7700E+03	-2469.	1.1190E+07	-182.95
-16.20	5.2733E+03	-2495.	8.8661E+06	-70.28
-16.63	4.1996E+03	-2473.	5.0542E+06	172.40
-17.00	3.3032E+03	-2371.	2.8722E+06	380.40
-17.48	2.2292E+03	-2126.	1.1816E+06	648.26
-18.00	1.2168E+03	-1708.	3.1736E+05	943.76
-19.00	7.4074E+01	-483.	9.6302E+02	1507.11
-19.30	0.0000E+00	0.	0.0000E+00	1677.98

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00	0.	0.	0.	0.	0.
2.00	0.	0.	0.	33.	319.
1.00	0.	0.	0.	66.	638.
0.00	0.	0.	0.	100.	957.
-1.00	0.	0.	0.	133.	1276.
-2.00	0.	0.	0.	166.	1595.
-2.11	0.	0.	0.	169.	1622.
-3.00	0.	0.	0.	184.	1772.
-4.00	0.	0.	0.	201.	1931.
-5.00	0.	0.	0.	218.	2091.
-5.50	0.	0.	0.	226.	2171.
-5.70	0.	26.	3.	229.	2201.
-6.00	0.	66.	7.	233.	2242.
-6.50	0.	132.	14.	240.	2308.
-7.00	0.	198.	21.	247.	2374.
-7.42	0.	253.	26.	253.	2429.
-8.00	0.	329.	34.	261.	2505.
-9.00	0.	461.	48.	275.	2637.
-10.00	0.	593.	62.	288.	2769.
-11.00	0.	725.	75.	302.	2901.
-12.00	0.	856.	89.	316.	3032.
-13.00	0.	988.	103.	329.	3164.
-14.00	0.	1120.	117.	343.	3296.

Page 5

Des2_LW_Stab_ST.out

-14.78	0.	1223.	127.	354.	3399.
-15.00	0.	1252.	130.	357.	3428.
-16.00	0.	1383.	144.	371.	3559.
-16.20	0.	1058.	82.	211.	1833.
-16.63+	0.	529.	0.	129.	1563.
-16.63-	0.	635.	0.	129.	1563.
-17.00	0.	546.	0.	58.	1331.
-17.48+	0.	1004.	0.	364.	1528.
-17.48-	0.	620.	0.	364.	1528.
-18.00	0.	1004.	77.	702.	1745.
-19.00	0.	1047.	119.	757.	1794.
-19.30	0.	1089.	161.	807.	1847.
-21.00	0.	1134.	204.	858.	1900.

Page 6

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                                Con_LW_Stab_ST.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                              BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:44:24

                              ****************
                              *  INPUT DATA  *
                              ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STABILITY; FS=1.25

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.25

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00   30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00   34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                   Page 1
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                                   Con_LW_Stab_ST.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS

         VII.A.--VERTICAL LINE LOADS
              NONE

         VII.B.--VERTICAL UNIFORM LOADS
                  NONE

         VII.C.--VERTICAL STRIP LOADS

              VII.C.1.--RIGHTSIDE
              <-DIST. FROM WALL->
                START       END      STRIP LOAD
                 (FT)       (FT)        (PSF)
                15.00      30.00       500.00

              VII.C.2.--LEFTSIDE
                  NONE

         VII.D.--VERTICAL RAMP LOADS
              NONE

         VII.E.--VERTICAL TRIANGULAR LOADS
              NONE

         VII.F.--VERTICAL VARIABLE LOADS
              NONE

    VIII.--HORIZONTAL LOADS
         NONE
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                        TIME: 9:44:26

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; SHORT TERM
      'UNUSUAL CONDITION; CONSTRUCTION
      'STABILITY; FS=1.25

                                   Page 2
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Con_LW_Stab_ST.out

II.--SOIL PRESSURES

RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

				<------NET------>			
	NET	<---LEFTSIDE--->		(SOIL + WATER)		<--RIGHTSIDE--->	
ELEV.	WATER	PASSIVE	ACTIVE	ACTIVE	PASSIVE	ACTIVE	PASSIVE
(FT)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	33.2	399.8	33.2	399.8
1.0	0.0	0.0	0.0	66.4	799.6	66.4	799.6
0.0	0.0	0.0	0.0	99.6	1199.4	99.6	1199.4
-1.0	0.0	0.0	0.0	132.8	1599.2	132.8	1599.2
-2.0	0.0	0.0	0.0	166.0	1999.1	166.0	1999.1
-2.1	0.0	0.0	0.0	168.8	2033.3	168.8	2033.3
-3.0	0.0	0.0	0.0	184.4	2231.9	184.4	2231.9
-4.0	0.0	0.0	0.0	201.0	2613.3	201.0	2613.3
-5.0	0.0	0.0	0.0	217.6	3242.1	217.6	3242.1
-5.5	0.0	0.0	0.0	225.9	3323.3	225.9	3323.3
-5.7	0.0	33.0	2.7	196.1	3151.7	229.1	3154.4
-6.0	0.0	82.6	6.9	150.8	3499.1	233.4	3506.0
-6.5	0.0	165.1	13.7	75.1	4313.8	240.2	4327.5
-7.0	0.0	247.0	20.5	0.0	4503.1	247.0	4523.7
-7.0	0.0	247.7	20.6	-0.6	4504.7	247.1	4525.3
-8.0	0.0	412.8	34.3	-152.1	5360.6	260.8	5394.9
-9.0	0.0	578.0	48.0	-303.5	5598.4	274.5	5646.4
-10.0	0.0	743.1	61.7	-454.9	4994.6	288.2	5056.3
-11.0	0.0	908.3	75.4	-606.3	4089.9	301.9	4165.3
-12.0	0.0	1073.4	89.1	-757.8	3813.0	315.7	3902.2
-13.0	0.0	1238.5	102.9	-909.2	3968.9	329.4	4071.7
-14.0	0.0	1403.7	116.6	-1060.6	4124.7	343.1	4241.2
-15.0	0.0	1568.8	130.3	-1212.0	4242.5	356.8	4372.8
-16.0	0.0	1734.0	144.0	-1273.6	4354.3	460.4	4498.3
-16.2	0.0	1162.8	81.8	-807.1	1310.2	355.7	1392.0
-16.6	0.0	528.7	0.0	-208.9	1359.1	319.8	1359.1
-17.0	0.0	546.3	0.0	-257.1	1330.8	289.1	1330.8
-17.5+	0.0	1096.2	0.0	-276.0	1581.5	556.5	1581.5
-17.5-	0.0	568.8	0.0	-276.0	1581.5	556.5	1581.5
-18.0	0.0	1096.2	77.4	-244.7	1780.7	851.5	1858.1
-19.0	0.0	1134.6	119.0	-233.2	1798.8	901.5	1917.8
-20.0	0.0	1176.5	161.4	-225.4	1814.4	951.1	1975.7
-21.0	0.0	1224.0	203.5	-223.5	1810.7	1000.5	2014.2
-22.0	0.0	1267.0	248.4	-217.3	1630.5	1049.7	1878.9
-23.0	0.0	1307.4	293.3	-208.6	1322.5	1098.8	1615.8
-23.7	0.0	8128.0	780.9	-3639.7	23496.8	4488.4	24277.7
-24.0	0.0	9196.8	811.3	-4500.5	26579.8	4696.3	27391.1
-25.0	0.0	3136.1	244.5	-2556.5	4800.2	579.6	5044.7
-26.0	0.0	3335.1	258.1	-2740.6	4963.7	594.6	5221.8
-26.7	0.0	5525.6	308.9	-4597.9	10351.5	927.8	10660.3
-27.0	0.0	5912.3	309.8	-4966.1	11213.5	946.2	11523.2
-28.0	0.0	4319.6	254.9	-3768.4	6757.3	551.3	7012.2
-29.0	0.0	4616.9	270.9	-4037.1	7397.6	579.7	7668.4
-30.0	0.0	4915.1	292.4	-4311.7	8343.4	603.4	8635.8
-31.0	0.0	5214.3	314.1	-4595.0	9188.1	619.3	9502.2
-32.0	0.0	5514.3	330.4	-4879.1	9597.1	635.2	9927.6
-33.0	0.0	5815.0	346.8	-5164.0	9920.6	651.0	10267.4
-34.0	0.0	6116.3	364.5	-5442.8	10304.4	673.5	10668.9
-35.0	0.0	6418.2	385.9	-5672.0	10656.9	746.2	11042.7
-36.0	0.0	6720.6	406.1	-5872.1	10604.8	848.5	11010.9

Page 3

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                                Con_LW_Stab_ST.out


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:44:26

                        ****************************
                        *  SUMMARY OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STABILITY; FS=1.25

   II.--SUMMARY

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

   WALL BOTTOM ELEV. (FT)     :      -17.44
         PENETRATION (FT)     :       11.94

   MAX. BEND. MOMENT (LB-FT)  :  8.5885E+03
         AT ELEVATION (FT)    :      -11.10

   MAX. SCALED DEFL. (LB-IN^3):  1.7549E+09
         AT ELEVATION (FT)    :        4.00

             NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                    ELLASTICITY IN PSI TIMES PILE MOMENT
                    OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                    IN INCHES.



PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:44:26

                        ****************************
                        * COMPLETE OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

     I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STABILITY; FS=1.25

                                   Page 4
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Con_LW_Stab_ST.out

II.--RESULTS

ELEVATION (FT)	BENDING MOMENT (LB-FT)	SHEAR (LB)	SCALED DEFLECTION (LB-IN^3)	NET PRESSURE (PSF)
4.00	0.0000E+00	0.	1.7549E+09	0.00
3.00	-1.7462E-10	0.	1.6294E+09	0.00
2.00	5.5336E+00	17.	1.5040E+09	33.20
1.00	4.4269E+01	66.	1.3786E+09	66.40
0.00	1.4941E+02	149.	1.2533E+09	99.60
-1.00	3.5415E+02	266.	1.1282E+09	132.81
-2.00	6.9170E+02	415.	1.0038E+09	166.01
-2.11	7.3836E+02	433.	9.9018E+08	168.85
-3.00	1.1930E+03	591.	8.8060E+08	184.43
-4.00	1.8787E+03	783.	7.5949E+08	201.03
-5.00	2.7653E+03	993.	6.4165E+08	217.64
-5.50	3.2892E+03	1104.	5.8442E+08	225.94
-5.70	3.5143E+03	1146.	5.6192E+08	196.05
-6.00	3.8662E+03	1198.	5.2862E+08	150.80
-6.50	4.4808E+03	1254.	4.7449E+08	75.09
-7.00	5.1089E+03	1273.	4.2271E+08	0.00
-7.00	5.1142E+03	1273.	4.2229E+08	-0.63
-8.00	6.3615E+03	1197.	3.2480E+08	-152.05
-9.00	7.4569E+03	969.	2.3828E+08	-303.48
-10.00	8.2487E+03	590.	1.6460E+08	-454.90
-11.00	8.5856E+03	59.	1.0511E+08	-606.33
-12.00	8.3162E+03	-623.	6.0374E+07	-757.76
-13.00	7.2944E+03	-1453.	2.9983E+07	-908.63
-13.00	7.2891E+03	-1457.	2.9895E+07	-906.60
-14.00	5.4720E+03	-2085.	1.1891E+07	-350.42
-15.00	3.3045E+03	-2157.	3.2925E+06	205.76
-16.00	1.3427E+03	-1673.	4.3328E+05	761.93
-16.20	1.0240E+03	-1510.	2.4187E+05	873.17
-16.63	4.6194E+02	-1082.	4.5210E+04	1112.75
-17.00	1.4286E+02	-633.	4.0145E+03	1318.11
-17.44	0.0000E+00	0.	0.0000E+00	1562.71

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00	0.	0.	0.	0.	0.
2.00	0.	0.	0.	33.	400.
1.00	0.	0.	0.	66.	800.
0.00	0.	0.	0.	100.	1199.
-1.00	0.	0.	0.	133.	1599.
-2.00	0.	0.	0.	166.	1999.
-2.11	0.	0.	0.	169.	2033.
-3.00	0.	0.	0.	184.	2232.
-4.00	0.	0.	0.	201.	2613.
-5.00	0.	0.	0.	218.	3242.
-5.50	0.	0.	0.	226.	3323.
-5.70	0.	33.	3.	229.	3154.
-6.00	0.	83.	7.	233.	3506.
-6.50	0.	165.	14.	240.	4328.

Page 5

Con_LW_Stab_ST.out

-7.00	0.	247.	21.	247.	4524.
-7.00	0.	248.	21.	247.	4525.
-8.00	0.	413.	34.	261.	5395.
-9.00	0.	578.	48.	275.	5646.
-10.00	0.	743.	62.	288.	5056.
-11.00	0.	908.	75.	302.	4165.
-12.00	0.	1073.	89.	316.	3902.
-13.00	0.	1238.	103.	329.	4071.
-13.00	0.	1239.	103.	329.	4072.
-14.00	0.	1404.	117.	343.	4241.
-15.00	0.	1569.	130.	357.	4373.
-16.00	0.	1734.	144.	460.	4498.
-16.20	0.	1163.	82.	356.	1392.
-16.63	0.	529.	0.	320.	1359.
-17.00	0.	546.	0.	289.	1331.
-17.44+	0.	1096.	0.	557.	1582.
-17.44-	0.	569.	0.	557.	1582.
-18.00	0.	1096.	77.	852.	1858.

Page 6

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                                Des1_LW_Stab_LT.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                              BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:57:52

                              ****************
                              *  INPUT DATA  *
                              ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STABILITY; FS=1.50

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.50

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00    30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00    34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                   Page 1
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                                   Des1_LW_Stab_LT.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS

         VII.A.--VERTICAL LINE LOADS
              NONE

         VII.B.--VERTICAL UNIFORM LOADS
                   LEFTSIDE     RIGHTSIDE
                     (PSF)        (PSF)
                      0.00        100.00

         VII.C.--VERTICAL STRIP LOADS
              NONE

         VII.D.--VERTICAL RAMP LOADS
              NONE

         VII.E.--VERTICAL TRIANGULAR LOADS
              NONE

         VII.F.--VERTICAL VARIABLE LOADS
              NONE

    VIII.--HORIZONTAL LOADS
         NONE
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                         BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:57:54

                         **************************
                         *   SOIL PRESSURES FOR   *
                         * CANTILEVER WALL DESIGN *
                         **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; LONG TERM
      'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
      'STABILITY; FS=1.50

    II.--SOIL PRESSURES

         RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

                                   Page 2
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Des1_LW_Stab_LT.out

ELEV. (FT)	NET WATER (PSF)	<---LEFTSIDE---> PASSIVE (PSF)	ACTIVE (PSF)	<------NET------> (SOIL + WATER) ACTIVE (PSF)	PASSIVE (PSF)	<--RIGHTSIDE---> ACTIVE (PSF)	PASSIVE (PSF)
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0-	0.0	0.0	0.0	30.0	328.1	30.0	328.1
2.0	0.0	0.0	0.0	62.1	596.3	62.1	596.3
1.0	0.0	0.0	0.0	95.3	915.3	95.3	915.3
0.0	0.0	0.0	0.0	128.5	1234.2	128.5	1234.2
-1.0	0.0	0.0	0.0	161.7	1553.2	161.7	1553.2
-2.0	0.0	0.0	0.0	194.9	1872.2	194.9	1872.2
-2.1	0.0	0.0	0.0	197.7	1899.5	197.7	1899.5
-3.0	0.0	0.0	0.0	213.3	2049.2	213.3	2049.2
-4.0	0.0	0.0	0.0	229.9	2208.7	229.9	2208.7
-5.0	0.0	0.0	0.0	246.5	2368.2	246.5	2368.2
-5.5	0.0	0.0	0.0	254.8	2447.9	254.8	2447.9
-5.7	0.0	25.5	2.8	226.1	2313.4	251.6	2316.3
-6.0	0.0	63.7	7.1	192.4	2227.1	256.0	2234.3
-6.5	0.0	127.3	14.2	151.9	2484.1	279.3	2498.3
-7.0	0.0	191.0	21.3	95.4	2540.6	286.4	2562.0
-7.8	0.0	298.4	33.4	0.0	2636.0	298.4	2669.4
-8.0	0.0	318.3	35.6	-17.7	2653.7	300.6	2689.3
-9.0	0.0	445.6	49.8	-130.8	2766.8	314.8	2816.6
-10.0	0.0	572.9	64.0	-243.9	2879.9	329.1	2943.9
-11.0	0.0	700.2	78.3	-356.9	2993.0	343.3	3071.2
-12.0	0.0	827.6	92.5	-470.0	3106.0	357.5	3198.6
-13.0	0.0	954.9	106.7	-583.1	3219.1	371.8	3325.9
-14.0	0.0	1082.2	121.0	-696.2	3332.2	386.0	3453.2
-15.0	0.0	1209.5	135.2	-809.3	3445.3	400.2	3580.5
-16.0	0.0	1336.8	149.4	-922.4	3558.4	414.5	3707.8
-16.2	0.0	1295.7	152.9	-888.8	3272.2	406.9	3425.1
-17.0	0.0	1204.1	175.2	-779.3	2606.7	424.8	2781.9
-18.0	0.0	1415.0	200.8	-914.6	3310.4	500.4	3511.2
-19.0	0.0	1527.0	217.0	-1010.3	3406.3	516.7	3623.3
-20.0	0.0	1639.0	233.2	-1106.1	3502.1	532.9	3735.3
-21.0	0.0	1751.0	249.4	-1201.8	3597.9	549.2	3847.4
-22.0	0.0	1863.0	265.6	-1297.5	3693.7	565.5	3959.4
-23.0	0.0	1974.9	281.8	-1393.2	3789.5	581.7	4071.4
-23.7	0.0	3834.3	411.4	-2762.6	10029.0	1071.7	10440.4
-24.0	0.0	4150.7	415.1	-3052.9	10897.1	1097.8	11312.2
-25.0	0.0	2681.9	257.3	-2181.5	4995.0	500.4	5252.3
-26.0	0.0	2835.5	271.8	-2320.7	5134.5	514.8	5406.3
-26.7	0.0	4678.4	378.0	-3816.4	10407.5	862.0	10785.5
-27.0	0.0	4990.9	384.3	-4105.3	11136.9	885.6	11521.2
-28.0	0.0	3591.0	270.2	-3106.1	6210.6	484.9	6480.9
-29.0	0.0	3819.8	288.2	-3317.1	6422.3	502.7	6710.5
-30.0	0.0	4048.8	305.2	-3529.1	6635.1	519.7	6940.3
-31.0	0.0	4278.0	322.1	-3741.3	6848.0	536.6	7170.2
-32.0	0.0	4507.3	339.0	-3953.7	7061.0	553.6	7400.1
-33.0	0.0	4736.8	355.9	-4166.3	7274.1	570.5	7630.0
-34.0	0.0	4966.4	372.9	-4379.0	7487.2	587.5	7860.1
-35.0	0.0	5196.1	389.7	-4591.7	7700.4	604.4	8090.1
-36.0	0.0	5425.9	406.6	-4804.6	7913.6	621.3	8320.2

Page 3

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                              Des1_LW_Stab_LT.out

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:57:54

                        ****************************
                        *  SUMMARY OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STABILITY; FS=1.50

   II.--SUMMARY

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

   WALL BOTTOM ELEV. (FT)     :      -20.14
         PENETRATION (FT)     :       14.64

   MAX. BEND. MOMENT (LB-FT)  :  1.3898E+04
         AT ELEVATION (FT)    :      -13.24

   MAX. SCALED DEFL. (LB-IN^3):  3.9425E+09
         AT ELEVATION (FT)    :        4.00

             NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                    ELLASTICITY IN PSI TIMES PILE MOMENT
                    OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                    IN INCHES.


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:57:54

                        ****************************
                        * COMPLETE OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

     I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STABILITY; FS=1.50

    II.--RESULTS

                   BENDING                          SCALED         NET
    ELEVATION      MOMENT          SHEAR          DEFLECTION     PRESSURE
       (FT)        (LB-FT)         (LB)           (LB-IN^3)       (PSF)
        4.00    0.0000E+00          0.            3.9425E+09        0.00
        3.00+   0.0000E+00          0.            3.6926E+09        0.00
        3.00-  -8.2991E-10          0.            3.6926E+09       30.04
                                  Page 4
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Des1_LW_Stab_LT.out

2.00	2.0358E+01	46.	3.4428E+09	62.07
1.00	1.0298E+02	125.	3.1930E+09	95.27
0.00	2.8088E+02	237.	2.9434E+09	128.48
-1.00	5.8725E+02	382.	2.6944E+09	161.68
-2.00	1.0553E+03	560.	2.4463E+09	194.88
-2.11	1.1181E+03	582.	2.4191E+09	197.72
-3.00	1.7160E+03	764.	2.2001E+09	213.30
-4.00	2.5899E+03	986.	1.9569E+09	229.91
-5.00	3.6937E+03	1224.	1.7182E+09	246.51
-5.50	4.3370E+03	1350.	1.6011E+09	254.81
-5.70	4.6118E+03	1398.	1.5548E+09	226.11
-6.00	5.0408E+03	1460.	1.4859E+09	192.38
-6.50	5.7934E+03	1547.	1.3729E+09	151.95
-7.00	6.5833E+03	1608.	1.2624E+09	95.40
-7.84	7.9628E+03	1649.	1.0825E+09	0.00
-8.00	8.2205E+03	1647.	1.0502E+09	-17.68
-9.00	9.8400E+03	1573.	8.5229E+08	-130.77
-10.00	1.1329E+04	1386.	6.7133E+08	-243.85
-11.00	1.2574E+04	1085.	5.0991E+08	-356.94
-12.00	1.3462E+04	672.	3.7016E+08	-470.03
-13.00	1.3880E+04	145.	2.5361E+08	-583.11
-14.00	1.3715E+04	-494.	1.6096E+08	-696.20
-15.00	1.2853E+04	-1247.	9.1909E+07	-809.28
-16.00	1.1183E+04	-2113.	4.4951E+07	-922.37
-16.20	1.0742E+04	-2294.	3.7982E+07	-888.83
-17.00	8.6337E+03	-2961.	1.7187E+07	-779.34
-17.57	6.8261E+03	-3425.	8.3650E+06	-856.00
-18.00	5.2850E+03	-3636.	4.2269E+06	-120.54
-19.00	1.8713E+03	-2908.	3.8312E+05	1577.02
-20.00	3.4658E+01	-482.	1.0163E+02	3274.59
-20.14	0.0000E+00	0.	0.0000E+00	3515.73

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00+	0.	0.	0.	0.	0.
3.00-	0.	0.	0.	30.	328.
2.00	0.	0.	0.	62.	596.
1.00	0.	0.	0.	95.	915.
0.00	0.	0.	0.	128.	1234.
-1.00	0.	0.	0.	162.	1553.
-2.00	0.	0.	0.	195.	1872.
-2.11	0.	0.	0.	198.	1899.
-3.00	0.	0.	0.	213.	2049.
-4.00	0.	0.	0.	230.	2209.
-5.00	0.	0.	0.	247.	2368.
-5.50	0.	0.	0.	255.	2448.
-5.70	0.	25.	3.	252.	2316.
-6.00	0.	64.	7.	256.	2234.
-6.50	0.	127.	14.	279.	2498.
-7.00	0.	191.	21.	286.	2562.
-7.84	0.	298.	33.	298.	2669.
-8.00	0.	318.	36.	301.	2689.
-9.00	0.	446.	50.	315.	2817.

Page 5

Des1_LW_Stab_LT.out

-10.00	0.	573.	64.	329.	2944.
-11.00	0.	700.	78.	343.	3071.
-12.00	0.	828.	93.	358.	3199.
-13.00	0.	955.	107.	372.	3326.
-14.00	0.	1082.	121.	386.	3453.
-15.00	0.	1210.	135.	400.	3581.
-16.00	0.	1337.	149.	414.	3708.
-16.20	0.	1296.	153.	407.	3425.
-17.00	0.	1204.	175.	425.	2782.
-17.57	0.	1324.	190.	468.	3195.
-18.00	0.	1415.	201.	500.	3511.
-19.00	0.	1527.	217.	517.	3623.
-20.00	0.	1639.	233.	533.	3735.
-20.14	0.	1751.	249.	549.	3847.
-22.00	0.	1863.	266.	565.	3959.

Page 6

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                                Des2_LW_Stab_LT.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                              BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:58:03

                              ****************
                              *  INPUT DATA  *
                              ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'USUAL CONDITION; DESIGN 2; HURRICANE
     'STABILITY; FS=1.50

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.50

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00    30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00    34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                  Page 1
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                                Des2_LW_Stab_LT.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS
         NONE

    VIII.--HORIZONTAL LOADS

         VIII.A.--HORIZONTAL LINE LOADS
                  NONE

         VIII.B.--HORIZONTAL DISTRIBUTED LOADS
              ELEVATION    DIST. LOAD
                 (FT)         (PSF)
                 4.00         50.00
                 3.00         50.00
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:58:05

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; LONG TERM
      'USUAL CONDITION; DESIGN 2; HURRICANE
      'STABILITY; FS=1.50

    II.--SOIL PRESSURES

         RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         NET SOIL PRESSURES INCLUDE APPLIED HORIZONTAL DISTRIBUTED LOADS.

                                   <------NET------>
          NET    <---LEFTSIDE--->     (SOIL + WATER)     <--RIGHTSIDE--->
ELEV.    WATER   PASSIVE   ACTIVE    ACTIVE   PASSIVE    ACTIVE   PASSIVE
(FT)     (PSF)     (PSF)    (PSF)     (PSF)     (PSF)     (PSF)     (PSF)
  4.0     0.0       0.0      0.0      50.0      50.0       0.0       0.0
  3.0+    0.0       0.0      0.0      50.0      50.0       0.0       0.0
  3.0-    0.0       0.0      0.0       0.0       0.0       0.0       0.0
  2.0     0.0       0.0      0.0      33.2     319.0      33.2     319.0
  1.0     0.0       0.0      0.0      66.4     637.9      66.4     637.9
                                   Page 2
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Des2_LW_Stab_LT.out

0.0	0.0	0.0	0.0	99.6	956.9	99.6	956.9
-1.0	0.0	0.0	0.0	132.8	1275.9	132.8	1275.9
-2.0	0.0	0.0	0.0	166.0	1594.8	166.0	1594.8
-2.1	0.0	0.0	0.0	168.8	1622.1	168.8	1622.1
-3.0	0.0	0.0	0.0	184.4	1771.8	184.4	1771.8
-4.0	0.0	0.0	0.0	201.0	1931.3	201.0	1931.3
-5.0	0.0	0.0	0.0	217.6	2090.8	217.6	2090.8
-5.5	0.0	0.0	0.0	225.9	2170.5	225.9	2170.5
-5.7	0.0	25.5	2.8	198.7	2062.8	224.1	2065.6
-6.0	0.0	63.7	7.1	165.3	1995.0	229.0	2002.1
-6.5	0.0	127.3	14.2	122.0	2216.0	249.3	2230.3
-7.0	0.0	191.0	21.3	65.4	2272.6	256.4	2293.9
-7.6	0.0	264.7	29.6	0.0	2338.0	264.7	2367.6
-8.0	0.0	318.3	35.6	-47.6	2385.7	270.6	2421.2
-9.0	0.0	445.6	49.8	-160.7	2498.8	284.9	2548.6
-10.0	0.0	572.9	64.0	-273.8	2611.8	299.1	2675.9
-11.0	0.0	700.2	78.3	-386.9	2724.9	313.3	2803.2
-12.0	0.0	827.6	92.5	-500.0	2838.0	327.6	2930.5
-13.0	0.0	954.9	106.7	-613.1	2951.1	341.8	3057.8
-14.0	0.0	1082.2	121.0	-726.2	3064.2	356.0	3185.2
-15.0	0.0	1209.5	135.2	-839.2	3177.3	370.3	3312.5
-16.0	0.0	1336.8	149.4	-952.3	3290.4	384.5	3439.8
-16.2	0.0	1295.7	152.9	-917.1	3036.3	378.6	3189.2
-17.0	0.0	1204.1	175.2	-806.5	2442.7	397.6	2617.9
-18.0	0.0	1415.0	200.8	-948.6	3075.7	466.4	3276.5
-19.0	0.0	1527.0	217.0	-1044.4	3171.5	482.6	3388.5
-20.0	0.0	1639.0	233.2	-1140.1	3267.3	498.9	3500.5
-21.0	0.0	1751.0	249.4	-1235.8	3363.1	515.2	3612.5
-22.0	0.0	1863.0	265.6	-1331.6	3458.8	531.4	3724.4
-23.0	0.0	1974.9	281.8	-1427.3	3554.6	547.7	3836.4
-23.7	0.0	3834.3	411.4	-2842.7	9219.3	991.6	9630.8
-24.0	0.0	4150.7	415.1	-3136.0	10017.5	1014.7	10432.6
-25.0	0.0	2681.9	257.3	-2208.9	4703.1	473.0	4960.4
-26.0	0.0	2835.5	271.8	-2348.1	4842.6	487.4	5114.3
-26.7	0.0	4678.4	378.0	-3874.3	9668.7	804.1	10046.7
-27.0	0.0	4990.9	384.3	-4165.5	10345.4	825.4	10729.6
-28.0	0.0	3591.0	270.2	-3130.4	5881.2	460.6	6151.4
-29.0	0.0	3819.8	288.2	-3341.2	6092.7	478.6	6381.0
-30.0	0.0	4048.8	305.2	-3553.2	6305.4	495.6	6610.6
-31.0	0.0	4278.0	322.1	-3765.5	6518.2	512.5	6840.3
-32.0	0.0	4507.3	339.0	-3977.9	6731.1	529.4	7070.1
-33.0	0.0	4736.8	355.9	-4190.4	6944.1	546.4	7300.0
-34.0	0.0	4966.4	372.9	-4403.1	7157.1	563.3	7529.9
-35.0	0.0	5196.1	389.7	-4615.9	7370.2	580.2	7759.9
-36.0	0.0	5425.9	406.6	-4828.8	7583.3	597.1	7989.9

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS

DATE: 29-JULY-2016 TIME: 6:58:05

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****************************
*  SUMMARY OF RESULTS FOR  *
*  CANTILEVER WALL DESIGN  *
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Page 3

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                              Des2_LW_Stab_LT.out

 I.--HEADING
  'MT. SINAI SEAWALL
  'LOW WATER; LONG TERM
  'USUAL CONDITION; DESIGN 2; HURRICANE
  'STABILITY; FS=1.50

II.--SUMMARY

     RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

     LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

WALL BOTTOM ELEV. (FT)      :      -18.90
      PENETRATION (FT)      :       13.40

MAX. BEND. MOMENT (LB-FT)   :  1.1046E+04
      AT ELEVATION (FT)     :      -12.53

MAX. SCALED DEFL. (LB-IN^3):  2.8031E+09
      AT ELEVATION (FT)     :        4.00

          NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                 ELLASTICITY IN PSI TIMES PILE MOMENT
                 OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                 IN INCHES.


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                         BY CLASSICAL METHODS
DATE: 29-JULY-2016                                        TIME: 6:58:05

                      ****************************
                      * COMPLETE OF RESULTS FOR  *
                      *  CANTILEVER WALL DESIGN  *
                      ****************************

 I.--HEADING
 'MT. SINAI SEAWALL
 'LOW WATER; LONG TERM
 'USUAL CONDITION; DESIGN 2; HURRICANE
 'STABILITY; FS=1.50

II.--RESULTS

                BENDING                        SCALED        NET
ELEVATION       MOMENT          SHEAR        DEFLECTION    PRESSURE
   (FT)         (LB-FT)         (LB)         (LB-IN^3)      (PSF)
    4.00     0.0000E+00          0.          2.8031E+09      50.00
    3.00+    2.5000E+01         50.          2.6169E+09      50.00
    3.00-    2.5000E+01         50.          2.6169E+09       0.00
    2.00     8.0534E+01         67.          2.4307E+09      33.20
    1.00     1.6927E+02        116.          2.2446E+09      66.40
    0.00     3.2441E+02        199.          2.0588E+09      99.60
   -1.00     5.7915E+02        316.          1.8736E+09     132.81
   -2.00     9.6670E+02        465.          1.6895E+09     166.01
   -2.11     1.0189E+03        483.          1.6693E+09     168.85
   -3.00     1.5180E+03        641.          1.5070E+09     184.43
   -4.00     2.2537E+03        833.          1.3272E+09     201.03
   -5.00     3.1903E+03       1043.          1.1512E+09     217.64
                                Page 4
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Des2_LW_Stab_LT.out

-5.50	3.7392E+03	1154.	1.0653E+09	225.94
-5.70	3.9743E+03	1196.	1.0313E+09	198.65
-6.00	4.3416E+03	1251.	9.8089E+08	165.31
-6.50	4.9858E+03	1322.	8.9839E+08	121.98
-7.00	5.6599E+03	1369.	8.1805E+08	65.44
-7.58	6.4596E+03	1388.	7.2814E+08	0.00
-8.00	7.0431E+03	1378.	6.6501E+08	-47.64
-9.00	8.3787E+03	1274.	5.2413E+08	-160.73
-10.00	9.5535E+03	1057.	3.9770E+08	-273.82
-11.00	1.0455E+04	726.	2.8774E+08	-386.90
-12.00	1.0969E+04	283.	1.9580E+08	-499.99
-13.00	1.0983E+04	-274.	1.2273E+08	-613.07
-14.00	1.0384E+04	-943.	6.8555E+07	-726.16
-15.00	9.0587E+03	-1726.	3.2218E+07	-839.25
-16.00	6.8944E+03	-2622.	1.1414E+07	-952.33
-16.20	6.3513E+03	-2809.	8.8143E+06	-917.14
-16.32	6.0133E+03	-2916.	7.4881E+06	-900.81
-17.00	3.8986E+03	-3164.	2.3933E+06	173.19
-18.00	1.0837E+03	-2203.	1.3451E+05	1748.13
-18.90	0.0000E+00	0.	0.0000E+00	3161.69

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00	0.	0.	0.	0.	0.
2.00	0.	0.	0.	33.	319.
1.00	0.	0.	0.	66.	638.
0.00	0.	0.	0.	100.	957.
-1.00	0.	0.	0.	133.	1276.
-2.00	0.	0.	0.	166.	1595.
-2.11	0.	0.	0.	169.	1622.
-3.00	0.	0.	0.	184.	1772.
-4.00	0.	0.	0.	201.	1931.
-5.00	0.	0.	0.	218.	2091.
-5.50	0.	0.	0.	226.	2171.
-5.70	0.	25.	3.	224.	2066.
-6.00	0.	64.	7.	229.	2002.
-6.50	0.	127.	14.	249.	2230.
-7.00	0.	191.	21.	256.	2294.
-7.58	0.	265.	30.	265.	2368.
-8.00	0.	318.	36.	271.	2421.
-9.00	0.	446.	50.	285.	2549.
-10.00	0.	573.	64.	299.	2676.
-11.00	0.	700.	78.	313.	2803.
-12.00	0.	828.	93.	328.	2931.
-13.00	0.	955.	107.	342.	3058.
-14.00	0.	1082.	121.	356.	3185.
-15.00	0.	1210.	135.	370.	3312.
-16.00	0.	1337.	149.	385.	3440.
-16.20	0.	1296.	153.	379.	3189.
-16.32	0.	1282.	156.	381.	3105.
-17.00	0.	1204.	175.	398.	2618.
-18.00	0.	1415.	201.	466.	3276.
-18.90	0.	1527.	217.	483.	3388.

Page 5

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                                Des2_LW_Stab_LT.out
-20.00          0.       1639.        233.        499.       3500.
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Page 6

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                                Con_LW_Stab_LT.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                              BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:57:39

                            ****************
                            *  INPUT DATA  *
                            ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STABILITY; FS=1.25

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.25

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00    30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00    34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                   Page 1
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                                   Con_LW_Stab_LT.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS

         VII.A.--VERTICAL LINE LOADS
              NONE

         VII.B.--VERTICAL UNIFORM LOADS
                 NONE

         VII.C.--VERTICAL STRIP LOADS

              VII.C.1.--RIGHTSIDE
              <-DIST. FROM WALL->
                START       END      STRIP LOAD
                 (FT)       (FT)        (PSF)
                15.00      30.00       500.00

              VII.C.2.--LEFTSIDE
                 NONE

         VII.D.--VERTICAL RAMP LOADS
              NONE

         VII.E.--VERTICAL TRIANGULAR LOADS
              NONE

         VII.F.--VERTICAL VARIABLE LOADS
              NONE

    VIII.--HORIZONTAL LOADS
         NONE
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 29-JULY-2016                                        TIME: 6:57:41

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; LONG TERM
      'UNUSUAL CONDITION; CONSTRUCTION
      'STABILITY; FS=1.25

                                   Page 2
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Con_LW_Stab_LT.out

II.--SOIL PRESSURES

RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

				<------NET------>			
	NET	<---LEFTSIDE--->		(SOIL + WATER)		<--RIGHTSIDE--->	
ELEV.	WATER	PASSIVE	ACTIVE	ACTIVE	PASSIVE	ACTIVE	PASSIVE
(FT)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	33.2	399.8	33.2	399.8
1.0	0.0	0.0	0.0	66.4	799.6	66.4	799.6
0.0	0.0	0.0	0.0	99.6	1199.4	99.6	1199.4
-1.0	0.0	0.0	0.0	132.8	1599.2	132.8	1599.2
-2.0	0.0	0.0	0.0	166.0	1999.1	166.0	1999.1
-2.1	0.0	0.0	0.0	168.8	2033.3	168.8	2033.3
-3.0	0.0	0.0	0.0	184.4	2231.9	184.4	2231.9
-4.0	0.0	0.0	0.0	201.0	2613.3	201.0	2613.3
-5.0	0.0	0.0	0.0	217.6	3242.1	217.6	3242.1
-5.5	0.0	0.0	0.0	225.9	3323.3	225.9	3323.3
-5.7	0.0	31.7	2.8	192.4	2778.7	224.1	2781.5
-6.0	0.0	79.3	7.1	149.7	2816.4	229.0	2823.5
-6.5	0.0	158.5	14.2	90.8	4088.0	249.3	4102.2
-7.0	0.0	237.8	21.3	18.6	4279.1	256.4	4300.5
-7.1	0.0	258.3	23.2	0.0	4388.0	258.3	4411.2
-8.0	0.0	396.3	35.6	-125.7	5122.2	270.6	5157.7
-9.0	0.0	554.8	49.8	-270.0	5457.2	284.9	5507.0
-10.0	0.0	713.4	64.0	-414.2	5045.6	299.1	5109.7
-11.0	0.0	871.9	78.3	-558.5	4095.5	313.3	4173.8
-12.0	0.0	1030.4	92.5	-702.8	3606.6	327.6	3699.1
-13.0	0.0	1188.9	106.7	-847.1	3755.3	341.8	3862.1
-14.0	0.0	1347.5	121.0	-991.4	3904.1	356.0	4025.1
-15.0	0.0	1506.0	135.2	-1118.1	4021.3	387.8	4156.5
-16.0	0.0	1664.5	149.4	-1188.4	4122.8	476.1	4272.2
-16.2	0.0	1580.5	152.9	-1093.0	3650.5	487.5	3803.4
-17.0	0.0	1386.5	175.2	-859.8	2617.9	526.7	2793.2
-18.0	0.0	1711.2	200.8	-1120.3	3814.3	590.9	4015.1
-19.0	0.0	1846.3	217.0	-1239.4	3942.8	607.0	4159.8
-20.0	0.0	1981.4	233.2	-1358.4	4065.7	623.0	4298.9
-21.0	0.0	2116.4	249.4	-1477.4	4178.9	639.0	4428.3
-22.0	0.0	2251.4	265.6	-1595.1	4237.2	656.2	4502.8
-23.0	0.0	2386.3	281.8	-1707.9	4262.1	678.4	4543.9
-23.7	0.0	5749.0	411.4	-4591.1	14376.3	1157.9	14787.8
-24.0	0.0	6273.9	415.1	-5090.5	15732.4	1183.4	16147.5
-25.0	0.0	3384.6	257.3	-2780.4	5912.4	604.1	6169.7
-26.0	0.0	3579.4	271.8	-2960.5	6093.2	618.9	6365.0
-26.7	0.0	6949.0	378.0	-5980.2	15169.8	968.7	15547.8
-27.0	0.0	7475.4	384.3	-6484.8	16372.0	990.6	16756.3
-28.0	0.0	4663.8	270.2	-4085.5	7698.1	578.4	7968.3
-29.0	0.0	4963.8	288.2	-4365.4	8106.4	598.4	8394.6
-30.0	0.0	5264.2	305.2	-4640.4	8522.4	623.8	8827.6
-31.0	0.0	5564.9	322.1	-4919.7	8867.1	645.2	9189.2
-32.0	0.0	5865.8	339.0	-5204.4	9201.8	661.4	9540.8
-33.0	0.0	6167.0	355.9	-5489.4	9579.2	677.7	9935.2
-34.0	0.0	6468.5	372.9	-5774.5	9906.7	693.9	10279.5
-35.0	0.0	6770.1	389.7	-6059.9	10086.8	710.2	10476.6
-36.0	0.0	7071.8	406.6	-6349.3	10237.9	722.5	10644.6

Page 3

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                                Con_LW_Stab_LT.out


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:57:42

                      ****************************
                      *  SUMMARY OF RESULTS FOR  *
                      *  CANTILEVER WALL DESIGN  *
                      ****************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STABILITY; FS=1.25

   II.--SUMMARY

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

   WALL BOTTOM ELEV. (FT)     :      -17.06
         PENETRATION (FT)     :       11.56

   MAX. BEND. MOMENT (LB-FT)  :  8.9005E+03
         AT ELEVATION (FT)    :      -11.35

   MAX. SCALED DEFL. (LB-IN^3):  1.8344E+09
         AT ELEVATION (FT)    :        4.00

             NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                    ELLASTICITY IN PSI TIMES PILE MOMENT
                    OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                    IN INCHES.



PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 29-JULY-2016                                          TIME: 6:57:42

                      ****************************
                      * COMPLETE OF RESULTS FOR  *
                      *  CANTILEVER WALL DESIGN  *
                      ****************************

     I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STABILITY; FS=1.25

    II.--RESULTS

                  BENDING                        SCALED         NET
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Con_LW_Stab_LT.out

ELEVATION (FT)	MOMENT (LB-FT)	SHEAR (LB)	DEFLECTION (LB-IN^3)	PRESSURE (PSF)
4.00	0.0000E+00	0.	1.8344E+09	0.00
3.00	1.7462E-10	0.	1.7042E+09	0.00
2.00	5.5336E+00	17.	1.5740E+09	33.20
1.00	4.4269E+01	66.	1.4438E+09	66.40
0.00	1.4941E+02	149.	1.3137E+09	99.60
-1.00	3.5415E+02	266.	1.1839E+09	132.81
-2.00	6.9170E+02	415.	1.0547E+09	166.01
-2.11	7.3836E+02	433.	1.0405E+09	168.85
-3.00	1.1930E+03	591.	9.2672E+08	184.43
-4.00	1.8787E+03	783.	8.0084E+08	201.03
-5.00	2.7653E+03	993.	6.7823E+08	217.64
-5.50	3.2892E+03	1104.	6.1862E+08	225.94
-5.70	3.5143E+03	1145.	5.9516E+08	192.41
-6.00	3.8659E+03	1197.	5.6043E+08	149.71
-6.50	4.4806E+03	1257.	5.0392E+08	90.78
-7.00	5.1173E+03	1284.	4.4934E+08	18.63
-7.13	5.2833E+03	1285.	4.3559E+08	0.00
-8.00	6.3868E+03	1231.	3.4709E+08	-125.66
-9.00	7.5307E+03	1033.	2.5586E+08	-269.95
-10.00	8.4046E+03	691.	1.7760E+08	-414.25
-11.00	8.8642E+03	204.	1.1381E+08	-558.54
-12.00	8.7653E+03	-426.	6.5254E+07	-702.83
-13.00	7.9636E+03	-1201.	3.1743E+07	-847.12
-14.00	6.3147E+03	-2121.	1.1872E+07	-991.42
-14.23	5.7939E+03	-2355.	8.9293E+06	-1020.92
-15.00	3.7857E+03	-2752.	2.7747E+06	-13.95
-16.00	1.2457E+03	-2109.	2.1755E+05	1298.61
-16.20	8.5159E+02	-1823.	9.6147E+04	1561.12
-17.00	4.4053E+00	-155.	1.8671E+00	2611.16
-17.06	0.0000E+00	0.	0.0000E+00	2687.71

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00	0.	0.	0.	0.	0.
2.00	0.	0.	0.	33.	400.
1.00	0.	0.	0.	66.	800.
0.00	0.	0.	0.	100.	1199.
-1.00	0.	0.	0.	133.	1599.
-2.00	0.	0.	0.	166.	1999.
-2.11	0.	0.	0.	169.	2033.
-3.00	0.	0.	0.	184.	2232.
-4.00	0.	0.	0.	201.	2613.
-5.00	0.	0.	0.	218.	3242.
-5.50	0.	0.	0.	226.	3323.
-5.70	0.	32.	3.	224.	2782.
-6.00	0.	79.	7.	229.	2823.
-6.50	0.	159.	14.	249.	4102.
-7.00	0.	238.	21.	256.	4300.
-7.13	0.	258.	23.	258.	4411.
-8.00	0.	396.	36.	271.	5158.
-9.00	0.	555.	50.	285.	5507.

Page 5

Con_LW_Stab_LT.out

-10.00	0.	713.	64.	299.	5110.
-11.00	0.	872.	78.	313.	4174.
-12.00	0.	1030.	93.	328.	3699.
-13.00	0.	1189.	107.	342.	3862.
-14.00	0.	1347.	121.	356.	4025.
-14.23	0.	1384.	124.	363.	4056.
-15.00	0.	1506.	135.	388.	4157.
-16.00	0.	1665.	149.	476.	4272.
-16.20	0.	1580.	153.	487.	3803.
-17.00	0.	1387.	175.	527.	2793.
-17.06	0.	1711.	201.	591.	4015.
-19.00	0.	1846.	217.	607.	4160.

Page 6

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                                   Des1_LW_Str_ST.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                              BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:32

                              ****************
                              *  INPUT DATA  *
                              ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STRUCTURAL; FS-1.00

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.00

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00   30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00   34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                   Page 1
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                                   Des1_LW_Str_ST.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS

         VII.A.--VERTICAL LINE LOADS
              NONE

         VII.B.--VERTICAL UNIFORM LOADS
                   LEFTSIDE     RIGHTSIDE
                     (PSF)        (PSF)
                      0.00        100.00

         VII.C.--VERTICAL STRIP LOADS
              NONE

         VII.D.--VERTICAL RAMP LOADS
              NONE

         VII.E.--VERTICAL TRIANGULAR LOADS
              NONE

         VII.F.--VERTICAL VARIABLE LOADS
              NONE

    VIII.--HORIZONTAL LOADS
         NONE
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                         BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:34

                         **************************
                         *   SOIL PRESSURES FOR   *
                         * CANTILEVER WALL DESIGN *
                         **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; SHORT TERM
      'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
      'STRUCTURAL; FS-1.00

    II.--SOIL PRESSURES

         RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

                                   Page 2
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Des1_LW_Str_ST.out

ELEV. (FT)	NET WATER (PSF)	<---LEFTSIDE---> PASSIVE (PSF)	ACTIVE (PSF)	<------NET------> (SOIL + WATER) ACTIVE (PSF)	PASSIVE (PSF)	<--RIGHTSIDE---> ACTIVE (PSF)	PASSIVE (PSF)
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0-	0.0	0.0	0.0	30.0	517.4	30.0	517.4
2.0	0.0	0.0	0.0	62.1	1070.8	62.1	1070.8
1.0	0.0	0.0	0.0	95.3	1643.6	95.3	1643.6
0.0	0.0	0.0	0.0	128.5	2216.4	128.5	2216.4
-1.0	0.0	0.0	0.0	161.7	2789.2	161.7	2789.2
-2.0	0.0	0.0	0.0	194.9	3362.0	194.9	3362.0
-2.1	0.0	0.0	0.0	197.7	3410.9	197.7	3410.9
-3.0	0.0	0.0	0.0	213.3	3679.9	213.3	3679.9
-4.0	0.0	0.0	0.0	229.9	3966.2	229.9	3966.2
-5.0	0.0	0.0	0.0	246.5	4252.6	246.5	4252.6
-5.5	0.0	0.0	0.0	254.8	4395.8	254.8	4395.8
-5.7	0.0	47.3	2.7	210.6	4447.4	258.0	4450.1
-6.0	0.0	118.3	6.9	143.9	4517.2	262.2	4524.1
-6.5	0.0	236.6	13.7	32.5	4628.7	269.1	4642.4
-6.6	0.0	271.1	15.7	0.0	4661.2	271.1	4676.9
-7.0	0.0	354.9	20.6	-78.9	4740.1	276.0	4760.7
-8.0	0.0	591.5	34.3	-301.8	4963.0	289.7	4997.2
-9.0	0.0	828.0	48.0	-524.7	5185.8	303.4	5233.8
-10.0	0.0	1064.6	61.7	-747.5	5408.7	317.1	5470.4
-11.0	0.0	1301.2	75.4	-970.4	5631.6	330.8	5707.0
-12.0	0.0	1537.8	89.1	-1193.3	5854.4	344.5	5943.6
-13.0	0.0	1774.4	102.9	-1416.1	6077.3	358.2	6180.2
-14.0	0.0	2011.0	116.6	-1639.0	6300.2	372.0	6416.7
-15.0	0.0	2247.5	130.3	-1861.9	6523.0	385.7	6653.3
-16.0	0.0	2484.1	144.0	-2084.7	6745.9	399.4	6889.9
-16.2	0.0	1261.7	81.8	-1039.2	1311.0	222.5	1392.8
-16.6	0.0	528.7	0.0	-392.3	1413.3	136.4	1413.3
-17.0	0.0	546.3	0.0	-483.6	1430.8	62.7	1430.8
-17.5+	0.0	1243.7	0.0	-501.1	1675.1	405.1	1675.1
-17.5-	0.0	568.8	0.0	-501.1	1675.1	405.1	1675.1
-18.0	0.0	1243.7	77.4	-460.7	1867.3	782.9	1944.7
-19.0	0.0	1277.6	119.0	-438.0	1889.2	839.6	2008.2
-20.0	0.0	1312.5	161.4	-420.5	1915.0	891.9	2076.4
-21.0	0.0	1360.9	203.5	-419.0	1937.9	941.9	2141.5
-22.0	0.0	1403.5	248.4	-406.1	1955.7	997.4	2204.1
-23.0	0.0	1439.3	293.3	-387.9	1971.5	1051.4	2264.8
-23.7	0.0	14589.3	780.9	-9947.5	56491.6	4641.9	57272.5
-24.0	0.0	16532.6	811.3	-11674.1	63394.1	4858.6	64205.5
-25.0	0.0	4369.4	244.5	-3881.0	8663.7	488.4	8908.3
-26.0	0.0	4633.6	258.1	-4125.1	8945.0	508.5	9203.0
-26.7	0.0	9186.5	308.9	-8338.2	23516.7	848.4	23825.6
-27.0	0.0	9942.5	309.8	-9073.9	25471.4	868.6	25781.2
-28.0	0.0	6289.4	254.9	-5823.1	11543.1	466.3	11798.0
-29.0	0.0	6702.1	270.9	-6219.0	12003.8	483.1	12274.7
-30.0	0.0	7148.4	292.4	-6648.1	12459.4	500.3	12751.8
-31.0	0.0	7605.9	314.1	-7082.4	12915.1	523.5	13229.2
-32.0	0.0	8065.5	330.4	-7519.1	13376.6	546.4	13707.0
-33.0	0.0	8526.9	346.8	-7963.5	13838.3	563.4	14185.1
-34.0	0.0	8990.0	364.5	-8409.6	14281.1	580.4	14645.5
-35.0	0.0	9454.5	385.9	-8857.2	14672.7	597.3	15058.5
-36.0	0.0	9920.4	406.1	-9306.2	15078.4	614.2	15484.5

Page 3

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                                   Des1_LW_Str_ST.out


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:35

                        ****************************
                        *  SUMMARY OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STRUCTURAL; FS-1.00

   II.--SUMMARY

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

   WALL BOTTOM ELEV. (FT)     :      -14.99
         PENETRATION (FT)     :        9.49

   MAX. BEND. MOMENT (LB-FT)  :  9.6487E+03
         AT ELEVATION (FT)    :      -10.31

   MAX. SCALED DEFL. (LB-IN^3):  1.6663E+09
         AT ELEVATION (FT)    :        4.00

             NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                    ELLASTICITY IN PSI TIMES PILE MOMENT
                    OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                    IN INCHES.



PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:35

                        ****************************
                        * COMPLETE OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

     I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STRUCTURAL; FS-1.00

    II.--RESULTS

                  BENDING                          SCALED          NET
    ELEVATION     MOMENT          SHEAR          DEFLECTION     PRESSURE
       (FT)       (LB-FT)          (LB)           (LB-IN^3)       (PSF)
                                    Page 4
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Des1_LW_Str_ST.out

4.00	0.0000E+00	0.	1.6663E+09	0.00
3.00+	8.7311E-11	0.	1.5380E+09	0.00
3.00-	-1.8966E-10	0.	1.5380E+09	30.04
2.00	2.0358E+01	46.	1.4097E+09	62.07
1.00	1.0298E+02	125.	1.2814E+09	95.27
0.00	2.8088E+02	237.	1.1534E+09	128.48
-1.00	5.8725E+02	382.	1.0258E+09	161.68
-2.00	1.0553E+03	560.	8.9931E+08	194.88
-2.11	1.1181E+03	582.	8.8549E+08	197.72
-3.00	1.7160E+03	764.	7.7464E+08	213.30
-4.00	2.5899E+03	986.	6.5298E+08	229.91
-5.00	3.6937E+03	1224.	5.3582E+08	246.51
-5.50	4.3370E+03	1350.	4.7951E+08	254.81
-5.70	4.6117E+03	1396.	4.5749E+08	210.64
-6.00	5.0390E+03	1449.	4.2508E+08	143.95
-6.50	5.7770E+03	1493.	3.7282E+08	32.52
-6.65	5.9951E+03	1496.	3.5803E+08	0.00
-7.00	6.5232E+03	1482.	3.2306E+08	-78.92
-8.00	7.9284E+03	1291.	2.3231E+08	-301.79
-9.00	9.0318E+03	878.	1.5521E+08	-524.66
-10.00	9.6106E+03	242.	9.3649E+07	-747.53
-11.00	9.4419E+03	-617.	4.8584E+07	-970.39
-12.00	8.3028E+03	-1699.	1.9695E+07	-1193.26
-13.00	5.9704E+03	-3003.	4.9810E+06	-1416.13
-13.50	4.2953E+03	-3736.	1.7710E+06	-1527.08
-14.00	2.3401E+03	-3824.	3.8277E+05	1174.90
-14.99	0.0000E+00	0.	0.0000E+00	6521.65

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00+	0.	0.	0.	0.	0.
3.00-	0.	0.	0.	30.	517.
2.00	0.	0.	0.	62.	1071.
1.00	0.	0.	0.	95.	1644.
0.00	0.	0.	0.	128.	2216.
-1.00	0.	0.	0.	162.	2789.
-2.00	0.	0.	0.	195.	3362.
-2.11	0.	0.	0.	198.	3411.
-3.00	0.	0.	0.	213.	3680.
-4.00	0.	0.	0.	230.	3966.
-5.00	0.	0.	0.	247.	4253.
-5.50	0.	0.	0.	255.	4396.
-5.70	0.	47.	3.	258.	4450.
-6.00	0.	118.	7.	262.	4524.
-6.50	0.	237.	14.	269.	4642.
-6.65	0.	271.	16.	271.	4677.
-7.00	0.	355.	21.	276.	4761.
-8.00	0.	591.	34.	290.	4997.
-9.00	0.	828.	48.	303.	5234.
-10.00	0.	1065.	62.	317.	5470.
-11.00	0.	1301.	75.	331.	5707.
-12.00	0.	1538.	89.	345.	5944.
-13.00	0.	1774.	103.	358.	6180.

Page 5

Des1_LW_Str_ST.out

-13.50	0.	1892.	110.	365.	6298.
-14.00	0.	2011.	117.	372.	6417.
-14.99	0.	2248.	130.	386.	6653.
-16.00	0.	2484.	144.	399.	6890.

Page 6

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                                Des2_LW_Str_ST.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                            BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:53:07

                            ****************
                            *  INPUT DATA  *
                            ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 2; HURRICANE
     'STRUCTURAL; FS-1.00

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.00

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00   30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00   34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                  Page 1
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                                   Des2_LW_Str_ST.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS
         NONE

    VIII.--HORIZONTAL LOADS

         VIII.A.--HORIZONTAL LINE LOADS
                  NONE

         VIII.B.--HORIZONTAL DISTRIBUTED LOADS
              ELEVATION    DIST. LOAD
                 (FT)         (PSF)
                 4.00         50.00
                 3.00         50.00
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:53:08

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'USUAL CONDITION; DESIGN 2; HURRICANE
     'STRUCTURAL; FS-1.00

   II.--SOIL PRESSURES

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        NET SOIL PRESSURES INCLUDE APPLIED HORIZONTAL DISTRIBUTED LOADS.

                                  <------NET------>
         NET    <---LEFTSIDE--->     (SOIL + WATER)     <--RIGHTSIDE--->
ELEV.   WATER   PASSIVE   ACTIVE    ACTIVE   PASSIVE    ACTIVE   PASSIVE
(FT)    (PSF)     (PSF)    (PSF)     (PSF)     (PSF)     (PSF)     (PSF)
  4.0     0.0       0.0      0.0      50.0      50.0       0.0       0.0
  3.0+    0.0       0.0      0.0      50.0      50.0       0.0       0.0
  3.0-    0.0       0.0      0.0       0.0       0.0       0.0       0.0
  2.0     0.0       0.0      0.0      33.2     572.8      33.2     572.8
  1.0     0.0       0.0      0.0      66.4    1145.6      66.4    1145.6
                                   Page 2
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Des2_LW_Str_ST.out

0.0	0.0	0.0	0.0	99.6	1718.3	99.6	1718.3
-1.0	0.0	0.0	0.0	132.8	2291.1	132.8	2291.1
-2.0	0.0	0.0	0.0	166.0	2863.9	166.0	2863.9
-2.1	0.0	0.0	0.0	168.8	2912.9	168.8	2912.9
-3.0	0.0	0.0	0.0	184.4	3181.8	184.4	3181.8
-4.0	0.0	0.0	0.0	201.0	3468.2	201.0	3468.2
-5.0	0.0	0.0	0.0	217.6	3754.6	217.6	3754.6
-5.5	0.0	0.0	0.0	225.9	3897.8	225.9	3897.8
-5.7	0.0	47.3	2.7	181.8	3949.3	229.1	3952.0
-6.0	0.0	118.3	6.9	115.1	4019.2	233.4	4026.0
-6.5	0.0	236.6	13.7	3.6	4130.6	240.2	4144.3
-6.5	0.0	240.5	13.9	0.0	4134.2	240.5	4148.2
-7.0	0.0	354.9	20.6	-107.8	4242.0	247.1	4262.6
-8.0	0.0	591.5	34.3	-330.7	4464.9	260.8	4499.2
-9.0	0.0	828.0	48.0	-553.5	4687.8	274.5	4735.8
-10.0	0.0	1064.6	61.7	-776.4	4910.6	288.2	4972.3
-11.0	0.0	1301.2	75.4	-999.3	5133.5	301.9	5208.9
-12.0	0.0	1537.8	89.1	-1222.1	5356.4	315.7	5445.5
-13.0	0.0	1774.4	102.9	-1445.0	5579.2	329.4	5682.1
-14.0	0.0	2011.0	116.6	-1667.9	5802.1	343.1	5918.7
-15.0	0.0	2247.5	130.3	-1890.7	6025.0	356.8	6155.3
-16.0	0.0	2484.1	144.0	-2113.6	6247.8	370.5	6391.8
-16.2	0.0	1261.7	81.8	-1050.9	1211.0	210.8	1292.8
-16.6	0.0	528.7	0.0	-400.0	1313.3	128.7	1313.3
-17.0	0.0	546.3	0.0	-487.9	1330.8	58.3	1330.8
-17.5+	0.0	1243.7	0.0	-542.0	1592.0	364.3	1592.0
-17.5-	0.0	568.8	0.0	-542.0	1592.0	364.3	1592.0
-18.0	0.0	1243.7	77.4	-541.8	1802.8	701.8	1880.2
-19.0	0.0	1277.6	119.0	-520.7	1822.6	756.8	1941.6
-20.0	0.0	1312.5	161.4	-505.6	1845.0	806.9	2006.3
-21.0	0.0	1360.9	203.5	-503.0	1865.0	857.9	2068.5
-22.0	0.0	1403.5	248.4	-491.3	1880.3	912.2	2128.7
-23.0	0.0	1439.3	293.3	-476.3	1893.8	963.0	2187.2
-23.7	0.0	14589.3	780.9	-10413.5	51275.7	4175.8	52056.6
-24.0	0.0	16532.6	811.3	-12163.0	57573.3	4369.7	58384.6
-25.0	0.0	4369.4	244.5	-3910.8	8157.2	458.6	8401.7
-26.0	0.0	4633.6	258.1	-4154.6	8428.9	479.0	8686.9
-26.7	0.0	9186.5	308.9	-8399.1	21766.4	787.5	22075.3
-27.0	0.0	9942.5	309.8	-9137.3	23574.4	805.2	23884.2
-28.0	0.0	6289.4	254.9	-5845.7	10917.6	443.7	11172.5
-29.0	0.0	6702.1	270.9	-6241.7	11375.1	460.4	11645.9
-30.0	0.0	7148.4	292.4	-6671.4	11827.6	477.0	12120.0
-31.0	0.0	7605.9	314.1	-7108.1	12280.6	497.8	12594.7
-32.0	0.0	8065.5	330.4	-7544.6	12739.4	520.9	13069.8
-33.0	0.0	8526.9	346.8	-7986.9	13198.7	540.0	13545.4
-34.0	0.0	8990.0	364.5	-8433.0	13648.9	557.0	14013.4
-35.0	0.0	9454.5	385.9	-8880.6	14042.8	573.9	14428.7
-36.0	0.0	9920.4	406.1	-9329.7	14441.3	590.8	14847.4

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS

DATE: 28-JULY-2016 TIME: 9:53:09

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Page 3

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                    Des2_LW_Str_ST.out
                 *  SUMMARY OF RESULTS FOR  *
                 *  CANTILEVER WALL DESIGN  *
                 ****************************

 I.--HEADING
  'MT. SINAI SEAWALL
  'LOW WATER; SHORT TERM
  'USUAL CONDITION; DESIGN 2; HURRICANE
  'STRUCTURAL; FS-1.00

II.--SUMMARY

     RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

     LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

WALL BOTTOM ELEV. (FT)      :      -14.30
      PENETRATION (FT)      :        8.80

MAX. BEND. MOMENT (LB-FT)   :  7.8432E+03
      AT ELEVATION (FT)     :       -9.89

MAX. SCALED DEFL. (LB-IN^3):  1.2489E+09
      AT ELEVATION (FT)     :        4.00

          NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                 ELLASTICITY IN PSI TIMES PILE MOMENT
                 OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                 IN INCHES.


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                        BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:53:09

                 ****************************
                 * COMPLETE OF RESULTS FOR  *
                 *  CANTILEVER WALL DESIGN  *
                 ****************************

 I.--HEADING
 'MT. SINAI SEAWALL
 'LOW WATER; SHORT TERM
 'USUAL CONDITION; DESIGN 2; HURRICANE
 'STRUCTURAL; FS-1.00

II.--RESULTS

                 BENDING                        SCALED        NET
ELEVATION        MOMENT          SHEAR        DEFLECTION    PRESSURE
   (FT)          (LB-FT)         (LB)         (LB-IN^3)      (PSF)
    4.00     0.0000E+00           0.          1.2489E+09      50.00
    3.00+    2.5000E+01          50.          1.1492E+09      50.00
    3.00-    2.5000E+01          50.          1.1492E+09       0.00
    2.00     8.0534E+01          67.          1.0495E+09      33.20
    1.00     1.6927E+02         116.          9.4994E+08      66.40
    0.00     3.2441E+02         199.          8.5070E+08      99.60
   -1.00     5.7915E+02         316.          7.5203E+08     132.81
   -2.00     9.6670E+02         465.          6.5438E+08     166.01
   -2.11     1.0189E+03         483.          6.4373E+08     168.85
                                 Page 4
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Des2_LW_Str_ST.out

-3.00	1.5180E+03	641.	5.5843E+08	184.43
-4.00	2.2537E+03	833.	4.6512E+08	201.03
-5.00	3.1903E+03	1043.	3.7574E+08	217.64
-5.50	3.7392E+03	1154.	3.3301E+08	225.94
-5.70	3.9742E+03	1194.	3.1636E+08	181.77
-6.00	4.3397E+03	1239.	2.9190E+08	115.08
-6.50	4.9689E+03	1269.	2.5267E+08	3.64
-6.52	4.9896E+03	1269.	2.5142E+08	0.00
-7.00	5.5990E+03	1243.	2.1558E+08	-107.79
-8.00	6.7505E+03	1023.	1.4891E+08	-330.66
-9.00	7.5713E+03	581.	9.3868E+07	-553.53
-10.00	7.8387E+03	-84.	5.1826E+07	-776.40
-11.00	7.3296E+03	-972.	2.3217E+07	-999.26
-12.00	5.8213E+03	-2082.	7.1293E+06	-1222.13
-12.86	3.5703E+03	-3209.	1.3678E+06	-1412.74
-13.00	3.0935E+03	-3361.	9.2510E+05	-680.99
-14.00	2.3481E+02	-1514.	3.0661E+03	4373.26
-14.30	0.0000E+00	0.	0.0000E+00	5868.01

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00	0.	0.	0.	0.	0.
2.00	0.	0.	0.	33.	573.
1.00	0.	0.	0.	66.	1146.
0.00	0.	0.	0.	100.	1718.
-1.00	0.	0.	0.	133.	2291.
-2.00	0.	0.	0.	166.	2864.
-2.11	0.	0.	0.	169.	2913.
-3.00	0.	0.	0.	184.	3182.
-4.00	0.	0.	0.	201.	3468.
-5.00	0.	0.	0.	218.	3755.
-5.50	0.	0.	0.	226.	3898.
-5.70	0.	47.	3.	229.	3952.
-6.00	0.	118.	7.	233.	4026.
-6.50	0.	237.	14.	240.	4144.
-6.52	0.	240.	14.	240.	4148.
-7.00	0.	355.	21.	247.	4263.
-8.00	0.	591.	34.	261.	4499.
-9.00	0.	828.	48.	275.	4736.
-10.00	0.	1065.	62.	288.	4972.
-11.00	0.	1301.	75.	302.	5209.
-12.00	0.	1538.	89.	316.	5446.
-12.86	0.	1740.	101.	327.	5648.
-13.00	0.	1774.	103.	329.	5682.
-14.00	0.	2011.	117.	343.	5919.
-14.30	0.	2248.	130.	357.	6155.
-16.00	0.	2484.	144.	371.	6392.

Page 5

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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                            BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:51:59

                            ****************
                            *  INPUT DATA  *
                            ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STRUCTURAL; FS-1.00

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.00

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00   30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00   34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00   30.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    0.00  250.00     0.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00   31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
                                   Page 1
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132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS

         VII.A.--VERTICAL LINE LOADS
              NONE

         VII.B.--VERTICAL UNIFORM LOADS
                 NONE

         VII.C.--VERTICAL STRIP LOADS

              VII.C.1.--RIGHTSIDE
              <-DIST. FROM WALL->
                START       END      STRIP LOAD
                 (FT)       (FT)        (PSF)
                15.00      30.00       500.00

              VII.C.2.--LEFTSIDE
                 NONE

         VII.D.--VERTICAL RAMP LOADS
              NONE

         VII.E.--VERTICAL TRIANGULAR LOADS
              NONE

         VII.F.--VERTICAL VARIABLE LOADS
              NONE

    VIII.--HORIZONTAL LOADS
         NONE
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                        TIME: 9:52:01

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; SHORT TERM
      'UNUSUAL CONDITION; CONSTRUCTION
      'STRUCTURAL; FS-1.00

                                   Page 2
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Con_LW_Str_ST.out

II.--SOIL PRESSURES

RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

				<------NET------>			
	NET	<---LEFTSIDE--->		(SOIL + WATER)		<--RIGHTSIDE--->	
ELEV.	WATER	PASSIVE	ACTIVE	ACTIVE	PASSIVE	ACTIVE	PASSIVE
(FT)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)	(PSF)
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	33.2	572.8	33.2	572.8
1.0	0.0	0.0	0.0	66.4	1145.6	66.4	1145.6
0.0	0.0	0.0	0.0	99.6	1718.3	99.6	1718.3
-1.0	0.0	0.0	0.0	132.8	2291.1	132.8	2291.1
-2.0	0.0	0.0	0.0	166.0	2863.9	166.0	2863.9
-2.1	0.0	0.0	0.0	168.8	2929.6	168.8	2929.6
-3.0	0.0	0.0	0.0	184.4	3468.5	184.4	3468.5
-4.0	0.0	0.0	0.0	201.0	4625.0	201.0	4625.0
-5.0	0.0	0.0	0.0	217.6	5712.5	217.6	5712.5
-5.5	0.0	0.0	0.0	225.9	6949.5	225.9	6949.5
-5.7	0.0	47.3	2.7	181.8	7426.0	229.1	7428.8
-6.0	0.0	118.3	6.9	115.1	7507.2	233.4	7514.1
-6.5	0.0	236.6	13.7	3.6	7499.1	240.2	7512.8
-6.5	0.0	240.5	13.9	0.0	7496.5	240.5	7510.4
-7.0	0.0	354.9	20.6	-107.8	7419.8	247.1	7440.4
-8.0	0.0	591.5	34.3	-330.7	6283.2	260.8	6317.5
-9.0	0.0	828.0	48.0	-553.5	5020.4	274.5	5068.4
-10.0	0.0	1064.6	61.7	-776.4	4994.8	288.2	5056.6
-11.0	0.0	1301.2	75.4	-999.3	5221.7	301.9	5297.2
-12.0	0.0	1537.8	89.1	-1222.1	5448.6	315.7	5537.7
-13.0	0.0	1774.4	102.9	-1445.0	5675.5	329.4	5778.3
-14.0	0.0	2011.0	116.6	-1667.9	5902.4	343.1	6018.9
-15.0	0.0	2247.5	130.3	-1890.7	6129.2	356.8	6259.5
-16.0	0.0	2484.1	144.0	-2023.7	6356.1	460.4	6500.1
-16.2	0.0	1261.7	81.8	-906.0	1211.0	355.7	1292.8
-16.6	0.0	528.7	0.0	-208.9	1313.3	319.8	1313.3
-17.0	0.0	546.3	0.0	-257.1	1330.8	289.1	1330.8
-17.5+	0.0	1243.7	0.0	-349.7	1614.5	556.5	1614.5
-17.5-	0.0	568.8	0.0	-349.7	1614.5	556.5	1614.5
-18.0	0.0	1243.7	77.4	-392.1	1850.1	851.5	1927.5
-19.0	0.0	1277.6	119.0	-376.1	1862.1	901.5	1981.1
-20.0	0.0	1312.5	161.4	-361.4	1886.8	951.1	2048.2
-21.0	0.0	1360.9	203.5	-360.3	1908.8	1000.5	2112.3
-22.0	0.0	1403.5	248.4	-353.7	1490.2	1049.7	1738.6
-23.0	0.0	1439.3	293.3	-340.5	1322.5	1098.8	1615.8
-23.7	0.0	14589.3	780.9	-10100.9	46531.0	4488.4	47311.9
-24.0	0.0	16532.6	811.3	-11836.4	52374.8	4696.3	53186.1
-25.0	0.0	4369.4	244.5	-3789.8	6671.5	579.6	6916.0
-26.0	0.0	4633.6	258.1	-4039.0	7159.5	594.6	7417.5
-26.7	0.0	9186.5	308.9	-8258.8	20480.1	927.8	20789.0
-27.0	0.0	9942.5	309.8	-8996.3	22520.6	946.2	22830.3
-28.0	0.0	6289.4	254.9	-5738.1	10911.8	551.3	11166.7
-29.0	0.0	6702.1	270.9	-6122.3	11868.5	579.7	12139.3
-30.0	0.0	7148.4	292.4	-6545.0	13186.9	603.4	13479.3
-31.0	0.0	7605.9	314.1	-6986.6	14050.0	619.3	14364.1
-32.0	0.0	8065.5	330.4	-7430.3	14605.2	635.2	14935.6
-33.0	0.0	8526.9	346.8	-7875.9	15227.0	651.0	15573.8
-34.0	0.0	8990.0	364.5	-8316.5	15293.4	673.5	15657.9
-35.0	0.0	9454.5	385.9	-8708.4	14809.3	746.2	15195.1
-36.0	0.0	9920.4	406.1	-9071.9	14788.9	848.5	15195.0

Page 3

Con_LW_Str_ST.out

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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:01

                        ****************************
                        *  SUMMARY OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STRUCTURAL; FS-1.00

   II.--SUMMARY

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

   WALL BOTTOM ELEV. (FT)     :      -14.07
         PENETRATION (FT)     :        8.57

   MAX. BEND. MOMENT (LB-FT)  :  7.1754E+03
         AT ELEVATION (FT)    :       -9.82

   MAX. SCALED DEFL. (LB-IN^3):  1.0950E+09
         AT ELEVATION (FT)    :        4.00

             NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                    ELLASTICITY IN PSI TIMES PILE MOMENT
                    OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                    IN INCHES.


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:01

                        ****************************
                        * COMPLETE OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

     I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; SHORT TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STRUCTURAL; FS-1.00

                                   Page 4
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Con_LW_Str_ST.out

II.--RESULTS

ELEVATION (FT)	BENDING MOMENT (LB-FT)	SHEAR (LB)	SCALED DEFLECTION (LB-IN^3)	NET PRESSURE (PSF)
4.00	0.0000E+00	0.	1.0950E+09	0.00
3.00	8.7311E-11	0.	1.0081E+09	0.00
2.00	5.5336E+00	17.	9.2121E+08	33.20
1.00	4.4269E+01	66.	8.3432E+08	66.40
0.00	1.4941E+02	149.	7.4751E+08	99.60
-1.00	3.5415E+02	266.	6.6097E+08	132.81
-2.00	6.9170E+02	415.	5.7507E+08	166.01
-2.11	7.3836E+02	433.	5.6568E+08	168.85
-3.00	1.1930E+03	591.	4.9039E+08	184.43
-4.00	1.8787E+03	783.	4.0779E+08	201.03
-5.00	2.7653E+03	993.	3.2847E+08	217.64
-5.50	3.2892E+03	1104.	2.9050E+08	225.94
-5.70	3.5142E+03	1144.	2.7570E+08	181.77
-6.00	3.8647E+03	1189.	2.5396E+08	115.08
-6.50	4.4689E+03	1219.	2.1908E+08	3.64
-6.52	4.4888E+03	1219.	2.1797E+08	0.00
-7.00	5.0740E+03	1193.	1.8614E+08	-107.79
-8.00	6.1755E+03	973.	1.2708E+08	-330.66
-9.00	6.9463E+03	531.	7.8636E+07	-553.53
-10.00	7.1637E+03	-134.	4.2119E+07	-776.40
-11.00	6.6046E+03	-1022.	1.7869E+07	-999.26
-12.00	5.0463E+03	-2132.	4.8873E+06	-1222.13
-12.72	3.1865E+03	-3067.	1.0736E+06	-1382.15
-13.00	2.2868E+03	-3242.	4.5005E+05	140.21
-14.00	1.4323E+01	-403.	1.0285E+01	5538.63
-14.07	0.0000E+00	0.	0.0000E+00	5918.31

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00	0.	0.	0.	0.	0.
2.00	0.	0.	0.	33.	573.
1.00	0.	0.	0.	66.	1146.
0.00	0.	0.	0.	100.	1718.
-1.00	0.	0.	0.	133.	2291.
-2.00	0.	0.	0.	166.	2864.
-2.11	0.	0.	0.	169.	2930.
-3.00	0.	0.	0.	184.	3468.
-4.00	0.	0.	0.	201.	4625.
-5.00	0.	0.	0.	218.	5712.
-5.50	0.	0.	0.	226.	6949.
-5.70	0.	47.	3.	229.	7429.
-6.00	0.	118.	7.	233.	7514.
-6.50	0.	237.	14.	240.	7513.
-6.52	0.	240.	14.	240.	7510.
-7.00	0.	355.	21.	247.	7440.
-8.00	0.	591.	34.	261.	6317.
-9.00	0.	828.	48.	275.	5068.
-10.00	0.	1065.	62.	288.	5057.

Page 5

Con_LW_Str_ST.out

-11.00	0.	1301.	75.	302.	5297.
-12.00	0.	1538.	89.	316.	5538.
-12.72	0.	1708.	99.	325.	5710.
-13.00	0.	1774.	103.	329.	5778.
-14.00	0.	2011.	117.	343.	6019.
-14.07	0.	2248.	130.	357.	6260.
-16.00	0.	2484.	144.	460.	6500.

Page 6

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                                Des1_LW_Str_LT.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                            BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:15

                            ****************
                            *  INPUT DATA  *
                            ****************

     I.--HEADING
    'MT. SINAI SEAWALL
    'LOW WATER; LONG TERM
    'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
    'STRUCTURAL; FS-1.00

    II.--CONTROL
       CANTILEVER WALL DESIGN
       FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
       FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.00

   III.--WALL DATA
       ELEVATION AT TOP OF WALL    = 4.00 FT.

    IV.--SURFACE POINT DATA

         IV.A.--RIGHTSIDE
            DIST. FROM     ELEVATION
            WALL (FT)         (FT)
                 0.00          3.00
                30.00          3.00

         IV.B.--LEFTSIDE
            DIST. FROM     ELEVATION
            WALL (FT)         (FT)
                 0.00         -5.50
                30.00         -5.50

     V.--SOIL LAYER DATA

        V.A.--RIGHTSIDE
            LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
            LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00    30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00    34.00    0.00    18.00    0.00                   DEF  DEF

        V.B.--LEFTSIDE
            LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
            LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00    30.00    0.00    16.00    0.00  -18.00   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -25.50   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -28.50   0.00   DEF  DEF
                                   Page 1
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                                   Des1_LW_Str_LT.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS

         VII.A.--VERTICAL LINE LOADS
              NONE

         VII.B.--VERTICAL UNIFORM LOADS
                   LEFTSIDE     RIGHTSIDE
                     (PSF)        (PSF)
                      0.00        100.00

         VII.C.--VERTICAL STRIP LOADS
              NONE

         VII.D.--VERTICAL RAMP LOADS
              NONE

         VII.E.--VERTICAL TRIANGULAR LOADS
              NONE

         VII.F.--VERTICAL VARIABLE LOADS
              NONE

    VIII.--HORIZONTAL LOADS
         NONE


 PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
 DATE: 28-JULY-2016                                          TIME: 9:52:17

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; LONG TERM
      'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
      'STRUCTURAL; FS-1.00

    II.--SOIL PRESSURES

         RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

                                   Page 2
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Des1_LW_Str_LT.out

ELEV. (FT)	NET WATER (PSF)	<---LEFTSIDE---> PASSIVE (PSF)	ACTIVE (PSF)	<------NET------> (SOIL + WATER) ACTIVE (PSF)	PASSIVE (PSF)	<--RIGHTSIDE---> ACTIVE (PSF)	PASSIVE (PSF)
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0+	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0-	0.0	0.0	0.0	30.0	517.4	30.0	517.4
2.0	0.0	0.0	0.0	62.1	1070.8	62.1	1070.8
1.0	0.0	0.0	0.0	95.3	1643.6	95.3	1643.6
0.0	0.0	0.0	0.0	128.5	2216.4	128.5	2216.4
-1.0	0.0	0.0	0.0	161.7	2789.2	161.7	2789.2
-2.0	0.0	0.0	0.0	194.9	3362.0	194.9	3362.0
-2.1	0.0	0.0	0.0	197.7	3410.9	197.7	3410.9
-3.0	0.0	0.0	0.0	213.3	3679.9	213.3	3679.9
-4.0	0.0	0.0	0.0	229.9	3966.2	229.9	3966.2
-5.0	0.0	0.0	0.0	246.5	4252.6	246.5	4252.6
-5.5	0.0	0.0	0.0	254.8	4395.8	254.8	4395.8
-5.7	0.0	47.3	2.7	204.3	3746.6	251.6	3749.3
-6.0	0.0	118.3	6.9	137.7	3331.0	256.0	3337.9
-6.5	0.0	236.6	13.7	42.7	4382.3	279.3	4396.0
-6.7	0.0	282.0	16.3	0.0	4422.6	282.0	4439.0
-7.0	0.0	354.9	20.6	-68.5	4487.4	286.4	4508.0
-8.0	0.0	591.5	34.3	-290.8	4697.7	300.6	4732.0
-9.0	0.0	828.0	48.0	-513.2	4908.0	314.8	4956.0
-10.0	0.0	1064.6	61.7	-735.5	5118.4	329.1	5180.1
-11.0	0.0	1301.2	75.4	-957.9	5328.7	343.3	5404.1
-12.0	0.0	1537.8	89.1	-1180.2	5539.0	357.5	5628.1
-13.0	0.0	1774.4	102.9	-1402.6	5749.3	371.8	5852.1
-14.0	0.0	2011.0	116.6	-1624.9	5959.6	386.0	6076.2
-15.0	0.0	2247.5	130.3	-1847.3	6169.9	400.2	6300.2
-16.0	0.0	2484.1	144.0	-2069.6	6380.2	414.5	6524.2
-16.2	0.0	2531.4	146.7	-2124.6	5189.6	406.9	5336.4
-17.0	0.0	2720.7	157.7	-2295.9	2617.0	424.8	2774.7
-18.0	0.0	2000.5	174.0	-1500.1	5541.5	500.4	5715.4
-19.0	0.0	1875.3	203.7	-1358.7	5694.4	516.7	5898.1
-20.0	0.0	2679.7	232.4	-2146.8	5848.1	532.9	6080.5
-21.0	0.0	2861.9	249.0	-2312.7	6013.7	549.2	6262.8
-22.0	0.0	3043.9	265.3	-2478.4	6179.6	565.5	6444.9
-23.0	0.0	3225.7	281.5	-2644.0	6345.4	581.7	6626.9
-23.7	0.0	3353.0	292.8	-2281.3	33479.8	1071.7	33772.6
-24.0	0.0	3407.5	297.7	-2309.6	36811.2	1097.8	37108.9
-25.0	0.0	3589.1	313.9	-3088.7	9371.9	500.4	9685.8
-25.5	0.0	7808.5	371.5	-7300.9	9459.0	507.6	9830.5
-26.0	0.0	9176.9	362.3	-8662.0	9612.9	514.8	9975.2
-26.7	0.0	5349.6	279.4	-4487.6	34248.4	862.0	34527.8
-27.0	0.0	5435.8	283.8	-4550.2	37243.8	885.6	37527.6
-28.0	0.0	5723.2	298.2	-5238.0	12531.9	485.2	12830.1
-28.5	0.0	10049.7	347.3	-9555.5	12716.6	494.2	13064.0
-29.0	0.0	12030.3	357.6	-11527.5	12940.3	502.7	13297.9
-30.0	0.0	7713.3	295.5	-7193.6	13470.4	519.7	13765.9
-31.0	0.0	8176.0	312.5	-7639.4	13921.7	536.6	14234.1
-32.0	0.0	8639.6	329.4	-8086.0	14373.2	553.6	14702.6
-33.0	0.0	9103.9	346.3	-8533.3	14824.9	570.5	15171.2
-34.0	0.0	9568.8	363.3	-8981.3	15276.7	587.5	15640.0
-35.0	0.0	10034.2	380.2	-9429.8	15728.8	604.4	16108.9
-36.0	0.0	10500.1	397.1	-9878.8	16180.9	621.3	16578.0

Page 3

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                                Des1_LW_Str_LT.out

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:17

                        ****************************
                        *  SUMMARY OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STRUCTURAL; FS-1.00

   II.--SUMMARY

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

   WALL BOTTOM ELEV. (FT)     :      -15.09
         PENETRATION (FT)     :        9.59

   MAX. BEND. MOMENT (LB-FT)  :  9.7206E+03
         AT ELEVATION (FT)    :      -10.36

   MAX. SCALED DEFL. (LB-IN^3):  1.6930E+09
         AT ELEVATION (FT)    :        4.00

             NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                    ELLASTICITY IN PSI TIMES PILE MOMENT
                    OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                    IN INCHES.


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:17

                        ****************************
                        * COMPLETE OF RESULTS FOR  *
                        *  CANTILEVER WALL DESIGN  *
                        ****************************

     I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'USUAL CONDITION; DESIGN 1; 50 PSF SURCHARGE
     'STRUCTURAL; FS-1.00

    II.--RESULTS

                   BENDING                          SCALED         NET
   ELEVATION       MOMENT          SHEAR          DEFLECTION     PRESSURE
      (FT)         (LB-FT)         (LB)           (LB-IN^3)       (PSF)
       4.00     0.0000E+00          0.            1.6930E+09        0.00
                                   Page 4
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Des1_LW_Str_LT.out

3.00+	8.7311E-11	0.	1.5631E+09	0.00
3.00-	-1.8966E-10	0.	1.5631E+09	30.04
2.00	2.0358E+01	46.	1.4332E+09	62.07
1.00	1.0298E+02	125.	1.3034E+09	95.27
0.00	2.8088E+02	237.	1.1737E+09	128.48
-1.00	5.8725E+02	382.	1.0446E+09	161.68
-2.00	1.0553E+03	560.	9.1646E+08	194.88
-2.11	1.1181E+03	582.	9.0246E+08	197.72
-3.00	1.7160E+03	764.	7.9019E+08	213.30
-4.00	2.5899E+03	986.	6.6693E+08	229.91
-5.00	3.6937E+03	1224.	5.4816E+08	246.51
-5.50	4.3370E+03	1350.	4.9106E+08	254.81
-5.70	4.6116E+03	1395.	4.6872E+08	204.26
-6.00	5.0385E+03	1447.	4.3582E+08	137.75
-6.50	5.7751E+03	1492.	3.8277E+08	42.68
-6.69	6.0621E+03	1496.	3.6304E+08	0.00
-7.00	6.5218E+03	1485.	3.3221E+08	-68.49
-8.00	7.9360E+03	1306.	2.3985E+08	-290.84
-9.00	9.0593E+03	904.	1.6116E+08	-513.20
-10.00	9.6694E+03	279.	9.8060E+07	-735.55
-11.00	9.5439E+03	-567.	5.1558E+07	-957.90
-12.00	8.4606E+03	-1636.	2.1411E+07	-1180.25
-13.00	6.1970E+03	-2928.	5.7130E+06	-1402.60
-13.52	4.4949E+03	-3681.	2.0635E+06	-1517.30
-14.00	2.6275E+03	-3842.	5.2373E+05	850.36
-15.00	2.5410E+01	-547.	3.1275E+01	5740.93
-15.09	0.0000E+00	0.	0.0000E+00	6189.20

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00+	0.	0.	0.	0.	0.
3.00-	0.	0.	0.	30.	517.
2.00	0.	0.	0.	62.	1071.
1.00	0.	0.	0.	95.	1644.
0.00	0.	0.	0.	128.	2216.
-1.00	0.	0.	0.	162.	2789.
-2.00	0.	0.	0.	195.	3362.
-2.11	0.	0.	0.	198.	3411.
-3.00	0.	0.	0.	213.	3680.
-4.00	0.	0.	0.	230.	3966.
-5.00	0.	0.	0.	247.	4253.
-5.50	0.	0.	0.	255.	4396.
-5.70	0.	47.	3.	252.	3749.
-6.00	0.	118.	7.	256.	3338.
-6.50	0.	237.	14.	279.	4396.
-6.69	0.	282.	16.	282.	4439.
-7.00	0.	355.	21.	286.	4508.
-8.00	0.	591.	34.	301.	4732.
-9.00	0.	828.	48.	315.	4956.
-10.00	0.	1065.	62.	329.	5180.
-11.00	0.	1301.	75.	343.	5404.
-12.00	0.	1538.	89.	358.	5628.
-13.00	0.	1774.	103.	372.	5852.

Page 5

Des1_LW_Str_LT.out

-13.52	0.	1896.	110.	379.	5968.
-14.00	0.	2011.	117.	386.	6076.
-15.00	0.	2248.	130.	400.	6300.
-15.09	0.	2484.	144.	414.	6524.
-16.20	0.	2531.	147.	407.	5336.

Page 6

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                                Des2_LW_Str_LT.out
PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                            BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:49

                            ****************
                            *  INPUT DATA  *
                            ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'USUAL CONDITION; DESIGN 2; HURRICANE
     'STRUCTURAL; FS-1.00

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.00

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00    30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00    34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00    30.00    0.00    16.00    0.00  -18.00   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -25.50   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -28.50   0.00   DEF  DEF
                                   Page 1
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                                   Des2_LW_Str_LT.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS
         NONE

    VIII.--HORIZONTAL LOADS

         VIII.A.--HORIZONTAL LINE LOADS
                  NONE

         VIII.B.--HORIZONTAL DISTRIBUTED LOADS
              ELEVATION    DIST. LOAD
                 (FT)         (PSF)
                 4.00         50.00
                 3.00         50.00
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:52:51

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; LONG TERM
      'USUAL CONDITION; DESIGN 2; HURRICANE
      'STRUCTURAL; FS-1.00

    II.--SOIL PRESSURES

         RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

         NET SOIL PRESSURES INCLUDE APPLIED HORIZONTAL DISTRIBUTED LOADS.

                                   <------NET------>
          NET    <---LEFTSIDE--->     (SOIL + WATER)     <--RIGHTSIDE--->
ELEV.    WATER   PASSIVE   ACTIVE    ACTIVE   PASSIVE    ACTIVE   PASSIVE
(FT)     (PSF)     (PSF)    (PSF)     (PSF)     (PSF)     (PSF)     (PSF)
  4.0     0.0       0.0      0.0      50.0      50.0       0.0       0.0
  3.0+    0.0       0.0      0.0      50.0      50.0       0.0       0.0
  3.0-    0.0       0.0      0.0       0.0       0.0       0.0       0.0
  2.0     0.0       0.0      0.0      33.2     572.8      33.2     572.8
  1.0     0.0       0.0      0.0      66.4    1145.6      66.4    1145.6
                                   Page 2
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Des2_LW_Str_LT.out

0.0	0.0	0.0	0.0	99.6	1718.3	99.6	1718.3
-1.0	0.0	0.0	0.0	132.8	2291.1	132.8	2291.1
-2.0	0.0	0.0	0.0	166.0	2863.9	166.0	2863.9
-2.1	0.0	0.0	0.0	168.8	2912.9	168.8	2912.9
-3.0	0.0	0.0	0.0	184.4	3181.8	184.4	3181.8
-4.0	0.0	0.0	0.0	201.0	3468.2	201.0	3468.2
-5.0	0.0	0.0	0.0	217.6	3754.6	217.6	3754.6
-5.5	0.0	0.0	0.0	225.9	3897.8	225.9	3897.8
-5.7	0.0	47.3	2.7	176.8	3367.7	224.1	3370.4
-6.0	0.0	118.3	6.9	110.7	3029.0	229.0	3035.9
-6.5	0.0	236.6	13.7	12.7	3910.6	249.3	3924.3
-6.6	0.0	250.1	14.5	0.0	3922.7	250.1	3937.2
-7.0	0.0	354.9	20.6	-98.5	4015.8	256.4	4036.4
-8.0	0.0	591.5	34.3	-320.8	4226.1	270.6	4260.4
-9.0	0.0	828.0	48.0	-543.2	4436.4	284.9	4484.4
-10.0	0.0	1064.6	61.7	-765.5	4646.7	299.1	4708.4
-11.0	0.0	1301.2	75.4	-987.9	4857.0	313.3	4932.5
-12.0	0.0	1537.8	89.1	-1210.2	5067.4	327.6	5156.5
-13.0	0.0	1774.4	102.9	-1432.6	5277.7	341.8	5380.5
-14.0	0.0	2011.0	116.6	-1654.9	5488.0	356.0	5604.5
-15.0	0.0	2247.5	130.3	-1877.3	5698.3	370.3	5828.6
-16.0	0.0	2484.1	144.0	-2099.6	5908.6	384.5	6052.6
-16.2	0.0	2531.4	146.7	-2152.9	4850.7	378.6	4997.4
-17.0	0.0	2720.7	157.7	-2323.1	2555.9	397.6	2713.6
-18.0	0.0	2000.5	174.0	-1534.2	5163.9	466.4	5337.9
-19.0	0.0	1875.3	203.7	-1392.7	5316.5	482.6	5520.2
-20.0	0.0	2679.7	232.4	-2180.8	5469.9	498.9	5702.3
-21.0	0.0	2861.9	249.0	-2346.7	5635.2	515.2	5884.3
-22.0	0.0	3043.9	265.3	-2512.5	5800.9	531.4	6066.2
-23.0	0.0	3225.7	281.5	-2678.1	5966.5	547.7	6248.0
-23.7	0.0	3353.0	292.8	-2361.4	30589.2	991.6	30882.0
-24.0	0.0	3407.5	297.7	-2392.7	33634.2	1014.7	33931.9
-25.0	0.0	3589.1	313.9	-3116.1	8828.3	473.0	9142.2
-25.5	0.0	7808.5	371.5	-7328.3	8915.3	480.2	9286.8
-26.0	0.0	9176.9	362.3	-8689.4	9069.1	487.4	9431.4
-26.7	0.0	5349.6	279.4	-4545.5	31610.6	804.1	31890.1
-27.0	0.0	5435.8	283.8	-4610.4	34371.9	825.4	34655.6
-28.0	0.0	5723.2	298.2	-5262.3	11870.0	460.9	12168.3
-28.5	0.0	10049.7	347.3	-9579.6	12054.3	470.1	12401.6
-29.0	0.0	12030.3	357.6	-11551.7	12277.6	478.6	12635.1
-30.0	0.0	7713.3	295.5	-7217.7	12806.9	495.6	13102.4
-31.0	0.0	8176.0	312.5	-7663.5	13257.4	512.5	13569.9
-32.0	0.0	8639.6	329.4	-8110.1	13708.2	529.4	14037.6
-33.0	0.0	9103.9	346.3	-8557.5	14159.3	546.4	14505.6
-34.0	0.0	9568.8	363.3	-9005.5	14610.6	563.3	14973.8
-35.0	0.0	10034.2	380.2	-9454.0	15062.1	580.2	15442.2
-36.0	0.0	10500.1	397.1	-9903.0	15513.7	597.1	15910.8

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS

DATE: 28-JULY-2016 TIME: 9:52:51

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****************************
*  SUMMARY OF RESULTS FOR  *
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Page 3

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                    Des2_LW_Str_LT.out
                 *  CANTILEVER WALL DESIGN  *
                 ****************************

 I.--HEADING
  'MT. SINAI SEAWALL
  'LOW WATER; LONG TERM
  'USUAL CONDITION; DESIGN 2; HURRICANE
  'STRUCTURAL; FS-1.00

II.--SUMMARY

     RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

     LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

WALL BOTTOM ELEV. (FT)      :      -14.38
      PENETRATION (FT)      :        8.88

MAX. BEND. MOMENT (LB-FT)   :  7.8957E+03
      AT ELEVATION (FT)     :       -9.93

MAX. SCALED DEFL. (LB-IN^3):  1.2672E+09
      AT ELEVATION (FT)     :        4.00

          NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                 ELLASTICITY IN PSI TIMES PILE MOMENT
                 OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                 IN INCHES.


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                        BY CLASSICAL METHODS
DATE: 28-JULY-2016                                      TIME: 9:52:51

                 ****************************
                 * COMPLETE OF RESULTS FOR  *
                 *  CANTILEVER WALL DESIGN  *
                 ****************************

 I.--HEADING
  'MT. SINAI SEAWALL
  'LOW WATER; LONG TERM
  'USUAL CONDITION; DESIGN 2; HURRICANE
  'STRUCTURAL; FS-1.00

II.--RESULTS

                BENDING                        SCALED        NET
ELEVATION       MOMENT          SHEAR        DEFLECTION    PRESSURE
   (FT)         (LB-FT)         (LB)         (LB-IN^3)      (PSF)
    4.00     0.0000E+00          0.          1.2672E+09      50.00
    3.00+    2.5000E+01         50.          1.1663E+09      50.00
    3.00-    2.5000E+01         50.          1.1663E+09       0.00
    2.00     8.0534E+01         67.          1.0655E+09      33.20
    1.00     1.6927E+02        116.          9.6481E+08      66.40
    0.00     3.2441E+02        199.          8.6443E+08      99.60
   -1.00     5.7915E+02        316.          7.6464E+08     132.81
   -2.00     9.6670E+02        465.          6.6586E+08     166.01
   -2.11     1.0189E+03        483.          6.5508E+08     168.85
   -3.00     1.5180E+03        641.          5.6877E+08     184.43
                                Page 4
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Des2_LW_Str_LT.out

-4.00	2.2537E+03	833.	4.7434E+08	201.03
-5.00	3.1903E+03	1043.	3.8383E+08	217.64
-5.50	3.7392E+03	1154.	3.4054E+08	225.94
-5.70	3.9742E+03	1194.	3.2366E+08	176.80
-6.00	4.3393E+03	1237.	2.9886E+08	110.68
-6.50	4.9675E+03	1268.	2.5907E+08	12.72
-6.56	5.0401E+03	1268.	2.5464E+08	0.00
-7.00	5.5984E+03	1246.	2.2141E+08	-98.46
-8.00	6.7586E+03	1037.	1.5362E+08	-320.81
-9.00	7.5979E+03	605.	9.7463E+07	-543.16
-10.00	7.8941E+03	-50.	5.4354E+07	-765.51
-11.00	7.4247E+03	-926.	2.4777E+07	-987.86
-12.00	5.9675E+03	-2025.	7.8870E+06	-1210.21
-12.87	3.7313E+03	-3159.	1.5897E+06	-1403.08
-13.00	3.3020E+03	-3304.	1.1348E+06	-793.63
-14.00	3.6710E+02	-1799.	8.1592E+03	3803.58
-14.38	0.0000E+00	0.	0.0000E+00	5568.73

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF
ELLASTICITY IN PSI TIMES PILE MOMENT
OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
IN INCHES.

III.--WATER AND SOIL PRESSURES

		<----------SOIL PRESSURES---------->			
	WATER	<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00	0.	0.	0.	0.	0.
2.00	0.	0.	0.	33.	573.
1.00	0.	0.	0.	66.	1146.
0.00	0.	0.	0.	100.	1718.
-1.00	0.	0.	0.	133.	2291.
-2.00	0.	0.	0.	166.	2864.
-2.11	0.	0.	0.	169.	2913.
-3.00	0.	0.	0.	184.	3182.
-4.00	0.	0.	0.	201.	3468.
-5.00	0.	0.	0.	218.	3755.
-5.50	0.	0.	0.	226.	3898.
-5.70	0.	47.	3.	224.	3370.
-6.00	0.	118.	7.	229.	3036.
-6.50	0.	237.	14.	249.	3924.
-6.56	0.	250.	14.	250.	3937.
-7.00	0.	355.	21.	256.	4036.
-8.00	0.	591.	34.	271.	4260.
-9.00	0.	828.	48.	285.	4484.
-10.00	0.	1065.	62.	299.	4708.
-11.00	0.	1301.	75.	313.	4932.
-12.00	0.	1538.	89.	328.	5156.
-12.87	0.	1743.	101.	340.	5351.
-13.00	0.	1774.	103.	342.	5381.
-14.00	0.	2011.	117.	356.	5605.
-14.38	0.	2248.	130.	370.	5829.
-16.00	0.	2484.	144.	385.	6053.

Page 5

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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:51:37

                            ****************
                            *  INPUT DATA  *
                            ****************

      I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STRUCTURAL; FS-1.00

     II.--CONTROL
        CANTILEVER WALL DESIGN
        FACTOR OF SAFETY FOR ACTIVE PRESSURES  = 1.00
        FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.00

    III.--WALL DATA
        ELEVATION AT TOP OF WALL    = 4.00 FT.

     IV.--SURFACE POINT DATA

          IV.A.--RIGHTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00          3.00
                 30.00          3.00

          IV.B.--LEFTSIDE
             DIST. FROM     ELEVATION
             WALL (FT)         (FT)
                  0.00         -5.50
                 30.00         -5.50

      V.--SOIL LAYER DATA

         V.A.--RIGHTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
120.00  115.00    30.00    0.00    16.00    0.00   -5.70   0.00   DEF  DEF
110.00  106.00    29.00    0.00    16.00    0.00  -16.20   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -23.70   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -26.70   0.00   DEF  DEF
132.00  126.00    34.00    0.00    18.00    0.00                   DEF  DEF

         V.B.--LEFTSIDE
             LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE  = DEFAULT
             LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = DEFAULT

                ANGLE OF         ANGLE OF                          <-SAFETY->
  SAT.   MOIST  INTERNAL  COH-     WALL    ADH-    <--BOTTOM-->  <-FACTOR->
 WGHT.   WGHT.  FRICTION  ESION  FRICTION  ESION   ELEV.  SLOPE  ACT. PASS.
 (PCF)   (PCF)    (DEG)   (PSF)    (DEG)   (PSF)   (FT)  (FT/FT)
110.00  106.00    30.00    0.00    16.00    0.00  -18.00   0.00   DEF  DEF
110.00  105.00    26.00    0.00    14.00    0.00  -25.50   0.00   DEF  DEF
115.00  110.00    31.00    0.00    17.00    0.00  -28.50   0.00   DEF  DEF
                                   Page 1
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                                   Con_LW_Str_LT.out
132.00  126.00    34.00    0.00    18.00    0.00                    DEF  DEF

      VI.--WATER DATA
         UNIT WEIGHT         = 62.50 (PCF)
         RIGHTSIDE ELEVATION = -2.11 (FT)
         LEFTSIDE ELEVATION  = -2.11 (FT)
         NO SEEPAGE

     VII.--VERTICAL SURCHARGE LOADS

         VII.A.--VERTICAL LINE LOADS
              NONE

         VII.B.--VERTICAL UNIFORM LOADS
                  NONE

         VII.C.--VERTICAL STRIP LOADS

              VII.C.1.--RIGHTSIDE
              <-DIST. FROM WALL->
                START       END      STRIP LOAD
                 (FT)       (FT)        (PSF)
                15.00      30.00       500.00

              VII.C.2.--LEFTSIDE
                  NONE

         VII.D.--VERTICAL RAMP LOADS
              NONE

         VII.E.--VERTICAL TRIANGULAR LOADS
              NONE

         VII.F.--VERTICAL VARIABLE LOADS
              NONE

    VIII.--HORIZONTAL LOADS
         NONE
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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                        TIME: 9:51:39

                          **************************
                          *   SOIL PRESSURES FOR   *
                          * CANTILEVER WALL DESIGN *
                          **************************

     I.--HEADING
      'MT. SINAI SEAWALL
      'LOW WATER; LONG TERM
      'UNUSUAL CONDITION; CONSTRUCTION
      'STRUCTURAL; FS-1.00

                                     Page 2
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Con_LW_Str_LT.out

II.--SOIL PRESSURES

RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

ELEV. (FT)	NET WATER (PSF)	<---LEFTSIDE---> PASSIVE (PSF)	ACTIVE (PSF)	<------NET------> (SOIL + WATER) ACTIVE (PSF)	PASSIVE (PSF)	<--RIGHTSIDE---> ACTIVE (PSF)	PASSIVE (PSF)
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	33.2	572.8	33.2	572.8
1.0	0.0	0.0	0.0	66.4	1145.6	66.4	1145.6
0.0	0.0	0.0	0.0	99.6	1718.3	99.6	1718.3
-1.0	0.0	0.0	0.0	132.8	2291.1	132.8	2291.1
-2.0	0.0	0.0	0.0	166.0	2863.9	166.0	2863.9
-2.1	0.0	0.0	0.0	168.8	2929.6	168.8	2929.6
-3.0	0.0	0.0	0.0	184.4	3468.5	184.4	3468.5
-4.0	0.0	0.0	0.0	201.0	4625.0	201.0	4625.0
-5.0	0.0	0.0	0.0	217.6	5712.5	217.6	5712.5
-5.5	0.0	0.0	0.0	225.9	6949.5	225.9	6949.5
-5.7	0.0	47.3	2.7	176.8	5973.8	224.1	5976.6
-6.0	0.0	118.3	6.9	110.7	5188.4	229.0	5195.2
-6.5	0.0	236.6	13.7	12.7	7349.7	249.3	7363.4
-6.6	0.0	250.1	14.5	0.0	7334.0	250.1	7348.5
-7.0	0.0	354.9	20.6	-98.5	7212.6	256.4	7233.1
-8.0	0.0	591.5	34.3	-320.8	6307.5	270.6	6341.7
-9.0	0.0	828.0	48.0	-543.2	5068.8	284.9	5116.8
-10.0	0.0	1064.6	61.7	-765.5	4717.2	299.1	4778.9
-11.0	0.0	1301.2	75.4	-987.9	4889.5	313.3	4964.9
-12.0	0.0	1537.8	89.1	-1210.2	5092.3	327.6	5181.5
-13.0	0.0	1774.4	102.9	-1432.6	5307.5	341.8	5410.3
-14.0	0.0	2011.0	116.6	-1654.9	5528.1	356.0	5644.6
-15.0	0.0	2247.5	130.3	-1859.7	5747.4	387.8	5877.7
-16.0	0.0	2484.1	144.0	-2008.0	5923.9	476.1	6067.9
-16.2	0.0	2531.4	146.7	-2044.0	4814.5	487.5	4961.2
-17.0	0.0	2720.7	157.7	-2194.0	2455.3	526.7	2613.0
-18.0	0.0	2000.5	174.0	-1409.6	5208.3	590.9	5382.2
-19.0	0.0	1875.3	203.7	-1268.4	5365.9	607.0	5569.5
-20.0	0.0	2679.7	232.4	-2056.7	5523.9	623.0	5756.3
-21.0	0.0	2861.9	249.0	-2222.9	5623.0	639.0	5872.1
-22.0	0.0	3043.9	265.3	-2387.6	5682.0	656.2	5947.2
-23.0	0.0	3225.7	281.5	-2547.3	5811.6	678.4	6093.1
-23.7	0.0	3353.0	292.8	-2195.0	30106.0	1157.9	30398.8
-24.0	0.0	3407.5	297.7	-2224.0	33097.5	1183.4	33395.2
-25.0	0.0	3589.1	313.9	-2984.7	8582.7	604.4	8896.6
-25.5	0.0	7808.5	371.5	-7196.6	8667.7	611.9	9039.2
-26.0	0.0	9176.9	362.3	-8558.0	8843.8	618.9	9206.1
-26.7	0.0	5349.6	279.4	-4380.9	32947.4	968.7	33226.9
-27.0	0.0	5435.8	283.8	-4445.2	35912.8	990.6	36196.5
-28.0	0.0	5723.2	298.2	-5144.8	11905.5	578.4	12203.7
-28.5	0.0	10049.7	347.3	-9463.5	12148.9	586.2	12496.2
-29.0	0.0	12030.3	357.6	-11433.3	12540.1	596.9	12897.7
-30.0	0.0	7713.3	295.5	-7089.4	13286.4	623.8	13581.9
-31.0	0.0	8176.0	312.5	-7530.8	13758.8	645.2	14071.3
-32.0	0.0	8639.6	329.4	-7978.1	14368.9	661.4	14698.3
-33.0	0.0	9103.9	346.3	-8426.2	14958.4	677.7	15304.7
-34.0	0.0	9568.8	363.3	-8874.8	15192.3	693.9	15555.6
-35.0	0.0	10034.2	380.2	-9324.0	15418.7	710.2	15798.9
-36.0	0.0	10500.1	397.1	-9777.6	15776.3	722.5	16173.4

Page 3

Con_LW_Str_LT.out

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PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:51:39

                      ****************************
                      *  SUMMARY OF RESULTS FOR  *
                      *  CANTILEVER WALL DESIGN  *
                      ****************************

    I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STRUCTURAL; FS-1.00

   II.--SUMMARY

        RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

        LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

   WALL BOTTOM ELEV. (FT)     :      -14.16
         PENETRATION (FT)     :        8.66

   MAX. BEND. MOMENT (LB-FT)  :  7.2256E+03
         AT ELEVATION (FT)    :       -9.87

   MAX. SCALED DEFL. (LB-IN^3):  1.1117E+09
         AT ELEVATION (FT)    :        4.00

             NOTE:  DIVIDE SCALED DEFLECTION MODULUS OF
                    ELLASTICITY IN PSI TIMES PILE MOMENT
                    OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
                    IN INCHES.


PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
                          BY CLASSICAL METHODS
DATE: 28-JULY-2016                                          TIME: 9:51:39

                      ****************************
                      * COMPLETE OF RESULTS FOR  *
                      *  CANTILEVER WALL DESIGN  *
                      ****************************

     I.--HEADING
     'MT. SINAI SEAWALL
     'LOW WATER; LONG TERM
     'UNUSUAL CONDITION; CONSTRUCTION
     'STRUCTURAL; FS-1.00

    II.--RESULTS
                                   Page 4
```

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ELEVATION (FT)	BENDING MOMENT (LB-FT)	SHEAR (LB)	SCALED DEFLECTION (LB-IN^3)	NET PRESSURE (PSF)
4.00	0.0000E+00	0.	1.1117E+09	0.00
3.00	4.3656E-11	0.	1.0238E+09	0.00
2.00	5.5336E+00	17.	9.3580E+08	33.20
1.00	4.4269E+01	66.	8.4787E+08	66.40
0.00	1.4941E+02	149.	7.6002E+08	99.60
-1.00	3.5415E+02	266.	6.7245E+08	132.81
-2.00	6.9170E+02	415.	5.8551E+08	166.01
-2.11	7.3836E+02	433.	5.7600E+08	168.85
-3.00	1.1930E+03	591.	4.9978E+08	184.43
-4.00	1.8787E+03	783.	4.1614E+08	201.03
-5.00	2.7653E+03	993.	3.3578E+08	217.64
-5.50	3.2892E+03	1104.	2.9730E+08	225.94
-5.70	3.5142E+03	1144.	2.8229E+08	176.80
-6.00	3.8643E+03	1187.	2.6023E+08	110.68
-6.50	4.4675E+03	1218.	2.2484E+08	12.72
-6.56	4.5372E+03	1218.	2.2091E+08	0.00
-7.00	5.0734E+03	1196.	1.9137E+08	-98.46
-8.00	6.1836E+03	987.	1.3127E+08	-320.81
-9.00	6.9729E+03	555.	8.1802E+07	-543.16
-10.00	7.2191E+03	-100.	4.4307E+07	-765.51
-11.00	6.6997E+03	-976.	1.9176E+07	-987.86
-12.00	5.1925E+03	-2075.	5.4799E+06	-1210.21
-12.73	3.3556E+03	-3011.	1.2808E+06	-1371.43
-13.00	2.4926E+03	-3206.	5.8239E+05	-44.21
-14.00	6.9292E+01	-836.	2.6581E+02	4783.16
-14.16	0.0000E+00	0.	0.0000E+00	5563.53

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELLASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

ELEVATION (FT)	WATER PRESSURE (PSF)	<----------SOIL PRESSURES----------> <----LEFTSIDE-----> PASSIVE (PSF)	ACTIVE (PSF)	<---RIGHTSIDE----> ACTIVE (PSF)	PASSIVE (PSF)
4.00	0.	0.	0.	0.	0.
3.00	0.	0.	0.	0.	0.
2.00	0.	0.	0.	33.	573.
1.00	0.	0.	0.	66.	1146.
0.00	0.	0.	0.	100.	1718.
-1.00	0.	0.	0.	133.	2291.
-2.00	0.	0.	0.	166.	2864.
-2.11	0.	0.	0.	169.	2930.
-3.00	0.	0.	0.	184.	3468.
-4.00	0.	0.	0.	201.	4625.
-5.00	0.	0.	0.	218.	5712.
-5.50	0.	0.	0.	226.	6949.
-5.70	0.	47.	3.	224.	5977.
-6.00	0.	118.	7.	229.	5195.
-6.50	0.	237.	14.	249.	7363.
-6.56	0.	250.	14.	250.	7348.
-7.00	0.	355.	21.	256.	7233.
-8.00	0.	591.	34.	271.	6342.
-9.00	0.	828.	48.	285.	5117.
-10.00	0.	1065.	62.	299.	4779.
-11.00	0.	1301.	75.	313.	4965.

Page 5

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-12.00	0.	1538.	89.	328.	5181.
-12.73	0.	1709.	99.	338.	5347.
-13.00	0.	1774.	103.	342.	5410.
-14.00	0.	2011.	117.	356.	5645.
-14.16	0.	2248.	130.	388.	5878.
-16.00	0.	2484.	144.	476.	6068.

Page 6

Attachment C – (Vertical Road Relocation)

MT. SINAI - VERTICAL ROAD RELOCATION ALTERNATIVE

CAP Project – Mount Sinai - Vertical Road Relocation Simplified Quantity Estimate			
General Road Properties	**Quantity**	**Unit of Measure**	**Assumptions**
Road Length	1310	FT	1230 ft of new road construction. 4*20' of road transition to existing roads
Road Width - Finish Pavement	20	FT	
Road Width - Subgrade	25	FT	
Sidewalk Length	1000	FT	Sidewalk is constructed between raised road and existing seawall to help control erosion
Sidewalk Width - Finish Pavement	8	FT	
Sidewalk Width - Subgrade	10	FT	
Existing infrastructure	NA		Existing infrastructure (lights, electric lines, gates, gatehouses, etc) will not be impacted by construction
Items to Cost	**Quantity**	**Unit of Measure**	**Assumptions**
Demolition - Existing Pavement	2910	SY	
Demolition - Existing Curb and Gutter	2620	LF	
Demolition - Existing Storm Grates	2	EA	
Demolition - Existing Culverts	100	LF	
Imported Fill Material - Aggregate Base - Road	3640	Tons	
Imported Fill Material - Aggregate Base - Sidewalk	1110	Tons	
Pavement - Road - Asphalt - 2" thick	2910	SY	
Pavement - Curb and Gutter - Concrete	2620	LF	
Pavement - Sidewalk - Concrete	8000	SF	
Storm Grates - 2' x 20'	2	EA	
Storm Grates - 3' x 3'	8	EA	
Culvert Junction Box - Concrete - 3' Diameter, 2' Height	2	EA	
Culvert - 15" RCP	760	LF	
Traffic Control	1	EA	
Erosion Control	1	EA	

CAP Project - Mt Sinai - Vertical Road Relocation			
Seawall Improvements			
Simplified Quantity Estimate			
General Seawall Properties	**Quantity**	**Unit of Measure**	**Assumptions**
Length of Seawall receiving rip rap protection	1000		
Items to Cost	**Quantity**	**Unit of Measure**	**Assumptions**
Demolition - create penetrations in existing seawall for drainage culvert installation	8	EA	
Ocean side rip rap protection of existing seawall (200 lb rip rap)	420	Tons	3' tall, 5' wide triangular protection against existing seawall, 1.5 Tons/CY

APPENDIX B
Project Cost Abbreviated Risk Analysis Report

MOUNT SINAI MEDICAL CENTER, CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

May 2017

US Army Corps of Engineers ®
Jacksonville District

US Army Corps of Engineers®

Mount Sinai Medical Center, City of Miami Beach, Florida

CAP Section 14 – Emergency Streambank and Shoreline Project

Project Cost Abbreviated Risk Analysis Report

Prepared by:

U.S. Army Corps of Engineers
Jacksonville District

May 2017

Table of Contents

EXECUTIVE SUMMARY.....ES-1
MAIN REPORT 1
1.0 PURPOSE..... 1
2.0 BACKGROUND..... 1
3.1 REPORT SCOPE..... 1
3.2 Project Scope 1
4.1 ABBREVIATED RISK ANALYSIS METHODOLOGY/PROCESS 3
4.2 Identify and Assess Risk Factors..... 3
5.0 KEY ASSUMPTIONS AND LIMITATIONS..... 3
6.1 RESULTS..... 4
6.2 Risk Register 4
6.3 Cost Contingency 4

LIST OF APPENDICES

Appendix A – Total Project Cost Summary (TPCS) 5

EXECUTIVE SUMMARY

This Abbreviated Risk Analysis (ARA) Report has been completed by the US Army Corps of Engineers (USACE), Jacksonville District. The ARA was developed with tools provided by the Cost Engineering Mandatory Center of Expertise (MCX) for Civil Works. The ARA was reviewed internally by Jacksonville District Cost Engineering before being presented for Agency Technical Review (ATR). This report presents a recommendation for the total project cost contingency for cost certification of the MT. Sinai Medical Center for Emergency Streambank and Shoreline Protection. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016, an abbreviated risk analysis study was conducted for the development of the contingency to be applied to the total project cost. The purpose of this risk analysis was to establish a project contingency by identifying and measuring the cost impact of project uncertainties with respect to the estimated total project cost.

Specific to Mount Sinai, the most likely total first cost (at current price level) is at approximately $6,300K. Based on the results of the analysis, the Jacksonville District recommends a contingency value of approximately $1,239K or 31% for construction costs; $91K or 17% for Planning, Engineering, and Design costs; and $68K or 23% for Construction Management costs for a combine contingency of 29%. An ARA was developed to model the remaining work concerning scope growth, potential for mods and claims, and other concerns as seen in the risk register.

The Jacksonville District Cost Engineering Section performed the abbreviate risk analysis for this project and it has been internally reviewed, as required, via the ATR process.

MAIN REPORT

1.0 PURPOSE

This report presents a recommendation for the total project cost contingencies for the cost certification of the Mount Sinai Medical Center Project.

2.0 BACKGROUND

This estimate is primarily based upon the September 2016 Final Feasibility Report, for assistance on the emergencies streambank and shoreline protection to protect the Mount Sinai Medical Center located in the City of Miami Beach, Florida.

The Mount Sinai Medical Center is a private non-profit hospital and is considered an eligible facility for Section 14 according to ER 1105-2-100, Appendix F, page F-30. **Furthermore, the Center's facilities have been properly maintained but are in imminent threat of damage by natural erosion processes on the shoreline.**

The project area is located in the City of Miami Beach, Florida, on a barrier island bordered to the east by the Atlantic Ocean and to the west by Biscayne Bay. The study area is the property of Mount Sinai Medical Center, located directly north of Julia Tuttle Causeway and extending approximately 0.57 miles along the bayside of the island. Refer to main report for more information.

The estimate is based on the new construction of 3,070 lineal ft of seawall, 300 lineal ft of concrete wall, and the raising of 1.5 ft an existing seawall segment (130 lineal feet). The final elevation is 4.0 ft (NAVD88).The alternative is known in the Feasibility Report as alternative 2. The project is under the Continuing Authorities Program Section 14 with the intent of protect the property of Mount Sinai Medical Center.

3.1 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost contingency at the 80% 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 cost risks for all remaining project features. The study and presentation does not include consideration for life cycle costs.

3.2 Project Scope

The recommended plan consists on the construction of 3,070 ft long of Seawall along alignment of the existing Seawall on the water side. At the land side the recommended plan consist on the construction of 300 ft long concrete T-wall. The combination of new seawall, raise concrete cap of existing seawall and build new the T-wall will allow the contractor to complete the project from the land side only.

A. Sea Wall:

1. 3,070 L-ft of Steel Sheet Pile (PZC-13).
   a. Installation of 21,142 Vertical Linear Feet (Driven 16 ft of 25 ft Long Sheet piles).
   b. 833 TON of Sheet Pile (PZC-13).
   c. 3 ft offset between existing wall and new sheet pile to be filled with stone.
   d. 3,377 cubic yards (cy) of Backfill – #57 Limestone.

2. 2 ft x 1 ft concrete cap. Elevation of 4.0 ft (NAVD88).
   a. 239 cy concrete.

3. Assumed to be install 100% from land.
4. Drainage feature.
5. 10 lf of PVC pipe extension 12 inches diameter.

B. Raise Concrete Cap of Existing Sea Wall:

1. 1.5 ft concrete lift to a 130 L-ft of newer existing seawall segment. Final concrete cap dimension are 2 ft wide x 1.5 ft raise x 130 ft long. Estimate 15 cy of concrete.

C. T-wall:

1. 300 L-ft of concrete T-wall at the North East of the property.
2. 1,600 sf - Clearing and Grubbing.
3. 134 ECY – Excavation.
4. 100 cy Concrete.
5. Debris Removal – Site clean-up.

D. Project Assumption used for the cost estimate:

1. The estimate assigns a Heavy Civil contractor as the Prime.
2. Unusually lengthy distances for mobilization/demobilization will not be necessary.
3. Assumed that construction will be completed 100% from land.
4. Only one (1) pipe, assumed clay, needs to be extended through the sheet pile. Max diameter assumed as 12”.
5. Contractor will have space to build the new seawall but they will need to maintain a traffic control plan to allow continue access to the Hospital.
6. The contractor will be able to use space from the west parking lot as the staging area.
7. Fuel and steel are considerate as volatile cost items.
8. The construction will be affected by weather conditions.
9. Any deviations from these assumptions will impact costs. The magnitude of those impacts will vary.

E. Construction sequence:

1. Mobilization
2. Sheet pile drive (New Seawall)
3. Raise concrete cap; T-wall; concrete cap for the new seawall
4. Site clean up

5. Demobilization
6. The estimated construction duration for this project is 260 calendars days. This estimate include weather delays and material procurements.

4.1 ABBREVIATED RISK ANALYSIS METHODOLOGY/PROCESS

The risk analysis process for this estimate is intended to determine the probability of various cost outcomes and to quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. In simple terms, contingency is an amount added to an estimate 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.

Contingency for the cost estimate has been developed using materials provided by the USACE Cost Center of Expertise located in Walla Walla District. The cost estimator assigned risk factors based upon the project Work Breakdown Structure. The contingency was developed using a condensed format since the total project cost is below the threshold for completing a Cost and Schedule Risk Analysis. The contingency was primarily affected by the weight of mostly likely and possible risks with regards to utilities, ramps, and levee work. Their impacts ranged from marginal to significant.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 5.

4.2 Identify and Assess Risk Factors

Identifying risk factors is considered a qualitative process that results in establishing a risk register that serves as the basis for the resulting contingency percentage. 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. A risk brainstorming session was conducted September 22, 2016, to discuss all possible risks and impacts. The Project Delivery Team (PDT) attendees are listed on the PDT Involvement tab of the ARA spreadsheet.

Contingency is analyzed using formulas within the spreadsheet, as opposed to the more complex analysis of the Crystal Ball software's Monte Carlo simulations used in a formal cost and schedule risk analysis. Contingencies are calculated according to the likelihood and impact of each factor identified in the risk register.

5.1 KEY ASSUMPTIONS AND LIMITATIONS

Key assumptions and limitations are those that are most likely to significantly affect the determinations of contingency presented in the CSRA. The key assumptions and limitations are important to help ensure that project leadership and other decision makers understand the steps, logic, and decisions made in the risk analysis, as well as any resultant implications on the use of outcomes and results.

A. The key assumption for this project are:

1. Construction will be completed 100% from land.
2. The contractor could encounter utilities that have not been identified during the feasibility study.
3. Contractor will have space to build the new seawall but they will need to maintain a traffic control plan to allow continue access to the Hospital.
4. Fuel and steel are considerate as volatile cost items.
5. The construction will be affected by weather conditions.

6.1 RESULTS

6.2 Risk Register

An abbreviated risk register is a tool commonly used in project planning and risk analysis. It is important to note that a risk register can be an effective tool for managing 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.

Specific to this abbreviated risk register, it should be noted that there are events reported in the register, but not included in the calculations. That is, the risk register shows the risk events, but they do not contribute to the contingency calculations. In a formal risk analysis, such a practice is commonly used on risks/opportunity events with a Low Risk Level (typical for cost and schedule events with some combination of, for example, Very Unlikely/Unlikely Likelihoods and Negligible/Marginal Impacts). These are documented, but excluded from the calculations in order to better prevent skewed results. Under Risk Level, these show with a Zero (0).

As mentioned in the Executive Summary, tools/materials from the MCX were used throughout the process of acknowledging this risk, trying to account for it, running into the calculation issue, and coming up with the resolution.

During the evaluation of the risk register the PDT identified various concern that could have an impact on the project cost, schedule or a combination both. The high risk level identified was level 3. The risk level scale is 1 for low risk up to 5 for high risk. The common concern for this project is the limited available information of the existing features and utilities that could require modify the current scope of work based on quantities and final material use for the construction. Refer to Appendix A for more details about the Risk Register.

6.3 Cost Contingency

The contingency was calculated based off the likelihood and impact of the risk concerns. Some of the major areas of concern were seen under the Construction Elements and External Project Risks categories. For example, the risks for Utilities could have a significant impact on the cost, as there has been a history of issues pertaining to Utilities for this project area.

APPENDIX A – TOTAL PROJECT COST SUMMARY

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 446835

SAJ Mt Sinai Medical Center Section 14

The Mt Sinai Medical Center Section 14 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 May 8, 2017, the Cost MCX certifies the estimated total project cost:

FY 17 Project First Cost:	$6,300,000
Total Project Cost:	$6,510,000
Estimated Federal Cost:	$4,495,000

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 project life.

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Date: 2017.05.08 11:08:35 -07'00'

FOR: **Kim C. Callan, PE, CCE, PM**
Chief, Cost Engineering MCX
Walla Walla District

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: **Mount Sinai Medical Center (MSMC) - CAP - Section 14**
PROJECT NO: **446835**
LOCATION: **City od Miami Beach, Florida**

DISTRICT: **SAJ, Jacksonville**
PREPARED: **5/1/2017**
POC: **CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM**

This Estimate reflects the scope and schedule in report; CAP Feasibility STUDY

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
								Program Year (Budget EC):		2017					
								Effective Price Level Date:		1-Oct- 16					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2016 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
10	BREAKWATER & SEAWALLS	$3,858	$1,204	31%	$5,062	1.1%	$3,901	$1,218	$5,119		$5,119	3.2%	$4,027	$1,257	$5,285
11	LEVEES & FLOODWALLS	$66	$21	31%	$87	2.4%	$68	$21	$89		$89	3.2%	$70	$22	$92
	CONSTRUCTION ESTIMATE TOTALS:	$3,924	$1,225		$5,149	1.1%	$3,969	$1,239	$5,208		$5,208	3.2%	$4,097	$1,279	$5,376
01	LANDS AND DAMAGES	$72	$11	15%	$83	3.0%	$74	$11	$85		$85	1.6%	$75	$11	$87
30	PLANNING, ENGINEERING & DESIGN	$531	$89	17%	$620	2.7%	$545	$91	$637		$637	3.2%	$563	$94	$657
31	CONSTRUCTION MANAGEMENT	$294	$66	23%	$360	2.7%	$302	$68	$370		$370	5.6%	$319	$72	$391
	PROJECT COST TOTALS:	$4,821	$1,391	29%	$6,212		$4,890	$1,410	$6,300		**$6,300**	3.3%	$5,054	$1,457	$6,510

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CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM

PROJECT MANAGER, ELIZABETH FIOCCHI

CHIEF, REAL ESTATE, AUDREY ORMERO

CHIEF, PLANNING, ERIC SUMMA

CHIEF, ENGINEERING, LAUREEN BOROCHANER

CHIEF, OPERATIONS, CANDIDA BRONSON

CHIEF, CONSTRUCTION, STEPHEN DUBA

CHIEF, CONTRACTING, TIMOTHY BLACK

CHIEF, PM-PB, KAREN SMITH

CHIEF, DPM, TIM MURPHY

ESTIMATED TOTAL PROJECT COST:		**$6,510**
ESTIMATED FEDERAL COST:	65%	$4,232
ESTIMATED NON-FEDERAL COST:	35%	$2,279
22 - FEASIBILITY STUDY (CAP studies):		**$425**
ESTIMATED FEDERAL COST:		$263
ESTIMATED NON-FEDERAL COST:		$162
ESTIMATED FEDERAL COST OF PROJECT		**$4,495**

Filename: MT Sinai TPCS updated 01MAY17.xlsx
TPCS

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 446835

SAJ Mt Sinai Medical Center Section 14

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Date: 2017.05.08 11:08:35 -07'00'

FOR: **Kim C. Callan, PE, CCE, PM**
Chief, Cost Engineering MCX
Walla Walla District

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: **Mount Sinai Medical Center (MSMC) - CAP - Section 14**
PROJECT NO: **446835**
LOCATION: **City od Miami Beach, Florida**

DISTRICT: **SAJ, Jacksonville**
PREPARED: **5/1/2017**
POC: **CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM**

This Estimate reflects the scope and schedule in report; CAP Feasibility STUDY

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
								Program Year (Budget EC):		2017					
								Effective Price Level Date:		1-Oct- 16					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2016 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
10	BREAKWATER & SEAWALLS	$3,858	$1,204	31%	$5,062	1.1%	$3,901	$1,218	$5,119		$5,119	3.2%	$4,027	$1,257	$5,285
11	LEVEES & FLOODWALLS	$66	$21	31%	$87	2.4%	$68	$21	$89		$89	3.2%	$70	$22	$92
	CONSTRUCTION ESTIMATE TOTALS:	$3,924	$1,225		$5,149	1.1%	$3,969	$1,239	$5,208		$5,208	3.2%	$4,097	$1,279	$5,376
01	LANDS AND DAMAGES	$72	$11	15%	$83	3.0%	$74	$11	$85		$85	1.6%	$75	$11	$87
30	PLANNING, ENGINEERING & DESIGN	$531	$89	17%	$620	2.7%	$545	$91	$637		$637	3.2%	$563	$94	$657
31	CONSTRUCTION MANAGEMENT	$294	$66	23%	$360	2.7%	$302	$68	$370		$370	5.6%	$319	$72	$391
	PROJECT COST TOTALS:	$4,821	$1,391	29%	$6,212		$4,890	$1,410	$6,300		**$6,300**	3.3%	$5,054	$1,457	$6,510

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CHIEF, COST ENGINEERING, MATTHEW CUNNINGHAM

PROJECT MANAGER, ELIZABETH FIOCCHI

CHIEF, REAL ESTATE, AUDREY ORMERO

CHIEF, PLANNING, ERIC SUMMA

CHIEF, ENGINEERING, LAUREEN BOROCHANER

CHIEF, OPERATIONS, CANDIDA BRONSON

CHIEF, CONSTRUCTION, STEPHEN DUBA

CHIEF, CONTRACTING, TIMOTHY BLACK

CHIEF, PM-PB, KAREN SMITH

CHIEF, DPM, TIM MURPHY

ESTIMATED TOTAL PROJECT COST:		**$6,510**
ESTIMATED FEDERAL COST:	65%	$4,232
ESTIMATED NON-FEDERAL COST:	35%	$2,279
22 - FEASIBILITY STUDY (CAP studies):		**$425**
ESTIMATED FEDERAL COST:		$263
ESTIMATED NON-FEDERAL COST:		$162
ESTIMATED FEDERAL COST OF PROJECT		**$4,495**

APPENDIX C
PERTINENT CORRESPONDENCE

MOUNT SINAI MEDICAL CENTER, CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

May 2017

US Army Corps of Engineers ®
Jacksonville District

MIAMIBEACH

City of Miami Beach, 1700 Convention Center Drive, Miami Beach, Florida 33139, www.miamibeachfl.gov

Jimmy L. Morales, City Manager
Tel: 305-673-7010, Fax: 305-673-7782

April 14, 2014

Lieutenant Colonel Thomas M. Greco
Deputy District Commander
U. S. Army Corps of Engineers District, South Florida
ATTN: Planning Branch

RE: CITY OF MIAMI BEACH'S INTENT TO SERVE AS NON-FEDERAL SPONSOR PERTAINING TO MOUNT SINAI MEDICAL CENTER OF FLORIDA, INC.'S APPLICATION FOR UNDER THE CONTINUING AUTHORITIES PROGRAM (CAP)

Dear LTC Greco:

I am writing with regard to a request from Mount Sinai Medical Center (MSMC) for assistance from the U. S. Army Corps of Engineers (the Corps) in addressing a serious potential flooding problem adjacent to its campus, which is located on the inter-coastal waterway in Miami Beach. At its meeting on April 9, 2014, the Mayor and City Commission adopted City Resolution No. 2014-28535, authorizing the City of Miami Beach, Florida (the City) to serve as the "non-Federal" project sponsor, as required under the Continuing Authorities Program (CAP).

You recently received a letter from MSMC Chief Executive Officer Steven Sonenreich explaining that the seawall adjacent to the MSMC campus is in serious need of repair to mitigate against damage from anticipated severe weather events. MSMC is the only hospital in the City and supports emergency operational functions during hurricanes and other major storm events. The protection afforded by the seawall in question is critical to avoid service disruptions and hazardous conditions that threaten the lives of patients, hospital staff, and residents who are unable to evacuate during a storm emergency and seek shelter at MSMC.

In its current state, the seawall would most certainly not provide sufficient protection during a hurricane. I respectfully request that the Corps perform a site visit to examine the seawall and evaluate the merit of this request for assistance.

The City is fully aware of the following non-federal requirements associated with the Section 103, Section 14 or Section 205 programs under which we understand the Corps could perform this project:

1. Feasibility Phase: The initial $100,000 of cost, if funded by the Federal government. Costs above $100,000 will be shared 50% Federal and 50% non-Federal in accordance with a Feasibility Cost-Sharing Agreement;

2. Implementation Phase: The non-Federal sponsor is responsible for costs of all lands, easements, relocations and disposal areas, plus a cash contribution of at least 5% of the

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total project cost. If this amount is less than 35% of the total project cost, the non-Federal sponsor must provide additional cash contribution to make the total equal to 35% of the total project cost; and

3. The non-Federal sponsor is responsible for the removal of all hazardous, toxic and radioactive wastes prior to construction and for all operations and maintenance of the project after it is constructed.

This letter serves as an expression of non-Federal intent to cooperate on this project and is not a contract obligation. Either party may discontinue this effort at any point prior to construction.

Thank you for your consideration. I look forward to hearing from you.

Sincerely,

Jimmy Morales
City Manager
City of Miami Beach

04/14/2014 16:57 FAX 3056737255 INFORMATION TECHNOLOGY 001

Mount Sinai
MEDICAL CENTER

January 13, 2014

Lieutenant Colonel Thomas M. Greco
Deputy District Commander
U.S. Army Corps of Engineers District, South Florida
4400 PGA Blvd., Suite 203
Palm Beach Gardens, FL 33410

ATTN: Planning Branch

Dear LTC Greco:

The purpose of this letter is to request the assistance for Mount Sinai Medical Center, located on the intercoastal waterway in Miami Beach. Mount Sinai is the only hospital and emergency services provider in Miami Beach. Built on submerged land in 1959, the hospital's seawall and adjacent infrastructure is located in a Special Hazard Flood Zone with an aggressively rising sea.

Mount Sinai has mitigated over $30 million dollars in property because of Hurricanes Katrina and Wilma and will soon take on another $22 million of disaster mitigation efforts. On top of these amounts are the estimated $5 million in damage that flood and storm waters have caused to the seawall, the adjacent roadway and drainage. The emergency room, diagnostic equipment, patient care towers and air transport helipad are at risk for being flooded.

Mount Sinai seeks the Corps' assistance in planning and mitigating the dangers that this situation poses. We are aware of the following non-federal requirements associated with projects under Sections 14 and 205:

1. Feasibility Phase: The initial $100,000 of cost, if funded by the Federal government. Costs above $100,000 are shared 50% Federal and 50% non-Federal in accordance with a Feasibility Cost-Sharing Agreement.

2. Implementation Phase: The non-Federal sponsor is responsible for costs of all lands, easements, relocations and disposal areas, plus a cash contribution of at least 5% of the total project cost. If this amount is less than 35% of the total project cost, the non-Federal sponsor must provide additional cash contribution to make the total equal to 35% of the total project cost.

3. The non-Federal sponsor is responsible for the removal of all hazardous, toxic and radioactive wastes prior to construction and for all operations and maintenance of the project after it is constructed.

Thank you for your consideration. I look forward to hearing from you.

Sincerely,

Steven D. Sonenreich
President and Chief Executive Officer

Mount Sinai Medical Center
4300 Alton Road
Miami Beach, FL 33140
Phone: 305-674-2121

Mount Sinai Aventura
2845 Aventura Boulevard
Aventura, FL 33180
Phone: 305-692-1010

Mount Sinai Coral Gables
3200 Ponce de Leon Blvd.
Coral Gables, FL 33134
Phone: 305-448-9990

Mount Sinai Hialeah
2150 W. 68th Street
Hialeah, FL 33016
Phone: 305-558-8700

Mount Sinai Key Biscayne
200 Crandon Blvd., Suite 300
Key Biscayne, FL 33149
Phone: 305-674-2599

www.msmc.com

DEBBIE WASSERMAN SCHULTZ
23RD DISTRICT, FLORIDA

CHIEF DEPUTY WHIP

COMMITTEES:
COMMITTEE ON APPROPRIATIONS
RANKING MEMBER
SUBCOMMITTEE ON LEGISLATIVE BRANCH
SUBCOMMITTEE ON STATE, FOREIGN OPERATIONS

STEERING AND POLICY COMMITTEE

Congress of the United States
House of Representatives
Washington, DC 20515–0923

WASHINGTON OFFICE:
118 CANNON HOUSE OFFICE BUILDING
WASHINGTON, DC 20515–0923
(202) 225–7931
(202) 226–2052 (FAX)

DISTRICT OFFICES:
10100 PINES BOULEVARD
PEMBROKE PINES, FL 33026
(954) 437–3936
(954) 437–4776 (FAX)

19200 WEST COUNTRY CLUB DRIVE
THIRD FLOOR
AVENTURA, FL 33180
(305) 936–5724
(305) 932–9664 (FAX)

February 24, 2014

Lieutenant Colonel Thomas M. Greco
Deputy District Commander
U.S. Army Corps of Engineers District, South Florida
4400 PGA Blvd., Suite 203
Palm Beach Gardens, FL 33410

Dear Lieutenant Colonel Greco:

I am writing with regard to a serious situation that poses an ongoing threat to public safety and potential disruption to vital health services in Miami Beach.

Mount Sinai Medical Center is located on Alton Road in Miami Beach and is the primary provider of health services for the City of Miami Beach and surrounding communities. The hospital is located directly on the Intracoastal Waterway and is protected against flooding from hurricanes and other serious storms by a seawall. Due to natural erosion and damage caused by serious storms over the past several decades, the seawall is in dire need of repairs in order to provide adequate protection to this critically important community asset.

I understand that the USACE has the authority to undertake a study of the affected area and perform necessary repairs to the seawall or entirely replace it under the Continuing Authorities Program. The Mayor of the City of Miami Beach has written to you to request that such a study be conducted, and I would like to make sure that you are aware of my strong support for this request.

If there is any way I can be helpful, please feel free to contact any of my offices. I appreciate your cooperation and look forward to working with you on this important matter.

Sincerely,

Debbie Wasserman Schultz

Debbie Wasserman Schultz
Member of Congress

PRINTED ON RECYCLED PAPER

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

SEP 2 9 2016

TO WHOM IT MAY CONCERN:

Pursuant to the National Environmental Policy Act, this letter constitutes the Notice of Availability of the Mt. Sinai Medical Center, Continuting Authorities Program (CAP) Section 14 Project, Draft Integrated Feasibility Report and Environmental Assessment.

The Draft Integrated Feasibility Report and Environmental Assessment are available for viewing on the Corps' website under the project "Dade County Beach Erosion Control and Hurricane Protection" at http://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents/. From this page, select "Dade County" from the list of Counties by clicking the "+" sign next to the county's name. The bottom of the table is a row labeled "Mt. Sinai Medical Center, Continuing Authority Program (CAP)". The document can be downloaded from this location. A copy of the Draft Integrated Feasibility Report and Environmental Assessment can also be requested by contacting Mrs. Terri Jordan-Sellers at 904-232-1817, or Terri.Jordan-Sellers@usace.army.mil.

Please provide all comments under NEPA to the Draft EA by close of business November 28, 2016. Comments can be submitted by letter to the address on the letterhead or by email to Terri.Jordan-Sellers@usace.army.mil.

Sincerely,

Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Mailing List – Mount Sinai Seawall Replacement – CAP 14

Sent by Email – 9/30/2016

Federal Agencies

EPA, Region IV

USFWS – Vero Beach

NMFS – SE Region

Habitat Conservation Division

Protected Resources Division

US Coast Guard – Region 7 Engineering

State Agencies

FLDEP State Clearinghouse

FLDEP – CAMA – Biscayne Bay AP

FLDEP – Ports and Inlets program

Florida Fish and Wildlife Conservation Commission

Division of Historical Resources - SHPO

City/County Agencies

Miami-Dade DERM

City of Miami Beach

PortMiami

NGOs

Biscayne Bay Keeper

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

OCT 2 3 2016

Virginia Fay
Asst. Regional Administrator
NMFS-SERO-HCD
263 13th Ave South
St. Petersburg, FL 33701

Dear Ms. Fay:

Pursuant to the National Environmental Policy Act (NEPA), this letter constitutes the Notice of Availability of the Draft Integrated Feasibility Report and Environmental Assessment for Mount Sinai Medical Center, Continuing Authorities Program (CAP) Section 14, Project, Miami-Dade County, Florida. This letter also serves to convey the Essential Fish Habitat (EFH) Assessment incorporated in the project IFR/EA.

The District is initiating coordination with NMFS under the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Per the May 3, 1999 EFH Finding between NMFS and the Corps Jacksonville District, the EFH Assessment for the project is integrated within the Draft IFR/EA. Per the 1999 Finding, the February 2004 "Preparing Essential Fish Habitat Assessments: A Guide for Federal Action Agencies" document and 50 CFR 600.920(e)(3), an EFH Assessment must include the specific items. Each item will be addressed in the table below with a reference to where the information is located in the Draft IFR/EA.

EFH Required Item	**Draft IFR/EA Location(s)**
Description of the Proposed Action	What is the action? - *Section 3.3.1 – Planning Objective* What is the purpose of the action? - *Section 1.3 – Study Purpose and Need* How, when and where will it be undertaken? - *Section 4 – Recommended Plan – Design and Construction Considerations* What will be the result of the action? - *Section 3.16.1 and 3.16.2 – Alternative 1/Alternative 2*

	- *Section 4 – Recommended Plan*
Analysis of the potential adverse effects (individual and cumulative) of the action on EFH and the management species	What EFH will be affected by the action? - *Section 2.3.4 – Essential Fish Habitat* - *Section 2.3.1.1 – Seagrass Survey* - *Section 2.3.2.3 – Johnson's Seagrass* - *Section 2.3.2.6 – Scleractinian Corals* - *Section 2.3.3.2 - Fishes* What are the adverse effects to EFH that could occur as a result of this action?/ How would they impact managed species?/ What would be the magnitude of effects?/What would the duration be? - *Section 3.1.8 – Essential Fish Habitat* - *Section 3.1.5 - Vegetation* - *Section 3.1.6.3 – Johnson's seagrass* - *Section 3.1.6.6 – Scleractinian Corals (ESA listed)* - *Section 3.1.7.2 – Fishes* - *Section 3.1.7.3 – Corals and Associated Species* - *Section 3.17.23 – Cumulative Impacts*
Proposed Compensatory Mitigation	*None required*
Avoidance and Minimization	*Section 3.25 – Impact Avoidance and Minimization*

Additionally, the Guidance states that for projects that may have substantial impacts on EFH, additional information may be necessary. These additional items are addressed throughout the IFR/EA and the information provided in the table below.

EFH Additional Information Item	**IFR/EA Location(s)**
Results of on-site inspections to evaluate the habitat and the site-specific effects of the project	- *Section 2.3.1.1 – Seagrass Survey* - *Section 2.3.2.6 – Scleractinian Corals* - *Appendix D-3 – Natural Resource Survey Reports*
Review of pertinent literature and related information	*Literature cited throughout IFR/EA and Natural Resource Survey Reports*

The District has determined that the effects of the construction of the Recommended Plan at Mount Sinai Medical Center, Miami-Dade County, Florida may adversely affect designated essential fish habitats and habitats of particular concern. The magnitude of the impacts are minor and insignificant.

Please provide all comments under NEPA and the MSFCMA to the Draft Integrated Feasibility Report and Environmental Assessment within 30 days of the receipt of this email. If you have any questions, please contact Mrs. Terri Jordan-Sellers at 904-232-1817 or Terri.Jordan-Sellers@usace.army.mil.

Sincerely,

Gina Paduano Ralph, Ph.D.
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

December 1, 2016 F/SER4:JK/pw

(Sent via Electronic Mail)

Colonel Jason A. Kirk, Commander
U.S. Army Corps of Engineers, Jacksonville District
Miami Permits Section
9900 Southwest 107th Avenue, Suite 203
Miami, Florida 33176

Attention: Terri Jordan-Sellers

Dear Colonel Kirk:

NOAA's National Marine Fisheries Service (NMFS) reviewed the public notice dated September 29, 2016, and letter dated October 29, 2016, for the *Draft Integrated Feasibility Report and Environmental Assessment (EA) for Mount Sinai Medical Center, Continuing Authorities Program Project*. The EA reviews two alternatives in addition to the No Action Alternative. The Recommended Plan includes installation of 3,070 linear feet of sheetpile approximately three feet waterward of the existing seawall in Biscayne Bay, Miami-Dade County. The three-foot offset is necessary to reconnect drainage systems or utilities between the new and existing seawall. The Recommended Plan differs from the other action alternative in that it eliminates a 130-foot section of seawall because the section was constructed in 1990 and not in need of replacement. The District estimates 11 corals colonies and 0.05 acres of seagrass would be impacted by the work. As described below, the NMFS believes these estimates are low. The Jacksonville District's initial determination is the proposed seawall replacement and coral relocation may have an adverse effect on federally managed fisheries or their essential fish habitat (EFH), including corals, seagrass, and the Biscayne Bay Aquatic Preserve. The South Atlantic Fishery Management Council (SAFMC) designates these habitats and the Bay as a Habitat Area of Particular Concern (HAPC) in the fishery management plan for the snapper/grouper complex. As the nation's federal trustee for the conservation and management of marine, estuarine, and anadromous fishery resources, the NMFS provides the following comments and recommendations pursuant to authorities of the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

EFH within the Project Area

Appendix D3 of the EA includes results from coral and vegetation assessments performed between May 2 and June 2, 2016. Scleractinian coral colonies occur on the seawall, with higher densities occurring near the center of the seawall. Bleaching or disease were not observed on any colony, and all colonies had 100 percent live tissue. The colonies were comprised of three species, *Oculina diffusa*, *Oculina robusta*, *Siderastrea siderea*, in addition to small colonies of *Siderastrea* spp. too small to identify to the species level in the field, but determined to likely be *S. siderea*.

The EA reports seagrass is present as well. Although much of the survey was performed outside the time of year optimal for detecting seagrass (June 1 to September 30), the nearshore seagrass edge was mapped on June 2, 2016, and within the recommended sampling season. Five species of seagrass were observed at the site, *Halophila decipiens*, *Halophila englemannii*, *Halodule wrightii*, *Syringodium filiforme*, and *Thalassia testudinum*. The nearshore edge of the seagrass beds ranges from the toe of the existing seawall to 28 feet waterward of the seawall.

The SAFMC identifies coral colonies and seagrass as EFH for several species, including adult white grunt (*Haemulon plumieri*); juvenile and adult gray snapper (*Lutjanus griseus*); juvenile mutton snapper (*Lutjanus analis*), lane snapper (*Lutjanus synagris*), schoolmaster (*Lutjanus apodus*), and dog snapper (*Lutjanus jocu*); and larval and juvenile pink shrimp (*Farfantepenaeus duorarum*). All demersal fish species under SAFMC management that associate with coral habitats are contained within the fishery management plan for snapper-grouper species and include some of the more commercially and recreationally valuable fish of the region. All of these species show an association with coral or hardbottom habitat during their life history. In groupers, the demersal life history of almost all *Epinephelus* species, several *Mycteroperca* species, and all *Centropristis* species, takes place in association with coral habitat. Coral, coral reef, and hardbottom habitats benefit fishery resources by providing food or shelter.

The SAFMC designates coral and seagrass as HAPCs, which are subsets of EFH that are either rare, particularly susceptible to human-induced degradation, especially important ecologically, or located in an environmentally stressed area. Coral directly benefit the fishery resources of Biscayne Bay by providing nursery habitat and shelter. Coral and mangrove are also part of a habitat complex that includes seagrass and hardbottom habitats, and this complex supports a diverse community of fish and invertebrates within Biscayne Bay. The SAFMC provides additional information on EFH and HAPCs and their support of federally managed fishery species in *Fishery Ecosystem Plan of the South Atlantic Region*, which is available at *www.safmc.net*. In light of their designation as EFH-HAPC's and Executive Order 13089, NMFS applies greater scrutiny to projects affecting corals, coral reefs, and hardbottoms to ensure practicable measures to avoid and minimize adverse effects to these habitats are fully explored.

Impacts to Essential Fish Habitat and Recommended Avoidance and Minimization

Corals

The NMFS believes the EA underrepresents the coral impacts. Approximately 6.5 percent of the seawall was surveyed[1], resulting in the documentation of 11 colonies. Five of the 11 colonies (45 percent) are within a size class the District determined suitable for relocation. If the results from the coral survey are extrapolated to the entire seawall, 300 corals may be present with approximately 135 colonies suitable for relocation.

While relocating coral colonies is proposed, a more detailed relocation plan is needed, especially in consideration of the newer estimate of coral colony abundance. The NMFS recommends the plan:

- Require updated pre-construction surveys within one to two years prior to coral relocation. The surveys should enumerate, regardless of size, all scleractinian coral colonies by species and all octocoral colonies by genus.
- Justify selection of the recipient sites and relocation densities as suitable for the coral colonies. This justification should include explaining how differences in colony orientation on seawall may affect the successful relocation of colonies.
- Have a performance criterion of no less than 85 percent of the coral colonies exhibiting positive growth and successful attachment after two years. If this criterion cannot be met due to

[1] Seventy transects were surveyed along the 3,500 foot (1,067 meter) length of the seawall and were spaced 15.2 meters apart (Appendix D3, page 1). Each transect was one meter wide by approximately 1.80 meters in length (1.80 meters is the mean of the transect length that ranged from 1.30 to 2.29 meters, as described on page 5 Appendix D3).

incompatibility with the recipient site, alternative relocation sites should be evaluated (e.g., an existing artificial reef).

- Include monitoring of no less than 25 percent of the relocated coral colonies, including at least ten colonies of each of the species or genus relocated. If less than ten colonies of one species or genus are relocated, all of the colonies of that species or genus should be monitored. Monitoring should occur immediately after relocation and annually for two additional events.
- Include compensatory mitigation for the loss of coral colonies too small to relocate.

Seagrass

The EA states direct impacts to seagrass would be less than 0.05 acres, however it is not clear how the acreage was estimated, nor was a map of the seagrass impact areas provided. A minimum of 0.21 acres of estuarine bottom would be directly impacted by extending the seawall three feet waterward. Approximately one-third of the 70 seagrass transects document seagrass within three feet of the seawall (Tables 7, 12, and 16 in Appendix D3), which would result in 0.08 acres of direct impacts to seagrass. Additional impacts to seagrass would likely occur from seawall installation and if the work is completed waterside and work vessels were unable to avoid anchoring or spudding down in seagrass.

The construction methods are not specified in the EA. According to Section 3.6.2.1 of the EA, the project was assumed to be constructed landside for cost engineering purposes, however, if a contractor proposes to construct from the waterside, temporary impacts to seagrass adjacent to the seawall may occur when the legs from a spud barge are placed on the bottom. The District determined these impacts would be temporary in nature and discountable in size as the spudding down would not change the bottom elevation in a manner that would prevent recolonization of seagrasses into the footprints of the spud feet. Based on the limited information available, the NMFS does not agree with this assessment of impacts. A seagrass mitigation plan is needed to offset the direct and indirect impacts to seagrass habitats. The mitigation plan should include a narrative of how the direct and indirect impacts were calculated and represent both types of impacts on a map.

EFH Conservation Recommendations

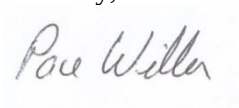
Section 305(b)(4)(A) of the Magnuson-Stevens Act requires NMFS to provide EFH conservation recommendations for any federal action or permit which may result in adverse impacts to EFH. Therefore, NMFS recommends the following to ensure the conservation of EFH and associated fishery resources:

1. The District should implement a coral relocation plan. The performance standard for the coral relocation should be 85 percent survival with positive tissue growth and secure substrate attachment two years after relocation. Failure to meet this standard should trigger a requirement for coordination with NMFS to evaluate mitigation of coral impacts.
2. The District should mitigate for impacts to all coral colonies not relocated, including the colonies smaller than 10 centimeters.
3. The District should prohibit work vessels from spudding down or anchoring in seagrass areas.
4. The District should mitigate the unavoidable impacts to seagrass habitat. The mitigation amount should be determined through the use of a functional assessment.
5. Post-construction seagrass surveys (i.e., the nearshore edge mapping) should be performed between June 1 to September 30 and provided to the NMFS to assess if unanticipated impacts to seagrass habitat occurred from the construction.
6. The District should implement Best Management Practices, including use of staked turbidity curtains around the project area during construction, to minimize indirect impacts and water quality degradation.

Section 305(b)(4)(B) of the Magnuson-Stevens Act and implementing regulation at 50 CFR Section 600.920(k) require the Jacksonville District to provide a written response to this letter within 30 days of its receipt. If it is not possible to provide a substantive response within 30 days, in accordance with the "findings" the NMFS has with the Jacksonville District, an interim response should be provided. A detailed response then must be provided prior to final approval of the action. The detailed response must include a description of measures proposed by the Jacksonville District agency to avoid, mitigate, or offset the adverse impacts of the activity. If the response is inconsistent with the EFH Conservation Recommendations, the Jacksonville District must provide a substantive discussion justifying the reasons for not following the recommendations.

Thank you for the opportunity to provide comments. Please direct related correspondence to the attention of Ms. Jocelyn Karazsia at 400 North Congress Avenue, Suite 110, West Palm Beach, Florida, 33401. She also may be reached by telephone at 561-249-1925 or by e-mail at Jocelyn.Karazsia@noaa.gov.

Sincerely,



/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc: CESAJ, Terri.Jordan-Sellers@usace.army.mil
FWS, Ashleigh_Blackford@fws.gov
FWCC, Lisa.Gregg@MyFWC.com
FDEP, Gregory.Garis@dep.state.fl.us
Miami-Dade County, MontyJ@miamidade.gov
EPA, Miedema.Ron@epa.gov
SAFMC, Roger.Pugliese@safmc.net
F/SER4, David.Dale@noaa.gov
F/SER47, Jocelyn.Karazsia@noaa.gov

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 SAN MARCO BOULEVARD
JACKSONVILLE, FLORIDA 32207-0019

REPLY TO
ATTENTION OF

DEC 27 2016

Planning and Policy Division
Environmental Branch

Ms. Virginia Fay
Assistant Regional Administrator
Habitat Conservation Division
National Marine Fisheries Service
263 13th Avenue South
St. Petersburg, Florida 33701-5505

Dear Ms. Fay:

This letter acknowledges the U.S. Army Corps of Engineers (Corps) receipt of your December 1, 2016 letter regarding the Essential Fish Habitat (EFH) consultation for the Draft Integrated Feasibility Report and Environmental Assessment (EA) for Mount Sinai Medical Center, Continuing Authorities Program Project Miami-Dade County, Florida. In that letter, the National Marine Fisheries Service (NMFS) staff expressed concern regarding potential impacts to EFH resulting from this project. The Corps has reviewed and considered the concerns and recommendations presented by NMFS in its letter, and has prepared the enclosed responses to these recommendations as required under the Magnuson-Stevens Fisheries Conservation and Management Act [MSFCMA; 50 CFR § 600.920(k)].

The Corps appreciates the input provided by NMFS on this project to develop measures that avoid impacts to NOAA trust resources. The submission of the enclosed responses completes the Corps' requirements for EFH consultation under the MSFCMA's EFH provisions. Any questions regarding this project should be directed to Terri Jordan-Sellers at the letterhead address or by telephoning 904-232-1817.

Sincerely,

Gina P. Ralph, Ph.D.
Chief, Environmental Branch

Enclosure

Copy Furnished:
Dr. Ken Riley, 101 Pivers Island Road, Beaufort, North Carolina 28516-9722

Draft Integrated Feasibility Report and Environmental Assessment (EA) for Mount Sinai Medical Center, Continuing Authorities Program Project
Miami-Dade County, Florida

U.S. Army Corps of Engineers (Corps) Responses to
National Marine Fisheries Service Conservation Recommendations

National Marine Fisheries Service (NMFS) conservation recommendations are listed below in italics, and the U.S. Army Corps of Engineers Jacksonville District (Corps) response is provided below each recommendation.

1. The District should implement a coral relocation plan. The performance standard for the coral relocation should be 85 percent survival with positive tissue growth and secure substrate attachment two years after relocation. Failure to meet this standard should trigger a requirement for coordination with NMFS to evaluate mitigation of coral impacts.

The Corps will work with the Medical Center to relocate corals from the seawall to an alternative location. However, if an alternative in-water location cannot be located, the Corps will coordinate with the Miami Science Museum to collect the corals and put them into culture in the museum's coral nursery. A new in-water relocation alternative location (i.e. artificial reef) will not be constructed. The new seawall will replace the habitat of the original seawall and will provide habitat for colonization of new corals within Biscayne Bay.

2. The District should mitigate for impacts to all coral colonies not relocated, including the colonies smaller than 10 centimeters.

The Corps will not mitigate for the small number of corals that are encrusting the bulkhead, as they have colonized a manmade structure and the new structure will provide habitat for corals and other encrusting organisms to encrust on the face.

3. The District should prohibit work vessels from spudding down or anchoring in seagrass areas.

The Corps will work with the contractor to limit the construction from the waterside to the maximum extent practicable, where construction can be completed without limiting access to the Emergency Room by the ring road. However, where this condition cannot be met, construction may be conducted from the waterside which may require spudding or anchoring in seagrass areas. Should this occur, GPS locations of the spuds or anchors will be collected and the grass reviewed after the spuds or anchors are removed to determine the condition of the grass. Since the spuds and anchors do not change the depth of water, long term impacts to grass from spudding or anchoring are expected to be minimal as any crushed grasses should recover or recolonize the area after the

spuds/anchors are removed. Post-construction surveys of the grass edge and any spud/anchor areas will be conducted and a determination of impact performed. This report will be forwarded to the agencies for information.

4. The District should mitigate the unavoidable impacts to seagrass habitat. The mitigation amount should be determined through the use of a functional assessment.

As stated in the Integrated Feasibility Study and Environmental Assessment, this work is consistent with activities conducted under Nationwide permit #3, and consistent with General Condition #23, USACE will avoid and minimize impacts to seagrass beds. Also in accordance with this condition, compensatory mitigation at a minimum one-for-one ratio will be required for all wetland (seagrass) losses resulting from the proposed work that exceed 0.10 acres. Currently the seagrass impact has been determined to be 0.05 acres. Additional seagrass surveys within the project footprint will be performed before and after construction, and this information will be coordinated with the appropriate regulatory agencies. If it is determined that project impacts have exceeded 0.10 acres, then the Corps will work with the agencies to determine appropriate compensatory mitigation for seagrasses.

5. Post-construction seagrass surveys (i.e., the nearshore edge mapping) should be performed between June 1 to September 30 and provided to the NMFS to assess if unanticipated impacts to seagrass habitat occurred from the construction.

The Corps has already committed to pre- and post-construction surveys for the project. A copy of this report will be forwarded to NMFS for information purposes.

6. The District should implement Best Management Practices, including use of staked turbidity curtains around the project area during construction, to minimize indirect impacts and water quality degradation.

The Corps will employ Best Management Practices for the project, including standard requirements to protect listed and threatened species (sea turtles, manatees, sawfish) through the use of an Endangered Species Observer, and will monitor water quality associated with the project as it takes place within a Designated Outstanding Florida waters. Turbidity curtains may or may not be used by the contractor depending on water depths and the adverse potential for entanglement of listed and threatened species.

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

January 9, 2017 F/SER47:JK/pw

(Sent via Electronic Mail)

Colonel Jason A. Kirk, Commander
U.S. Army Corps of Engineers, Jacksonville District
701 San Marco Boulevard
Jacksonville, Florida 32207-0019

Attention: Terri Jordan-Sellers

Dear Colonel Kirk:

NOAA's National Marine Fisheries Service (NMFS) reviewed the letter dated December 27, 2016, from the Jacksonville District regarding the *Draft Integrated Feasibility Report and Environmental Assessment (EA) for Mount Sinai Medical Center, Continuing Authorities Program Project.* The Recommended Plan includes installing 3,070 linear feet of sheetpile approximately three feet waterward of the existing seawall in Biscayne Bay, Miami-Dade County. The letter replies to conservation recommendations the NMFS provided by letter dated December 1, 2016, to protect essential fish habitat (EFH). The NMFS recommended:

1. The District should implement a coral relocation plan. The performance standard for the coral relocation should be 85 percent survival with positive tissue growth and secure substrate attachment two years after relocation. Failure to meet this standard should trigger a requirement for coordination with the NMFS to evaluate mitigation of coral impacts.
2. The District should mitigate for impacts to all coral colonies not relocated, including the colonies smaller than 10 centimeters.
3. The District should prohibit work vessels from spudding down or anchoring in seagrass areas.
4. The District should mitigate the unavoidable impacts to seagrass habitat. The mitigation amount should be determined through the use of a functional assessment.
5. Post-construction seagrass surveys (i.e., the nearshore edge mapping) should be performed between June 1 to September 30 and provided to the NMFS to assess if unanticipated impacts to seagrass habitat occurred from the construction.
6. The District should implement Best Management Practices, including use of staked turbidity curtains around the project area during construction, to minimize indirect impacts and water quality degradation.

The Jacksonville District agrees to fully implement recommendation 6. While it appears the District may implement recommendation 5, the District's response does not specify a timeframe for completion of the seagrass surveys making it unclear if the recommendation will be met fully.

In accordance with the intentions of 50 CFR 600.920(k)(2), the NMFS requests continued coordination on the issues pertaining to EFH conservation recommendations 1, 2, 3, and 4. Regarding recommendations 1 and 2 and as described in our letter dated December 1, 2016, the crux of the matter is the Jacksonville District not extrapolating to the entire seawall the results from the transects surveyed, leaving 93.5 percent of the seawall unaccounted for in the coral impact assessment. Regarding recommendations 3 and 4, it would be helpful for the District to explain how the seagrass impacts were estimated and to provide a corresponding visual depiction. The NMFS appreciates the District's desire to have as much construction as practicable occur from the land, however considerable impacts to seagrass may result if waterside construction proves necessary. Fast-growing seagrass species, such as *Halodule wrightii*, may take longer than one year to recover especially when the is bottom scarred or scoured (Creed and Fihlo 1999[1]). Anchoring also may impact seagrass habitat in terms of shoot density declines and rhizome baring impeding recovery (Montefalcome et al. 2008[2]). Accordingly, the NMFS disagrees with the presumption that seagrass impacted by anchoring or spudding would be minimal and quickly recover.

Thank you for the opportunity to provide comments. Please direct related correspondence to the attention of Ms. Jocelyn Karazsia at our West Palm Beach office, 400 North Congress Avenue, Suite 110, West Palm Beach, Florida, 33401. She may be reached by telephone at (561) 249-1925, or by e-mail at Jocelyn.Karazsia@noaa.gov.

Sincerely,

/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc: COE, Terri.Jordan-Sellers@usace.army.mil
COE, Gina.P.Ralph@usace.army.mil
FWS, Ashleigh_Blackford@fws.gov
EPA, Miedema.Ron@epa.gov
FWCC, Lisa.Gregg@MyFWC.com
FDEP ERP, Monica.Sovacool@dep.state.fl.us
SAFMC, Roger.Pugliese@safmc.net
F/SER4, David.Dale@noaa.gov
F/SER47, Jocelyn.Karazsia@noaa.gov

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[1] Creed JC and Filho GM. 1999. Disturbance and recovery of the macroflora of a seagrass (*Halodule wrightii* Ascherson) meadow in the Abrolhos Marine National Park, Brazil: an experimental evaluation of anchor damage. Journal of Experimental Marine Biology and Ecology 235:285-306

[2] Montefalcone M, Chiantore M, Lanzone A, Morri C, Albertelli G, and Bianchi CN. BACI design reveals the decline of the seagrass *Posidonia oceanica* induced by anchoring. Marine Pollution Bulletin 56:1637-1645

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 SAN MARCO BOULEVARD
JACKSONVILLE, FLORIDA 32207-0019

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

FEB 0 2 2017

Ms. Virginia Fay
Assistant Regional Administrator
Habitat Conservation Division
National Marine Fisheries Service
263 13th Avenue South
St. Petersburg, Florida 33701-5505

Dear Ms. Fay:

This letter acknowledges the U. S. Army Corps of Engineers (Corps) receipt of your January 9, 2017 letter regarding the Essential Fish Habitat (EFH) consultation for the Draft Integrated Feasibility Report and Environmental Assessment (EA) for Mount Sinai Medical Center, Continuing Authorities Program Project Miami-Dade County, Florida. In that letter, the National Marine Fisheries Service (NMFS) staff expressed continued concern regarding potential impacts to EFH resulting from this project. The Corps has reviewed and considered the concerns and recommendations presented by NMFS in its letter, and has prepared the enclosed responses to these recommendations in accordance with the intentions of 50 CFR 600.920(k)(2) under the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA).

The Corps appreciates the input provided by NMFS on this project to develop measures that avoid impacts to NMFS trust resources. The submission of the enclosed responses completes the Corps' requirements for EFH consultation under the MSFCMA's EFH provisions. Any questions regarding this project should be directed to Terri Jordan-Sellers at the letterhead address or by telephoning 904-232-1817.

Sincerely,

Gina P. Ralph, Ph.D.
Chief, Environmental Branch

Enclosure

Copy Furnished:

Dr. Ken Riley, 101 Pivers Island Road, Beaufort, North Carolina, 28516-9722

Conservation Recommendations #1 and #2–

1. The District should implement a coral relocation plan. The performance standard for the coral relocation should be 85 percent survival with positive tissue growth and secure substrate attachment two years after relocation. Failure to meet this standard should trigger a requirement for coordination with NMFS to evaluate mitigation of coral impacts.
2. The District should mitigate for impacts to all coral colonies not relocated, including the colonies smaller than 10 centimeters.

Upon further review of the analysis for encrusting corals along the face of seawall, NMFS is correct that the number of corals documented in the survey had not been extrapolated to cover the entire submerged surface of the seawall. This analysis has been updated in the Environmental Assessment (EA; Section 2.3.2.6) and is included below. The U.S. Army Corps of Engineers (Corps) has coordinated with the Miami-Dade Department of Environmental Resources Management (DERM) and has identified a potential relocation site on one of their artificial reefs in Biscayne Bay for corals greater than 10 cm in size, estimated to be about 63 colonies. The Corps does not intend to move corals smaller than 10 cm in diameter but will ensure these corals are available to the Miami Science Museum to remove and use in the education programs. The Miami Science Museum will also be invited to collect any other encrusting organisms at the same time. The Corps does not plan to monitor any of the corals after they are relocated to the DERM artificial reef, nor does the Corps plan to mitigate for the loss of any remaining colonies (estimated to be approximately 52 less than 10cm in size) as these colonies have attached themselves to a manmade structure, and the new structure will provide ample new habitat for new corals to colonize after construction is complete. The Corps commits to using coral reef biologists with coral relocation experience to conduct the relocation, and will provide the exact relocation information (how many, where relocated to) to both NMFS and DERM after the work has been completed.

<u>Potential Coral colonization along the entire face of the seawall at Mount Sinai</u>
Seawall length – 3,150 feet

The Engineering appendix indicates an assumed depth of water at Mean Low Water (MLW) is between -2 and -3 feet, this assumption is from the 1966 permitting document and was the basis of analysis in the engineering appendix.

Area below MLW – 3 feet max (between 2-3 feet; 3 feet was used in this analysis to be conservative)

Total area would be between: 3,150 * 3 = 9,450 square feet

Convert 9,450 square feet to meters squared (m^2) = 877.9 m^2

Survey area = 70 m^2. This equals 12.5% of the bulkhead surface below MLW available for coral colonization.

11 colonies found in the 70 m^2 survey area.

878 m^2 – 70 m^2 = 808 m^2

808/70 = 11.54 times of the survey area remaining

11.54 * 11 corals per survey area = 115 colonies

55% > 10cm in diameter = 63 colonies above 10 cm that may be relocated to a DERM artificial reef in Biscayne Bay. Colonies less than 10 cm (52 colonies) will be made available to the Miami Science Center for their educational and coral nursery programs.

Conservation Recommendations #3 and 4

3. The District should prohibit work vessels from spudding down or anchoring in seagrass areas.
4. The District should mitigate the unavoidable impacts to seagrass habitat. The mitigation amount should be determined through the use of a functional assessment.

The Corps has revised the EA to provide a detailed discussion of how the 0.05-acre impact to seagrass was calculated. This information is included below for NMFS' information. We hope that this discussion helps NMFS to better understand our calculations and analysis. As previously stated, if the project cannot be constructed from the landside without jeopardizing access to the hospital's Emergency Room and thus threatening human health and safety, then the contractor will be authorized to access the project area from the water. All of the monitoring conditions previously discussed in the EA and in the December 2016 response remain in place. The Corps' post-construction seagrass survey will be performed immediately post-construction, whenever construction is complete, in an effort to ensure the largest impact footprint, without regard to the time of year. Delaying the survey to the timeframe requested by NMFS (June – September) may result in less impact being documented, since recovery of impacts would likely to have occurred. Additionally, FWC recognizes a year-round growing season in most of Biscayne Bay (south of Virginia Key) and has an extended survey window of April 1 through October 31 for the remainder of the bay. Also, it has been recognized by several seagrass experts (Fonseca, Kenworthy) that seagrasses in Biscayne Bay do not have a growing season as compared to the rest of the year.

Section 3.6.2.1 Seagrass Impacts – (this information was added to the final EA in response to NMFS comments)

Seagrass impacts associated with the construction of the recommended plan (Alternative 2) were calculated by dividing each of the original 50 foot wide seagrass transects in half using ArcGIS software, so that each new transect was 25 feet in width and mapping the seagrasses within three feet of the existing seawall face. The coverage of this area (one foot, two feet or three feet) was multiplied by 25 feet to obtain a coverage of the area between the transects. The square footage for each of these areas was totaled and all of the areas summed together. In an effort to be conservative, where the grass was documented as being three feet from the seawall face, an impact of 25 square feet was assumed, which would be excessive given the location of the new seawall is within three feet of the current seawall and may be as close as 18 inches. Where the values exceeded three feet, those transects are not listed below.

Transect Number	Distance of Bed Edge from Existing Seawall	Impacted Sq Footage of Seagrass on Transect
1	0	75
1.5	0	75
2	3	25
2.5	2	25
3	2	25
3.5	1	50

12	1	50
13.5	2	25
14	3	25
14.5	1	50
16	3	25
17	2	25
17.5	2	25
18.5	1	50
19.5	0	75
20	3	25
20.5	2	25
22.5	0	75
24.5	1	50
25.5	1	50
26	3	25
27	3	25
27.5	1	50
28.5	1	50
29.5	3	25
31	0	75
31.5	0	75
32.5	3	25
33	1	50
33.5	0	75
34.5	3	25
35	3	25
36	1	50
37	2	25
37.5	1	50
38	2	25
38.5	0	75
39.5	3	25
40	1	50
41	2	25
42.5	1	50
42	3	25
42.5	1	50
43.5	2	25
45.5	3	25
46	3	25
47.5	3	25
49	3	25
51.5	2	25
52	3	25
52.5	3	25
1	1	50
54.5	2	25
56	3	25
56.5	3	25
Total Square Footage		**2,275**

The total square footage of 2,275 equals 0.05 acres (conversion 1 sq foot equals 0.000 023 acre (http://www.onlineconversion.com/area.htm). Using this conversion, the Corps has determined that Alternative 1 would result in minor impacts, 0.05 acres, to seagrass beds. Although this project would be constructed in accordance with Section 14 of the 1946 Flood Control Act, as amended - Streambank and Shoreline Erosion Protection of Public Works and Non-Profit Public Services, its construction will also be consistent with Nationwide Permit 3

(NWP), 33 CFR 320.4, and 40 CFR Part 230. Activities authorized by this NWP may result in the loss of small amounts of wetlands. Seagrass beds are considered to be a type of saltwater wetlands (NOAA 2004). The Corps would require, and thus would be compliant with General Condition 23 of Nationwide Permits, that the proposed work avoid and minimize impacts to seagrass beds. Also in accordance with this condition, compensatory mitigation at a minimum one-for-one ratio will be required for all wetland (seagrass) losses resulting from the proposed work that exceed 0.10 acres. Additional seagrass surveys within the project footprint would be performed before and after construction, and this information would be coordinated with the appropriate regulatory agencies. The project was assumed to be constructed from the shoreside for cost engineering purposes, however, if a contractor proposes to construct from the waterside, temporary impacts to seagrasses adjacent to the seawall may occur when the legs from a spud barge are placed on the bottom. Since the spuds and anchors do not change the depth of water, long-term impacts to grass from spudding or anchoring are expected to be minimal as any crushed grasses should recover or recolonize the area after the spuds/anchors are removed. If a contractor proposes to build from the waterside, GPS locations of all anchors/spud down locations shall be recorded and those areas surveyed for seagrass impacts after the anchor/spud operations are complete and the results included in the report on seagrass impacts associated with the project footprint. If total project seagrass impacts exceed 0.10 acres, then the Corps will work with the agencies to determine the appropriate compensatory mitigation for seagrasses.

FLORIDA DEPARTMENT of STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

Mr. Marc A. Tiemann
Jacksonville USACE
Department of the Army
701 San Marco Blvd
Jacksonville, Florida 32207-8175

September 26, 2016

RE: DHR Project File No.: 2016-03678, Received by DHR: September 8, 2016 / County: Miami-Dade
Applicant: U.S. Army Corps of Engineers / Application No: None Provided
Project: Mount Sinai Medical Center Seawall and Infrastructure, 4308 Alton Rd, Miami Beach, FL
Owner: Mount Sinai Medical Office Building II, Inc., Folio: 02-3222-011-0370

Dear Mr. Tiemann:

The Florida State Historic Preservation Officer reviewed the referenced project for possible effects on historic properties listed, or eligible for listing, on the *National Register of Historic Places.* The review was conducted in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, and its implementing regulations in *36 CFR Part 800: Protection of Historic Properties.*

Based on the information provided and the nature of the project, it is the opinion of this office that the proposed project is unlikely to adversely affect historic properties. However, finds may occur during ground disturbing activities, and we request that the permit include the following special condition regarding inadvertent discoveries:

- If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, *Florida Statutes*.

If you have any questions, please contact Florence McCullough, M.A., RPA, Historic Sites Specialist, by email at *Florence.McCullough@dos.myflorida.com*, or by telephone at 850.245.6333 or 800.847.7278.

Sincerely,

Jason Aldridge
For

Timothy A. Parsons, Ph.D., RPA
Director, Division of Historical Resources
and State Historic Preservation Officer

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

OCT 28 2016

Roxanna Hinzman
Field Supervisor
South Florida Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960

Dear Ms. Hinzman:

Pursuant to Section 7(a) of the Endangered Species Act, please find enclosed the Draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) for Mount Sinai Medical Center, Continuing Authorities Program (CAP) Section 14, Project, Miami-Dade County, Florida. This integrated document also serves to address the concerns of the threatened and endangered species under the purview of the U.S. Fish and Wildlife Service (USFWS). Listed species which may occur in the vicinity of the proposed work and are under the jurisdiction of the USFWS are: the West Indian manatee (*Trichecus manatus)* and the American crocodile (*Crocodylus acutus)*.

Information normally included in a stand-alone biological assessment is included within the Draft IFR/EA. Each item will be addressed in the table below with a reference to where the information is located in the Draft IFR/EA.

ESA Required Item	**Draft IFR/EA Location(s)**
Description of the Proposed Action/Project Location	What is the action? - *Section 3.3.1 – Planning Objective* What is the purpose of the action? - *Section 1.3 – Study Purpose and Need* How, when and where will it be undertaken? - *Section 4 – Recommended Plan – Design and Construction Considerations* What will be the result of the action? - *Section 3.16.1 and 3.16.2 – Alternative 1/Alternative 2* - *Section 4 – Recommended Plan*

Species under USFWS jurisdiction	Florida Manatee and Designated Critical Habitat - *Section 2.3.2.2* American Crocodile - *Section 2.3.2.4*
Potential Impacts/Effects to Listed Species and Efforts to Eliminate/Avoid Impacts to Listed Species	Florida Manatee and Designated Critical Habitat - *Section 3.6.3.2* American Crocodile - *Section 3.6.3.4*
Effect Determination	Florida Manatee and Designated Critical Habitat - *Section 3.6.3.2* American Crocodile - *Section 3.6.3.4*

Based on the enclosed analysis included in the in Draft IFR/EA associated with the effects of the construction of the Recommended Plan at Mount Sinai Medical Center, Miami-Dade County, Florida, the Corps has determined that the proposed action may affect, but is not likely to adversely affect West Indian manatee and American crocodile. The project will also not adversely modify designated critical habitat for the Florida manatee.

The Corps respectfully requests that USFWS provide a letter of concurrence within 30 days of the receipt of this letter. If you have any questions, please contact Mrs. Terri Jordan-Sellers at 904-232-1817 or Terri.Jordan-Sellers@usace.army.mil.

Sincerely,

Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960
772-562-3909 Fax 772-562-4288

FWS Log No. 04EF2000-~~2017~~-2017-I-0053

The U.S. Fish and Wildlife Service has reviewed the information provided and finds that the proposed action is not likely to adversely affect any federally listed species or designated critical habitat protected by the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 et. seq.). A record of this consultation is on file at the South Florida Ecological Service Offi

This fulfills the requirements of section 7 of the Act and further action is not required. If modifications are made to the project, if additional information involving potential effects to listed species becomes available, or if a new specie listed, reinitiation of consultation may be necessary.

Victoria A. Foster for Roxanna Hinzman, Field Supervisor — 11/15/16 Date

Roxanna Hinzman
Field Supervisor
South Florida Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960

Dear Ms. Hinzman:

Pursuant to Section 7(a) of the Endangered Species Act, please find enclosed the Draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) for Mount Sinai Medical Center, Continuing Authorities Program (CAP) Section 14, Project, Miami-Dade County, Florida. This integrated document also serves to address the concerns of the threatened and endangered species under the purview of the U.S. Fish and Wildlife Service (USFWS). Listed species which may occur in the vicinity of the proposed work and are under the jurisdiction of the USFWS are: the West Indian manatee (*Trichecus manatus)* and the American crocodile (*Crocodylus acutus)*.

Information normally included in a stand-alone biological assessment is included within the Draft IFR/EA. Each item will be addressed in the table below with a reference to where the information is located in the Draft IFR/EA.

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Species under USFWS jurisdiction	Florida Manatee and Designated Critical Habitat - *Section 2.3.2.2* American Crocodile - *Section 2.3.2.4*
Potential Impacts/Effects to Listed Species and Efforts to Eliminate/Avoid Impacts to Listed Species	Florida Manatee and Designated Critical Habitat - *Section 3.6.3.2* American Crocodile - *Section 3.6.3.4*
Effect Determination	Florida Manatee and Designated Critical Habitat - *Section 3.6.3.2* American Crocodile - *Section 3.6.3.4*

Based on the enclosed analysis included in the in Draft IFR/EA associated with the effects of the construction of the Recommended Plan at Mount Sinai Medical Center, Miami-Dade County, Florida, the Corps has determined that the proposed action may affect, but is not likely to adversely affect West Indian manatee and American crocodile. The project will also not adversely modify designated critical habitat for the Florida manatee.

The Corps respectfully requests that USFWS provide a letter of concurrence within 30 days of the receipt of this letter. If you have any questions, please contact Mrs. Terri Jordan-Sellers at 904-232-1817 or Terri.Jordan-Sellers@usace.army.mil.

Sincerely,

Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

Mr. David Bernhart
National Marine Fisheries Service
Southeast Regional Office
Protected Species Resources Division
263 13th Avenue South
St. Petersburg, Florida 33701

OCT 2 8 2016

Dear Mr. Bernhart:

Pursuant to Section 7(a) of the Endangered Species Act, please find enclosed the Draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) for Mount Sinai Medical Center, Continuing Authorities Program (CAP) Section 14, Project, Miami-Dade County, Florida. This integrated document also serves to address the concerns of the threatened and endangered species under the purview of the National Marine Fisheries Service (NMFS). Listed species which may occur in the vicinity of the proposed work and are under the jurisdiction of the NMFS are: green (North Atlantic DPS) (*Chelonia mydas*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), and olive ridley (*Lepidochelys oliveacea)* sea turtles, smalltooth sawfish (*Pristis pectinate)*, listed scleractinian corals and Johnson's seagrass (*Halophila johnsonii*) and its designated critical habitat.

Information normally included in a stand-alone biological assessment is incorporated into the Draft IFR/EA. Each item will be addressed in the table below with a reference to where the information is located in the Draft IFR/EA.

ESA Required Item	**Draft IFR/EA Location(s)**
Description of the Proposed Action/Project Location	What is the action? - *Section 3.3.1 – Planning Objective* What is the purpose of the action? - *Section 1.3 – Study Purpose and Need* How, when and where will it be undertaken? - *Section 4 – Recommended Plan – Design and Construction Considerations* What will be the result of the action? - *Section 3.16.1 and 3.16.2 – Alternative 1/Alternative 2* - *Section 4 – Recommended Plan*

Species under NMFS jurisdiction	Sea Turtles - *Section 2.3.2.1* Smalltooth sawfish - *Section 2.3.2.5* Listed Scleractinian Corals - *Section 2.3.2.6* Johnson's Seagrass and Designated Critical Habitat - *Section 2.3.2.3*
Potential Impacts/Effects to Listed Species and Efforts to Eliminate/Avoid Impacts to Listed Species	Sea Turtles - *Section 3.6.3.1* Smalltooth sawfish - *Section 3.6.3.5* Listed Scleractinian Corals - *Section 3.6.3.6* Johnson's Seagrass and Designated Critical Habitat *Section 3.6.3.3*
Effect Determination	Sea Turtles - *Section 3.6.3.1* Smalltooth sawfish - *Section 3.6.3.5* Listed Scleractinian Corals - *Section 3.6.3.6* Johnson's Seagrass and Designated Critical Habitat *Section 3.6.3.3*

Based on the enclosed analysis included in the in Draft IFR/EA associated with the effects of the construction of the Recommended Plan at Mount Sinai Medical Center, Miami-Dade County, Florida, the Corps determined that the proposed action may affect, but is not likely to adversely affect, listed sea turtles and the smalltooth sawfish. The project will have no effect on Johnson's seagrass or the listed scleractinian corals. Also the construction will not adversely modify designated critical habitat for Johnson's seagrass.

The Corps respectfully requests that NMFS provide a letter of concurrence within 30 days of the receipt of this letter. If you have any questions, please contact Mrs. Terri Jordan-Sellers at 904-232-1817 or Terri.Jordan-Sellers@usace.army.mil.

Sincerely,

Gina Paduano Ralph, Ph.D.
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
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F/SER31: TWD

JUN 13 2017

Chief, Environmental Branch
Planning and Policy Division
Jacksonville District Corps of Engineers
Department of the Army
701 San Marco Boulevard
Jacksonville, Florida 32207-8175

Dear Sir or Madam:

The enclosed Biological Opinion ("Opinion") responds to your request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act (ESA) for the following action.

Reference	Applicant	PCTS Number	Project Types
CAP Section 14	Mount Sinai Medical Center	SER-2016-18319	Seawall Construction

The Opinion considers the effects of construction of a new 3,070 linear foot seawall and installation of a new concrete riser on an existing seawall on the following listed species and critical habitat: green sea turtles (North and South Atlantic distinct population segments [DPSs], hawksbill sea turtles, Kemp's ridley sea turtles, loggerhead sea turtles (Northwest Atlantic Ocean DPS), smalltooth sawfish, and Johnson's seagrass critical habitat. NMFS concludes that the proposed action is not likely to adversely affect green, hawksbill, Kemp's ridley, or loggerhead sea turtles, or smalltooth sawfish. NMFS also concludes that the proposed action is not likely to result in the destruction or adverse modification of designated critical habitat for Johnson's seagrass.

We look forward to further cooperation with you on other USACE projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Dr. Thomas Dolan, Consultation Biologist, at (727) 551-5741, or by email at thomas.dolan@noaa.gov.

Sincerely,

FOR Roy E. Crabtree, Ph.D.
Regional Administrator

Enc.: Biological Opinion
File: 1514-22.F.4

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	United States Army Corps of Engineers, Jacksonville District
Applicant:	Mount Sinai Medical Center
Activity:	Construction of a new seawall and installation of a concrete riser on an existing seawall in Miami Beach, Miami-Dade County, Florida
Consulting Agency:	Protected Resources Division Southeast Regional Office National Marine Fisheries Service Consultation Number SER-2016-18319
Approved by:	For Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued:	JUNE 13, 2017

Table of Contents

1 CONSULTATION HISTORY 4
2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA 5
3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT 7
4 ENVIRONMENTAL BASELINE 14
5 EFFECTS OF THE ACTION ON JOHNSON'S SEAGRASS CRITICAL HABITAT 17
6 CUMULATIVE EFFECTS 17
7 CRITICAL HABITAT DESTRUCTION/ADVERSE MODIFICATION ANALYSIS 18
8 CONCLUSION 20
9 LITERATURE CITED 22

Figures

Figure 1. Images of the Mount Sinai Medical Center seawall project site, ... 5
Figure 2. Image showing the approximate action area 6
Figure 3. Benthic habitats in and near the action area 7
Figure 4. Johnson's seagrass critical habitat Unit J 13

Tables

Table 1. Effects Determinations and Status for Species and Critical Habitat 7
Table 2. Designated Critical Habitat Units for Johnson's Seagrass 11

Acronyms and Abbreviations

cSEL	cumulative sound exposure level
ESA	Endangered Species Act
IPCC	Intergovernmental Panel on Climate Change
MLLW	mean lowest low water
NMFS	National Marine Fisheries Service
RMS	root mean square
RPMs	reasonable and prudent measures
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

Units of Measurement

ac	acre(s)
dB	decibel(s)
ft	foot/feet
ft^2	square foot/feet
in	inch(es)
lin ft	linear foot/feet
m	meter(s)
mi	mile(s)
mi^2	square mile(s)

Background
Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 et seq.), requires each federal agency to "insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species." Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary on any such action. National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action "may affect" listed species or designated critical habitat. Consultation is concluded after NMFS determines that the action is not likely to adversely affect listed species or critical habitat or issues a Biological Opinion ("Opinion") that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat. The Opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures - RPMs) to reduce the effect of take, and recommends conservation measures to further the recovery of the species. Notably, no incidental destruction or adverse modification of designated critical habitat can be authorized, and thus there are no RPMs—only reasonable and prudent alternatives that must avoid destruction or adverse modification.

This document represents NMFS's Opinion based on our review of impacts associated with the proposed action to issue a permit within Miami-Dade County, Florida. This Opinion analyzes the project's effects on threatened and endangered species and designated critical habitat, in accordance with Section 7 of the ESA. We based it on project information provided by the USACE and other sources of information, including the published literature cited herein.

1 CONSULTATION HISTORY

NMFS received a request for ESA consultation from the U.S. Army Corps of Engineers (USACE) on October 31, 2016. We requested additional information on November 30, 2016, to which the USACE responded on December 6, 2016. We initiated consultation the same day. On December 22, 2016, we requested additional information regarding the presence of the olive ridley sea turtle in the action area, and the USACE responded the same day, withdrawing the olive ridley sea turtle from the consultation. Between December 22, 2016, and May 12, 2016, numerous communications were exchanged between NMFS and USACE regarding pile driving methods and noise abatement measures, due to the large area that would be affected by driving metal sheet piles using an impact driver with no noise abatement. The USACE agreed to require a ramp-up/soft-start procedure, deployment of a bubble curtain, and use of cushion blocks in conjunction with impact pile driving.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

The site currently consists of an approximately 3,000 linear foot (lin ft) seawall running along the shoreline of the Mount Sinai Medical Center on Biscayne Bay (Figure 1). The seawall is encrusted with various organisms, including turf algae, macroalgae, sponges, hydroids, tunicates, anemonae, fanworms, barnacles, bivalves, limpets, and corals. Species of coral present include *Siderastrea siderea*, *Oculina diffusa*, and *O. robusta*. No federally listed endangered or threatened corals are present. The nearshore benthos consists of areas of sand, rubble, muck, and mixed sand/muck matrix. A mixed seagrass bed, composed of paddle grass, shoalgrass, manatee grass, and turtle grass, occupies most of the area within 400 feet (ft) of the existing seawall, though the densities of the seagrasses vary. The distance of the nearshore bed edge to the bulkhead ranges between 0-28 ft and is closest to the bulkhead toward its middle. A photograph provided by the USACE shows that some of the benthos near the seawall is intertidal, exposed to air at low tides, which may prevent colonization by some seagrasses.

Figure 1. Images of the Mount Sinai Medical Center seawall project site, showing its location in Biscayne Bay (left) and the local environment and existing structures (right) (©2017 Google Earth, TerraMetrics, data SIO, NOAA, U.S. Navy, NGA, GEBCO; Figure ES-2: Recommended Plan from, "Mount Sinai Medical Center, Continuing Authorities Program (CAP) Section 14, Project: Draft Integrated Feasibility Report and Environmental Assessment," USACE)

The applicant proposes to construct a new 3,070 lin ft, steel, sheet pile seawall, 3 ft waterward of an existing seawall, with a concrete T wall cap, overhanging the water by 1.5 ft; back fill with clean stone landward of the new seawall; and add a 1.5 ft high concrete lift to 130 lin ft of extant seawall that is still structurally sound. Pile installation will consist of driving 12.56 inch (in), steel sheet piles using barge-mounted equipment. The method of pile driving has not been specified, so could use either a vibratory hammer or impact driver. If an impact driver is used, it is expected that each pile will require 300 strikes to reach final depth. Up to 10 piles will be driven each day. Completion of the project is expected to require 266 days.

All construction activity will take place during daylight hours. Turbidity curtains will only enclose small areas at any one time in the project area, and will be removed upon project completion. If an impact driver is used for pile driving, the applicant will be required to use a ramp-up/soft-start procedure in which the force exerted by the hammer is gradually increased to maximum power, which is intended to provide a stimulus for mobile species, including sea turtles and smalltooth sawfish, causing them to leave the area before the single strike sound exposure level reaches an injury-causing threshold. If an impact driver will be used for pile driving, the applicant will also be required to deploy a bubble curtain and to use cushion blocks as noise abatement measures. Additionally, the applicant will adhere to NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, including stopping work if a sea turtle or smalltooth sawfish is observed within 50 ft of construction equipment, and resumption of work only after the animal departs the area of its own volition.

2.2 Action Area

50 CFR 404.02 defines action area as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The project site is located at latitude 25.870854°N, longitude 80.127942°W (North American Datum 1983). The action area includes the waters and submerged lands within and in the immediate vicinity of the project site, and within a radius of approximately 2,070 ft (0.392 miles [mi]) around each pile, within which endangered species could be exposed to potentially harmful noise levels caused by pile driving (Figure 2). The southern extent of the action area is limited to the straight-line paths that sound waves travel through the cuts between land areas.

Figure 2. Image showing the approximate action area, outlined in red (©2017 Google, TerraMetrics, data SIO, NOAA, U.S. Navy, NGA, GEBCO)

The action area is at the southeastern extreme of an approximately 7.5-square-mile (mi^2) (4,800 acres [ac]), open area of Biscayne Bay, bounded to the south by the Julia Tuttle Causeway and to the north by the North Bay Causeway (Figure 3). This larger area includes approximately 3,154 ac of continuous seagrass beds and 475 ac of patchy seagrass beds, composed primarily of turtle grass, manatee grass, paddle grass, and shoalgrass (Figure 3) (FWRI 2011). The remainder of the bottom is primarily unconsolidated sand and silt. There are 2 clusters of artificial reef

structures approximately 1.5 mi west of the proposed seawall, and an isolated artificial reef structure approximately 2.4 mi northwest of the proposed seawall that support a growth of sponges, soft corals, and algae (FWRI and DMFM 2017). Several deep channels cross the action area, including the Atlantic Intracoastal Waterway. No hardbottom, coral reefs, or significant mangrove stands are located in this part of the bay (FWRI 2013; FWRI 2014; FWRI 2017), although the Julia Tuttle Causeway supports a narrow fringe of mangroves. Within this larger area, the action area occupies approximately 245 ac, approximately half of which is covered by seagrass beds (245 ac / 2 = 122.5 ac of seagrasses).

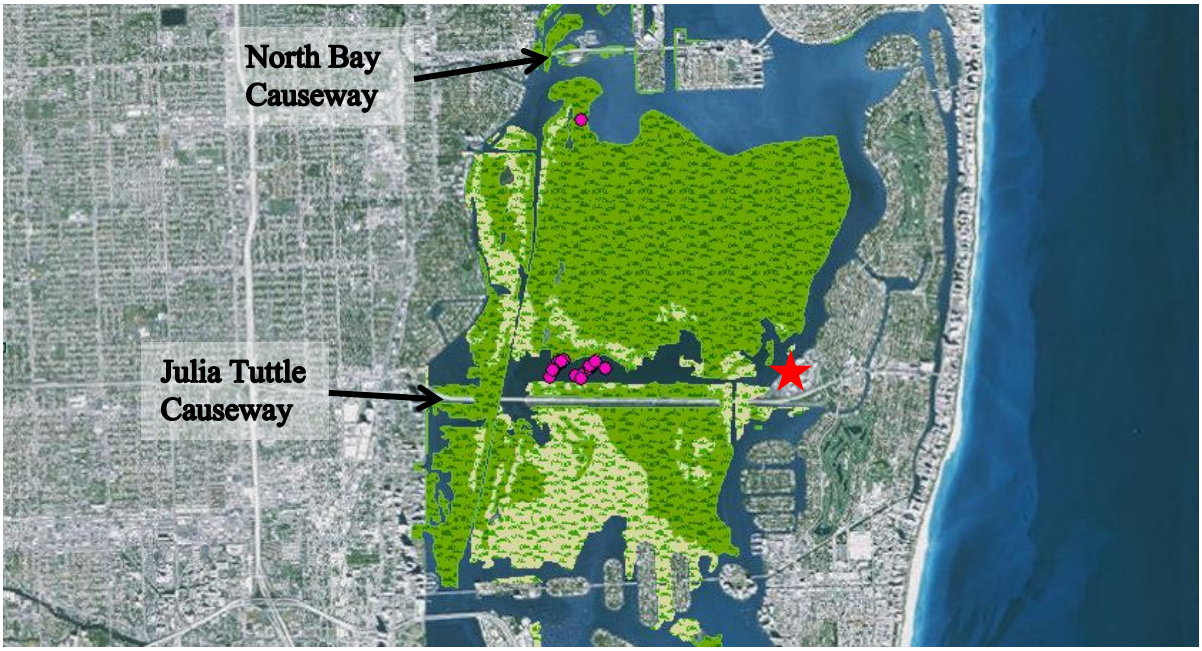

Figure 3. Benthic habitats in and near the action area: continuous seagrass beds (dark green); patchy seagrass beds (light green), artificial reefs (pink dot), proposed construction site (red star) (Basemap © Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; data layers provided by Florida Wildlife Research Institute)

3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Table 1. Effects Determinations and Status for Species and Critical Habitat in or Near the Action Areas that Either the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North and South Atlantic distinct population segment [DPS])	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Leatherback	E	NLAA	NE
Loggerhead (Northwest Atlantic Ocean DPSs)	T	NLAA	NLAA
Hawksbill	E	NLAA	NLAA

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Fish			
Smalltooth sawfish (U.S. DPS)	E	NLAA	NLAA
Critical Habitat			
Johnson's seagrass Unit J		NLAA	LAA/No DAM
E = endangered; T = threatened; DAM = destruction or adverse modification; LAA = likely to adversely affect; NLAA = may affect, not likely to adversely affect; NE = no effect			

We believe that smalltooth sawfish and green, hawksbill, Kemp's ridley, and loggerhead sea turtles may be within the action area and may be affected by the project. The USACE determined that leatherback sea turtles also may be affected. However, we believe this project will have no effect on leatherback sea turtles due to their very specific life history strategy, which is not supported at the project site. Leatherback sea turtles have a pelagic, deepwater life history, wherein they forage primarily on jellyfish. The action area is also within the boundary of Johnson's seagrass Critical Habitat Unit J, but Johnson's seagrass does not occur within the footprint of the proposed construction activity.

3.1 Species Not Likely to be Adversely Affected

Green, hawksbill, Kemp's ridley, and loggerhead sea turtles (hereafter referred to as sea turtles) and smalltooth sawfish and may be found in or near the action area and may be affected by the project. We have identified the following potential adverse effects to these species and concluded that they are not likely to be adversely affected by the proposed action for the reasons described below in Sections 3.1.1, 3.1.2, and 3.1.3.

3.1.1 Direct Physical Effects

Direct, physical injury to sea turtles and smalltooth sawfish is not expected from construction machinery or materials because we expect sea turtles and smalltooth sawfish to detect and move away from the types of construction activities that are proposed for this project. Additionally, required turbidity controls may act as a physical barrier to species presence during construction. The project will adhere to NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006 (enclosed), which will provide additional protection by requiring work to stop if a listed species is observed within 50 ft of operating machinery. Thus, direct physical impacts are considered extremely unlikely to occur and adverse effects are, therefore, discountable.

3.1.2 Noise Effects

Effects to listed species as a result of noise created by construction activities can physically injure animals in the affected areas or change animal behavior in the affected areas. Injurious effects can occur in 2 ways. First, immediate adverse effects can occur to listed species if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects prevent animals from

migrating, feeding, resting, or reproducing, for example. All in-water noise levels discussed below are referenced to 1 micropascal. The NMFS-accepted noise thresholds for impact pile driving are 206 decibels (dB) for peak-pressure injury, 187 dB for cumulative sound exposure level (cSEL) injury, 150 dB root mean square (RMS) for behavioral disturbance of fishes, and 160 dB RMS for behavioral disturbance of sea turtles. Our evaluation of effects to listed species as a result of noise created by construction activities is based on the analysis prepared in support of the Opinion for SAJ-82 (NMFS 2014). Because the pile driving method has not been specified, the applicant could choose to use either a vibratory hammer or impact hammer. Therefore, this analysis includes both methods.

Vibratory installation of steel sheet piles:
Based on our noise calculations, installation of metal sheet piles by vibratory hammer will not result in any form of injurious noise effects. Yet, this installation method could result in behavioral effects at radii of 52 ft (16 meters [m]) for sea turtles and 243 ft (74 m) for smalltooth sawfish. Given the mobility of these species, we expect them to move away from noise disturbances. Because there is similar habitat nearby, we believe this effect will be insignificant. If an individual chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since installation will occur only during the day, these species will be able to resume normal activities during quiet periods between pile installations and at night. Therefore, installation of metal sheet piles by vibratory hammer will not result in any injurious noise effect, and we anticipate any behavioral effects will be insignificant.

Installation of up to 10 steel sheet piles per day by an impact hammer using a ramp-up procedure, bubble curtain, and cushion block:
Based on our noise calculations, installation of steel sheet piles by impact hammer will cause single-strike or peak-pressure injurious noise effects to sea turtles and smalltooth sawfish within 5.2 ft of the pile driving impact. However we expect this effect to be discountable for the following reasons. Sea turtles and smalltooth sawfish are highly mobile and are expected to the leave areas disturbed by construction activity. The ramp-up procedure is intended to provide a stimulus for mobile species, including sea turtles and smalltooth sawfish, causing them to leave the area before the single strike sound exposure level reaches an injury-causing threshold. Once they have left the area, it is expected that they will continue to avoid it. In the unlikely event that a sea turtle or smalltooth sawfish approaches the pile driving operation in spite of the construction activity, the applicant has agreed to cease all in-water activity until the animal is observed to leave the area. In accordance with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, all construction workers will be required to continuously watch for sea turtles and smalltooth sawfish. If a sea turtle or smalltooth sawfish is observed within 50 ft of the construction site, all in-water activities, including pile driving, will cease until the animal is observed to leave the area of its own accord. Because the area monitored for listed species is larger than the physical injury zone, we feel that observers will provide adequate protection for listed species in the area, making adverse effects extremely unlikely to occur.

The cumulative sound exposure level of multiple pile strikes over the course of a day may cause physical injury to sea turtles and smalltooth sawfish up to 430 ft from the impact location. Due

to the mobility of smalltooth sawfish, and because the project occurs in open water, we expect them to move away from construction activity and noise disturbances. Because we anticipate that sawfish and turtles will move away from the project area during the ramp-up period, we believe that an animal's suffering physical injury from cumulative noise exposure is extremely unlikely to occur. The project has adequate avenues for a sawfish or sea turtle to leave or avoid the project area during pile-driving activities, and there is similar habitat outside of the cumulative sound exposure injury zone. Thus, we believe the risk of injury is extremely unlikely and is discountable. However, an animal's movement away from the injurious impact zone is a behavioral response, with the effects discussed below.

The installation of piles using an impact hammer could also result in behavioral effects for sea turtles at a distance of 446 ft from the impact location and for smalltooth sawfish at a distance of 2,070 ft from the impact location. Due to the mobility of sea turtles, we expect them to move away from noise disturbances in this open-water environment. Because there is similar habitat nearby and because there are no other barriers to movement around the area, we believe any behavioral effect will be insignificant. Because pile driving will occur only during the day, these species will be able to resume normal activities during quiet periods between driving piles and at night. Therefore, we anticipate any behavioral effects to sea turtles or smalltooth sawfish will be insignificant.

3.1.3 Foraging and Refuge

Sea turtles and smalltooth sawfish may be temporarily unable to use the project site for forage and shelter habitat due to avoidance of construction activities, related noise, and physical exclusion from areas blocked by turbidity curtains. We expect these effects will be temporary and intermittent (impact hammering and construction will only occur during daylight hours). Also, because these species are mobile, we expect that they will move away from the construction activities and forage in adjacent areas with similar available habitat. As described above, in the description of the Action Area (Section2.2), this portion of Biscayne Bay includes extensive seagrass beds, large areas of silt and sand, and substrate for sponge, soft coral, and algae. The action area includes only about 3% of the seagrasses available in this portion of the bay (100% × 122.5 ac / [3,154 ac continuous seagrass + 475 ac patchy seagrass] ≈ 3.3756%), and 10% of sand and silty bottom (100% × 122.5 ac / [4800 ac total area - (3,154 ac + 475 ac seagrasses)] ≈ 10.461%). Therefore, the effects to sea turtles and smalltooth sawfish from the impacts of temporary loss of foraging and refuge habitat will be insignificant.

Sea turtles and smalltooth sawfish may also be affected by the permanent loss of approximately 9,210 ft^2 of forage habitat (3,070 lin ft seawall × 3 ft offset). We expect this effect to be insignificant, given the large amount of similar habitat nearby, described above, that will not be affected by the action.

3.2 Status of Critical Habitat Likely to be Adversely Affected

The term "critical habitat" is defined in Section 3(5)(A) of the ESA as (i) the specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (1) essential to the conservation of the species and (2) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a

determination that such areas are essential for the conservation of the species. "Conservation" is defined in Section 3(3) of the ESA as "…the use of all methods and procedures that are necessary to bring any endangered or threatened species to the point at which listing under the ESA is no longer necessary."

3.2.1 Johnson's seagrass critical habitat

Description
NMFS designated Johnson's seagrass critical habitat on April 5, 2000 (65 FR 17786; see also, 50 CFR 226.213). The specific areas occupied by Johnson's seagrass and designated by NMFS as critical habitat are those with 1 or more of the following criteria:

1. Locations with populations that have persisted for 10 years
2. Locations with persistent flowering populations
3. Locations at the northern and southern range limits of the species
4. Locations with unique genetic diversity
5. Locations with a documented high abundance of Johnson's seagrass compared to other areas in the species' range

Ten areas (Units) within the range of Johnson's seagrass (approximately 200 kilometers) of coastline from Sebastian Inlet to northern Biscayne Bay, Florida) are designated as Johnson's seagrass critical habitat (Table 2). The total range-wide acreage of critical habitat for Johnson's seagrass is roughly 22,574 ac (NMFS 2002).

Table 2. Designated Critical Habitat Units for Johnson's Seagrass

Unit A	A portion of the Indian River, Florida, north of the Sebastian Inlet Channel
Unit B	A portion of the Indian River, Florida, south of the Sebastian Inlet Channel
Unit C	A portion of the Indian River Lagoon, Florida, in the vicinity of the Fort Pierce Inlet
Unit D	A portion of the Indian River Lagoon, Florida, north of the St. Lucie Inlet
Unit E	A portion of Hobe Sound, Florida, excluding the federally marked navigation channel of the Intracoastal Waterway
Unit F	A portion of the south side of Jupiter Inlet, Florida
Unit G	A portion of Lake Worth, Florida, north of Bingham Island
Unit H	A portion of Lake Worth Lagoon, Florida, located just north of the Boynton Inlet
Unit I	A portion of northeast Lake Wyman, Boca Raton, Florida, excluding the federally marked navigation channel of the Intracoastal Waterway
Unit J	A portion of northern Biscayne Bay, Florida, including all parts of the Biscayne Bay Aquatic Preserve excluding the Oleta River, Miami River, and Little River beyond their mouths, the federally marked navigation channel of the Intracoastal Waterway, and all existing federally authorized navigation channels, basins, and berths at the Port of Miami to the currently documented southernmost range of Johnson's seagrass, Central Key Biscayne

The physical habitat that supports Johnson's seagrass includes both shallow intertidal and deeper subtidal zones. The species thrives either in water that is clear and deep (2-5 m) or in water that is shallow and turbid. In tidal channels, it inhabits coarse sand substrates. The spread of the species into new areas is limited by its reproductive potential. Johnson's seagrass possesses only female flowers; thus vegetative propagation, most likely through asexual branching, appears to be its only means of reproduction and dispersal. If an established community is disturbed, regrowth and reestablishment are extremely unlikely. This species' method of reproduction impedes the ability to increase distribution as establishment of new vegetation requires considerable stability in environmental conditions and protection from human-induced disturbances.

Essential Features of Critical Habitat

NMFS identified 4 habitat features essential for the conservation of Johnson's seagrass: (1) adequate water quality, defined as being free from nutrient over-enrichment by inorganic and organic nitrogen and phosphorous or other inputs that create low oxygen conditions; (2) adequate salinity levels, indicating a lack of very frequent or constant discharges of fresh or low-salinity waters; (3) adequate water transparency, which would allow sunlight necessary for photosynthesis; and (4) stable, unconsolidated sediments that are free from physical disturbance. All 4 essential features must be present in an area for it to function as critical habitat for Johnson's seagrass.

Critical Habitat Unit Impacted by this Action

This consultation focuses on an activity that occurs in Unit J, which encompasses the northern portion of Biscayne Bay from Northeast 163rd Street south to Central Key Biscayne at 25º45´N (Figure 4). This portion of Biscayne Bay is bound by heavy residential and commercial development, though a few areas of mangrove shoreline remain. Dredge and fill projects have resulted in a number of spoil islands and channels too deep for seagrass growth. Biscayne Bay supports a diversity of biological communities including intertidal wetlands, seagrasses, hard bottom, assemblages, and open water. Unit J is wholly within the Biscayne Bay Aquatic Preserve.

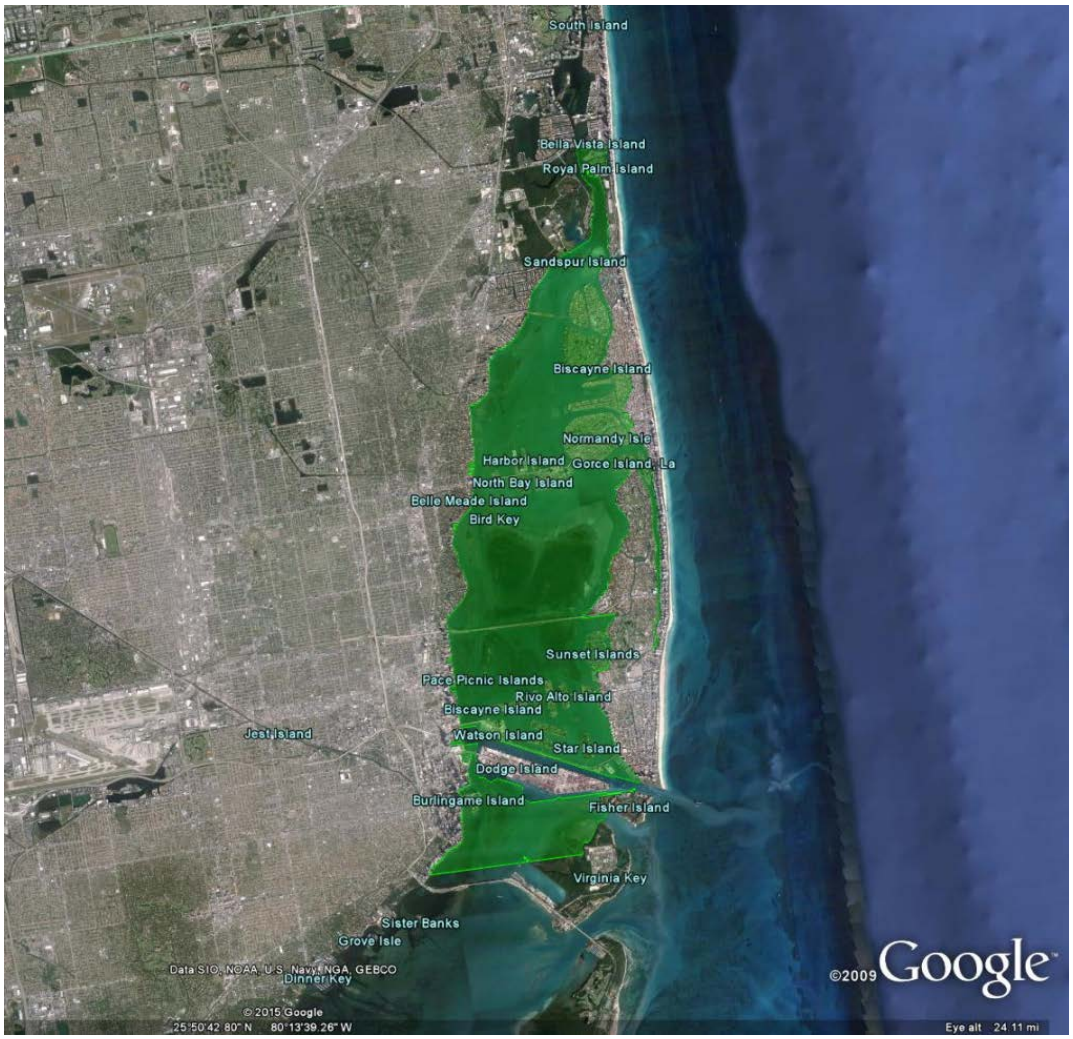

Figure 4. Johnson's seagrass critical habitat Unit J (©2015 Google, Data SIO, NOAA, U.S. Navy, NGA, GEBCO)

Status and Threats

A wide range of activities, many funded authorized or carried out by federal agencies, have and will continue to affect the essential habitat requirements of Johnson's seagrass. These are generally the same activities that may affect the species itself, and include: (1) vessel traffic and the resulting propeller dredging; (2) dredge and fill projects; (3) dock, marina, and bridge construction; (4) water pollution; and (5) land use practices (shoreline development, agriculture, and aquaculture).

Vessel traffic has the potential to affect Johnson's seagrass critical habitat by reducing water transparency. Operation of vessels in shallow water environments often leads to the suspension of sediments due to the spinning of propellers on or close to the bottom. Suspended sediments reduce water transparency and the depth to which sunlight penetrates the water column. Populations of Johnson's seagrass that inhabit shallow water and water close to inlets where vessel traffic is concentrated are likely to be most affected. This effect is expected to worsen with increases in boating activity.

The dredging of bottom sediments to maintain, or in some cases create, inlets, canals, and navigation channels can directly affect essential features of Johnson's seagrass critical habitat. Dredging results in turbidity through the suspension of sediments. As discussed previously, the suspension of sediments reduces water transparency and the depth to which sunlight can penetrate the water column. The suspension of sediments from dredging can also re-suspend nutrients, which could result in over-enrichment and/or reduce dissolved oxygen levels. Further, dredging can destabilize sediments and alter both the shape and depth of the bottom within the dredged footprint. This may affect the ability of the critical habitat to function through the removal or modification of essential features.

Dock, marina, and bridge construction leads to loss of habitat via construction impacts (e.g., pile installation) and shading. Similar to dredging, installation of piles for docks or bridges can result in increased turbidity that can negatively impact water transparency over short durations. Additionally, installed piles also replace the stable, unconsolidated bottom sediments essential for the species. Completed structures can have long-term effects on critical habitat in the surrounding area because of the shade they produce. While shading does not affect water transparency directly, it does affect the amount and/or duration of sunlight that can reach the bottom. The threat posed by dock, marina, and bridge construction is especially apparent in coastal areas where Johnson's seagrass is found.

Other threats include inputs from adjacent land use. Johnson's seagrass critical habitat located in proximity to rivers, canal mouths, or other discharge structures is affected by land use within the watershed. Waters with low salinity that are highly colored and often polluted are discharged to the estuarine environment. This can impact salinity, water quality, and water transparency, all essential features of Johnson's seagrass critical habitat. Frequent pulses of freshwater discharge to an estuarine area may decrease salinity of the habitat and provoke physiological stress to the species. Nutrient over-enrichment, caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off, stimulates increased algal growth, decreased water transparency, and diminished oxygen content within the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities. Discharges can also contain colored waters stained by upland vegetation or pollutants. Colored waters released into these areas reduce the amount of sunlight available for photosynthesis by rapidly reducing the amount of shorter wavelength light that reaches the bottom. In general, threats from adjacent land use will be ongoing, randomly occurring events that follow storm events.

4 ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and the ecosystem, within the action area. It does not include the effects of the action under review in this consultation.

By regulation, environmental baselines for Biological Opinions include the past and present impacts of all state, federal, or private actions and other human activities in the action area, other than the action under review. We identify the anticipated impacts of all proposed federal projects in the specific action area of the consultation at issue, that have already undergone

formal or early Section 7 consultation as well as the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

Focusing on the impacts of the activities in the action area specifically, allows us to assess the prior experience and state (or condition) of the endangered and threatened individuals, and areas of designated critical habitat that occur in an action area, and that will be exposed to effects from the actions under consultation. This is important because, in some phenotypic states or life history stages, listed individuals will commonly exhibit, or be more susceptible to, adverse responses to stressors than they would be in other states, stages, or areas within their distributions. The same is true for localized populations of endangered and threatened species: the consequences of changes in the fitness or performance of individuals on a population's status depends on the prior state of the population. Designated critical habitat is not different: under some ecological conditions, the physical and biotic features of critical habitat will exhibit responses that they would not exhibit in other conditions.

4.1 Status of Johnson's seagrass critical habitat within the Action Area

As discussed above, this consultation focuses on activities occurring in Unit J, which encompasses the northern portion of Biscayne Bay from NE 163rd Street south to Central Key Biscayne at 25º 45´N (Figure 4). This portion of Biscayne Bay is bounded by heavy residential and commercial development, though a few areas of mangrove shoreline remain. The average depth of Biscayne Bay within the action area ranges from 0 ft to approximately -19.63 ft Mean Lowest Low Water (MLLW), referenced to the local tidal datum at the time of the hydrographic survey that measured it, with a mean of -3.79 ft MLLW (NOS 1998). The deepest water, more than -9 ft MLLW, is within the Meloy Channel, which comprises approximately 25% of the horizontal extent of the action area, but is excluded from the critical habitat unit. Seagrass beds occupy approximately 50% of the benthos within the action area. The distribution of Johnson's seagrass in this area is not known, but the essential features of Johnson's seagrass critical habitat appear to be present throughout the area.

4.2 Factors Affecting Johnson's seagrass critical habitat within the Action Area

4.2.1 Federal Actions

A wide range of activities funded, authorized, or carried out by federal agencies may affect the essential features of critical habitat for Johnson's seagrass. These include actions permitted or implemented by the USACE such as dredging; dock/marina construction; bridge/highway construction; residential construction; shoreline stabilization; breakwaters; and the installation of subaqueous lines or pipelines. Other federal activities that may affect Johnson's seagrass critical habitat include actions by the Environmental Protection Agency and the USACE to manage freshwater discharges into waterways; management of National Parks; regulation of vessel traffic to minimize propeller dredging and turbidity; and other activities by the U.S. Coast Guard and U.S. Navy. Although these actions have probably affected Johnson's seagrass critical habitat, none of these past actions have destroyed or adversely modified Johnson's seagrass critical habitat. Although some of these actions may have the potential to indirectly affect nutrient load, salinity, or water transparency in the action area, the continued growth of seagrasses in the action area indicates that any effect they may have had on the essential features of Johnson's seagrass critical habitat have been insignificant.

According to NMFS's Public Consultation Tracking System database, there have been no ESA Section 7 consultations completed on activities with the potential to affect Johnson's seagrass critical habitat within the action area.

4.2.2 State or Private Actions

4.2.2.1 Development and Urbanization

The action area is located in a highly developed coastal area with an extensive canal system. Freshwater discharges and nutrient over-enrichment due to coastal runoff and discharge into Biscayne Bay may be increased by upland development. Freshwater discharge may reduce salinity to inadequate levels for survival of Johnson's seagrass, thus affecting the second essential feature of the designated critical habitat, adequate water quality. Similarly, nutrient over-enrichment can lead to planktonic algae blooms, decreasing water transparency, the third essential feature of the designated critical habitat. Death and decomposition of the algal bloom typically decrease dissolved oxygen content in the water, thus affecting the first essential feature of the designated critical habitat, adequate water quality, defined as being free from nutrient over-enrichment by inorganic and organic nitrogen and phosphorous or other inputs that create low oxygen conditions. These processes affect all of the waters of Biscayne Bay to varying degrees due to large-scale mixing of waters, diffusion, and currents. Thus activities outside of the action area may affect the essential features of Johnson's seagrass critical habitat within the action area.

4.2.2.2 Recreational Vessel Traffic

Marina and dock construction increases recreational vessel traffic within areas of Johnson's seagrass critical habitat, which increases suspended sediments from propellers. As mentioned above, suspended sediments are known to adversely affect Johnson's seagrass critical habitat by reducing water transparency, which is one of the essential features. Increases in vessel traffic may also result in an increase in propeller dredging and vessel grounding incidents. Propeller dredging and grounding incidents in soft bottom disturb the sediment, and, thus may adversely affect another essential feature of Johnson's seagrass critical habitat: stable, unconsolidated sediments that are free from physical disturbance.

4.2.3 Conservation and Recovery Actions Shaping the Environmental Baseline

State and federal conservation measures exist to protect Johnson's seagrass and its habitat under an umbrella of management and conservation programs that address seagrasses in general (Kenworthy et al. 2006). Johnson's seagrass habitat is also included in the designation of critical habitat for the Florida manatee and is therefore subject to ESA Section 7 consultation by the USFWS, which has ESA jurisdiction over that species. These conservation measures must be continually monitored and assessed to determine if they will ensure the long-term protection of the species and the maintenance of environmental conditions suitable for its continued existence throughout its geographic distribution.

5 EFFECTS OF THE ACTION ON JOHNSON'S SEAGRASS CRITICAL HABITAT

Effects of the action include direct and indirect effects of the action under consultation. Indirect effects are those that result from the proposed action, occur later in time (i.e., after the proposed action is complete), but are still reasonably certain to occur.

Effects of the proposed action also include effects of other activities that are interrelated or interdependent with the proposed action. Interrelated actions are those that are part of a larger action and depend on that larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Thus these actions are also described and their effects on listed species and critical habitat are evaluated as effects of the proposed action. We have identified no interrelated or interdependent actions relative to the proposed action.

All four essential features of Johnson's seagrass critical habitat are present within the proposed action area. The proposed action will not affect the essential features of adequate water quality or adequate salinity within the action area. The construction of the new seawall will result in the loss of approximately 9,210 ft^2 (3,070 ft × 3 ft) of stable, unconsolidated sediments that are free from physical disturbance. The construction of an overhanging T-wall and cap will affect water transparency by reducing transmission of sunlight necessary for photosynthesis in an area of 4,800 ft^2 (3,200 ft × 1.5 ft). A permanent loss of any one of these essential features renders the area incapable of supporting Johnson's seagrass and constitutes a total loss of the conservation function of the critical habitat in the area of the loss. Therefore, this project will result in the loss of 14,010 ft^2 (~0.322 ac) of Johnson's seagrass critical habitat (9,210 ft^2 sediments replaced + 4,800 ft^2 shaded).

6 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, or local private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed actions are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

No categories of effects beyond those already described are expected in the action areas. Dock and marina construction will likely continue at current rates, with concomitant loss and degradation of seagrass habitat, including Johnson's seagrass. However, these activities are subject to USACE permitting and thus the ESA Section 7 consultation requirement. Furthermore, NMFS and the USACE have developed protocols to encourage the use of light-transmitting materials in future construction of docks within the range of Johnson's seagrass. However, even if all new docks are constructed in full compliance with the NMFS and USACE's *Construction Guidelines for Minor Piling-Supported Structures in or over Submerged Aquatic Vegetation (SAV), Marsh or Mangrove Habitat*, there will still be shading impacts to Johnson's seagrass from new docks (but shading impacts would be reduced if guidelines are followed). As previously stated, Landry et al. (2008) found that Johnson's seagrass persisted under docks constructed of grated decking versus non-grated decking. Although it was reduced in frequency under grated docks, Johnson's seagrass was observed in higher densities under grated versus non-grated docks. In summary, NMFS acknowledges that shading impacts to Johnson's seagrass

will continue via dock construction. As NMFS and the USACE continue to encourage permit applicants to design and construct new docks in full compliance with the NMFS and USACE's *Construction Guidelines for Minor Piling-Supported Structures in or over Submerged Aquatic Vegetation (SAV), Marsh or Mangrove Habitat*, the NMFS and USACE's *Key for Construction Conditions for Docks or Other Minor Structures Constructed in or Over Johnson's seagrass (Halophila johnsonii)*, and the recommendations in Landry et al. (2008) and Shafer et al. (2008), NMFS believes that shading impacts to Johnson's seagrass will be reduced in the short- and long-term.

Upland development and associated runoff will continue to degrade water quality and decrease water clarity necessary for growth of seagrasses. Flood control and imprudent water management practices will continue to result in freshwater inputs into estuarine systems, thereby degrading water quality and altering salinity. Long-term, large-scale reduction in salinity has been identified as a potentially significant threat to the persistence and recovery of Johnson's seagrass.

7 CRITICAL HABITAT DESTRUCTION/ADVERSE MODIFICATION ANALYSIS

NMFS's regulations define destruction or adverse modification to mean a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR § 402.02). Other alterations that may destroy or adversely modify critical habitat may include impacts to the area itself, such as those that would impede access to or use of the essential features. We intend the phrase "significant delay" in development of essential features to encompass a delay that interrupts the likely natural trajectory of the development of physical and biological features in the designated critical habitat to support the species' recovery. NMFS will generally conclude that a federal action is likely to "destroy or adversely modify" designated critical habitat if the action results in an alteration of the quantity or quality of the essential physical or biological features of designated critical habitat, or that precludes or significantly delays the capacity of that habitat to develop those features over time, and if the effect of the alteration is to appreciably diminish the value of critical habitat for the conservation of the species. This analysis takes into account the geographic and temporal scope of the proposed action, recognizing that "functionality" of critical habitat necessarily means that it must now and must continue in the future to support the conservation of the species and progress toward recovery. Destruction or adverse modification does not depend strictly on the size or proportion of the area adversely affected, but rather on the role the action area serves with regard to the function of the overall designation, and how that role is affected by the action.

Recovery for Johnson's seagrass as set forth in the final recovery plan (NMFS 2002), will be achieved when the following recovery objectives are met: (1) the species' present geographic range remains stable for at least 10 years, or increases; (2) self-sustaining populations are present throughout the range at distances less than or equal to the maximum dispersal distance to allow for stable vegetative recruitment and genetic diversity; and (3) populations and supporting habitat in its geographic range have long-term protection (through regulatory action or purchase acquisition). We evaluated the projects' expected impacts on critical habitat to determine

whether it will be able to continue to provide its intended functions in achieving these recovery objectives and supporting the conservation of the species.

The first recovery criterion for Johnson's seagrass is for its present range to remain stable for 10 years or to increase during that time. NMFS's 5-year review (2007) of the status of the species concluded that the first recovery objective had been achieved as of 2007. In fact, the range had increased slightly northward, and we have no information indicating range stability has decreased since then. In Section 5, we determined that this project will result in the loss of approximately 14,010 ft^2 (0.322 ac) of Johnson's seagrass critical habitat by placement of piles and shading by non-grated, overwater structures and vessels. But the action area is not at a boundary of the species' range; the area that will be impacted is very small; and the loss of the potential areas for colonization will not affect the stability of the species' range now or in the future. Thus, we believe the project will not reduce the ability of the critical habitat to contribute to range stability for Johnson's seagrass.

The second recovery criterion for Johnson's seagrass requires that self-sustaining populations be present throughout the range at distances less than or equal to the maximum dispersal distance for the species. Due to its asexual reproductive mode, self-sustaining populations are present throughout the range of species. As discussed in Section 3.2.1, there are approximately 22,574 ac of Johnson's seagrass critical habitat. The loss of approximately 14,010 ft^2 (0.322 ac) of designated critical habitat for Johnson's seagrass in Unit J would equate to a loss of approximately 0.0014% of Johnson's seagrass critical habitat (0.322 ac × 100% / 22,574 ac ≈ 0.001426%). This loss will not affect the conservation value of available critical habitat to an extent that it would impact Johnson's seagrass self-sustaining populations by adversely affecting the availability of suitable habitat in which the species can spread/flow in the future. Drifting fragments of Johnson's seagrass can remain viable in the water column for 4-8 days (Hall et al. 2006), and can travel several kilometers under the influence of wind, tides, and waves. Because of this, we believe that the removal of approximately 14,010 ft^2 of critical habitat by this project will not appreciably diminish the conservation value of critical habitat in supporting self-sustaining populations.

The final recovery criterion is for populations and supporting habitat in the geographic range of Johnson's seagrass to have long-term protection (through regulatory action or purchase acquisition). Though the affected portions of the project sites will not be available for the long-term, thousands of acres of designated critical habitat are still available for long-term protection, which include areas surrounding the action areas.

The proposed project will not affect the stability of the geographic range of the species; it will not appreciably diminish the conservation value of the critical habitat in supporting self-sustaining populations; and it will not prevent the long-term protection of the species and its supporting habitat in the remainder of its geographic range. Therefore, we conclude that the adverse effects of the proposed action on Johnson's seagrass critical habitat will not impede achieving the recovery objectives listed above and will, therefore, not appreciably diminish the value of the critical habitat for the conservation and recovery of the species.

8 CONCLUSION

We have analyzed the best available scientific and commercial data, the current status of the species, environmental baseline, effects of the proposed actions, and cumulative effects to determine whether the proposed action is likely to destroy or adversely modify Johnson's seagrass critical habitat. Because the proposed action will not appreciably diminish the value of the critical habitat for the conservation and recovery of Johnson's seagrass, it is our Opinion that the proposed action is likely to adversely affect, but not likely to destroy or adversely modify Johnson's seagrass critical habitat.

8.1 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

NMFS believes the following conservation recommendations are reasonable, necessary, and appropriate to conserve and recover Johnson's seagrass. NMFS strongly recommends that these measures be considered and adopted.

1. NMFS recommends that a report of all current and proposed USACE projects in the range of Johnson's seagrass be prepared and used by the USACE to assess impacts on the species from these projects, to assess cumulative impacts, and to assist in early consultation that will avoid and/or minimize impacts to Johnson's seagrass and its critical habitat. Information in this report should include location and scope of each project and identify the federal lead agency for each project. The information should be made available to NMFS.

2. NMFS recommends that the USACE conduct and support research to assess trends in the distribution and abundance of Johnson's seagrass. Data collected should be contributed to the Florida Fish and Wildlife Conservation Commission's Florida Wildlife Research Institute to support ongoing GIS mapping of Johnson's and other seagrass distribution.

3. NMFS recommends that the USACE, in coordination with seagrass researchers and industry, support ongoing research on light requirements and transplanting techniques to preserve and restore Johnson's seagrass, and on collection of plants for genetics research, tissue culture, and tissue banking.

4. NMFS recommends that the USACE prepare an assessment of the effects of other actions under its purview on Johnson's seagrass for consideration in future consultations.

5. NMFS recommends that the USACE continue promoting the use of the October 2002 *Key for Construction Conditions for Docks or other Minor Structures Constructed in or over Johnson's Seagrass* as the standard construction methodology for proposed docks located in the range of Johnson's seagrass.

6. NMFS recommends that the USACE review and implement the recommendations in the July 2008 report, *The Effects of Docks on Seagrasses, With Particular Emphasis on the Threatened Seagrass, Halophila johnsonii* (Landry et al. 2008).

7. NMFS recommends that the USACE review and implement the Conclusions and Recommendations in the October 2008 report, *Evaluation of Regulatory Guidelines to Minimize Impacts to Seagrasses from Single-family Residential Dock Structures in Florida and Puerto Rico* (Shafer et al. 2008).

8.2 REINITIATION OF CONSULTATION

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 taking specified in the proposed action is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the Biological Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

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From:	Stahl, Chris
To:	SELLERS, Tracey Jordan (Terri) CIV USARMY CESAJ (US)
Subject:	[EXTERNAL] State Clearance Letter for FL201610037775C - Draft Integrated Feasibility Report and Environmental Assessment for the Mt. Sinai Medical Center
Date:	Wednesday, December 07, 2016 1:02:25 PM
Attachments:	16-7775C DEP Comments.pdf

December 7, 2016

Terri Jordan-Sellers

Biologist/Regional Technical Specialist

Coastal Section

Environmental Branch-Planning Division

Jacksonville District-US Army Corps of Engineers

PO Box 4970

Jacksonville, FL 32232

RE: Department of the Army, Jacksonville District Corps of Engineers - Draft Integrated Feasibility Report and Environmental Assessment for the Mt. Sinai Medical Center, Continuing Authorities Program (Cap) Section 14 Project, Miami-Dade County, Florida

SAI # FL201610037775C

Dear Terri:

Florida State Clearinghouse staff has reviewed the proposal under the following authorities: Presidential Executive Order 12372; § 403.061(42), Florida Statutes; the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended; and the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347, as amended.

The Florida Department of Environmental Protection has reviewed the proposal and provided several comments on potential impact to some of the surrounding resources. Please see the attached memorandum for specific information.

Based on the information submitted and minimal project impacts, the state has no objections to allocation of federal funds for the subject project and, therefore, the funding award is consistent with the Florida Coastal Management Program (FCMP). The state's final concurrence of the project's consistency with the FCMP will be determined

during any environmental permitting processes, in accordance with Section 373.428, Florida Statutes.

Thank you for the opportunity to review the proposed plan. If you have any questions or need further assistance, please don't hesitate to contact me at (850) 717-9076.

Sincerely,

Chris Stahl

Chris Stahl, Coordinator

Florida State Clearinghouse

Florida Department of Environmental Protection

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TO: Chris Stahl, Coordinator, Florida State Clearinghouse

FROM: Roxane Dow, Environmental Specialist, Beaches, Inlets and Ports

SUBJECT: Department of the Army, Jacksonville District Corps of Engineers - Draft Integrated Feasibility Report and Environmental Assessment for the Mt. Sinai Medical Center, Continuing Authorities Program (Cap) Section 14 Project, Miami-Dade County, Florida.

SAI # FL201610037775C

This proposed project is to reinforce and heighten about 3,000 feet of the seawall on the Biscayne Bay side of Mount Sinai Medical Center in Miami Beach. The wall is disintegrating and being overtopped in high tides, threatening the facility.

The report erroneously says the activity will need a Joint Coastal Permit. The seawall is not on the active Atlantic coast, and will need an Environmental Resource Permit (ERP) issued by the District office (Page 17 and appendices). Note: specific conditions of the ERP permit may require monitoring to identify potential impacts to seagrass resources in the project area, and compensatory mitigation may be required for unavoidable impacts to seagrass resources that result from the proposed construction activities.

The local sponsor needs to be clarified. Page 6 says it is the City of Miami Beach. Page 84 says it is Miami-Dade County.

The discussion of water quality impacts on pages 45 and 45 needs to be clarified. Turbidity impacts from beach restoration activities are not applicable to this project. Biscayne Bay is an antidegradation, Outstanding Florida Water and turbidity should not exceed background. Methods to limit any increase in turbidity should be discussed with the Southeast District Office of DEP, and the Biscayne Bay Aquatic Resource staff.

An issued ERP will constitute final state consistency with the Coastal Zone Management Act.

Thank you for the opportunity to comment.

cc. Lainie Edwards

Paul Wierzbicki

Joanna Walczak

APPENDIX D
SECTION 404(b) EVAULATION

MOUNT SINAI MEDICAL CENTER, CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

May 2017

US Army Corps of Engineers ®
Jacksonville District

SECTION 404(b) EVALUATION
DRAFT ENVIRONMENTAL ASESSMENT
ON
MT SINAI MEDICAL CENTER
CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT
DADE COUNTY, FLORIDA

I. Project Description

a. Location. The proposed work will be performed along the Biscayne Bay shoreline of Dade County, Florida. Project locations specifically include the existing seawall adjacent to Mt. Sinai Hospital. See Figure 1 in the main text.

b. General Description. The proposed work includes steel sheet pile driven on the waterside of the entire alignment of the existing seawall to an elevation of 4.0 feet NAVD88. The total length of the new sheetpile would be 3,200 feet driven to a depth of 16 feet with a 3 foot offset between it and the existing wall.At the northeast end of the driven sheetpile, a modification to S-1 (adding elevation) will be added; A T-wall will tie-in and continue landward to the 3.5 foot contour to prevent flanking of the seawall.

Authority.

d. General Description of Fill Material.

(1) General Characteristics of Material. Steel sheetpile and stone.

(2) Quantity of Material. Approximately 3,200 feet of steel sheetpile and 9,600 square feet of stone.

(3) Source of Material. To be determined.

e. Description of the Proposed Discharge Site.

(1) Location. Seawall adjacent to Mt. Sinai Hospital, Miami Beach, Dade County.

(2) Size. The total project area is approximately 3,200 linear feet of shoreline.

(3) Type of Site. Urban seawall along Biscayne Bay shoreline

(4) Type of Habitat. Shallow water habitat in an urban environment.

(5) Timing and Duration of Discharge. The exact timing of initial construction is not known.

f. Description of Disposal Method. Sheetpile would be driven by pile driver and stone backfilled between sheetpile and existing seawall. Work is anticipated to be performed from the land side.

II. Factual Determinations

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. Details will be available with the final design.

(2) Sediment Type. Backfill material would be comprised of quarried stone.

(3) Dredge/Fill Material Movement. The seawall and backfill material would create a stable structure.

(4) Physical Effects on Benthos. The placement of the wall will result in the burial and loss of some infauna. However, encrusting organisms and other marine life will colonize the new structure. Corals 10cm and greater would be voluntarily relocated or provided to an educational institution.

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.

(3) Normal Water Level Fluctuations and Salinity Gradients. Tides in the project area are semi-diurnal.

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 potential temporary increase in turbidity levels during construction of the new seawall. Turbidity will be short-term and localized and no significant adverse impacts are expected. State standards for turbidity should not be exceeded during construction.

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

(a) Light Penetration. There would be a temporary minor increase in turbidity along the shoreline during construction.

(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 seawall once the work is completed.

(3) Effects on Biota.

(a) Primary Productivity and Photosynthesis. The level of suspended particles will temporarily increase along the shoreline during construction. Suspended material will prevent light from reaching existing algae temporarily restricting photosynthesis and primary productivity in local areas.

(b) Suspension/Filter Feeders. Suspension feeders will experience minor short-term impacts during construction, but no long-term adverse impact.

(c) Sight Feeders. Visual feeders will experience short term impacts, but no long-term adverse impact.

(d) Contaminant Determinations. Deposited fill material will not introduce, relocate, or increase contaminants.

(e) Aquatic Ecosystem and Organism Determinations. No long term effects are anticipated to the aquatic ecosystem. The proposed fill material meets the exclusion criteria, therefore, no additional chemical-biological testing will be required.

(1) Effects on Plankton. Although minor short term effects (e.g., clogging of feeding appendages) on plankton are likely, no adverse long term impacts to planktonic organisms are anticipated.

(2) Effects on Benthos. Minor impacts to non-motile or motile benthic invertebrates are anticipated. However, encrusting organisms and other marine life will colonize the new structure. Corals 10cm and greater would be voluntarily relocated or provided to an educational institution.

(3) Effects on Nekton. No adverse long-term impacts to nektonic species are anticipated.

(4) Effects on the Aquatic Food Web. No adverse long-term impacts to any trophic group in the food web are anticipated.

(5) Effects on Special Aquatic Sites.

(a) Coral Reefs. There are no coral reefs located within the placement areas. However, individual corals 10cm or greater would be voluntarily relocated or provided to an educational institution.

(b) Sanctuaries and Refuges. There are no sanctuaries or wildlife refuges located within the proposed placement areas.

(c) Wetlands. There are seagrass beds located in the project area. Effects to seagrass would be minor (less than 0.05 acres).

(d) Mud Flats. There are no mud flats located within the proposed placement areas.

(e) Vegetated Shallows. There are seagrass beds located in the project area. Effects to seagrass would be minor (less than 0.05 acres).

(6) Endangered and Threatened Species. There will be no significant impacts on any threatened or endangered species from the proposed project or to designated critical habitat.

(7) Other Wildlife. No significant adverse impacts to small foraging mammals, reptiles, wading birds, or wildlife in general are expected.

(8) Actions to Minimize Impacts. All practical safeguards will be taken during construction to preserve and enhance environmental, aesthetic, recreational, and economic values in the project area.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. 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.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. No municipal or private water supplies will be impacted by the implementation of the project.

(b) Recreational and Commercial Fisheries. Recreational and commercial fisheries will not be permanently impacted by the construction of the seawall.

(c) Water Related Recreation. Local waterborne recreation should not be affected by the proposed work.

(d) Aesthetics. The reconstruction of the seawall will improve aesthetics of the shoreline.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. There are no parks, national and historic monuments, national seashores, wilderness areas, research sites and similar preserves located within the project area.

(f). Determination of Cumulative Effects on the Aquatic Ecosystem. There will be no significant cumulative impacts that result in a major impairment of water quality of the existing aquatic ecosystem as a result of placement of fill at the project site.

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

III. 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 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.

On the basis of the guidelines, the proposed placement site for the discharge of fill material is specified as complying with the requirements of these guidelines.

APPENDIX D-2
COASTAL ZONE MANAGEMENT CONSISTENCY

MOUNT SINAI MEDICAL CENTER, CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

May 2017

US Army Corps of Engineers ®
Jacksonville District

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM
FEDERAL CONSISTENCY EVALUATION PROCEDURES

MT. SINAI MEDICAL CENTER, CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

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 shall be 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 development 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 reconstruction of a seawall along the Biscayne Bay shoreline within Dade County. Therefore, this project would be consistent with the efforts of Division of Emergency Management.

4. Chapter 253, State Lands. This chapter governs the management of submerged state lands and resources within state lands. This includes archeological and historical resources; water resources; fish and wildlife resources; beaches and dunes; submerged grass beds and other benthic communities; swamps, marshes and other wetlands; mineral resources; unique natural features; submerged lands; spoil islands; and artificial reefs.

Response: All proposed work would avoid or minimize impacts to resources within submerged state lands. Appropriate protective measures shall be implemented. The proposed project would comply with the intent of this chapter.

5. Chapters 253, 259, 260, and 375, Land Acquisition. This chapter authorizes the state to acquire land to protect 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 are no state parks or preserves that occur within or along the project area.

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 project based upon the results of site investigations 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 work would help protect Mt. Sinai Hospital and would not affect tourism. Therefore, the project is consistent with the goals of this chapter.

9. Chapters 334 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 proposed project is expected to have temporary or minimal impacts to saltwater living resources. Appropriate projection measures shall be implemented.

11. Chapter 372, Living Land and Freshwater Resources. This chapter establishes the Game and Freshwater Fish Commission and directs it to manage freshwater aquatic life and wild animal life and their habitat to perpetuate a diversity of species with densities and distributions which provide sustained ecological, recreational, scientific, educational, aesthetic, and economic benefits.

Response: The project is expected to 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: This project does not involve water resources as described by this chapter.

13. Chapter 376, Pollutant Spill Prevention and Control. This chapter regulates the transfer, storage, and transportation of pollutants and the cleanup of pollutant discharges.

Response: 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, this chapter 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: Environmental protection measures will be implemented to ensure that no lasting adverse effects on water quality, air quality, or other environmental resources will occur. Coordination with the Florida Department of Environmental Protection shall occur 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 expected to occur near or on agricultural lands; therefore, this chapter does not apply.

APPENDIX D-3
ENVIRONMENTAL SURVEY REPORTS

MOUNT SINAI MEDICAL CENTER, CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

May 2017

US Army Corps of Engineers ®
Jacksonville District

Mount Sinai CAP 14 Project
Seagrass, Coral, and Upland Tree Surveys

Submittal Date: August 2016

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TABLE OF CONTENTS

INTRODUCTION 1
METHODS 1
Encrusting Organism/Scleractinian Coral Survey 1
Seagrass Survey 6
Tree Survey 7
GIS Desktop Analysis 12
RESULTS AND DISCUSSION 13
Encrusting Organism/Scleractinian Coral Survey 13
Seagrass Survey 14
Tree Survey 46
CONCLUSIONS 53

LIST OF FIGURES

Figure 1. Seagrass Survey Transect Location Map……2

Figure 2. NOAA Bathymetry Map of Study Area Showing Approximate Seagrass Survey Area Boundary……3

Figure 3. Vertical Stony Coral Transects……4

Figure 4. Encrusting Organism Vertical Transects Survey……8

Figure 5. Seagrass Survey Transects Seagrass Habitat Map of the Study Area……17

Figure 6. Seagrass Survey Transects Line-intercept Species Richness……18

Figure 7. Seagrass Survey Transects Line-intercept Species Composition……19

Figure 8. Seagrass Survey Transects Line-intercept Braun-Blanquet Score……20

Figure 9. Seagrass Survey Transects Line-intercept *Halophila decipiens* Braun-Blanquet Score…..21

Figure 10. Seagrass Survey Transects Line-intercept *Halodule wrightii* Braun-Blanquet Score……22

Figure 11. Seagrass Survey Transects Line-intercept *Syringodium filiforme* Braun-Blanquet Score……23

Figure 12. Seagrass Survey Transects Line-intercept *Thalassia testudinum* Braun-Blanquet Score……24

Figure 13. Seagrass Survey Transect Line-intercept Substrate……25

Figure 14a. Line Intercept Braun Blanquet Scores along the North Segment Transects and Seagrass Habitat within 20 ft and 50 from the Seawall……26

Figure 14b. I Line Intercept Braun Blanquet Scores along the Central Segment Transects and Seagrass Habitat within 20 ft and 50 from the Seawall……27

Figure 14c. Line Intercept Braun Blanquet Scores along the South Segment Transects and Seagrass Habitat within 20 ft and 50 from the Seawall……28

Figure 15a. Seagrass Habitats within 50 ft of the Seawall - North Segment……29

Figure 15b. Seagrass Habitats within 50 ft of the Seawall - Central Segment……30

Figure 15c. Seagrass Habitats within 50 ft of the Seawall -South Segment……31

Figure 16a. Mt. Sinai Bulkhead Replacement Tree Survey North Segment, Trees 1-13.……49

Figure 16b. Mt. Sinai Bulkhead Replacement Tree Survey Central Segment, Trees 14-30.……50

Figure 16c. Mt. Sinai Bulkhead Replacement Tree Survey South Segment, Trees 31-43.……51

Figure 16d. Mt. Sinai Bulkhead Replacement Tree Survey South Segment, Trees 44-66……52

LIST OF TABLES

Table 1a-c. Length of each seagrass transect, coral/encrusting organism transect and data collected at each transect type……9-11

Table 2. Braun-Blanquet (BB) and line-intercept cover scale for seagrass abundance……..12

Table 3. Location, species, and size data for each scleractinian coral identified along the 70 vertical seawall transects……13

Table 4. Percent cover of each functional group identified along the ten vertical encrusting transects within the project area……..14

Table 5. Linear extent (ft) of seagrass abundance classifications along transects in the north segment of the survey area, Transects 1-9……32

Table 6. Location of the seagrass bed edges, linear extent (ft) of vegetated bottom, and percent cover of unvegetated bottom along the entire transect and within the first 20 ft and 50 ft of each transect in the north segment, Transects 1-9……33

Table 7. Distance of the nearshore bed edge to the bulkhead, seagrass abundance, species composition, and substrate type at the nearshore bed edge at transects in the north segment, Transects 1-9……34

Table 8. Approximate distance of the nearshore bed edge to the bulkhead at approximately 25 ft intervals between Transects 1-9 in the north segment……34

Table 9. Average (±SE) macroalgal cover, and linear extent and percent cover of the dominant substrate at transects in the north segment, Transects 1-9……35

Table 10. Linear extent (ft) of seagrass abundance along transects in the central segment of the survey area, Transects 10-35……36

Table 11. Location of the seagrass bed edges, linear extent (ft) of vegetated bottom, and percent cover of unvegetated bottom along the entire transect and within the first 20 ft and 50 ft of each transect in the central segment, Transects 10-35……..37

Table 12. Distance of the nearshore bed edge to the bulkhead, seagrass abundance, species composition, and substrate type at the nearshore bed edge at transects in the central segment, Transects 10-35……38

Table 13. Approximate distance of the nearshore bed edge to the bulkhead at approximately 25 ft intervals between Transects 10-35 in the central segment……39

Table 14. Average (±SE) macroalgal cover, and linear extent and percent cover of the dominant substrate at transects in the central segment, Transects 10-35……..40

Table 15. Linear extent (ft) of seagrass abundance classifications along transects in the south segment of the survey area, Transects 36-70……41

Table 16. Location of the seagrass bed edges, linear extent (ft) of vegetated bottom, and percent cover of unvegetated bottom along the entire transect and within the first 20 ft and 50 ft of each transect in the south segment, Transects 36-70……42

Table 17. Distance of the nearshore bed edge to the bulkhead, seagrass abundance, species composition, and substrate type at the nearshore bed edge at transects in the south segment, Transects 36-70……..43

Table 18. Approximate distance of the nearshore bed edge to the bulkhead at approximately 25 ft intervals between Transects 36-70 in the south segment……44

Table 19. Average (±SE) macroalgal cover, and linear extent and percent cover of the dominant substrate at transects in the south segment, Transects 36-70……45

Table 20a. Upland tree survey results, Trees 1 through 30 ……..47

Table 20b. Upland tree survey results, Trees 31 through 66……48

Table 21. Seagrass habitat acreages within the entire survey area and within 20 ft of the bulkhead, 21 to 50 ft of the bulkhead, and 51 to 400 ft from the bulkhead ……53

Table 22a. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 20 ft of each transect in the north segment, Transects 1-9……54

Table 22b. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 20 ft of each transect in the central segment, Transects 10-35……55

Table 22c. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 20 ft of each transect in the south segment, Transects 36-70……56

Table 23a. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 50 ft of each transect in the north segment, Transects 1-9……57

Table 23b. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 50 ft of each transect in the central segment, Transects 10-35……57

Table 23c. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 50 ft of each transect in the south segment, Transects 36-70……58

Table 24. Average BB Score (±SE) of seagrass in muck versus sand in the central segment and northern half of the south segment where muck was the dominant substrate…….59

LIST OF APPENDICES

Appendix A Seawall Vertical Transect Survey- Scleractinian Coral Colonies (Electronic)

Appendix B Seawall Vertical Transect Survey- Representative Photos of the Encrusting Organism Community (Electronic)

Appendix C Representative Photos of the Seagrass Habitat throughout the Survey Area(Electronic)

Appendix D Upland Tree Survey Photos (Electronic)

INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Jacksonville District, is proposing to replace a 3,500-foot long bulkhead along the westward shoreline of Biscayne Bay. The bulkhead protects the shoreline of Mt. Sinai Medical Center located at 4300 Alton Road, Miami, Florida. Damage and wear to the bulkhead have rendered the structure unfit to protect the shoreline in the event of a severe weather event. Coastal Eco Group, Inc. (CEG) was contracted by GRB Environmental Services, Inc. (GRB) to collect, analyze, and report field data necessary to assess impacts to hardbottom and seagrass resources associated with the proposed bulkhead replacement. The three survey tasks in the scope of work were: 1) Encrusting Organism/Scleractinian Coral Survey; 2) Seagrass Survey; and 3) Upland Tree Survey.

METHODS

The CEG field team consisted of certified scientific SCUBA divers/marine scientists with extensive experience in coral identification, hardbottom characterization, and seagrass monitoring and mapping. The encrusting organism survey of the bulkhead was conducted on May 2, 2016, and the seagrass survey was conducted on 8 days between May 2 and June 2, 2016 due to several inclement weather days. Seventy transects were established in 50-ft. increments along the 3,500-ft (1,067 m) length of the bulkhead. The transects were created in ArcGIS 10.2 and located in the field using a handheld Trimble XH Differential GPS (DGPS) with decimeter accuracy. Transects were set from north (Transect 1) to south (Transect 70) (**Figure 1**). Each transect was marked with a wooden survey stake at the top of the bulkhead; the transect number was written on the stake for reference. Because the original coordinates for each transect were created in ArcGIS using aerial imagery, transect locations were adjusted in the field to correspond with the edge of the bulkhead. DGPS coordinates were collected in the field during installation of the transect stakes. The survey area is shown on the NOAA bathymetry map in **Figure 2**.

The encrusting organism transects were located vertically along the bulkhead from the stake to the bay bottom. At each stake, the seagrass transects began at the base of the bulkhead and extended waterward of the bulkhead for a maximum distance of 400 ft.

A survey of upland trees located immediately adjacent to the bulkhead was conducted by GRB staff on May 2 and 3, 2016.

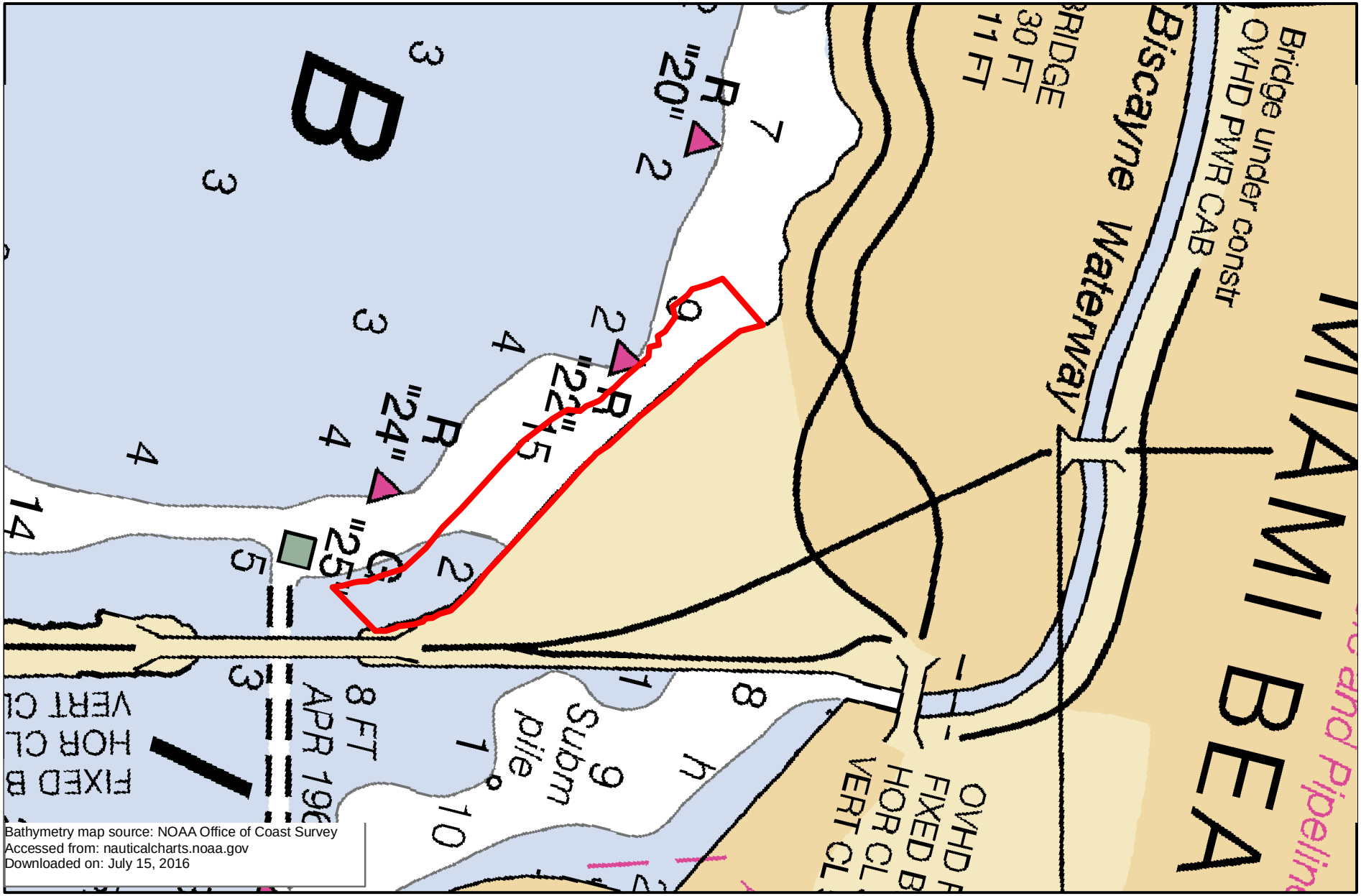
Encrusting Organism/Scleractinian Coral Survey

The purpose of the survey was to determine the number of corals ≥ 10 cm that will potentially be relocated to an alternative location and to determine the number of corals < 10 cm that would be impacted by bulkhead replacement.

The total scleractinian coral transect survey area was 70 sq. m (70 transects, each 1 m in width) (**Figure 3**). At each transect, a survey tape was extended from the wooden stake down the length of the bulkhead and weighted on the seafloor. Scientists carried a meter stick to reference the 0.5-m transect width. Transect lengths varied based on exposure of the bulkhead.

Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transect Location Map
Figure 1

Coastal Eco-Group Inc.



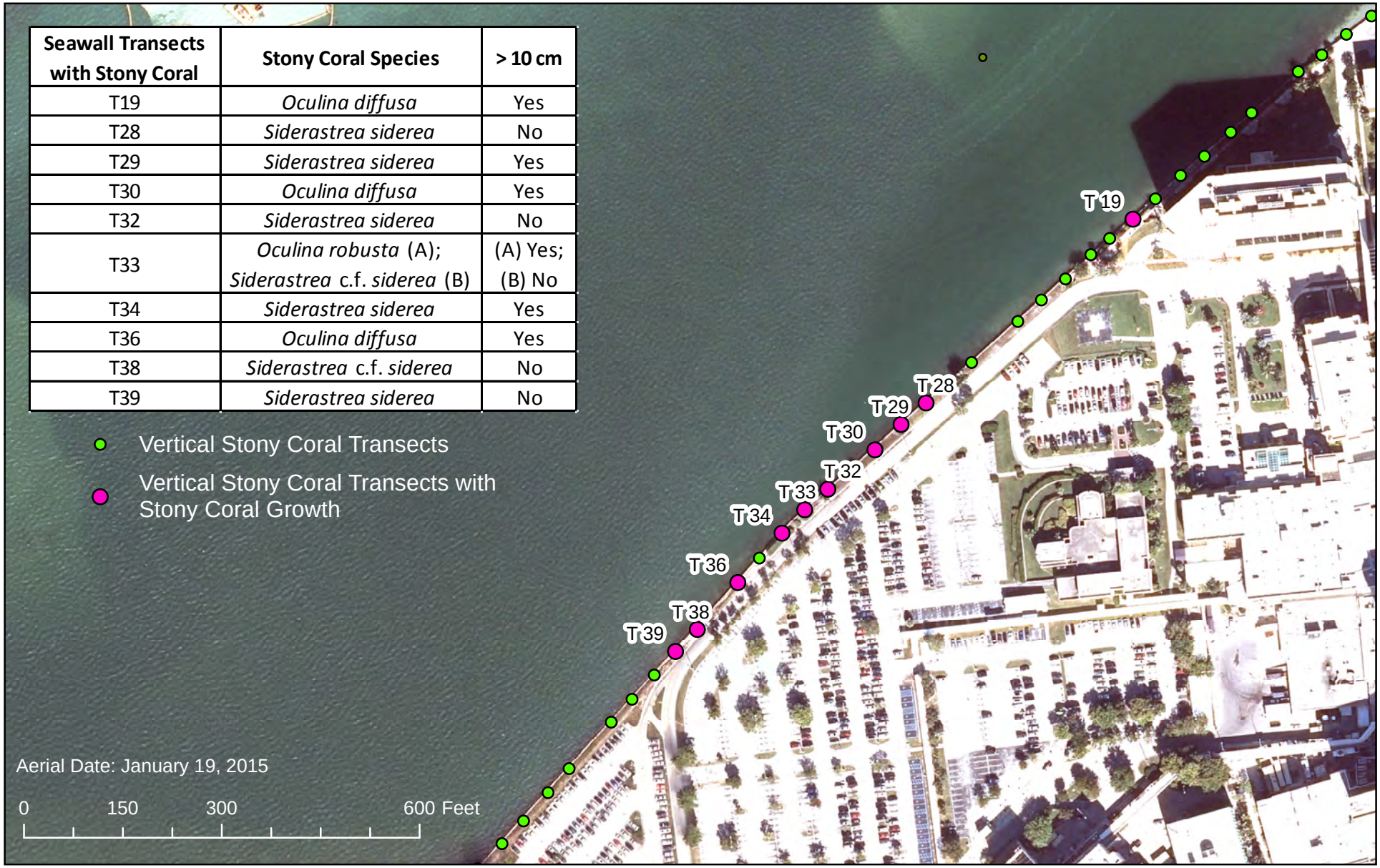
Bathymetry map source: NOAA Office of Coast Survey
Accessed from: nauticalcharts.noaa.gov
Downloaded on: July 15, 2016

N
W
E
S

Mt. Sinai Bulkhead Replacement
NOAA Bathymetry Map of Study Area Showing
Approximate Seagrass Survey Area Boundary
Figure 2

Coastal Eco-Group Inc.

Seawall Transects with Stony Coral	Stony Coral Species	> 10 cm
T19	*Oculina diffusa*	Yes
T28	*Siderastrea siderea*	No
T29	*Siderastrea siderea*	Yes
T30	*Oculina diffusa*	Yes
T32	*Siderastrea siderea*	No
T33	*Oculina robusta* (A); *Siderastrea* c.f. *siderea* (B)	(A) Yes; (B) No
T34	*Siderastrea siderea*	Yes
T36	*Oculina diffusa*	Yes
T38	*Siderastrea* c.f. *siderea*	No
T39	*Siderastrea siderea*	No



Mt Sinai Hospital Bulkhead Replacement
Vertical Stony Coral Transects
Survey completed on May 2, 2015
Figure 3

Coastal Eco-Group Inc.

Due to shallow water depths at the time of the survey, the coral survey was conducted by snorkeling or wading along the bulkhead. Several of the transects, particularly those along the southern end of the survey area, were located along portions of the bulkhead that are buried by wrack and debris.

The following data were collected for all scleractinian coral colonies ≥ 1 cm in diameter within 0.5 m on either side of the transect line (1-m wide belt):

- Species (to the lowest taxonomic rank possible) including a note if the species is listed as threatened under the Endangered Species Act.
- Colony size, including length (longest axis), width (perpendicular to the longest axis), and height (in the direction of growth)
- Colony orientation (x,y,z)
- Overall health (i.e., presence of disease or bleaching)
- Percent live and dead tissue; and
- General description of the original colony location (i.e., eastern Colonized Habitat-shallow or segments) and depth.

All scleractinian coral colonies were documented with still digital photography (**Appendix A**). A PVC pole with 10-cm increments and slate with a unique identification number were included in each photograph to accurately identify each coral colony. A representative landscape photograph of the encrusting organisms was also collected at each transect (**Appendix B**).

A quantitative encrusting organism survey was conducted at 10 of the 70 transects. The ten transects were located along the bulkhead from Transect 7 to 55 (**Figure 4**). The transects were spaced approximately 350 ft apart from Transect 7 to Transect 49; Transects 49 through 55 were spaced approximately 150 ft intervals due to burial of the bulkhead along the southern extent of the survey area.

Flora and sessile fauna within 0.5 m on either side of the survey tape (1-m wide transect) were characterized by functional group, identified to the lowest possible taxon, and assigned percent cover at each transect. Percent cover was calculated based on a visual assessment of the entire transect defined as 1 m in width by the length of the bulkhead, which ranged from 4.27 ft to 7.51 ft (1.30 m to 2.29 m). Due to the short transect lengths, scientists were able to assess the entire transect area for percent cover. Four of the ten transects (25, 31, 37, and 43) were assessed by dividing the transects into two sections by exposure, either emergent at the time of the survey or submerged, assessing percent cover of functional groups within each section, and then averaging percent cover over the two segments. Functional groups present at the transects were empty space, turf algae, macroalgae, sponge, hydroid, scleractinian coral, tunicate, anemone, fanworm, barnacle, bivalve and limpet.

Seagrass Survey

Seagrass surveys were conducted along the 70 transects to document seagrass presence/absence, species composition, and distribution. The data will be used to determine areas of potential impacts to seagrasses adjacent to the bulkhead. Highly-used navigable waters are located within the boundaries of the survey areas between Transects 10 and 35 (**Figure 1**). Due to safety concerns with diving in and adjacent to these waters, CEG coordinated with GRB and the USACE Project Manager after the first two survey days to discuss shortening transect lengths in this area where the channel markers are closest to the bulkhead. Several of the original 400-ft length transects extended waterward of the channel red day marker. The USACE Project Manager approved shortening these transects by as much as 150 ft to provide a larger buffer from vessel activity. Transect lengths and survey dates are provided in **Tables 1a** through **1c**.

A survey vessel equipped with a Trimble STS461 DGPS and HYPACK navigational software or a Trimble XH DGPS was used to locate each transect in the water. Weighted buoys were used to mark the location of transect reference points. Due to persistently strong currents within the survey area, survey tapes were only used at Transects 1 through 15 to reference distance. At these transects, the dive team weighted the survey tape at the bulkhead and swam the transect using an underwater compass to follow a directional heading of 315° toward the weighted buoy at the end of the transect. At the remaining 55 transects, surface buoys were placed at 50 ft increments along the length of the transect to replace the survey tape.

Marine scientists swam along the transects, noting seagrass cover and species composition; macroalgae cover and composition; and substrate type within a 2-meter wide area centered along the transect. A 2-m PVC pipe was used as a reference for transect width. At Transects 1 to 15, the dive team used the survey tape laid on bottom to record changes in seagrass cover/species along the transect. Survey tapes were replaced with surface buoys at 50-ft intervals for Transects 16 to 70 as described above. Scientists swam each 50 ft segment and recorded habitat type within the segment.

Seagrass occurrence and substrate type along each transect were characterized using a line-intercept assessment. Although the RFQ included point quadrat sampling for seagrass cover, this method was not required pursuant to the USACE responses to questions to the RFQ.

Field data sheets on waterproof paper were attached to clipboards and used to record data at each transect. Percent cover was assessed using the Braun Blanquet (BB) classification system to provide more detailed information on percent cover in comparison to the general classifications in the line-intercept protocol (**Table 2**). A total BB score was determined for all seagrass and macroalgae species present; individual BB scores were then assigned to each seagrass species. The BB scores were used to calculate the more general description of linear extent of bottom type described in the RFQ: seagrass cover < 25%; 25-50%; 50-75%; and > 75%. Percent cover of vegetated and unvegetated bottom type along the transects were calculated by summing the linear extent of each category and dividing by the total length of transect line. Due to the distribution of seagrass abundance throughout the survey area with the greatest

transitions observed within the first 100 ft of the transects, overall mean percent cover of seagrass at each transect is not displayed in this report. Seagrass abundance data are displayed as linear extent and percent cover.

Substrate was characterized as muck, sand, rubble, shell, or any combination thereof. Transects were documented with digital videography using a GoPro HERO 4 HD video camera. Representative photographs throughout the survey area were extracted from the video data and are presented in **Appendix C**. The complete video transect and still photograph library have been provided to the Corps on a portable hard drive.

The seagrass bed edge at each transect was marked with a weighted buoy; coordinates of the landward edge were recorded at all transects. The landward bed edge along the bulkhead was mapped in the field on June 2, 2016; scientists snorkeled along the bed edge and recorded the edge position using a handheld Trimble XH DGPS.

Tree Survey

GRB conducted a survey of a subset of upland trees located behind the bulkhead. The tree survey concentrated on the northern and southern sections of the property behind and adjacent to the bulkhead. The location of each surveyed tree was recorded with a handheld Trimble XH DGPS with decimeter accuracy. Representative photographs were taken for each tree using a Ricoh GPS camera with 1-m accuracy (**Appendix D**); GPS locations of a few trees were determined from photographs taken with the Ricoh camera. Diameter at breast height (DBH) and health of the tree, noting any deflects or disease, were recorded for each tree. Species identifications were verified from the digital still photographs.

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Mt. Sinai Hospital Bulkhead Replacement
Encrusting Organism Vertical Transects Survey
Completed on May 2, 2016
Figure 4

Coastal Eco-Group Inc.

Table 1a. Length of each seagrass transect, coral/encrusting organism transect, and data collected at each transect type

Transect	SAV			CORAL/ENCRUSTING ORGANISMS		
	Seagrass Transect Length (ft)	Survey Date	Data Collected	Coral Transect Length (ft)	Coral/General Encrusting Data Collected	Quantitative Encrusting Data Collected
1	400	5/2/2016	Line Intercept Data for Seagrass Density and Substrate/ Video	4.59	Species, size, location, and overall health of each stony coral colony/ Landscape photos of the encrusting community/ Representative photos of the encrusting community	Percent cover of functional groups, with identification to lowest possible taxon where appropriate
2	400	5/2/2016		4.27		
3	400	5/3/2016		3.94		
4	400	5/3/2016		3.28		
5	400	5/3/2016		6.56		
6	400	5/3/2016		5.25		
7	400	5/3/2016		4.27		
8	400	5/3/2016		3.61		
9	400	5/3/2016		3.61		
10	330	5/5/2016		4.27		
11	313	5/5/2016		3.61		
12	303	5/5/2016		4.92		
13	313	5/5/2016		5.41		
14	257	5/5/2016		5.91		
15	290	5/5/2016		6.23		
16	250	5/20/2016		6.56		
17	250	5/20/2016		6.00		
18	250	5/20/2016		5.91		
19	250	5/20/2016		6.23		
20	250	5/20/2016		6.23		
21	250	5/24/2016		5.58		
22	250	5/24/2016		6.82		
23	250	5/24/2016		6.40		
24	250	5/24/2016		6.69		

Notes: Coral data were collected at all 70 transects; quantitative encrusting data were only collected at the 10 transects highlighted in yellow. Coral and encrusting organism surveys were conducted on May 2, 2016.

Table 1b. Length of each seagrass transect, coral/encrusting organism transect, and data collected at each transect type

Transect	SAV			CORAL/ENCRUSTING ORGANISMS		
	Seagrass Transect Length (ft)	Survey Date	Data Collected	Coral Transect Length (ft)	Coral/General Encrusting Data Collected	Quantitative Encrusting Data Collected
25	250	5/31/2016	Line Intercept Data for Seagrass Density and Substrate/ Video	6.56	Species, size, location, and overall health of each stony coral colony/ Landscape photos of the encrusting community/ Representative photos of the encrusting community	Percent cover of functional groups, with identification to lowest possible taxon where appropriate
26	260	5/24/2016		6.89		
27	280	5/24/2016		6.23		
28	280	5/24/2016		6.56		
29	345	5/24/2016		6.23		
30	300	6/2/2016		5.91		
31	365	5/31/2016		5.91		
32	325	6/2/2016		5.91		
33	350	5/31/2016		5.91		
34	350	6/2/2016		6.23		
35	350	5/31/2016		6.00		
36	400	6/2/2016		5.91		
37	400	5/31/2016		5.58		
38	400	6/2/2016		5.09		
39	400	5/31/2016		5.51		
40	400	6/2/2016		5.28		
41	400	5/31/2016		7.22		
42	400	6/2/2016		7.87		
43	400	6/2/2016		7.51		
44	400	6/2/2016		7.87		
45	400	6/2/2016		7.41		
46	400	6/2/2016		6.89		
47	400	6/2/2016		6.89		

Notes: Coral data were collected at all 70 transects; quantitative encrusting data were only collected at the 10 transects highlighted in yellow. Coral and encrusting organism surveys were conducted on May 2, 2016.

Table 1c. Length of each seagrass transect, coral/encrusting organism transect, and data collected at each transect type

Transect	SAV			CORAL/ENCRUSTING ORGANISMS		
	Seagrass Transect Length (ft)	Survey Date	Data Collected	Coral Transect Length (ft)	Coral/General Encrusting Data Collected	Quantitative Encrusting Data Collected
48	400	6/2/2016	Line Intercept Data for Seagrass Density and Substrate/ Video	6.23	Species, size, location, and overall health of each stony coral colony/ Landscape photos of the encrusting community/ Representative photos of the encrusting community	Percent cover of functional groups, with identification to lowest possible taxon where appropriate
49	400	6/2/2016		5.25		
50	400	6/2/2016		4.92		
51	400	6/2/2016		5.12		
52	400	6/2/2016		4.92		
53	400	6/2/2016		4.76		
54	400	6/2/2016		5.25		
55	400	5/20/2016		5.09		
56	400	5/20/2016		5.25		
57	400	5/16/2016		4.92		
58	400	5/20/2016		4.10		
59	400	5/16/2016		3.12		
60	400	5/16/2016		0.00		
61	400	5/16/2016		0.00		
62	400	5/16/2016		0.00		
63	400	5/16/2016		0.00		
64	400	5/16/2016		0.00		
65	400	5/16/2016		0.00		
66	400	5/16/2016		0.00		
67	400	5/16/2016		0.00		
68	400	5/16/2016		0.00		
69	400	5/20/2016		0.00		
70	400	5/20/2016		4.40		

Notes: Coral data were collected at all 70 transects; quantitative encrusting data were only collected at the 10 transects highlighted in yellow. Coral and encrusting organism surveys were conducted on May 2, 2016.

Table 2. Braun-Blanquet (BB) and line-intercept cover scale for seagrass abundance

Line Intercept Score	Percent Abundance	BB Score	Percent Abundance
0	Seagrass absent	0	Species absent
1	< 25%	0.1	Species represented by a solitary short shoot
2	25-50%	0.5	Species represented by a few short shoots
		1	< 5% cover
3	50-75%	2	5-25% cover
		3	25-50% cover
4	>75%	4	50-75% cover
		5	75-100% cover

GIS Desktop Analysis

Prior to the field survey, a desktop GIS analysis was conducted in ArcGIS 10.2 to create a shapefile of the study area and transect locations along the bulkhead. Seventy 400-ft transects were created at a perpendicular angle along the entire 3,500-ft bulkhead. Nine points were generated along each transect: one at each endpoints and at 50-ft intervals along the transects. These points were used to deploy buoys in the field for distance and location references while scientists collected line intercept data.

Twenty-six transects (26) were shortened to less than 400 ft in length. The navigation channel marker (Red 22) was located approximately 330 ft from the bulkhead around the end of Transects 18 and 19. Transects 10 through 35 were shortened in order to provide a safety buffer from the highly-used navigable channel through the study area.

Transect field data were entered into an Excel spreadsheet, and the lengths from the line intercept survey were used to split each transect line into segments. Once transects were split, seagrass and substrate data for each line segment were imported into the shapefile attribute table. Line intercept attribute data were displayed in a map by symbolizing the cover values with different colors.

To create the seagrass habitat polygon shapefile, a polygon was first delineated around all transects to create the study area. Next, the study area polygon was split into multiple polygons based on habitat type. Habitat types were delineated by interpolating between transect line segments of similar seagrass composition. Each polygon delineated within the project area was then displayed with different colors based on species composition.

RESULTS AND DISCUSSION

Encrusting Organism/Scleractinian Coral Survey

Scleractinian corals were recorded at only 10 of the 70 belt transects on the bulkhead. Nine of the ten transects had only one scleractinian coral colony, and one transect (Transect 33) had two colonies for a total of 11 colonies. The 10 transects with scleractinian corals were generally located at the center of the project area (**Figure 3**). Only four species from two genera were identified. All colonies identified were located within the first 40 cm of the transects from the base of the bulkhead. Six of the 11 colonies were located within the first 15 cm of the transects. **Table 3** provides the location, species, and size data for each scleractinian coral.

Five of the 11 scleractinian coral colonies were < 10 cm in diameter; three were identified as *Siderastrea siderea* and two were identified as *S.* cf. *siderea* (meaning that they were too small to confirm in the field, but are likely *S. siderea*). The six remaining colonies were ≥ 10 cm in diameter and were identified as *Oculina diffusa*, *O. robusta*, or *S. siderea*. None of the 11 colonies displayed signs of bleaching or disease, and all had 100% live tissue.

Table 3. Location, species, and size data for each scleractinian coral identified along the 70 vertical seawall transects.

Transect	Transect Length (m)	Water Depth (m)	Scleractinian Coral Species	Coral ID	Length (cm)	Width (cm)	Height (cm)	> 10 cm	% Live	Location on transect (cm)	Orientation (R/L)	Distance from transect line (cm)
T19	1.90	0.85	*Oculina diffusa*	A	15	13	7	Yes	100	20	West	16
T28	2.00	0.94	*Siderastrea siderea*	A	2	2	0.5	No	100	0.05	East	12
T29	1.90	0.90	*Siderastrea siderea*	A	11	8	1	Yes	100	15	East	25
T30	1.80	0.80	*Oculina diffusa*	A	16	10	16	Yes	100	30	East	32
T32	1.80	0.75	*Siderastrea siderea*	A	7	6	1	No	100	4	West	25
T33	1.80	0.80	*Oculina robusta*	A	17	14	9	Yes	100	20	West	5
T33	1.80	0.80	*Siderastrea* cf. *siderea*	B	6	5	0.5	No	100	25	East	30
T34	1.90	0.85	*Siderastrea siderea*	A	12	7	1	Yes	100	14	West	4
T36	1.80	0.75	*Oculina diffusa*	A	24	16	11	Yes	100	36	West	50
T38	1.55	0.50	*Siderastrea* cf. *siderea*	A	3	3	0.5	No	100	12	West	50
T39	1.68	0.72	*Siderastrea siderea*	A	4	3	0.5	No	100	0.5	East	18

Four functional groups dominated the percent cover across the 10 encrusting organism transects (**Table 4**). Macroalgae, empty space, turf algae, and sponge cover, when combined, comprised 80% to 100% of the total cover. Empty space was defined as areas along the transect that did not contain any live encrusting flora or fauna. Empty space was highest at Transects 7, 52 and 55. These three transects also had the shortest total lengths from the base to the top of the bulkhead. Macroalgae contributed to more than 50% of the total cover at 7 of the 10 transects and more than 20% at all transects. The highest macroalgae cover was at Transects 31 and 37. Sponge cover was highest at Transects 25 and 43, which had the longest total transect lengths. Other functional groups identified during the encrusting surveys were hydroid, scleractinian coral, tunicate, anemone, fanworm, barnacle, bivalve and limpets.

Table 4. Percent cover of each functional group identified along the ten vertical encrusting transects within the project area.

Encrusting Organism Survey Transects	Transect Length (ft)	Functional Groups												
		Empty Space	Turf Algae	Macroalgae	Sponge	Hydroid	Scler. Coral	Tunicate	Anenome	Fanworm	Barnacle	Bivalve	Limpets	Cyano bacteria
T 7	4.27	60	20	20	0	0	0	0	0	0	0	0	0	0
T 13	5.41	35	5	55	1	0	0	0	0	0	1	0	3	0
T 19	6.23	20	15	49	10	0	1	1	0	0	2	1	1	0
*T 25	6.56	30 ± 30	3 ± 2	51 ± 16	13 ± 12	0 ± 0	0	1 ± 0	0	0	0.5 ± 0.5	0.5 ± 0.5	1 ± 0	0
*T 31	5.91	15 ± 15	3.5 ± 3.5	78.5 ± 18.5	0.5 ± 0.5	0 ± 0	0	0.5 ± 0.5	0	0.5 ± 0.5	1 ± 1	0 ± 0	0.5 ± 0.5	0
*T 37	5.58	25 ± 25	5 ± 5	67 ± 30	1.5 ± 1.5	0 ± 0	0	0 ± 0	0	0	0.5 ± 0.5	0.5 ± 0.5	0.5 ± 0.5	0
*T 43	7.51	7 ± 7	15 ± 5	51.5 ± 6.5	10.5 ± 9.5	3 ± 2	0	3 ± 2	0	0	5.5 ± 4.5	1.5 ± 0.5	3 ± 3	1
T 49	5.25	35	8	53	0	0	0	1	1	0	0	0	2	0
T 52	4.92	59	2	35	1	0	0	1	0	0	0	1	1	0
T 55	5.09	50	2	44	1	0	0	1	0	0	1	0	1	0

Notes: (*) Identifies transects that were split between the area that was exposed along the transect and the submerged portion. Percent cover values for the split transects were averaged between the exposed and submerged areas (average ± SE).

Seagrass Survey

Figures 5 through **15** display the distribution of seagrasses and substrate types throughout the survey area. A total of 17.04 acres of seagrass habitat and 9.11 acres of unvegetated bottom were mapped within the survey area. The seagrass bed is dominated by *Halophila decipiens*, *Halodule wrightii*, and *Syringodium filiforme*; *Thalassia testudinum* occurs in sporadic, dense patches, primarily in the northern and southern extents of the bed (**Figure 5**). A mixed species seagrass bed dominates the nearshore and increases in extent at the south end of the survey area; this mixed species bed accounts for 10.16 acres of seagrass habitat in the study area. The mixed species bed transitions to 6.75 acres of *H. decipiens* in the offshore portion of the study area. Monospecific *H. wrightii* and *T. testudium* patches accounted for 0.10 and 0.03 acres of the total seagrass habitat, respectively. Two occurrences of *Halophila engelmannii* were noted along Transect 12. *Halophila johnsoniii* was not observed during the survey.

Based on distribution of species abundances throughout the survey area, the seagrass bed has been divided into three segments for presentation of the results: north, central and south. The north segment consists of Transects 1 through 9 (**Table 5**). The seagrass bed is consistent throughout the north segment and characterized by moderate to high density seagrass dominated by *H. decipiens*. There is a distinct transition from a mixed species bed of *H. wrightii, H. decipiens, S. filiforme,* and *T. testudinum* from the bulkhead to a monospecific bed of *H. decipiens* around 100 ft offshore of the bulkhead. *Halodule wrightii* and *H. decipens* were recorded at every transect in the north segment. Although *H. wrightii* is generally distributed throughout the first 100 ft of each transect, occurrences were noted to 220 ft at Transect 1. *Syringodium filiforme* and *T. testudinum* occur in low density throughout the north segment. An occurrence of *S. filiforme* was noted to 220 ft; however, this species was generally confined to the first 50 ft and was observed at seven of the nine transects. *Thalassia testudinum* was recorded at six transects and was consistently recorded with < 5% cover. The greatest extent of *T. testudinum* was 263 ft at Transect 1, but it mostly occurred within the first 100 ft.

The seagrass bed edge ranged from 322 ft to 410 ft from the bulkhead; Transect 5 extended 410 ft from the bulkhead (**Table 6**). The nearshore bed edge ranged from 0 ft to 26 ft waterward of the bulkhead (**Tables 7**and **8**). The area between the bulkhead and the seagrass bed edge was dominated by rubble; sand was the dominant substrate at the bed edge. Transect 9 had the greatest linear extent of unvegetated bottom (101 ft, 25%) and the smallest linear extent in the north segment (322 ft). The unvegetated portion of Transect 9 from 322 ft to 400 ft was sand and low cover of macroalgae. Transect 5 had the lowest percent cover of unvegetated bottom (10 ft, 2%); *H. decipiens* extended to 410 ft.

Substrate in the north segment was dominated by sand (**Table 9**). Rubble was common at the start of the transects. Muck was recorded at Transects 1, 2, and 5, generally between 50 ft and 200 ft. Muck was noted at Transect 5 from about 40 ft to 100 ft followed by a sand/muck matrix from 100 ft to the end of the transect; seagrass density was high at this transect despite the presence of muck and comprised *H. wrightii*, *H. decipiens*, and *T. testudinum*. *Halophila decipiens* was the only species noted waterward of 100 ft.

The central segment consists of Transects 10 through 35. These transects were shortened due to safety concerns and ranged between 250 ft and 365 ft in length. **Table 10** provides the total length of each central segment transect and linear extent of seagrass abundance. Similar to the north segment, the seagrass bed is characterized a dense, mixed species bed in the nearshore transitioning to *H. decipiens* in the offshore where the bottom type transitions into a muck-dominated substrate and water depth is deeper. Bed widths varied throughout the central segment (**Table 11**). The offshore bed edge at Transects 10 through 21 ranged from 210 ft to 313 ft; the nearshore edge extended between 0 ft and 15 ft from the bulkhead (**Tables 12** and **13**). The bed narrowed to the south, extending only 50 ft to 100 ft seaward of the bulkhead at Transects 22 through 35.

All four species of seagrass observed in the north segment were present throughout the entire length of the central segment. Two occurrences of *H. engelmannii* were observed along

Transect 12. *Halophila decipiens* and *Halodule wrightii* were observed at every transect. *Syringodium filiforme* and *T. testudinum* were recorded at 18 and 14 of the 26 transects, respectively. The dense, mixed bed had the greatest extent from Transects 10 to 14; *H. decipiens, H. wrightii* and *T. testudium* were observed to 100 ft at most of the transects in this area. Throughout the central segment, *S. filiforme* was only recorded within the mixed bed to 30 ft, but occurred in high density. Beginning at Transect 15 and continuing south to Transect 35, the extent of the dense, mixed bed ranged from 15 ft to 50 ft. With the exception of Transect 12, *H. decipiens* was the only species present beyond 100 ft from the bulkhead. *Halodule wrightii* was observed to 121 ft, and the two occurrences of *H. engelmannii* were observed between 210 ft and 240 ft.

Muck was the dominant substrate throughout the central segment of the survey area (**Table 14**). The presence of muck had a negative relationship with seagrass presence. Transects in the northern extent of the central segment were characterized by sand and exhibited greater seagrass cover than transects characterized by muck. Furthermore, line intercept data revealed a general transition from muck to sand along the offshore seagrass bed edge.

Transects 36 through 70 are in the south segment of the study area. Seagrass cover and diversity increased throughout this segment to the south, and the greatest extent of the mixed species bed was noted in the south segment (**Table 15**). *Halophila decipiens, H. wrightii,* and *S. filiforme* were observed at every transect in the south segment; and *T. testudinum* was recorded at 21 of the 35 transects. Bed extent of the mixed species bed ranged from 20 ft to 80 ft from Transects 36 to 48 and increased to between 100 ft and 300 ft at Transects 49 through 54. All four species were observed to some extent to 400 ft from Transects 55 through 64, then decreased slightly to between 300 ft and 350 ft throughout the remaining transects. At several transects, the bed transitioned from a combination of *H. decipiens, H. wrightii, S. filiforme,* and *T. testudinum* into a mixed *H. decipiens/H. wrightii* bed before transitioning into the monospecific *H. decipiens* at the end of the transects. The nearshore bed edge in the south segment ranged from 1 ft to 28 ft from the bulkhead (**Tables 16, 17,** and **18**).

The bed edge at Transects 43 through 48, excluding Transect 47, represents the easternmost occurrence of seagrass along these transects and not the actual offshore edge of the seagrass bed (**Table 16**). There were no occurrences of *H. decipiens* at Transect 47 west of the continuous bed; however, at Transects 43 to 48 occurrences of seagrass were noted waterward of the consistent seagrass bed edge. The edge of consistent seagrass at Transects 43 through 48 ranged from 50 ft to 100 ft; the remainder of the transect is characterized as a zone of seagrass occurrence due to the very sparse cover. Muck was the dominant substrate from Transects 36 to 50; sand or a sand/shell mix dominated the remaining transects (**Table 19**). Although there are occurrences of *H. decipiens*, it is unlikely, due to the presence, that seagrass will persistently establish within this portion of the study area. Additionally, several of the plants were uprooted, likely due to the strong currents in this area.

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Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Seagrass Habitat Map of the Study Area
Figure 5

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Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept Species Richness
Figure 6

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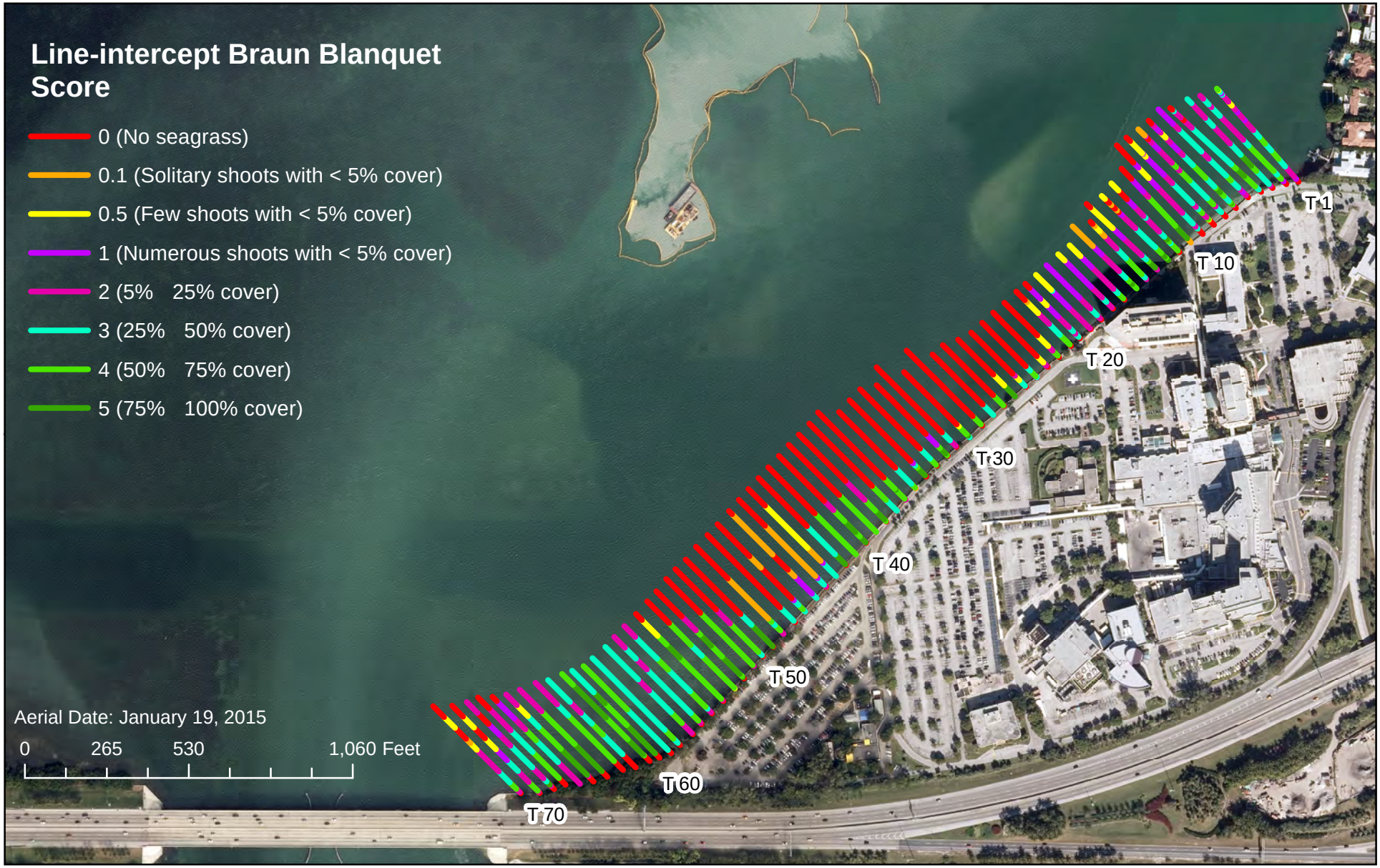
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept Species Composition
Figure 7

Coastal Eco-Group Inc.



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Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept Braun-Blanquet Score
Figure 8

Coastal Eco-Group Inc.

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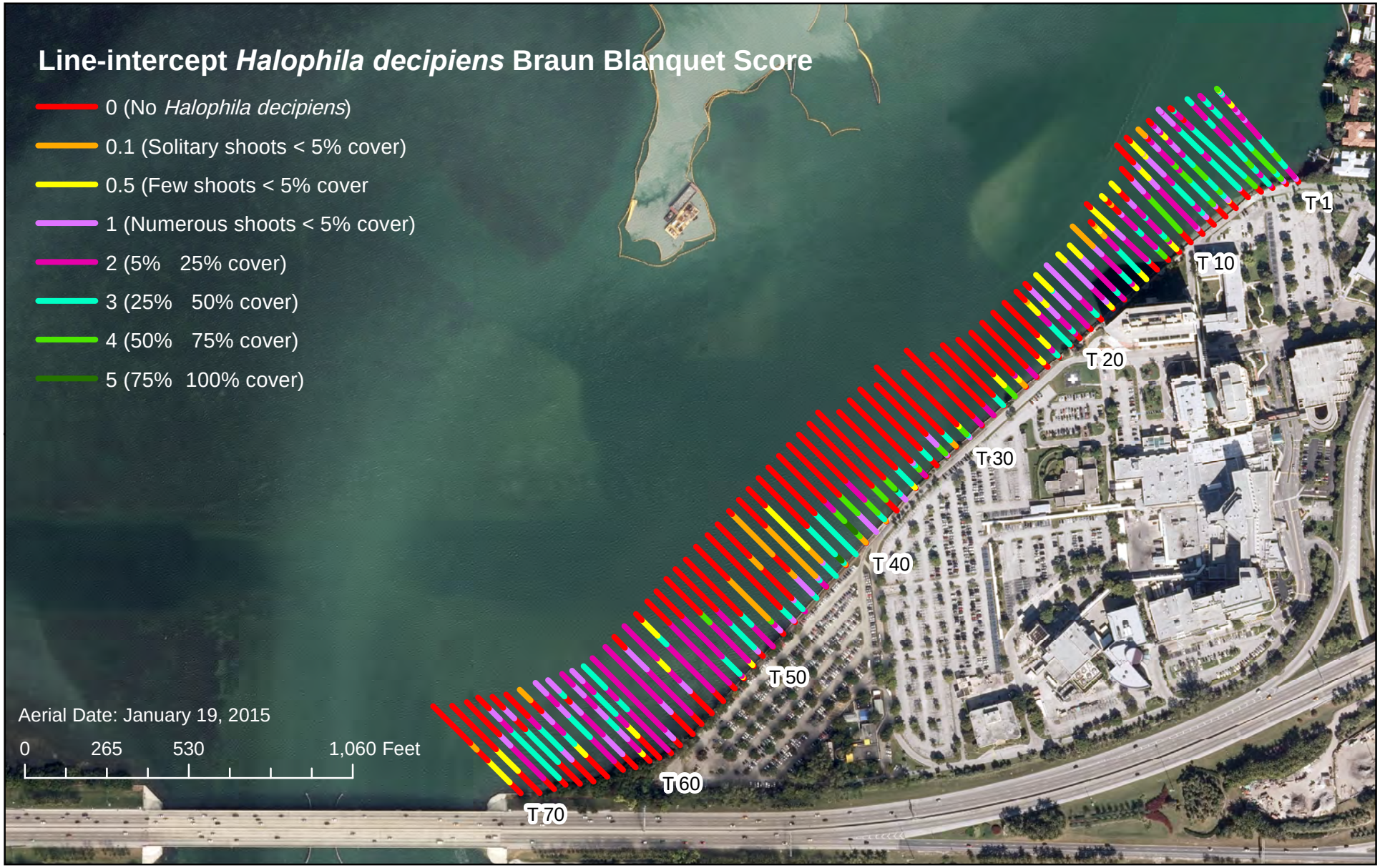
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Seagrass Habitat Map of the Study Area
Figure 5

Coastal Eco-Group Inc.



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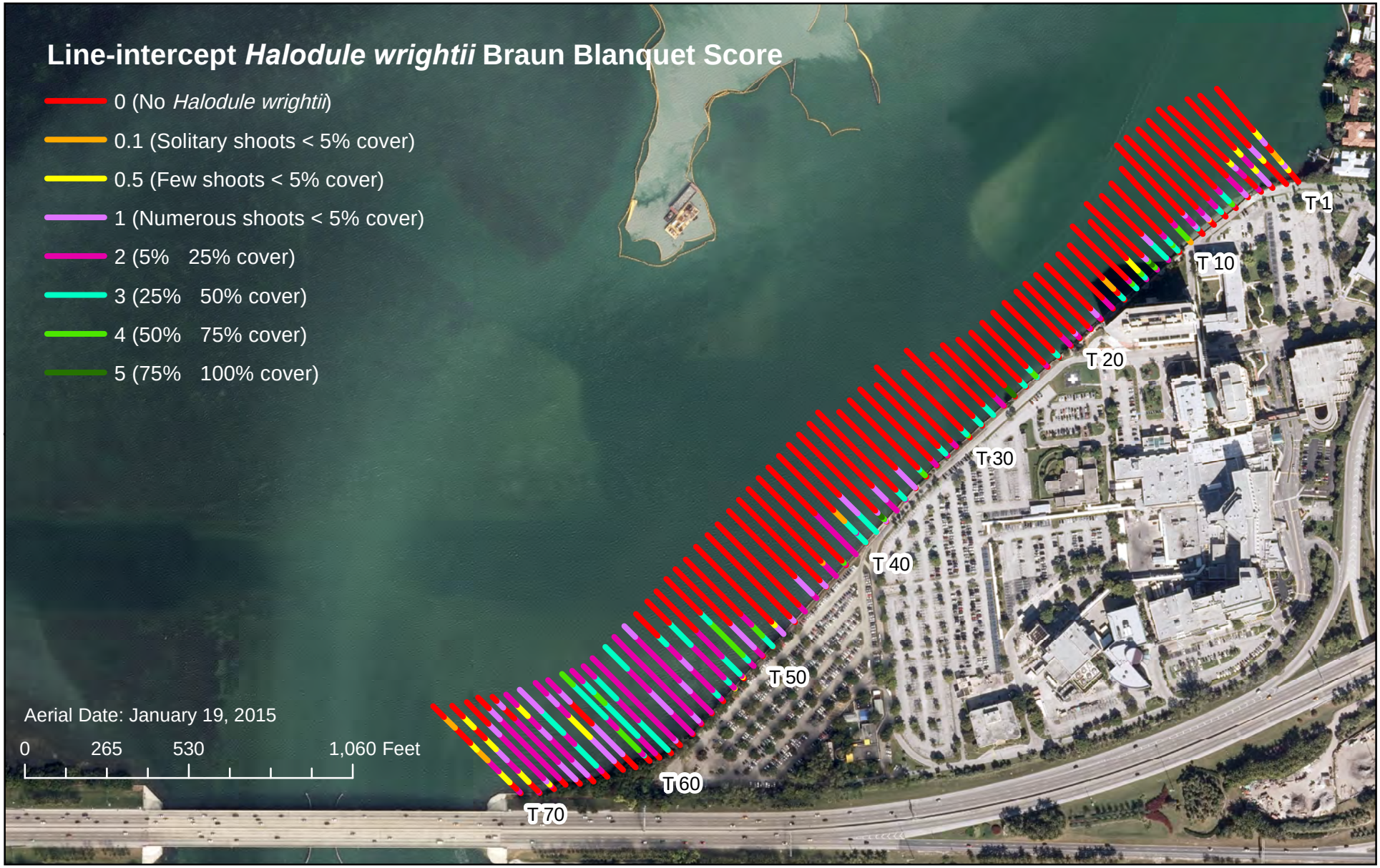
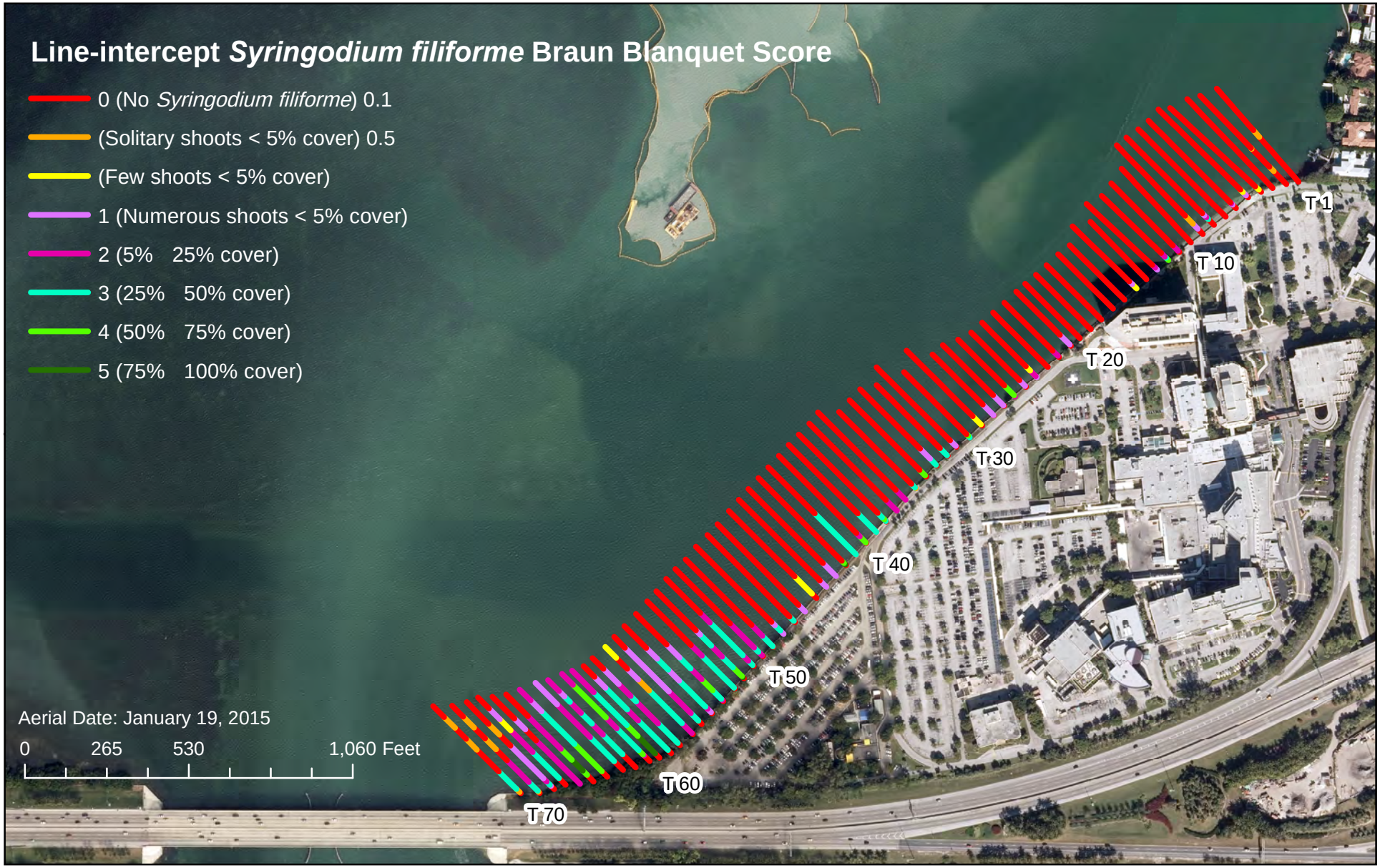
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Halophila decipiens* Braun-Blanquet Score
Figure 9

Coastal Eco-Group Inc.



Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Halodule wrightii* Braun-Blanquet Score
Figure 10

Coastal Eco-Group Inc.



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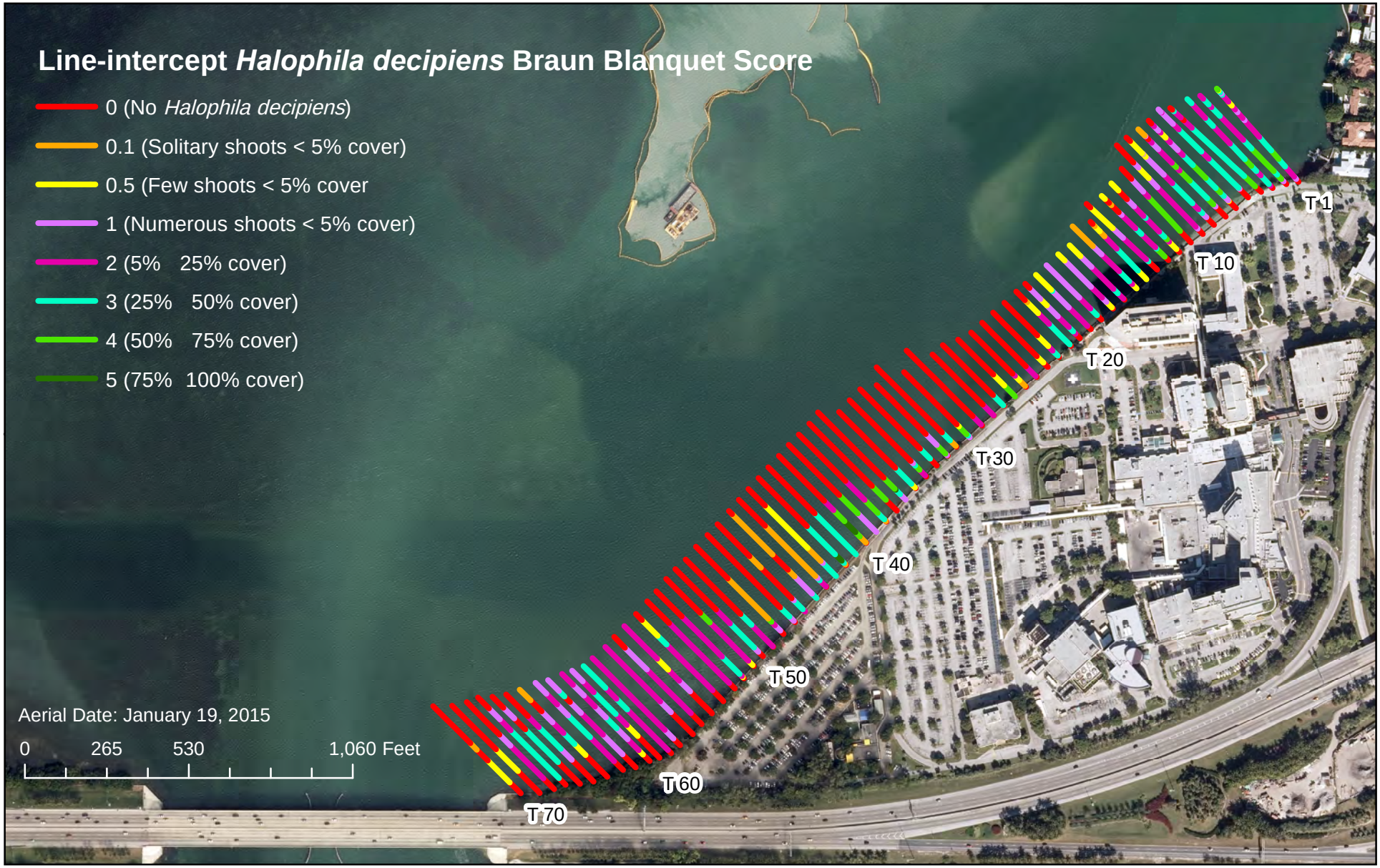
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Syringodium filiforme* Braun-Blanquet Score
Figure 11

Coastal Eco-Group Inc.



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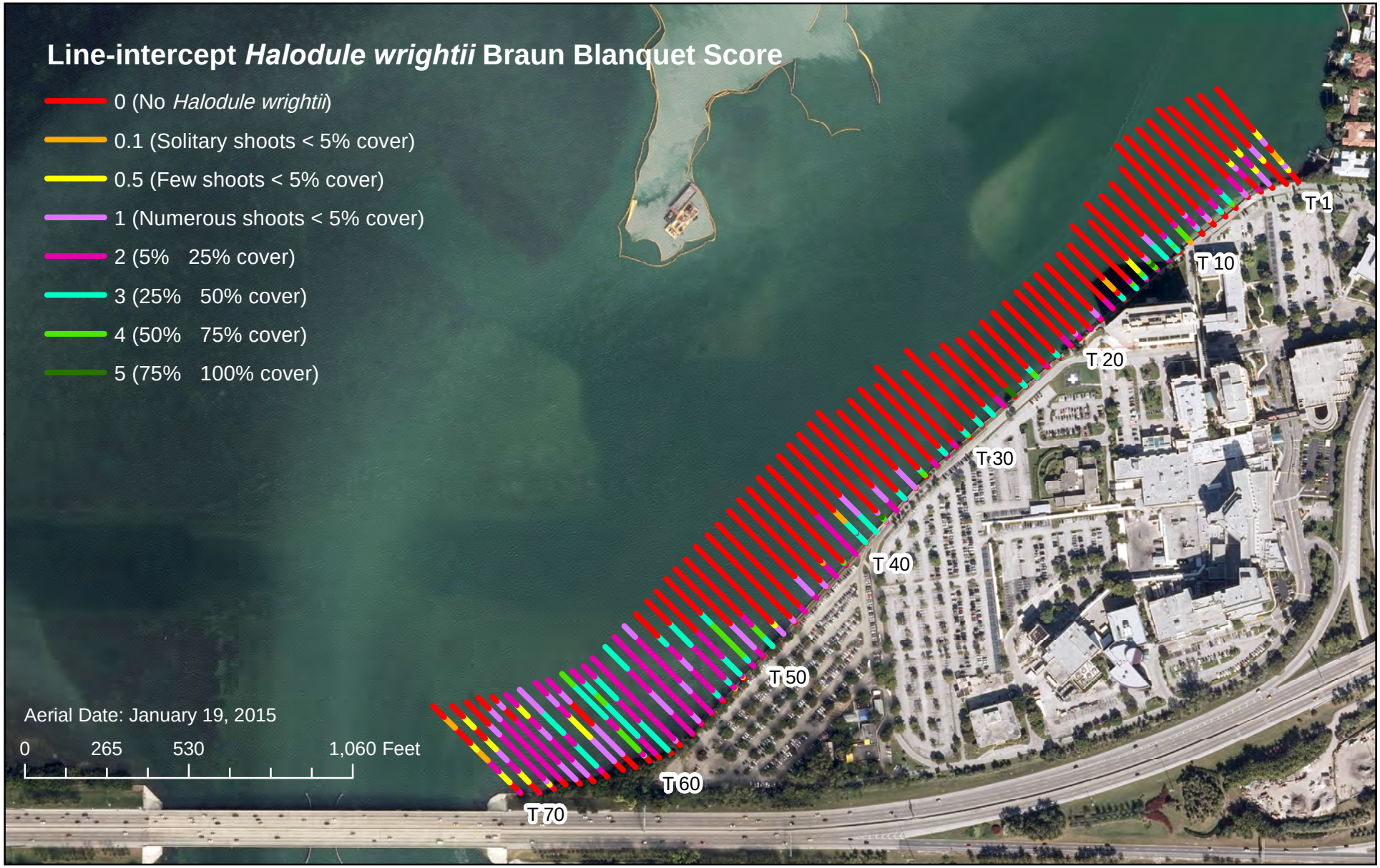
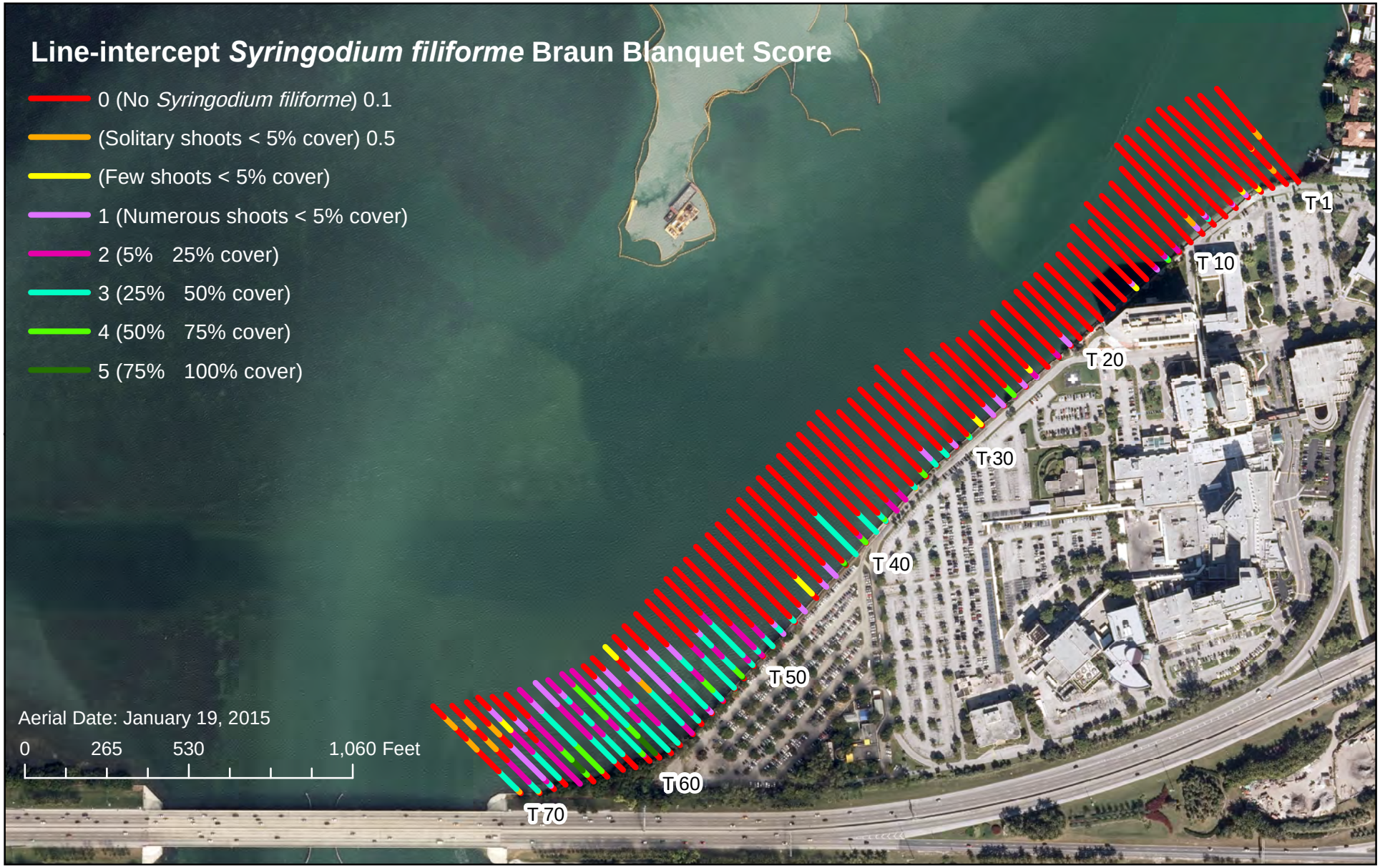
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Halophila decipiens* Braun-Blanquet Score
Figure 9

Coastal Eco-Group Inc.



Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Halodule wrightii* Braun-Blanquet Score
Figure 10

Coastal Eco-Group Inc.



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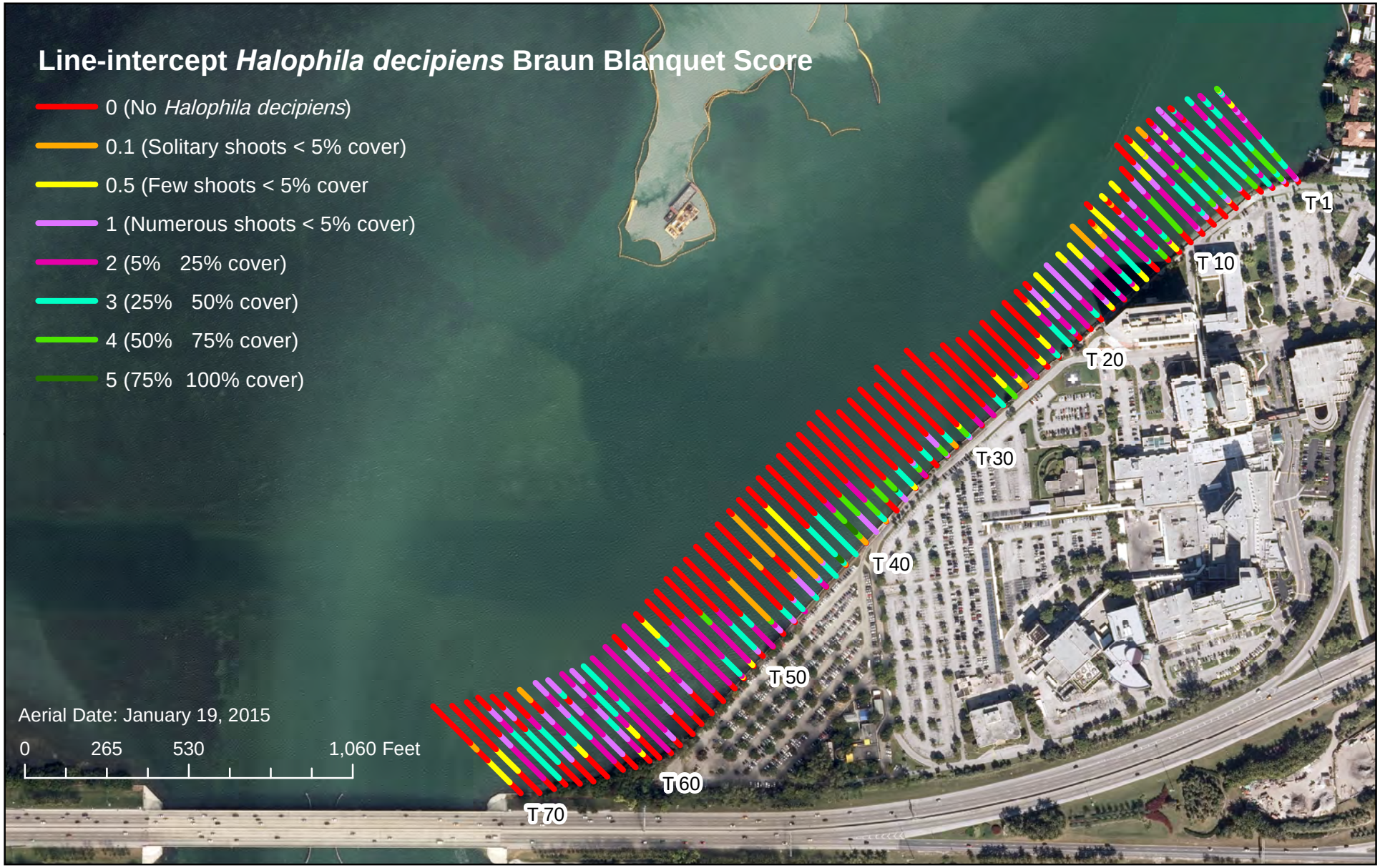
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Syringodium filiforme* Braun-Blanquet Score
Figure 11

Coastal Eco-Group Inc.



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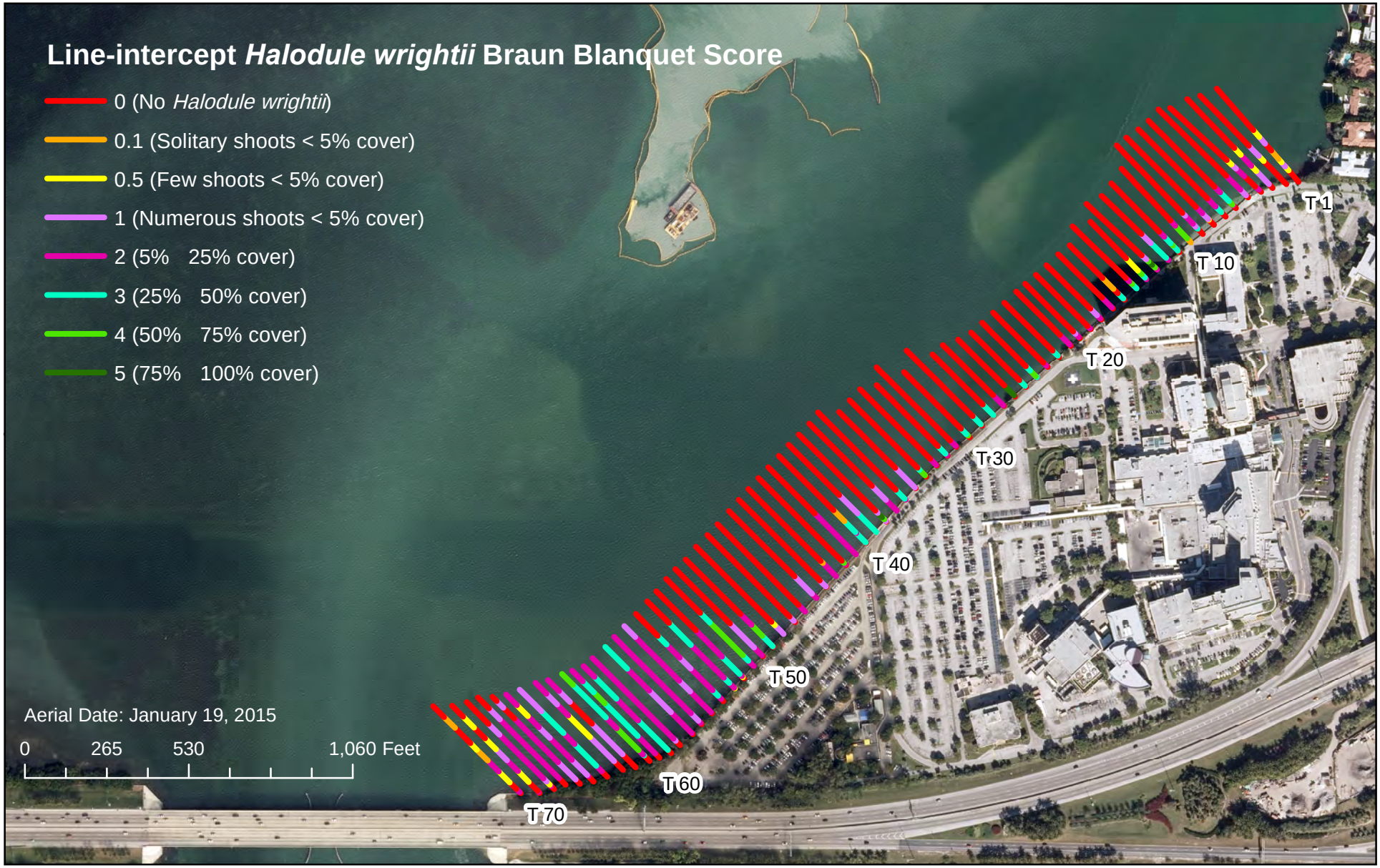
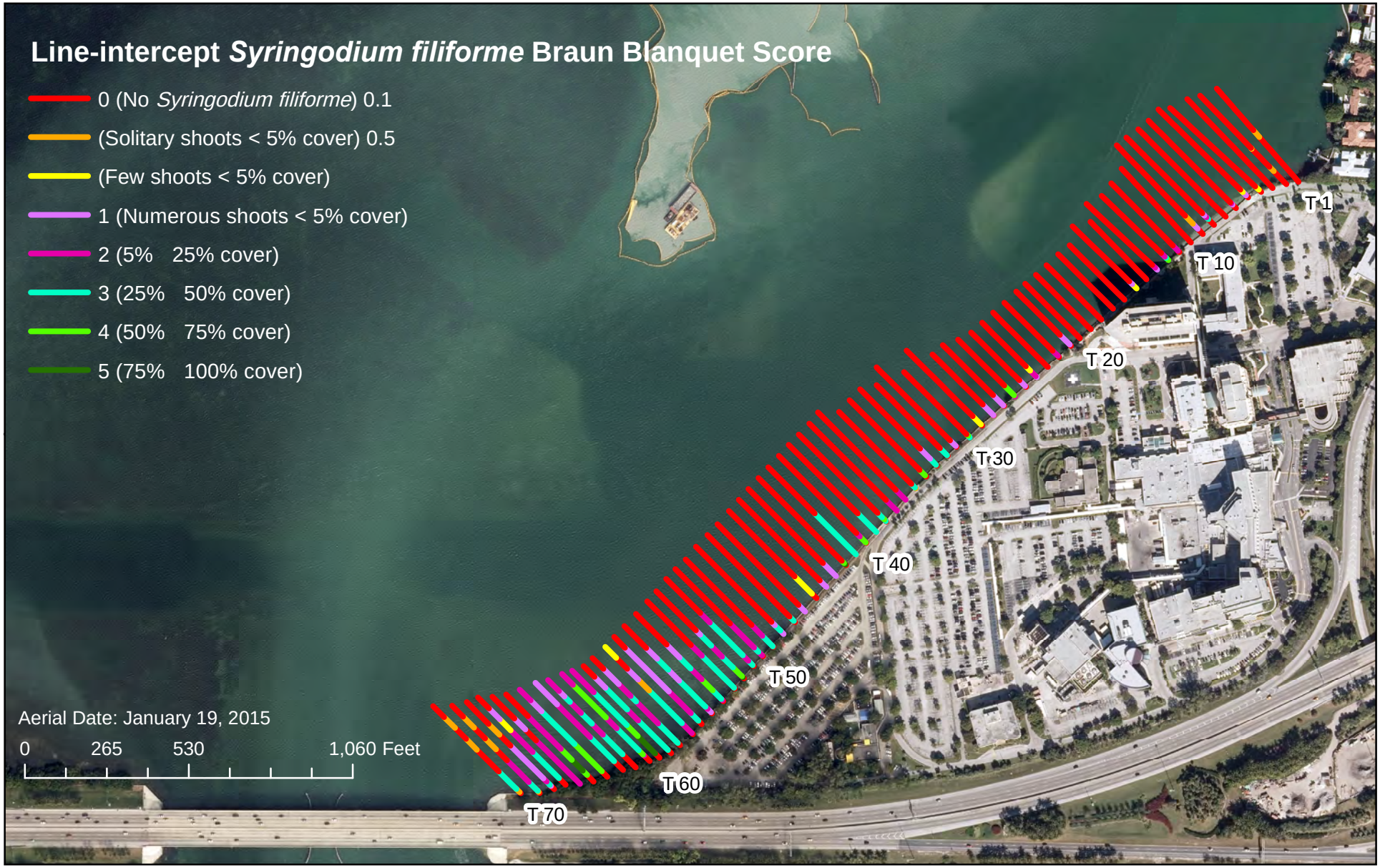
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Halophila decipiens* Braun-Blanquet Score
Figure 9

Coastal Eco-Group Inc.



Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Halodule wrightii* Braun-Blanquet Score
Figure 10

Coastal Eco-Group Inc.



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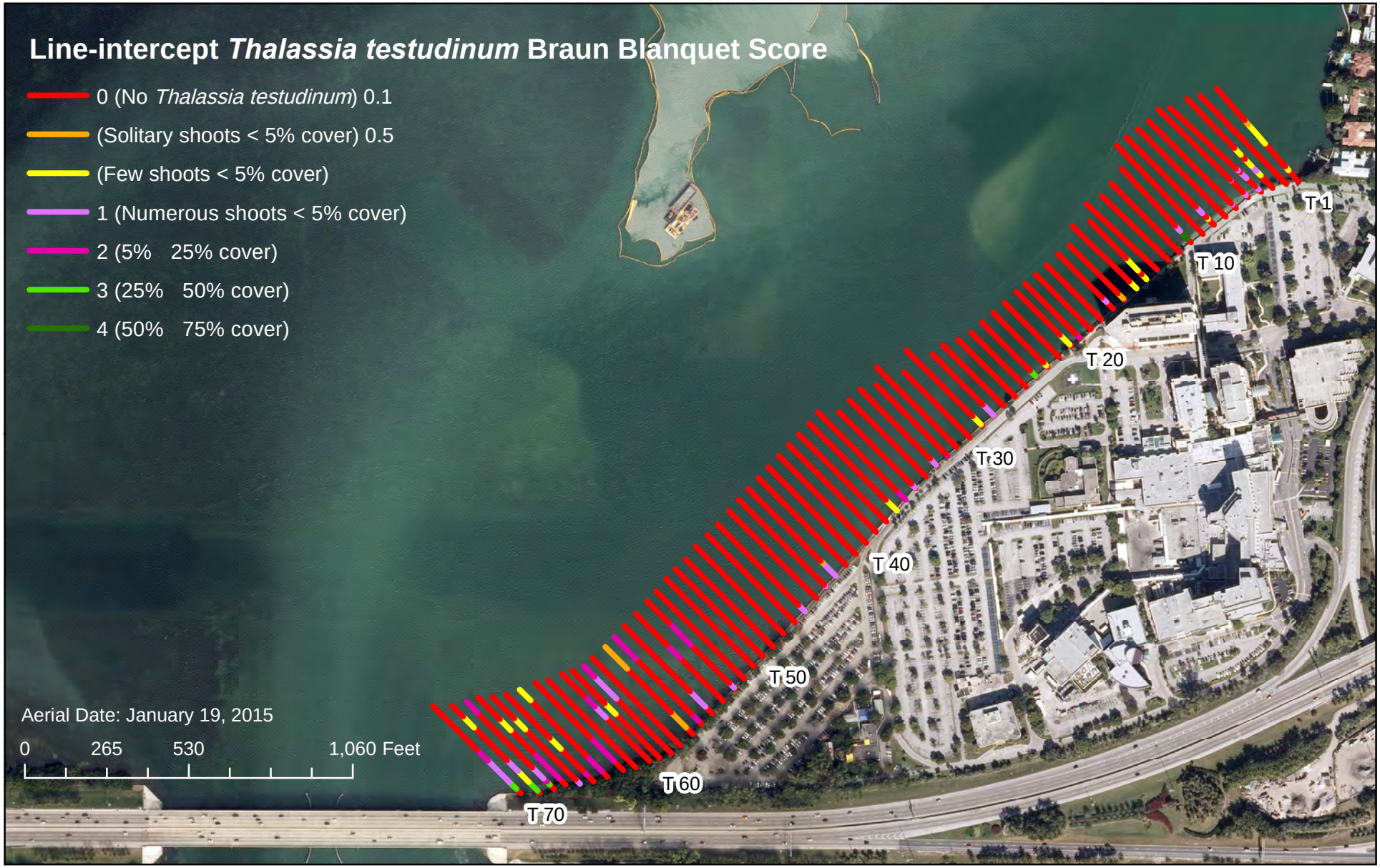
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Syringodium filiforme* Braun-Blanquet Score
Figure 11

Coastal Eco-Group Inc.



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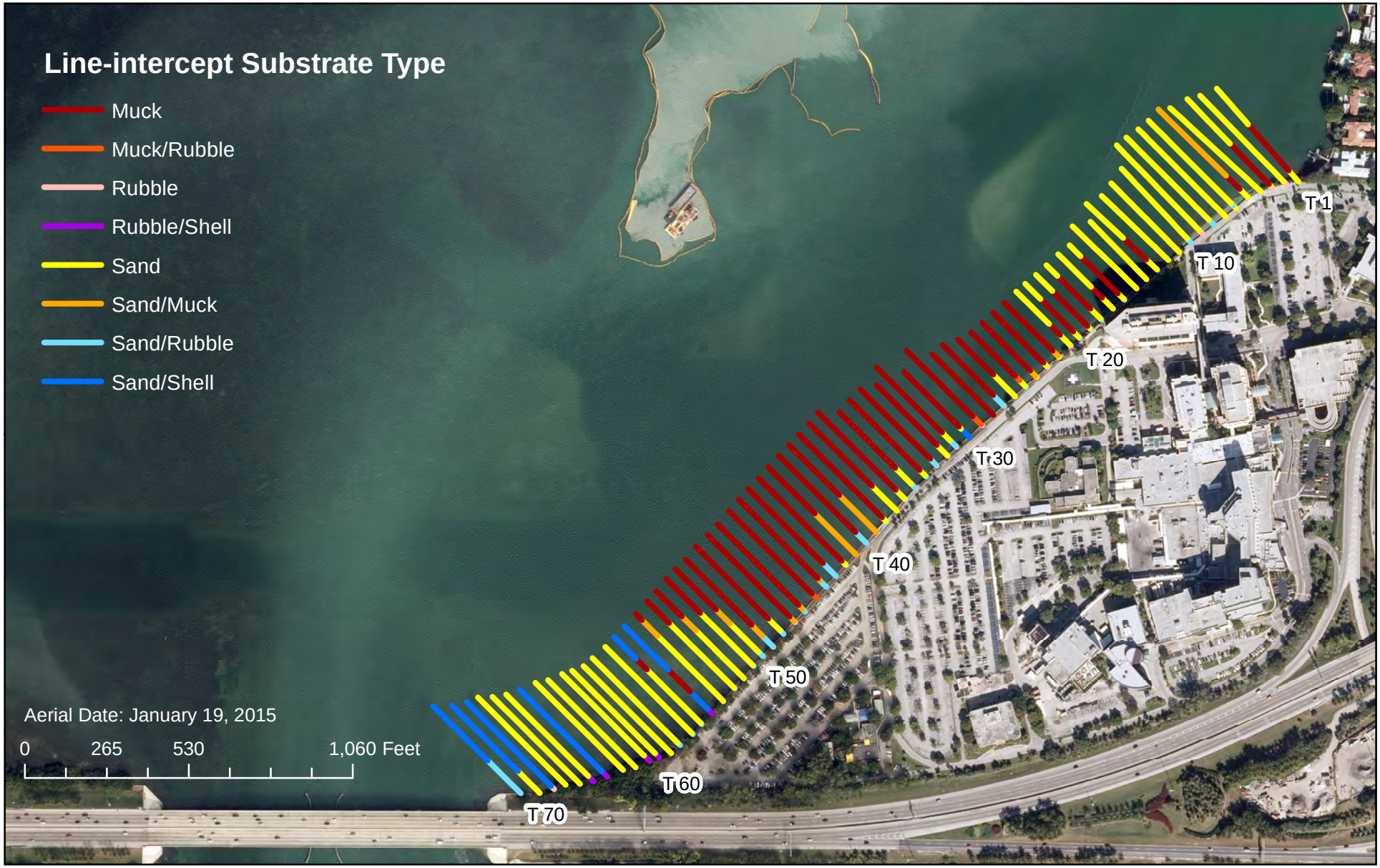
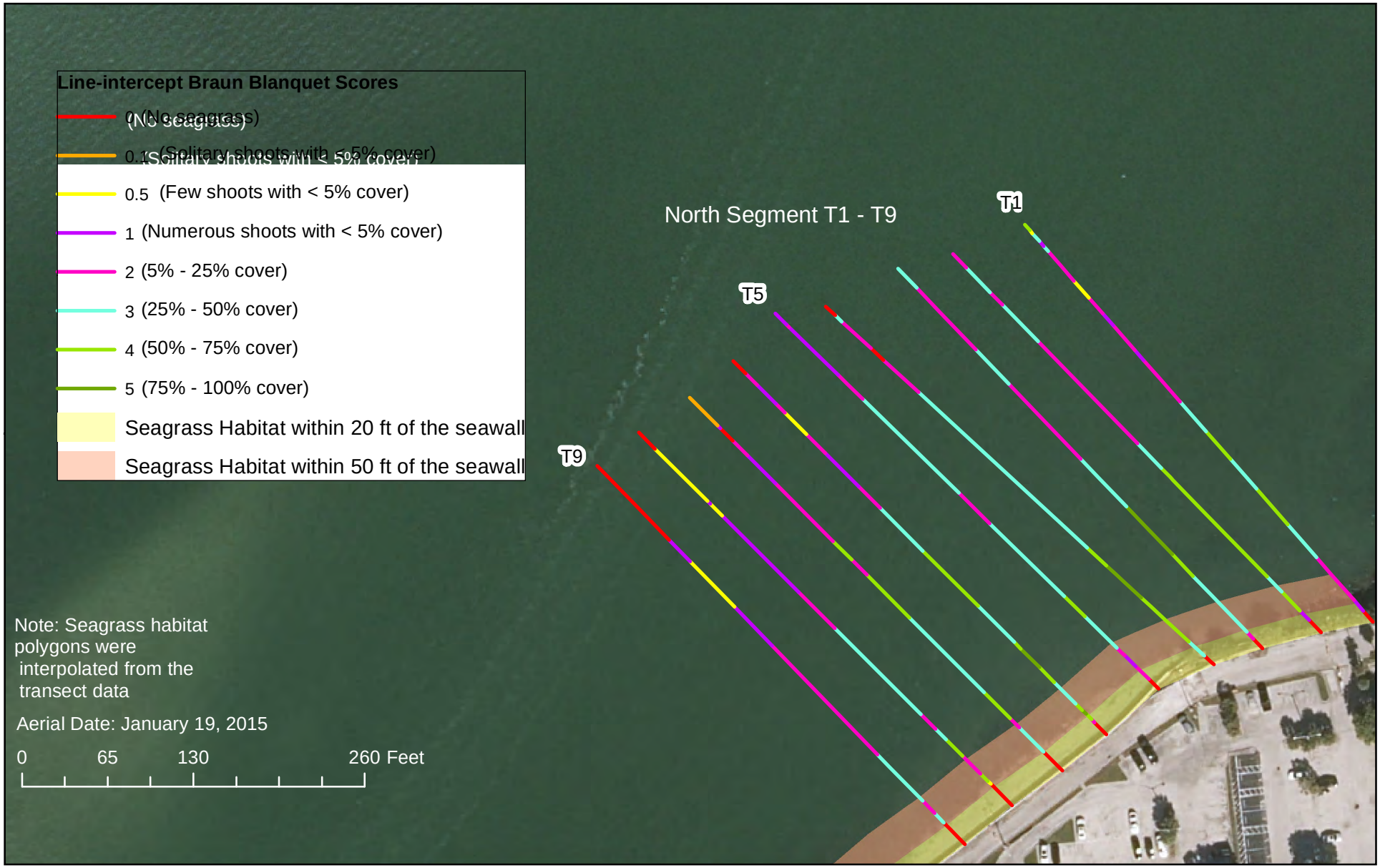
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transects
Line-intercept *Thalassia testudinum* Braun-Blanquet Score
Figure 12

Coastal Eco-Group Inc.



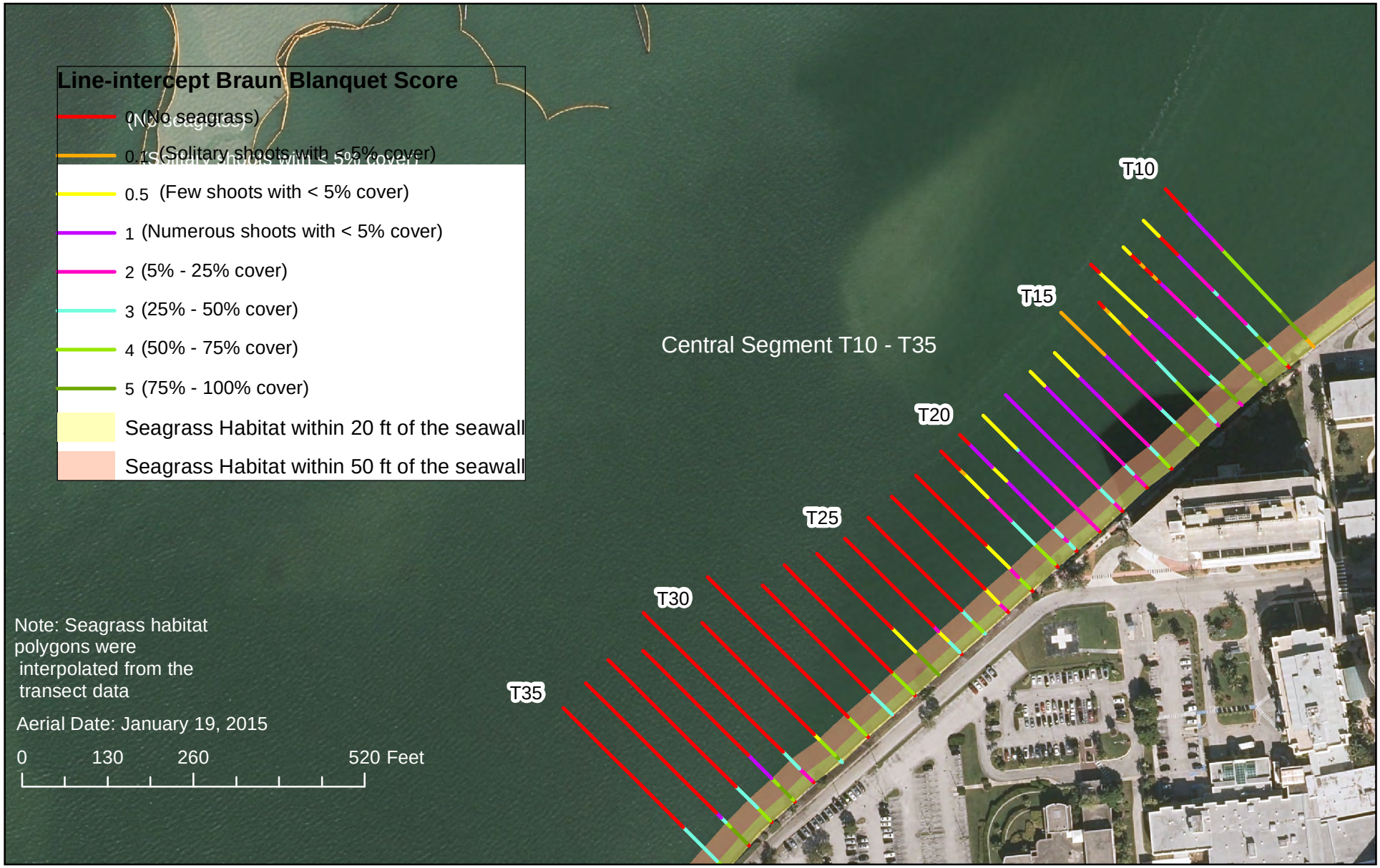
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey Transacts
Line-intercept Substrate
Figure 13

Coastal Eco-Group Inc.



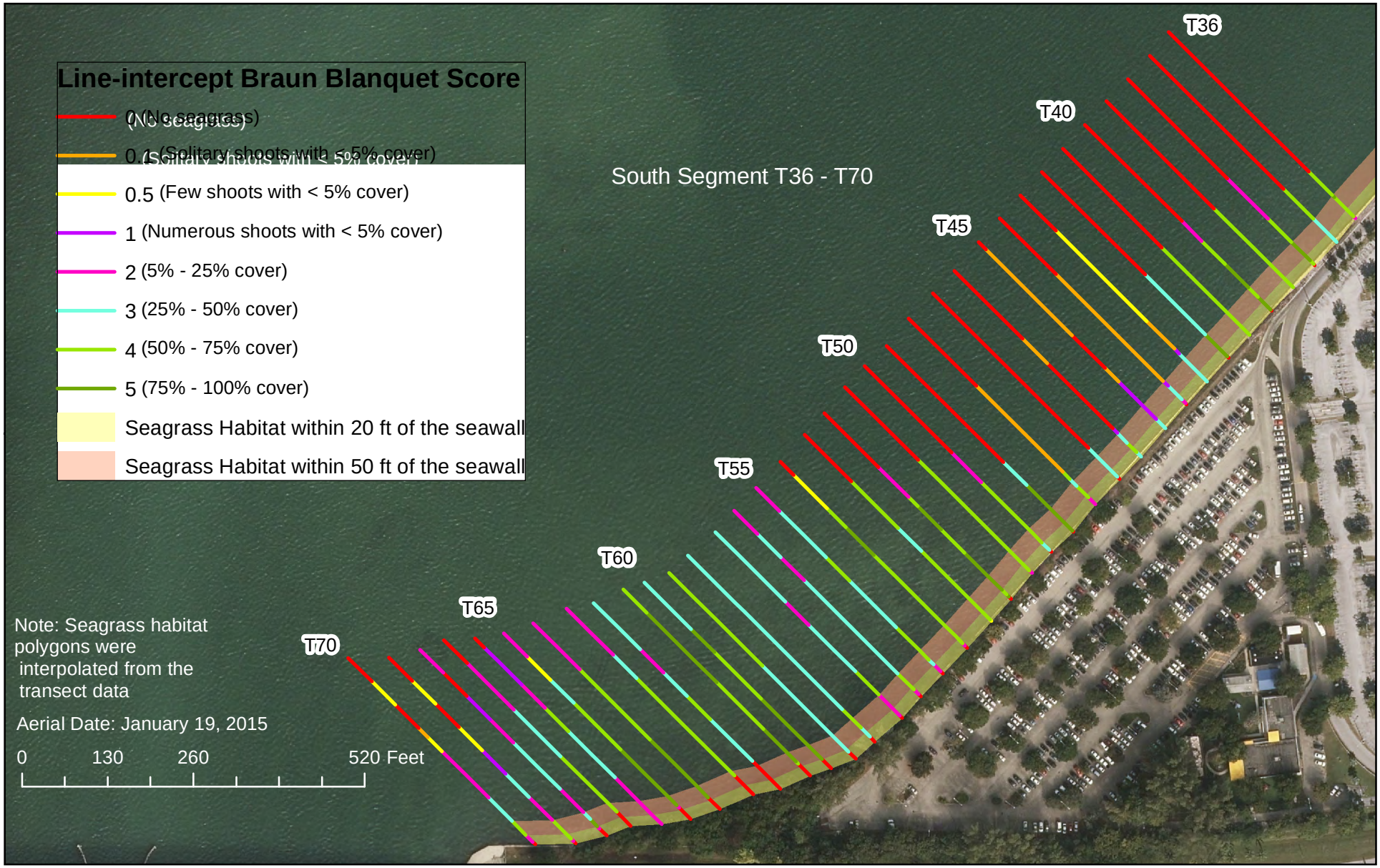
Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey
Line Intercept Braun-Blanquet Scores along the North Segment Transects and Seagrass Habitat within 20 ft and 50 ft from the Seawall
Figure 14a

Coastal Eco-Group Inc.



Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey
Line Intercept Braun-Blanquet Scores along the Central Segment Transects and Seagrass Habitat within 20 ft and 50 ft from the Seawall
Figure 14b

Coastal Eco-Group Inc.



Mt. Sinai Hospital Bulkhead Replacement
Seagrass Survey
Line Intercept Braun-Blanquet Scores along the South Segment Transects and Seagrass Habitat within 20 ft and 50 ft from the Seawall
Figure 14c

Coastal Eco-Group Inc.

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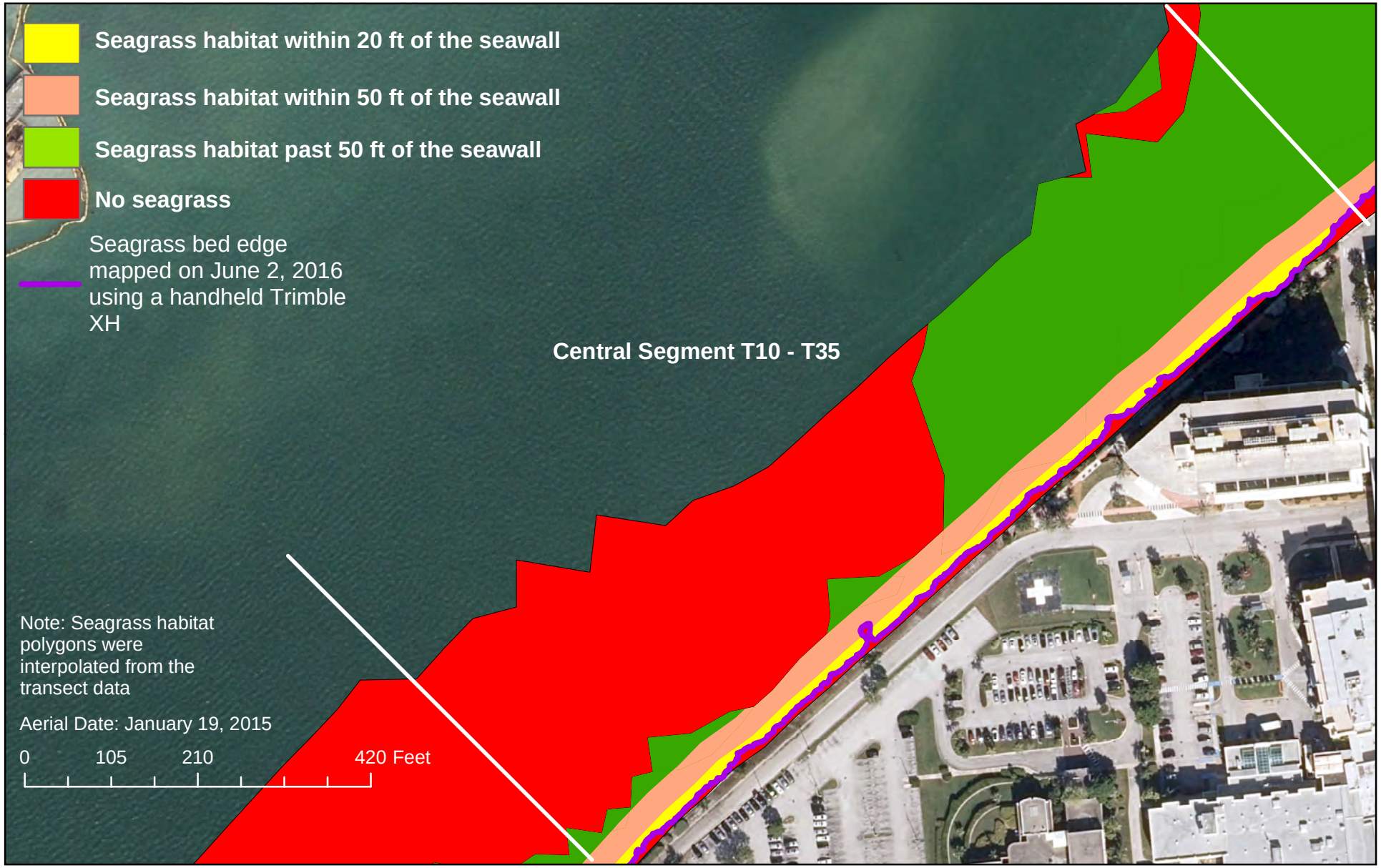
Mt. Sinai Hospital Bulkhead Replacement Seagrass Survey

Seagrass Habitats within 50 ft of the Seawall- North Segment

Figure 15a

Coastal Eco-Group Inc.



Mt. Sinai Hospital Bulkhead Replacement Seagrass Survey

Seagrass Habitats within 50 ft of the Seawall- Central Segment

Figure 15b

Coastal Eco-Group Inc.

Mt. Sinai Hospital Bulkhead Replacement Seagrass Survey

Seagrass Habitats within 50 ft of the Seawall- South Segment

Figure 15c

Coastal Eco-Group Inc.

Table 5. Linear extent (ft) of seagrass abundance classifications along transects in the north segment of the survey area, Transects 1-9

	Transect	Line Intercept (ft)					Line Intercept (ft)							
		Percent Cover					Braun-Blanquet Scale							
		0%	<25%	25-50%	50-75%	> 75%	0	0.1	0.5	1	2	3	4	5
North Segment	1	11	217	105	67	0	11	0	20	40	157	105	67	0
	2	13	144	108	135	0	13	0	0	10	134	108	135	0
	3	10	150	167	23	50	10	0	0	0	150	167	23	50
	4	33	66	196	68	37	33	0	0	0	66	196	68	37
	5	10	162	216	22	0	10	0	0	78	84	216	22	0
	6	26	147	109	94	24	26	0	22	56	69	109	94	24
	7	33	167	106	94	0	33	29	0	34	104	106	94	0
	8	39	231	103	27	0	39	0	72	85	74	103	27	0
	9	101	240	59	0	0	101	0	48	64	128	59	0	0

Note: Transect 5 was 410 ft in length, all other transects were 400 ft. total length. Line intercept category <25% only reflects area where seagrass was present (1-25%).

Table 6. Location of the seagrass bed edges, linear extent (ft) of vegetated bottom, and percent cover of unvegetated bottom along the entire transect and within the first 20 ft and 50 ft of each transect in the north segment, Transects 1-9

	Transect	Nearshore Bed Edge (ft)	Offshore Bed Edge (ft)	Total Linear ft Vegetated Bottom	Total % Unvegetated Bottom	0-20 ft		0-50 ft	
						Linear ft Vegetated Bottom	% Unvegetated Bottom	Linear ft Vegetated Bottom	% Unvegetated Bottom
North Segment	1	0	400	389	3%	9	55%	39	22%
	2	3	400	387	3%	7	65%	37	26%
	3	2	400	390	3%	10	50%	40	20%
	4	5	390	367	8%	10	50%	40	20%
	5	9	410	390	2%	10	50%	40	20%
	6	21	387	374	7%	7	65%	37	26%
	7	18	400	367	8%	0	100%	30	40%
	8	26	384	361	10%	0	100%	27	46%
	9	21	322	299	25%	0	100%	27	46%

Table 7. Distance of the nearshore bed edge to the bulkhead, seagrass abundance, species composition, and substrate type at the nearshore bed edge at transects in the north segment, Transects 1-9

	Transect	Distance of Nearshore Bed Edge to Bulkhead (ft)	BB Score	LI Score	Species Present	Substrate
North Segment	1	0	1	1	Hd	Sand
	2	3	1	1	Hd	Sand
	3	2	2	1	Hd	Sand
	4	5	3	2	Hw, Sf, Tt	Sand
	5	9	2	1	Hw, Sf, Tt	Sand
	6	21	2	1	Hw	Sand/Rubble
	7	18	3	2	Hw	Sand
	8	26	0.5	1	Hw	Sand
	9	21	3	2	Hd, Hw, Sf	Sand

Table 8. Approximate distance of the nearshore bed edge to the bulkhead at approximately 25 ft intervals between Transects 1-9 in the north segment

	Transect	Distance of Nearshore Bed Edge to Bulkhead (ft)
North Segment	1.5	0
	2.5	2
	3.5	1
	4.5	6
	5.5	15
	6.5	13
	7.5	18
	8.5	19
	9.5	17

Note: Distances were estimated in ArcGIS 10.2.

Table 9. Average (±SE) macroalgal cover, linear extent, and percent cover of the dominant substrate at transects in the north segment, Transects 1-9

	Transect	Avg (±SE) Macroalgae BB	Dominant Substrate		
			Type	LI (ft)	% Cover
North Segment	1	1.1 (±0.1)	Sand	204	51%
	2	1.7 (±0.2)	Sand	387	97%
	3	2.0 (±0.3)	Sand	209	52%
	4	2.4 (±0.2)	Sand	397	99%
	5	1.7 (±0.2)	Sand/Muck	309	75%
	6	1.9 (±0.2)	Sand	391	98%
	7	1.0 (±0.1)	Sand	400	100%
	8	1.4 (±0.2)	Sand	377	94%
	9	1.0 (±0.1)	Sand	383	96%

Note: Transect 5 was 410 ft in length, all other transects were 400 ft. total length.

Table 10. Linear extent (ft) of seagrass abundance along transects in the central segment of the survey area, Transects 10-35

	Transect	Transect Length (ft)	Line Intercept (ft) Percent Cover					Line Intercept (ft) Braun-Blanquet Scale							
			0%	<25%	25-50%	50-75%	> 75%	0	0.1	0.5	1	2	3	4	5
Central Segment	10	330	48	98	0	128	56	48	18	0	57	23	0	128	56
	11	313	46	172	40	42	13	46	0	34	33	105	40	42	13
	12	303	42	113	89	32	27	42	20	18	13	62	89	32	27
	13	313	17	237	20	10	29	17	0	99	46	92	20	10	29
	14	257	8	118	59	72	0	8	32	23	0	63	59	72	0
	15	290	0	211	30	36	13	0	93	0	40	78	30	36	13
	16	250	5	200	20	25	0	5	0	50	50	100	20	25	0
	17	250	5	225	20	0	0	5	0	30	120	75	20	0	0
	18	250	5	215	30	0	0	5	0	0	150	65	30	0	0
	19	250	4	241	5	0	0	4	0	70	75	96	5	0	0
	20	250	25	190	35	0	0	25	0	30	100	60	35	0	0
	21	250	46	110	50	44	0	46	10	50	0	50	50	44	0
	22	250	156	70	0	24	0	156	0	50	0	20	0	24	0
	23	250	206	44	0	0	0	206	0	30	0	14	0	0	0
	24	250	200	0	25	25	0	200	0	0	0	0	25	25	0
	25	250	193	31	26	0	0	193	0	20	0	11	26	0	0
	26	260	160	50	0	0	50	160	0	50	0	0	0	0	50
	27	280	233	0	0	47	0	233	0	0	0	0	0	47	0
	28	280	231	0	49	0	0	231	0	0	0	0	49	0	0
	29	345	307	0	0	38	0	307	0	0	0	0	0	38	0
	30	300	239	11	8	35	7	239	0	11	0	0	8	35	7
	31	365	303	26	36	0	0	303	0	0	0	26	36	0	0
	32	325	228	50	0	22	25	228	0	0	50	0	0	22	25
	33	350	277	0	46	27	0	277	0	0	0	0	46	27	0
	34	350	284	11	10	10	35	284	0	0	11	0	10	10	35
	35	350	257	3	73	17	0	257	3	0	0	0	73	17	0

Table 11. Location of the seagrass bed edges, linear extent (ft) of vegetated bottom, and percent cover of unvegetated bottom along the entire transect and within the first 20 ft and 50 ft of each transect in the central segment, Transects 10-35

	Transect	Nearshore Bed Edge (ft)	Offshore Bed Edge (ft)	Total Linear ft Vegetated Bottom	Total % Unvegetated Bottom	0-20 ft		0-50 ft	
						Linear ft Vegetated Bottom	% Unvegetated Bottom	Linear ft Vegetated Bottom	% Unvegetated Bottom
Central Segment	10	15	282	282	15%	20	0%	50	0%
	11	5	313	267	15%	13	35%	43	14%
	12	1	285	261	14%	20	0%	50	0%
	13	4	296	296	5%	20	0%	50	0%
	14	3	249	249	3%	20	0%	50	0%
	15	5	290	290	0%	20	0%	50	0%
	16	3	250	245	2%	15	25%	45	10%
	17	2	250	245	2%	15	25%	45	10%
	18	10	250	245	2%	15	25%	45	10%
	19	5	250	246	2%	16	20%	46	8%
	20	3	230	225	10%	15	25%	45	10%
	21	10	210	204	18%	14	30%	44	12%
	22	4	100	94	62%	14	30%	44	12%
	23	8	50	44	82%	14	30%	44	12%
	24	7	50	50	80%	20	0%	50	0%
	25	4	61	57	77%	16	20%	46	8%
	26	3	100	100	62%	20	0%	50	0%
	27	3	50	47	83%	17	15%	47	6%
	28	6	50	49	83%	19	5%	49	2%
	29	4	43	38	89%	15	25%	38	24%
	30	5	61	61	80%	20	0%	50	0%
	31	0	66	62	83%	16	20%	46	8%
	32	4	100	97	70%	17	15%	47	6%
	33	1	76	73	79%	17	15%	47	6%
	34	7	71	66	81%	15	25%	45	10%
	35	3	93	93	73%	20	0%	50	0%

Note: See Table 9 for transect lengths

Table 12. Distance of the nearshore bed edge to the bulkhead, seagrass abundance, species composition, and substrate type at the nearshore bed edge at transects in the central segment, Transects 10-35

	Transect	Distance of Nearshore Bed Edge to Bulkhead (ft)	BB Score	LI Score	Species Present	Substrate
Central Segment	10	15	5	4	Hw, Tt	Sand
	11	5	4	3	Hw, Sf	Sand
	12	1	5	4	Hw, Sf	Sand
	13	4	2	1	Hw, Sf	Sand
	14	3	2	1	Hd, Hw, Tt	Sand
	15	5	4	3	Hd, Hw, Sf, Tt	Sand
	16	3	4	3	Hd, Hw, Tt	Sand
	17	2	2	1	Hd, Hw	Sand
	18	10	2	1	Hw	Sand
	19	5	2	1	Hw	Sand
	20	3	3	2	Hw, Tt	Sand
	21	10	4	3	Hd, Hw, Sf, Tt	Sand
	22	4	4	3	Hd, Hw, Sf	Sand
	23	8	2	1	Hw, Tt	Sand
	24	7	3	2	Hw, Sf, Tt	Sand
	25	4	3	2	Hd, Hw, Sf	Sand
	26	3	5	4	Hd, Sf	Sand
	27	3	4	3	Hd, Hw, Sf	Sand/Rubble
	28	6	3	2	Hd, Hw, Sf, Tt	Muck
	29	4	4	3	Hd, Hw, Sf, Tt	Muck/Rubble
	30	5	3	2	Hd, Sf	Sand/Shell
	31	0	2	1	Hd, Hw, Sf	Sand/Rubble
	32	4	4	3	Hd, Hw, Sf, Tt	Sand
	33	1	4	3	Hw, Sf, Tt	Sand/Rubble
	34	7	5	4	Hd, Hw, Sf	Sand
	35	3	4	3	Hd, Hw, Sf, Tt	Sand/Rubble

Note: A zone of occurrence was noted at Transects 10 and 35 immediately east of the bed edge at the time of the survey; zone of occurrence is defined as a BB score of 0.1 referring to a single occurrence of seagrass within that segment.

Table 13. Approximate distance of the nearshore bed edge to the bulkhead at approximately 25 ft intervals between Transects 1-35 in the central segment

	Transect	Distance of Nearshore Bed Edge to Bulkhead (ft)
Central Segment	10.5	8
	11.5	12
	12.5	0
	13.5	2
	14.5	1
	15.5	4
	16.5	4
	17.5	2
	18.5	1
	19.5	0
	20.5	2
	21.5	4
	22.5	0
	23.5	4
	24.5	1
	25.5	1
	26.5	8
	27.5	1
	28.5	1
	29.5	3
	30.5	7
	31.5	0
	32.5	3
	33.5	0
	34.5	3
	35.5	0

Note: Distances were estimated in ArcGIS 10.2

Table 14. Average (±SE) macroalgal cover, and linear extent and percent cover of the dominant substrate at transects in the central segment, Transects 10-35

	Transect	Avg (±SE) Macroalgae BB	Dominant Substrate		
			Type	LI (ft)	% Cover
Central Segment	10	1.6 (±0.3)	Sand	312	95%
	11	0.7 (±0.1)	Sand	313	100%
	12	1.6 (±0.2)	Sand	303	100%
	13	1.0 (±0.3)	Sand	210	67%
	14	0.6 (±0.1)	Sand	257	100%
	15	1.4 (±0.4)	Sand	290	100%
	16	1.0 (±0.0)	Muck	170	68%
	17	0.7 (±0.1)	Sand	200	80%
	18	0.9 (±0.2)	Muck	150	60%
	19	0.9 (±0.3)	Muck	160	64%
	20	0.9 (±0.3)	Muck	150	60%
	21	0.9 (±0.3)	Sand	194	78%
	22	1.5 (±0.7)	Muck	220	88%
	23	1.0 (±0.5)	Muck	230	92%
	24	1.7 (±0.7)	Muck	220	88%
	25	1.3 (±0.5)	Muck	200	80%
	26	0.7 (±0.3)	Muck	160	62%
	27	0.8 (±0.5)	Muck	230	82%
	28	0.6 (±0.4)	Muck	279	100%
	29	0.7 (±0.4)	Muck	302	88%
	30	1.1 (±0.4)	Muck	250	83%
	31	0.7 (±0.4)	Muck	299	82%
	32	1.3 (±0.3)	Muck	275	85%
	33	0.7 (±0.3)	Muck	320	91%
	34	0.8 (±0.3)	Muck	320	91%
	35	0.7 (±0.3)	Muck	257	73%

Table 15. Linear extent (ft) of seagrass abundance classifications along transects in the south segment of the survey area, Transects 36-70

	Transect	Line Intercept (ft)					Line Intercept (ft)							
		Percent Cover					Braun-Blanquet Scale							
		0%	<25%	25-50%	50-75%	> 75%	0	0.1	0.5	1	2	3	4	5
South Segment	36	300	4	0	91	5	300	0	0	0	4	0	91	5
	37	286	0	50	64	0	286	0	0	0	0	50	64	0
	38	215	87	0	58	40	215	0	0	0	87	0	58	40
	39	231	0	0	169	0	231	0	0	0	0	0	169	0
	40	209	43	0	70	78	209	0	0	0	43	0	70	78
	41	212	0	0	188	0	212	0	0	0	0	0	188	0
	42	224	0	129	0	47	224	0	0	0	0	129	0	47
	43	76	264	60	0	0	76	60	194	10	0	60	0	0
	44	122	248	30	0	0	122	230	0	10	8	30	0	0
	45	85	295	20	0	0	85	215	0	80	0	20	0	0
	46	286	64	30	20	0	286	54	0	10	0	30	20	0
	47	338	0	62	0	0	338	0	0	0	0	62	0	0
	48	145	200	15	40	0	145	185	0	0	15	15	40	0
	49	252	0	50	0	98	252	0	0	0	0	50	0	98
	50	190	64	16	130	0	190	0	0	0	64	16	130	0
	51	156	5	0	239	0	156	0	0	0	5	0	239	0
	52	121	64	0	80	135	121	0	0	0	64	0	80	135
	53	100	3	50	247	0	100	0	3	0	0	50	247	0
	54	33	77	0	230	60	33	0	72	0	5	0	230	60
	55	5	65	210	120	0	5	0	0	0	65	210	120	0
	56	5	110	250	35	0	5	0	0	0	110	250	35	0
	57	5	95	250	50	0	5	0	0	0	95	250	50	0
	58	10	0	350	40	0	10	0	0	0	0	350	40	0
	59	15	0	185	200	0	15	0	0	0	0	185	200	0
	60	20	0	100	100	180	20	0	0	0	0	100	100	180
	61	25	0	0	155	220	25	0	0	0	0	0	155	220
	62	60	50	240	50	0	60	0	0	0	50	240	50	0
	63	40	100	50	210	0	40	0	0	0	100	50	210	0
	64	25	100	0	150	125	25	0	0	0	100	0	150	125
	65	25	105	50	100	120	25	0	50	0	55	50	100	120
	66	20	230	100	50	0	20	0	0	80	150	100	50	0
	67	80	100	100	120	0	80	0	0	0	100	100	120	0
	68	65	205	115	0	15	65	0	0	50	155	115	0	15
	69	105	205	50	40	0	105	0	100	50	55	50	40	0
	70	105	215	50	30	0	105	20	80	0	115	50	30	0

Note: All transects in the south segment were 400 ft in length.

Table 16. Location of the seagrass bed edges, linear extent (ft) of vegetated bottom, and percent cover of unvegetated bottom along the entire transect and within the first 20 ft and 50 ft of each transect in the south segment, Transects 36-70

	Transect	Nearshore Bed Edge (ft)	Offshore Bed Edge (ft)	Total Linear ft Vegetated Bottom	Total % Unvegetated Bottom	0-20 ft		0-50 ft	
						Linear ft Vegetated Bottom	% Unvegetated Bottom	Linear ft Vegetated Bottom	% Unvegetated Bottom
South Segment	36	1	100	100	75%	20	0%	50	0%
	37	2	114	114	72%	20	0%	50	0%
	38	2	187	185	54%	18	10%	48	4%
	39	4	169	169	58%	20	0%	50	0%
	40	1	193	191	52%	18	10%	48	4%
	41	2	188	188	53%	20	0%	50	0%
	42	3	179	176	56%	17	15%	47	6%
	43	7	324	324	19%	20	0%	50	0%
	44	5	280	278	31%	18	10%	48	4%
	45	4	385	315	21%	20	0%	50	0%
	46	3	254	114	72%	20	0%	50	0%
	47	5	67	62	85%	15	25%	45	10%
	48	7	255	255	36%	20	0%	50	0%
	49	3	152	148	63%	18	10%	48	4%
	50	4	214	210	48%	16	20%	46	8%
	51	5	244	244	39%	20	0%	50	0%
	52	3	284	279	30%	15	25%	45	10%
	53	1	300	300	25%	20	0%	50	0%
	54	5	372	367	8%	15	25%	45	10%
	55	8	400	395	1%	15	25%	45	10%
	56	3	400	395	1%	15	25%	45	10%
	57	8	400	395	1%	15	25%	45	10%
	58	12	400	390	3%	10	50%	40	20%
	59	22	400	385	4%	5	75%	35	30%
	60	20	400	380	5%	0	100%	30	40%
	61	21	400	375	6%	0	100%	25	50%
	62	28	400	340	15%	0	100%	0	100%
	63	26	400	360	10%	0	100%	10	80%
	64	22	400	375	6%	0	100%	25	50%
	65	28	400	375	6%	0	100%	25	50%
	66	27	380	380	5%	20	0%	50	0%
	67	22	350	320	20%	0	100%	20	60%
	68	26	400	335	16%	5	75%	35	30%
	69	19	350	295	26%	15	25%	45	10%
	70	5	350	295	26%	15	25%	45	10%

Table 17. Distance of the nearshore bed edge to the bulkhead, seagrass abundance, species composition, and substrate type at the nearshore bed edge at transects in the south segment, Transects 36-70

	Transect	Distance of Nearshore Bed Edge to Bulkhead (ft)	BB Score	LI Score	Species Present	Substrate
South Segment	36	1	2	1	Hd, Hw, Sf, Tt	Sand/Rubble
	37	2	3	2	Hw, Sf, Tt	Sand
	38	2	4	3	HD, Hw, Sf, Tt	Sand
	39	4	4	3	Hd, Hw, Sf	Sand
	40	1	5	4	Hd, Hw, Sf	Sand/Rubble
	41	2	4	3	Hd, Hw, Sf	Sand
	42	3	5	4	Hd, Hw, Sf	Sand
	43	7	3	2	Hd, Hw, Sf, Tt	Sand/Rubble
	44	5	2	1	Hd, Hw, Sf, Tt	Sand/Rubble
	45	4	3	2	Hd, Hw	Muck/Rubble
	46	3	3	2	Hd, Hw, Sf, Tt	Sand/Rubble
	47	5	3	2	Hd, Hw, Sf	Sand
	48	7	2	1	Hw, Sf	Sand/Shell/Rubble
	49	3	5	4	Hd, Hw, Sf	Sand/Rubble
	50	4	3	2	Hw, Sf	Sand/Rubble
	51	5	2	1	Hw	Sand/Rubble
	52	3	5	4	Hd, Hw, Sf	Sand
	53	1	4	3	Hw, Sf, Tt	Sand
	54	5	2	1	Sf	Sand
	55	8	2	1	Hw, Sf	Sand/Shell/Rubble
	56	3	2	1	Hw	Sand
	57	8	2	1	Hw, Sf	Sand
	58	12	3	2	Sf	Sand
	59	22	3	2	Hd, Hw, Sf	Sand
	60	20	5	4	Hw, Sf	Sand
	61	21	4	3	Hw, Sf	Sand
	62	28	3	2	Hd, Hw, Sf	Sand
	63	26	4	3	Hd, Hw, Sf, Tt	Sand
	64	22	5	4	Hw, Sf, Tt	Sand/Shell
	65	28	2	1	Hw	Sand
	66	27	2	1	Sf, Tt	Sand
	67	22	4	3	Hd, Hw, Sf, Tt	Sand
	68	26	2	1	Hw, Sf	Sand/Shell
	69	19	2	1	Hw, Sf	Sand
	70	5	2	1	Hw, Sf	Sand/Rubble

Table 18. Approximate distance of the nearshore bed edge to the bulkhead at approximately 25 ft intervals between Transects 36-70 in the south segment

	Transect	Distance of Nearshore Bed Edge to Bulkhead (ft)
South Segment	36.5	12
	37.5	1
	38.5	0
	39.5	3
	40.5	0
	41.5	0
	42.5	1
	43.5	2
	44.5	7
	45.5	3
	46.5	3
	47.5	3
	48.5	12
	49.5	10
	50.5	4
	51.5	2
	52.5	0
	53.5	0
	54.5	0
	55.5	4
	56.5	3
	57.5	8
	58.5	16
	59.5	17
	60.5	19
	61.5	21
	62.5	23
	63.5	16
	64.5	18
	65.5	22
	66.5	18
	67.5	20
	68.5	16
	69.5	11

Note: Distances were estimated in ArcGIS 10.2

Table 19. Average (±SE) macroalgal cover and linear extent and percent cover of the dominant substrate at transects in the south segment, Transects 36-70

	Transect	Avg (±SE) Macroalgae BB	Dominant Substrate		
			Type	LI (ft)	% Cover
South Segment	36	1.3 (±0.4)	Muck	355	89%
	37	0.7 (±0.3)	Muck	286	72%
	38	0.8 (±0.3)	Muck	380	95%
	39	0.7 (±0.3)	Muck	231	58%
	40	1.7 (±0.6)	Muck	350	88%
	41	0.5 (±0.5)	Muck	212	53%
	42	2.2 (±0.4)	Muck	380	95%
	43	0.9 (±0.6)	Muck	340	85%
	44	2.3 (±0.6)	Muck	360	90%
	45	0.4 (±0.3)	Muck	380	95%
	46	1.4 (±0.6)	Muck	370	93%
	47	1.1 (±0.6)	Muck	375	94%
	48	2.3 (±0.7)	Muck	330	83%
	49	1.3 (±0.5)	Muck	300	75%
	50	2.6 (±0.7)	Muck	186	47%
	51	1.3 (±0.3)	Sand	239	60%
	52	1.8 (±0.3)	Sand	220	55%
	53	1.5 (±0.3)	Sand	297	74%
	54	2.1 (±0.4)	Sand	300	75%
	55	2.3 (±0.1)	Sand/Shell	280	70%
	56	2.3 (±0.2)	Sand	245	61%
	57	2.1 (±0.2)	Sand	395	99%
	58	2.3 (±0.1)	Sand	390	98%
	59	1.3 (±0.3)	Sand	400	100%
	60	2.8 (±0.3)	Sand	380	95%
	61	2.3 (±0.3)	Sand	375	94%
	62	2.3 (±0.5)	Sand	400	100%
	63	2.5 (±0.8)	Sand	400	100%
	64	2.6 (±0.4)	Sand/Shell	375	94%
	65	2.4 (±0.3)	Sand	375	94%
	66	1.9 (±0.1)	Sand	400	100%
	67	1.8 (±0.4)	Sand	400	100%
	68	2.0 (±0.2)	Sand/Shell	385	96%
	69	2.0 (±0.1)	Sand/Shell	300	75%
	70	2.5 (±0.2)	Sand/Shell	250	63%

Tree Survey

GRB identified the locations of 67 trees along the bulkhead. **Tables 17a** and **17b** present the results of the tree survey, and **Figures 16a** through **16d** show the tree locations identified within the survey area. The locations of Trees 63 through 66 appear to be slightly off from their actual locations when comparing photographs of the trees in relation to the transect stakes. This positioning error is likely due to the loss of differential positioning/satellites from interference with the dense tree canopy. The photographs suggest that these trees may be up to 155 ft from their actual locations. Review of the digital photographs suggest that Tree 63 was located near the stake for Transect 62; Tree 64 was close to the stake for Transect 63; Tree 65 was by Transect 64; and Tree 66 was by Transect 66. Additionally, coordinates were not collected at Tree 35; the location of Tree 35 was estimated in ArcGIS using aerial photography and field data notes.

Table 20a. Upland tree survey results, Trees 1 through 30

Tree	Common Name	Scientific Name	Category	Circumference (inches)	Diameter (in.)	Height (Ft.)
1	Brazilian pepper	*Schinus terebinthifolius*	FLEPPC Category 1 invasive exotic	36	11.46	15
2	Golden Dewdrop	*Duranta erecta L.*	Non-native	15	4.77	11
3	Seagrape	*Coccoloba uvifera*		11	3.50	11
4	Seagrape	*Coccoloba uvifera*		16	5.09	8.8
5	Seagrape	*Coccoloba uvifera*		14	4.46	8.8
6	Seagrape	*Coccoloba uvifera*		13	4.14	14
7	Seagrape	*Coccoloba uvifera*		14	4.46	12
8	Seagrape	*Coccoloba uvifera*		16	5.09	12
9	Seagrape	*Coccoloba uvifera*		17	5.41	10
10	Seagrape	*Coccoloba uvifera*		14.5	4.62	14.5
11	Seagrape	*Coccoloba uvifera*		41	13.05	12
12	Seagrape	*Coccoloba uvifera*		24	7.64	15.5
13	Black Mangrove	*Avicennia germinans*		12	3.82	10.5
14	Seagrape	*Coccoloba uvifera*		16.5	5.25	9
15	Washington Fan Palm	*Washingtonia robusta*	Possible *Livistona spp* however both are non-native	22	7.00	9
16	Washington Fan Palm	*Washingtonia robusta*		22	7.00	6
17	Washington Fan Palm	*Washingtonia robusta*		19	6.05	10
18	Seagrape	*Coccoloba uvifera*		11	3.50	5.5
19	Washington Fan Palm	*Washingtonia robusta*	Possible *Livistona spp* however both are non-native	10	3.18	6.5
20	Washington Fan Palm	*Washingtonia robusta*		12	3.82	11
21	Seagrape	*Coccoloba uvifera*		12	3.82	9
22	Seagrape	*Coccoloba uvifera*		15	4.77	14
23	Seagrape	*Coccoloba uvifera*		15	4.77	Tree 1=22', Tree 2=19'
24	Seagrape	*Coccoloba uvifera*		14/Palm Tree 40	4.5/ 12.7	8
25	Pitch Apple	*Clusia rosea*		8	2.55	27
26	Black Olive	*Terminalia buceras*	Non-native	49	15.60	7
27	Seagrape	*Coccoloba uvifera*		23	7.32	10
28	Seagrape	*Coccoloba uvifera*		19 Left Trunk/22 Right Trunk	6 Left Trunk/ 7 Right Trunk	17
29	Black Olive	*Terminalia buceras*	Non-native	37	11.78	11
30	Silver Buttonwood	*Conocarpus erectus var. sericeus*		11	3.50	31

Note: Data collected by GRB.

Table 20b. Upland tree survey results, Trees 31 through 66.

Tree	Common Name	Scientific Name	Category	Circumference (inches)	Diameter (in.)	Height (Ft.)
31	Black Olive	*Terminalia buceras*	Non-native	58	18.46	31
32	Black Olive	*Terminalia buceras*	Non-native	49	15.60	28
33	Black Olive	*Terminalia buceras*	Non-native	39	12.41	31
34	Black Olive	*Terminalia buceras*	Non-native	33	10.50	31
35	Black Olive	*Terminalia buceras*	Non-native	49	15.60	31
36	Black Olive	*Terminalia buceras*		34	10.82	25
37	Black Olive	*Terminalia buceras*		40	12.73	25
38	Black Olive	*Terminalia buceras*	Non-native	40	12.73	24
39	Black Olive	*Terminalia buceras*	Non-native	48	15.28	29
40	Black Olive	*Terminalia buceras*	Non-native	50	15.92	29
41	Black Olive	*Terminalia buceras*	Non-native	29	9.23	38
42	Black Olive	*Terminalia buceras*	Non-native	68	21.65	13
43	Seagrape	*Coccoloba uvifera*		20.5 Left Trunk/20 Right Trunk	6.5 Left Trunk/ 6.3 Right Trunk	23
44	Black Olive	*Terminalia buceras*	Non-native	25	7.96	39
45	Black Olive	*Terminalia buceras*	Non-native	60	19.10	39
46	Black Olive	*Terminalia buceras*	Non-native	39	12.41	110-115
47	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic	60	19.10	80-90
47A	Silk Tree	*Albizia julibrissin*	FLEPPC Category 1 invasive exotic	24	7.64	25
48	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic	45	14.32	30
49	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic	28	8.91	50-60
50	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic	42	13.37	110-115
51	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic	64	20.37	80
52	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic	49.5	15.76	12
53	Seagrape	*Coccoloba uvifera*		11	3.50	25
54	Seagrape	*Coccoloba uvifera*		18	5.70	10
55	Seagrape	*Coccoloba uvifera*		18	5.73	30
56	Seagrape	*Coccoloba uvifera*		19	6.05	19
57	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic	22	7.00	20
58	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic	19	6.05	150
59	Australian Pine	*Casuarina equisetifolia*	FLEPPC Category 1 invasive exotic	70	22.28	45
60	Strangler Fig	*Ficus aurea*	On Brazillian Pepper	96	30.56	35
61	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic	25	7.96	50
62	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic	34	10.82	40
63	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic	30	9.55	30
64	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic	31	9.87	25
65	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic	28	8.91	28
66	Seaside Mahoe	*Thespesia populnea*	FLEPPC Category 1 invasive exotic	20	6.37	25

Note: Data collected by GRB.

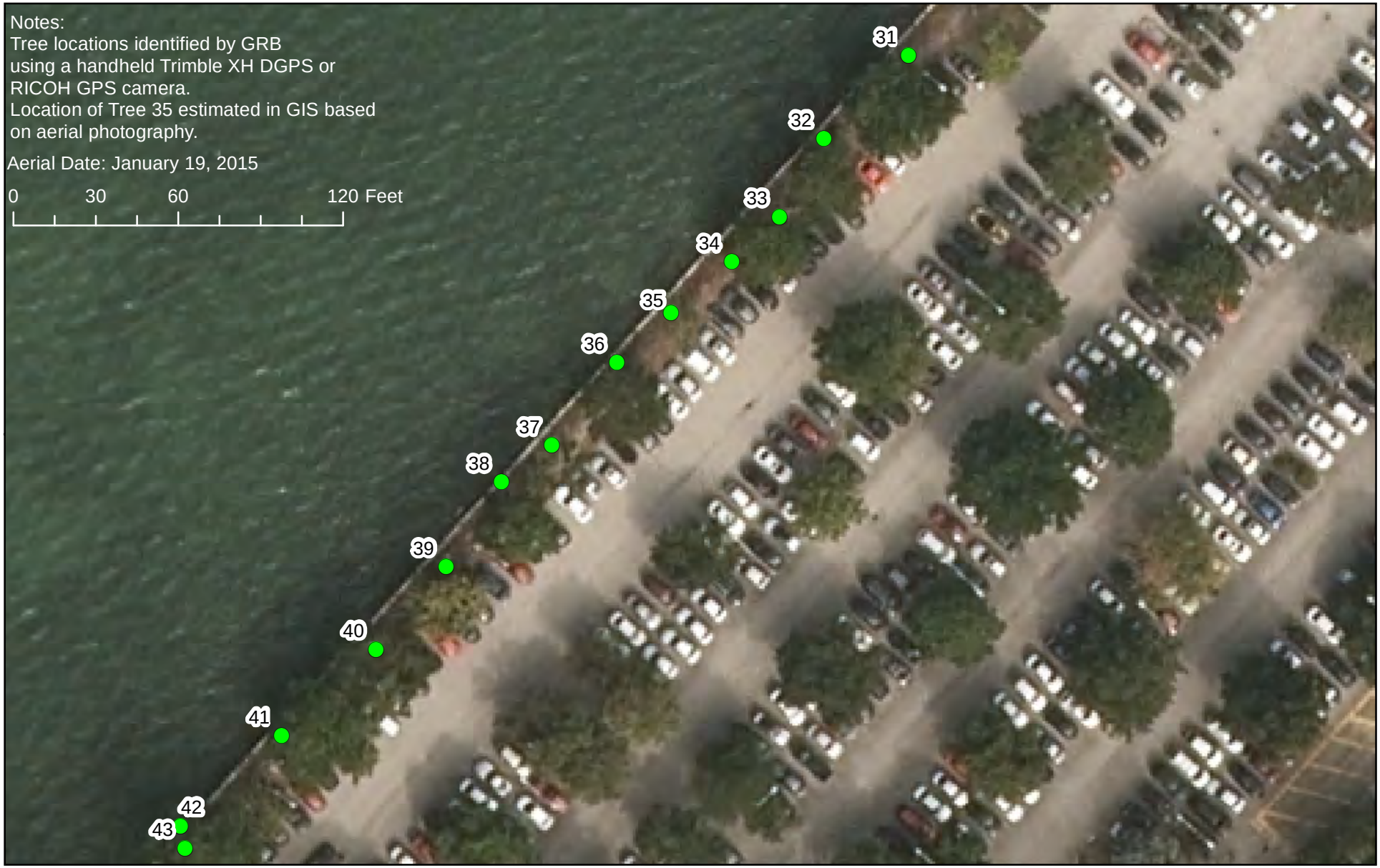
N
W E
S

Mt. Sinai Hospital Bulkhead Replacement Tree Survey
North Segment Trees 1-13
Figure 16a

Coastal Eco Group Inc.

Mt. Sinai Hospital Bulkhead Replacement Tree Survey
Central Segment Trees 14-30
Figure 16b

Coastal Eco Group Inc.



Mt. Sinai Hospital Bulkhead Replacement Tree Survey
South Segment Trees 31-43
Figure 16c

Coastal Eco Group Inc.

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Mt. Sinai Hospital Bulkhead Replacement Tree Survey
South Segment Trees 44-66
Figure 16d

Coastal Eco Group Inc.

CONCLUSIONS

A total of 11 scleractinian corals greater than 1 cm in diameter were identified at the 70 transects along the bulkhead, six colonies were greater than 10 cm in diameter. All coral colonies less than 10 cm in diameter were identified as *S. siderea* or *S*. cf *siderea*. Larger corals greater than 10 cm in diameter were *O. diffusa*, *O. robusta*, and *S. siderea*. Macroalgae, empty space, turf algae, and sponge cover, when combined, comprised 80% to 100% of the total cover at the encrusting organism transects.

A total of 17.04 acres of seagrass habitat are present within the 26.15-acre survey area, representing 65% of the survey area (**Table 21**). Seagrass habitat is dominated by a mixed species bed and a monospecific *H. decipiens* bed, each accounted for approximately 39% and 26% of the total seagrass area, respectively. The mixed species bed consists of *H. decipiens, H. wrightii, S. filforme,* and *T. testudinum*. The mixed bed is dominant along the first 50 ft to 100 ft of each transect and increases; this bed increases in extent in the south segment to a distance of 400 ft from the bulkhead. In areas where the mixed bed did not extend along the entire length of the transect, seagrass cover transitioned to a monospecific bed of *H. decipiens* in deeper water.

Table 21. Seagrass habitat acreages within the entire survey area and within 20 ft of the bulkhead, 21 to 50 ft of the bulkhead, and 51 to 400 ft from the bulkhead.

Habitat	Acreages			
	Total Survey Area	0 ft (Bulkhead) to 20 ft	21 ft to 50 ft	51 ft to Offshore Extent
Mixed Species Bed	10.16	0.67	1.77	7.72
HD Bed	6.75	0.02	0.34	6.38
HW Bed	0.10			0.10
TT Bed	0.03			0.03
Total Seagrass	**17.04**	**0.69**	**2.11**	**14.23**
Unvegetated	**9.11**	**0.78**	**0.07**	**8.27**
Total Survey Area	26.15	1.47	2.18	22.50

The distance of the nearshore bed edge to the bulkhead ranged between 0 and 28 ft and was closest to the bulkhead in the central segment (**Tables 7, 11,** and **15**). Seagrass density along the nearshore bed edge varied, but was generally higher in the central and south segments. The bed edge was characterized by mixed species along the majority of the edge; however, the nearshore edge at several transects was dominated by a single species, either *H. decipiens, H. wrightii,* or *S. filiforme*. Seagrass along the first 20 ft of each transect was generally characterized as low density with the majority of the segment comprised of less than 25% seagrass cover in all three segments (**Tables 22a-22c**). Seagrass was absent from the first 20 ft at several transects (Transects 7, 8, 9, 60-65, and 67). Seagrass density was higher when averaged over the first 50 ft of each transect (**Tables 23a-23c**). In the north segment, Category

1 (< 25% seagrass cover) had the greatest linear extent within the first 50 ft of each transect. However, in the central and south segments, the greatest linear extent of seagrass cover was between 50 and 75% cover.

There was a strong relationship between substrate type and seagrass bed throughout the survey area (**Table 24**). Sand was the dominant substrate along the bed edges. Muck was present along the offshore bed edge at 19 transects and along the nearshore edge at 3 transects (Transects 28, 29, and 45). The transects where muck was present at the offshore edge were located throughout the central and south segments between Transects 22 and 49. Muck was the dominant substrate throughout the central segment of the survey area. Thirty-three (33) transects were dominated by muck, 32 were dominated by sand, and 5 were dominated by a sand/shell matrix. At the muck-dominated transects, the average bed extent was 150 ft.

Table 22a. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 20 ft of each transect in the north segment, Transects 1-9

	Transect	Avg BB (± SE)	Species Present	Line Intercept (ft)				Dominant Substrate
				<25%	25-50%	50-75%	> 75%	
North Segment	1	0.5 (±0.5)	Hd	20	0	0	0	Sand
	2	0.5 (±0.5)	Hd	20	0	0	0	Rubble
	3	1.7 (±0.9)	Hd Hw	16	4	0	0	Rubble
	4	1.0 (±1.0)	Hw Sf Tt	10	10	0	0	Sand
	5	1.0 (±1.0)	Hw Sf Tt	20	0	0	0	Sand
	6	2.0 (±1.2)	Hw Sf Tt	16	0	4	0	Sand
	7	0.0		20	0	0	0	Sand
	8	0.0		20	0	0	0	Sand
	9	0.0 (±0.0)		20	0	0	0	Rubble

Table 22b. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 20 ft of each transect in the central segment, Transects 10-35

	Transect	Avg BB (± SE)	Species Present	Line Intercept (ft)				Dominant Substrate
				<25%	25-50%	50-75%	> 75%	
Central Segment	10	2.6 (±2.5)	Hw Tt	18	0	0	2	Sand
	11	2.7 (±1.3)	Hd Hw Sf	7	0	13	0	Sand
	12	4.7 (±0.3)	Hd Hw Sf	0	0	6	14	Sand
	13	3.5 (±1.5)	Hw Sf	10	0	0	10	Sand
	14	2.5 (±0.5)	Hd Hw Tt	7	13	0	0	Sand
	15	4.0	Hd Hw Sf Tt	0	0	20	0	Sand
	16	2.0 (±2.0)	Hd Hw Tt	5	0	15	0	Sand
	17	1.0 (±1.0)	Hd Hw	20	0	0	0	Sand
	18	1.0 (±1.0)	Hw	20	0	0	0	Sand
	19	1.3 (±0.7)	Hd Hw	20	0	0	0	Sand
	20	1.5 (±1.5)	Hw Tt	5	15	0	0	Sand
	21	2.0 (±2.0)	Hd Hw Sf Tt	6	0	14	0	Sand
	22	2.0 (±2.0)	Hd Hw Sf	6	0	14	0	Sand
	23	1.0 (±1.0)	Hw Tt	20	0	0	0	Sand
	24	3.5 (±0.5)	Hd Hw Sf Tt	0	5	15	0	Sand
	25	1.5 (±1.5)	Hd Hw Sf	4	16	0	0	Sand
	26	5.0 (±0.0)	Hd Hw Sf	0	0	0	20	Sand
	27	2.0 (±2.0)	Hd Hw Sf	3	0	17	0	Sand
	28	1.5 (±1.5)	Hd Hw Sf Tt	1	19	0	0	Muck
	29	2.0 (±2.0)	Hd Hw Sf Tt	5	0	15	0	Muck
	30	4.0 (±0.6)	Hd Hw Sf	0	8	5	7	Sand
	31	1.0 (±1.0)	Hd Hw Sf	20	0	0	0	Sand
	32	3.0 (±1.5)	Hd Hw Sf Tt	3	0	7	10	Sand
	33	2.0 (±2.0)	Hw Sf Tt	3	0	17	0	Sand
	34	2.5 (±2.5)	Hd Hw Sf	5	0	0	15	Sand
	35	2.1 (±2.0)	Hd Hw Sf Tt	3	0	17	0	Sand

Table 22c. Average BB score (±SE), species composition, line intercept and dominant substrate within the first 20 ft of each transect in the south segment, Transects 36-70

	Transect	Avg BB (± SE)	Species Present	Line Intercept (ft)				Dominant Substrate
				<25%	25-50%	50-75%	> 75%	
South Segment	36	3.0 (±1.0)	Hd Hw Sf Tt	4	0	16	0	Sand
	37	3.0	Hw Sf Tt	0	20	0	0	Sand
	38	3.0 (±1.5)	Hd Hw Sf	2	0	8	10	Sand
	39	4.0	Hd Hw Sf	0	0	20	0	Sand
	40	2.5 (±2.5)	Hd Hw Sf	2	0	0	18	Sand
	41	4.0	Hd Hw Sf	0	0	20	0	Sand
	42	3.3 (±1.7)	Hd Hw Sf	3	0	0	17	Sand
	43	3.0	Hd Hw Sf Tt	0	20	0	0	Sand
	44	1.7 (±0.9)	Hd Hw Sf Tt	10	10	0	0	Sand
	45	3.0	Hd Hw	0	20	0	0	Muck
	46	3.5 (±0.5)	Hd Hw Sf Tt	0	10	10	0	Sand
	47	1.5 (±1.5)	Hd Hw Sf	5	15	0	0	Sand
	48	3.0 (±1.0)	Hd Hw Sf	15	0	5	0	Sand
	49	2.5 (±2.5)	Hd Hw Sf	2	0	0	18	Sand
	50	1.5 (±1.5)	Hw Sf	4	16	0	0	Sand
	51	3.0 (±1.0)	Hd Hw Sf	5	0	15	0	Sand
	52	3.0 (±1.5)	Hd Hw Sf	5	0	10	5	Sand
	53	2.3 (±1.8)	Hw Sf Tt	3	0	17	0	Sand
	54	2.0 (±1.2)	Hw Sf	10	0	10	0	Sand
	55	1.0 (±1.0)	Hw Sf	20	0	0	0	Sand
	56	2.0 (±1.2)	Hw Sf Tt	15	0	5	0	Sand
	57	1.0 (±1.0)	Hw Sf	20	0	0	0	Sand
	58	1.5 (±1.5)	Sf	10	10	0	0	Sand
	59	1.5 (±1.5)	Hd Hw Sf	15	5	0	0	Sand
	60	0.0		20	0	0	0	Rubble
	61	0.0		20	0	0	0	Rubble
	62	0.0		20	0	0	0	Sand
	63	0.0		20	0	0	0	Sand
	64	0.0		20	0	0	0	Rubble
	65	0.0		20	0	0	0	Rubble
	66	2.0	Sf Tt	20	0	0	0	Sand
	67	0.0		20	0	0	0	Sand
	68	1.0 (±1.0)	Hw Sf	20	0	0	0	Rubble
	69	2.0 (±1.2)	Hw Sf Tt	10	0	10	0	Sand
	70	1.0 (±1.0)	Hw Sf	20	0	0	0	Sand

Table 23a. Average BB score (±SE), species composition, line intercept, and dominant substrate within the first 50 ft of each transect in the north segment, Transects 1-9

	Transect	Avg BB (± SE)	Species Present	Line Intercept (ft)				Dominant Substrate
				<25%	25-50%	50-75%	> 75%	
North Segment	1	1.0 (±0.6)	Hd	50	0	0	0	Sand
	2	2.0 (±0.9)	Hd	23	7	20	0	Sand
	3	1.7 (±0.9)	Hd Hw	16	34	0	0	Muck
	4	1.8 (±1.0)	Hd Hw Sf Tt	10	16	24	0	Sand
	5	1.7 (±0.4)	Hd Hw Sf Tt	44	6	0	0	Sand
	6	3.0 (±0.6)	Hd Hw Sf Tt	16	17	13	4	Sand
	7	2.3 (±0.9)	Hd Hw	24	26	0	0	Sand
	8	1.7 (±0.7)	Hd Hw Sf Tt	42	0	8	0	Sand
	9	1.6 (±0.7)	Hd Hw Sf	36	14	0	0	Sand

Table 23b. Average BB score (±SE), species composition, line intercept, and dominant substrate within the first 50 ft of each transect in the central segment, Transects 10-35

	Transect	Avg BB (± SE)	Species Present	Line Intercept (ft)				Dominant Substrate
				<25%	25-50%	50-75%	> 75%	
Central Segment	10	2.6 (±2.5)	Hw Tt	18	0	0	32	Sand
	11	3.2 (±0.7)	Hd Hw Sf	7	7	36	0	Sand
	12	4.5 (±0.3)	Hd Hw Sf	0	0	23	27	Sand
	13	3.8 (±0.6)	Hd Hw Sf	10	1	10	29	Sand
	14	3.3 (±0.5)	Hd Hw Tt	7	16	27	0	Sand
	15	4.0 (±0.4)	Hd Hw Sf Tt	0	1	36	13	Sand
	16	2.3 (±1.2)	Hd Hw Tt	5	20	25	0	Sand
	17	1.7 (±0.9)	Hd Hw Tt	30	20	0	0	Sand
	18	1.7 (±0.9)	Hd Hw	20	30	0	0	Sand
	19	1.3 (±0.7)	Hd Hw	50	0	0	0	Muck
	20	2.0 (±0.7)	Hd Hw Tt	15	35	0	0	Sand
	21	2.0 (±2.0)	Hd Hw Sf Tt	6	0	44	0	Sand
	22	2.0 (±1.2)	Hd Hw Sf	26	0	24	0	Sand
	23	0.8 (±0.6)	Hd Hw Tt	50	0	0	0	Muck
	24	3.3 (±0.3)	Hd Hw Sf Tt	0	25	25	0	Sand
	25	1.2 (±0.9)	Hd Hw Sf	24	26	0	0	Sand
	26	5.0 (±0.0)	Hd Hw Sf	0	0	0	50	Sand
	27	2.0 (±2.0)	Hd Hw Sf	3	0	47	0	Sand
	28	1.5 (±1.5)	Hd Hw Sf Tt	1	49	0	0	Muck
	29	1.3 (±1.3)	Hd Hw Sf Tt	12	0	38	0	Muck
	30	4.0 (±0.4)	Hd Hw Sf	0	8	35	7	Sand
	31	1.7 (±0.9)	Hd Hw Sf	30	20	0	0	Sand
	32	3.4 (±0.9)	Hd Hw Sf Tt	3	0	22	25	Sand
	33	2.3 (±1.2)	Hd Hw Sf Tt	3	20	27	0	Sand
	34	3.4 (±0.9)	Hd Hw Sf	5	0	10	35	Sand
	35	2.4 (±1.2)	Hd Hw Sf Tt	3	30	17	0	Sand

Table 23c. Average BB score (±SE), species composition, line intercept, and dominant substrate within the first 50 ft of each transect in the south segment, Transects 36-70

	Transect	Avg BB (± SE)	Species Present	Line Intercept (ft)				Dominant Substrate
				<25%	25-50%	50-75%	> 75%	
South Segment	36	3.8 (±0.6)	Hd Hw Sf Tt	4	0	41	5	Sand
	37	3.0 (±)	Hw Sf Tt	0	50	0	0	Sand
	38	3.8 (±1.0)	Hd Hw Sf	2	0	8	40	Muck
	39	4.0 (±)	Hd Hw Sf	0	0	50	0	Sand
	40	3.3 (±1.1)	Hd Hw Sf	2	0	20	28	Sand
	41	4.0 (±)	Hd Hw Sf	0	0	50	0	Sand
	42	3.8 (±1.3)	Hd Hw Sf	3	0	0	47	Muck
	43	3.0 (±)	Hd Hw Sf Tt	0	50	0	0	Sand
	44	1.8 (±0.6)	Hd Hw Sf Tt	20	30	0	0	Sand
	45	2.0 (±1.0)	Hd Hw Sf	30	20	0	0	Muck
	46	3.3 (±0.3)	Hd Hw Sf Tt	0	30	20	0	Sand
	47	2.0 (±1.0)	Hd Hw Sf	5	45	0	0	Sand
	48	3.0 (±0.6)	Hd Hw Sf	15	10	25	0	Sand
	49	2.5 (±2.5)	Hd Hw Sf	2	0	0	48	Sand
	50	2.8 (±0.9)	Hd Hw Sf	4	16	30	0	Sand
	51	3.3 (±0.7)	Hd Hw Sf	5	0	45	0	Sand
	52	3.5 (±1.2)	Hd Hw Sf	5	0	10	35	Sand
	53	2.8 (±1.2)	Hd Hw Sf Tt	3	0	47	0	Sand
	54	2.5 (±1.0)	Hw Sf	10	0	40	0	Sand
	55	2.3 (±0.9)	Hw Sf Tt	20	10	20	0	Sand
	56	2.0 (±1.2)	Hw Sf Tt	15	0	35	0	Sand
	57	1.3 (±0.7)	Hw Sf Tt	50	0	0	0	Sand
	58	2.5 (±0.9)	Hd Hw Sf	10	20	20	0	Sand
	59	1.5 (±1.5)	Hd Hw Sf	15	35	0	0	Sand
	60	2.5 (±2.5)	Hw Sf	20	0	0	30	Sand
	61	3.0 (±1.5)	Hd Hw Sf	25	0	5	20	Sand
	62	1.5 (±1.5)	Hd Hw Sf	50	0	0	0	Sand
	63	2.0 (±2.0)	Hd Hw Sf Tt	40	0	10	0	Sand
	64	2.5 (±2.5)	Hw Sf Tt	25	0	0	25	Sand
	65	2.3 (±1.5)	Hw Sf Tt	30	0	0	20	Sand
	66	2.0 (±0.0)	Hw Sf Tt	50	0	0	0	Sand
	67	2.0 (±2.0)	Hd Hw Sf Tt	30	0	20	0	Sand
	68	2.5 (±1.0)	Hw Sf Tt	20	15	0	15	Sand
	69	2.0 (±1.2)	Hw Sf Tt	10	0	40	0	Sand
	70	2.0 (±1.2)	Hw Sf Tt	20	0	30	0	Sand

Table 24. Average BB Score (±SE) of seagrass in muck versus sand in the central segment and northern half of the south segment where muck was the dominant substrate

	Transect	Muck	Sand
		Avg BB ± SE	Avg BB ± SE
Central Segment	10		2.8 (±0.7)
	11		2.5 (±0.4)
	12		2.2 (±0.5)
	13	2.5 (±0.5)	2.5 (±0.8)
	14		1.9 (±0.5)
	15		2.7 (±0.7)
	16	2.0 (±0.4)	2.3 (±1.8)
	17	2.0	1.3 (±0.4)
	18	1.3 (±0.3)	2.0 (±0.6)
	19	1.5 (±0.3)	1.8 (±0.7)
	20	1.6 (±0.6)	1.5 (±0.6)
	21	3.0	1.3 (±0.8)
	22	0.5 (±0.4)	0.0
	23	0.1 (±0.1)	2.0
	24	0.6 (±0.6)	3.0
	25	0.4 (±0.4)	3.0
	26	0.0 (±0.0)	3.5 (±1.5)
	27	0.0 (±0.0)	
	28	0.5 (±0.5)	
	29	0.0 (±0.0)	
	30	0.1 (±0.1)	4.0
	31	0.0 (±0.0)	3.0
	32	0.3 (±0.2)	4.3 (±0.3)
	33	0.4 (±0.4)	
	34	1.4 (±0.7)	5.0
	35	0.0 (±0.0)	3.0

	Transect	Muck	Sand
		Avg BB ± SE	Avg BB ± SE
South Segment	36	1.1 (±0.7)	4.0 (±0.0)
	37	0.0	3.5 (±0.5)
	38	2.0 (±0.8)	4.5 (±0.5)
	39	0.0	
	40	2.8 (±1.1)	
	41	0.0	
	42	2.7 (±1.5)	5.0 (±0.0)
	43	0.4 (±0.2)	
	44	0.4 (±0.3)	
	45	0.2 (±0.2)	
	46	0.8 (±0.6)	
	47	0.6 (±0.6)	
	48	0.1 (±0.1)	3.7 (±0.3)
	49	1.0 (±1.0)	
	50	0.0	4.0 (±0.0)

Notes: If the substrate type was not recorded along a transect, the cell is blank. An average BB of 0.0 means that seagrass was not recorded within the substrate type. No SE means that only a single BB cover score was recorded within the substrate type, suggesting that seagrass density did not change within the substrate type and does not restrict seagrass occurrence.

The offshore extent of seagrass is likely influenced by the location of the navigation channel. There was a significant ledge at the boundary of the navigational channel, which corresponded to the offshore seagrass bed edge along several transects in the central and south segments. These transects were also dominated by muck and characterized by deeper water depths in the offshore. Strong currents were noted during the survey; currents were strongest offshore and decreased in velocity along the transects towards shore with little to no current observed from approximately 100 ft to the bulkhead. The presence of the navigational channel combined with persistently strong currents and muck most likely limit seagrass expansion in this area.

APPENDIX E
REAL ESTATE PLAN

MOUNT SINAI MEDICAL CENTER, CONTINUTING AUTHORITIES PROGRAM (CAP) SECTION 14, PROJECT

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

May 2017

US Army Corps of Engineers ®
Jacksonville District

DRAFT

APPENDIX E

MOUNT SINAI MEDICAL CENTER
CONTINUING AUTHORITY PROGRAM (CAP)
SEC 14 EMERGENCY STREAMBANK PROTECTION
AND SHORELINE PROTECTION
MIAMI BEACH, FLORIDA

INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

REAL ESTATE PLAN

MAY 2017

DRAFT

MOUNT SINAI MEDICAL CENTER

CONTINUING AUTHORITY PROGRAM (CAP)

SEC 14 EMERGENCY STREAMBANK PROTECTION

AND SHORELINE PROTECTION

MIAMI BEACH, FLORIDA

INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

REAL ESTATE PLAN

TABLE OF CONTENTS

Section	Page No
1. STATEMENT OF PURPOSE.	E-4
2. STUDY AND PROJECT AUTHORIZATION.	E-4
3. PROJECT LOCATION	E-5
4. PROJECT DESCRIPTION	E-5
5. REAL ESTATE REQUIREMENTS.	E-6
6. ESTATES TO BE ACQUIRED.	E-6
7. FEDERALLY OWNED LANDS.	E-8
8. NON-FEDERAL OWNED LANDS.	E-8
9. NON-FEDERAL OPERATION/MAINTENANCE RESPONSIBILITIES.	E-8
10. NON-FEDERAL AUTHORITY TO PARTICIPATE IN PROJECT.	E-8
11. NAVIGATION SERVITUDE.	E-9
12. ATTITUDE OF OWNERS.	E-9
13. MINERALS.	E-9
14. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW).	E-9

15. INDUCED FLOODING. **E-9**

16. ZONING ORDINANCES **E-9**

17. RELOCATIONS ASSISTANCE (PUBLIC LAW 91-646). **E-9**

18. RELOCATIONS, ALTERATIONS, VACATIONS, AND ABANDONMENTS. **E-9**

19. STANDING TIMBER AND VEGETATIVE COVER. **E-10**

20. RECREATION RESOURCES. **E-10**

21. CULTURAL RESOURCES. **E-10**

22. OUTSTANDING RIGHTS. **E-10**

23. MITIGATION. **E-10**

24. ACQUISITION/ADMINISTRATIVE COSTS. **E-10**

25. SUMMARY OF PROJECT REAL ESTATE COST **E-10**

26. REAL ESTATE ACQUISITION SCHEDULE. **E-11**

27. CHART OF ACCOUNTS FOR PROJECT. **E-11**

EXHIBIT 1: REAL ESTATE CAPABILITY ASSESSMENT **E-12**

EXHIBIT 2: RISK LETTER **E-14**

APPENDIX E

MOUNT SINAI MEDICAL CENTER
CONTINUING AUTHORITY PROGRAM (CAP)
SEC 14 EMERGENCY STREAMBANK PROTECTION
AND SHORELINE PROTECTION
MIAMI BEACH, FLORIDA

INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

REAL ESTATE PLAN

1. STATEMENT OF PURPOSE.

This Real Estate Plan (REP) is provided in support of the City of Miami Beach, Florida the Non- Federal sponsor and the Mount Sinai Medical Center Feasibility Study. The purpose of the study is to recommend a plan for streambank and shoreline protection to infrastructure located at the Mount Sinai Medical Center, Miami-Dade County, which is on the shoreline of Biscayne Bay.

This report is preliminary and is intended for planning purposes only. Both the final real property lines and land value estimates 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 costs.

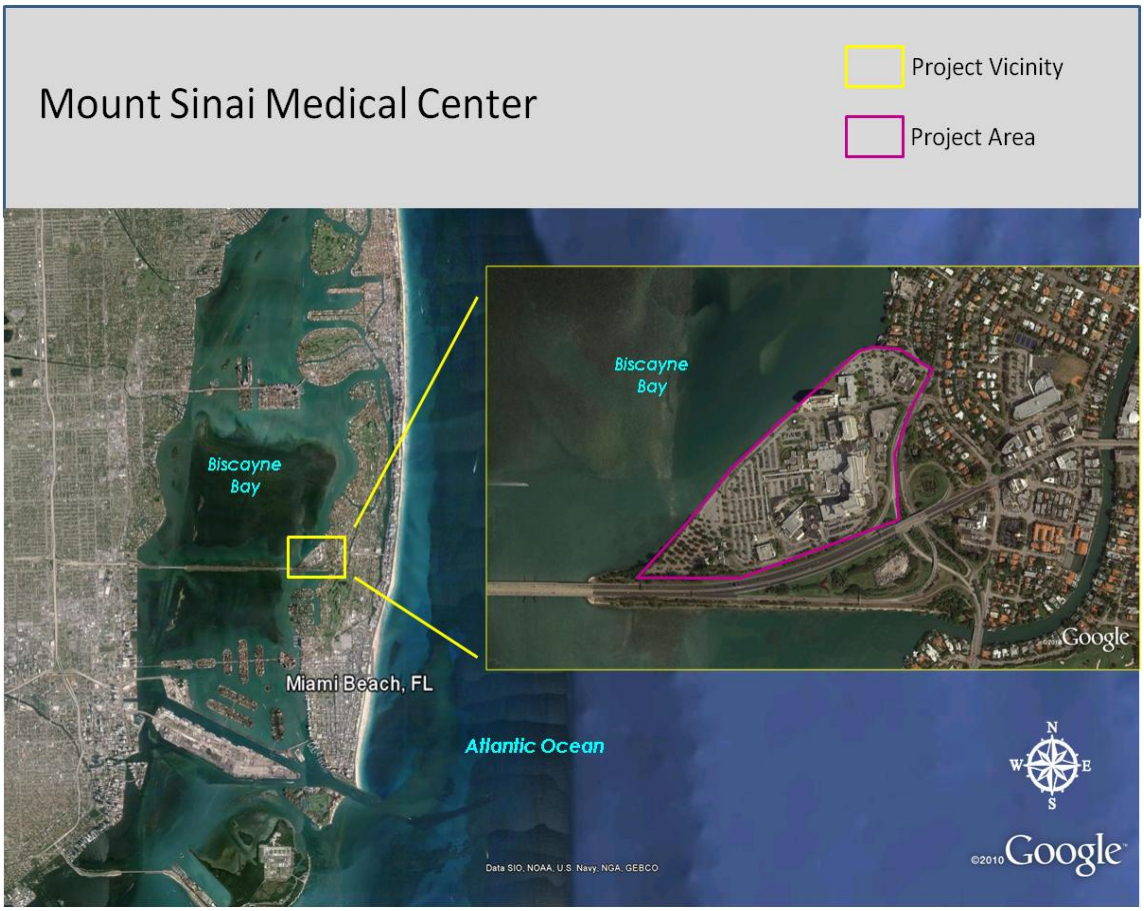
2. PROJECT AND STUDY AUTHORIZATION.

The Mount Sinai project is eligible under the Continuing Authorities Program (CAP) Section 14, Streambank and Shoreline Erosion Protection of Public Works and Non-Profit Public Services, of the 1946 Flood Control Act, as amended.

Section 14 is designed to implement projects to protect public facilities and facilities owned by non-profit organizations that are used to provide public services that are open to all on equal terms. These facilities must have been properly maintained but be in imminent threat of damage or failure by natural erosion processes on stream banks and shorelines, and are essential and important enough to merit Federal participation in their protection.

3. PROJECT LOCATION

The project area is located in the City of Miami Beach, Florida, on a barrier island bordered to the east by the Atlantic Ocean and to the west by Biscayne Bay. The study area is the property of Mount Sinai Medical Center, located directly north of Julia Tuttle Causeway and extending approximately 0.57 miles along the bayside of the island as indicated in Figure 1.



(Figure 1)

4. PROJECT DESCRIPTION

The project addresses the existing state of the seawall at Mount Sinai Medical Center of which portions of the seawall are in critical condition and at risk of failure. An evaluation of the current conditions led to a design to reinforce the existing seawall. The recommended plan has three components: a 300-foot T-wall along the northern edge of the property shoreline tied to the existing sea wall and new sheet pile construction; the placement of 3,070 feet of sheet pile along the seaward edge of the existing seawall; and 1.5-foot concrete cap added to 130 linear feet of the newer existing seawall segment.

5. REAL ESTATE REQUIREMENTS

Construction is proposed to take place 100% from the land. Refer to Figure 2. Construction of 3,070 linear feet of sheet pile wall will occur along the northwest shoreline of Mount Sinai Medical Center. The sheet pile wall will tie into a 300-foot T-wall along the northern edge of Mount Sinai Medical Center property line. The non-federal sponsor will acquire the lands via a flood protection levee easement and certify that lands are available for construction, operations and maintenance of both the sheet pile wall and the T-wall. A staging area of approximately .95 acre of land has been identified. The non-federal sponsor will certify the availability of the staging area via a temporary work area easement. Access will be provided via pubic access roads. Access to the staging area will not require exclusive use of the identified access route. The non-federal sponsor will acquire the lands via a temporary road easement and certify the availability of access. Construction is estimated to take approximately 18 months. No borrow or disposal areas are required for the construction of subject project.

6. ESTATE TO BE AQUIRED.

A. Flood Protection Levee Easement

A perpetual and assignable right and easement in (the land described in schedule A) (Tract, Nos, ___, ___ and ___) to construct, maintain, repair, operate, patrol and replace a flood protection floodwall including all appurtenance thereto; reserving, however to the owners, their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easements herby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipeline.

B. Temporary Work Area Easement

A temporary easement and right-of-way in, on, and over across (the land described in Schedule A) Tracts Nos _____, _____ and _____), for a period not to exceed _____, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agent, and contractors as a work area to 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 _____ Project, together with the right to trim, cut fell and remove therefrom all trees, underbrush , obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowner, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridge the rights and easements hereby required ; subject however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

Location Map
North Bay Village
Biscayne Bay
Miami Beach
Port of Miami
N
Sulivan Dr
0.93 acres
Alton Rd
MOUNT SINAI MEDICAL OFFICE 0232220110370
MOUNT SINAI MEDICAL CTR OF FL 0232220110360
907
195
N
Legend
Staging Area (0.93 ac. approx)
Construction Footprint (6ft)
Access Route
Miami-Dade Parcels 2015
Department of the Army South Atlantic Division
Jacksonville District, Corps of Engineers
REAL ESTATE
CAP Mount Sinai Medical Center
Sec 14 Emergency Streambank and Shoreline Protection
Miami, FL
Mapper: Eduardo Butler
Reviewer: B. Price
Map Date: 9/8/2016
1:2,500
0 60 120 180
Feet
Document Name: Mt Sinai Medical Center 2
Preliminary Draft Project #446835
IMAGERY:
Main Frame- Miami-Dade County 2015
Location Map- ESRI Imagery
Data Notes: This is a Sketch. For reference only. This is not a boundary survey.
Document Path: P:\RealEstate\FedInterest\Mount Sinai\maps\mxd\Mt Sinai Medical Center 2.mxd

Figure 2

C. Temporary Road Easement

A non-exclusive and assignable temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. ____, ____ and ___) for the location, construction, operation, maintenance, alteration replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles with the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way access to their adjoining land at the locations indicated in Schedule B); subject , however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

7. FEDERALLY-OWNED LAND

There are no federally owned lands within the project limits.

8. NON-FEDERALLY-OWNED LAND

The non-federal sponsor owns all lands required to support construction of the proposed project. The lands owned by the non-federal sponsor and provided to Mount Sinai Medical Center by lease and easement are the same lands the structures being protected by the project are located. In accordance with ER 1105-2-100, Appendix F, Continuing Authorities Program, Section III,"… the non-Federal sponsor will not receive credit for the value of LERRD it provides that are part of the tract of land on which the facility or structure to be protected is located, if such tract of land is owned by either the non-Federal sponsor or the owner of the facility…". Lands and Damages cost are being shown as zero dollars in the Real Estate Project Cost Schedule as no credit is allowed.

9. NON-FEDERAL OPERATION AND MAINTENACE RESPONSIBILITIES

The Non-Federal Sponsor will be required to provide without cost to the United States the aforementioned lands, access routes for ingress/egress, and staging areas, necessary for project construction of the project. A Right-of-Entry for Authorization for Entry for Construction will be provided by the non-Federal Sponsor to USACE prior to solicitation for a construction contract in order to identify and validate that sufficient real property interests are available. Operation and maintenance is a 100% non-federal responsibility.

10. NON-FEDERAL AUTHORITY TO PARTICIPATE IN PROJECT.

The City of Miami Beach is empowered by Florida Statue, Chapter 161.51 Part III to act as the city beach and shore preservation authority.

11. NAVIGATION SERVITUDE

Navigation servitude does not have nexus to navigation so does not meet the two-step process for determination of availability.

12. ATTITUDE OF OWNERS

This project was requested by the City of Miami Beach, the non-federal sponsor, in a letter dated 13 January 2014. Mount Sinai Medical Center, a non-profit, fee simple owner, fully supports the project. The project has both public support and strong congressional support.

13. MINERALS

There are no present or anticipated mineral activity within the project area that would affect the construction, operation, or maintenance of the project.

14. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW).

No signs of potential HTRW problems were identified and no sites with potential for contamination with HTRW were found as cited in section 2.3.12 of the main report.

15. INDUCED FLOODING

There will be no induced flooding directly associated with this project.

16. ZONING ORDINACES

Applications or enactment of zoning ordinances will not be used in lieu of acquisition.

17. RELOCATIONS ASSISTANCE (PUBLIC LAW 91-646 AS AMENDED)

No persons or businesses will be impacted by the project. There are no benefits anticipated under Public Law 91-646, codified in U.S.C. Title 42 – The Public Health and Welfare, Chapter 61 – Uniform Relocation Assistance and Real Property Acquisition Policies for Federal and Federally Assisted Programs which are implemented in the Uniform Regulations contained in 49 Code Of Federal Regulation, Part 24 as amended.

18. RELOCATIONS, ALTERATIONS, VACATIONS, AND ABANDONMENTS

No relocations, alterations, vacations or abandonments of utilities, structures, facilities, cemeteries, or towns have been identified within the proposed construction limits of the recommended plan.

19. STANDING TIMBER AND VEGETATIVE COVER

There is no timber or unusual vegetative cover that will be impacted by the project.

20. RECREATION RESOURCES

There are no separable recreational lands identified for the project.

21. CULTURAL RESOURCES

There are no known cultural resources that have been identified as being affected by the project.

22. OUTSTANDING RIGHTS

There are no known outstanding rights in the project area.

23. MITIGATION

There is no mitigation for the Recommended Plan.

24. AQUISISTION/ADMINISTRATIVE COSTS

The estimate of the Federal real estate administrative cost is **$ 46,962.50**. This figure includes project real estate planning, mapping, review, oversight, monitoring, analysis of real estate requirements and estates. The non-Federal sponsor will receive credit towards its share of real estate administrative project cost incurred for certifications. Non-Federal acquisition/administrative costs are estimated to be **$ 25,287.50.**

25. SUMMARY OF PROJECT REAL ESTATE COSTS.

The following cost figures are subject to change prior to construction. The Lands and Damages cost are being shown as zero dollars in accordance with Section 8 of this report.

a. Lands and Damages		$ 0
b. Acquisition Administrative cost		$ 72,250.50
Federal	$ 46,962.50	
Non-Federal	$ 25,287.50	
c. Public Law 91-646		$ 0
d. Condemnations		$ 0
e. Total Estimated Real Estate Cost		$ 72,250.50

f. Contingency (15%)	$ 12,750.00
g. Total Real Estate Costs	$ 85,000.00

26. REAL ESTATE ACQUISTION SCHEDULE

The City of Miami Beach, as the non-federal sponsor is responsible for certifying that lands are available for project advertisement and construction. Lands required for the project fall under one owner, Mount Sinai Medical Center. Mount Sinai Medical Center owns the lands in fee. Acquisition of the required interests in real estate is not anticipated to take a long time. For scheduling purposes, six months has been established to accomplish real estate acquisition. 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 Manager will formulate the milestone schedule upon project approval to meet date for advertisement and award of the construction contract.

27. CHART OF ACCOUNTS FOR PROJECT

01 - Lands & Damages		$ 0
01B-- Acquisitions Administrative cost		$ 72,250.50
01B20 - Non-Federal	$25,287.50	
01B40 – Federal	$46,962.50	
01B10 - By Govt	$ 0	
01B20 - By Local sponsor	$ 0	
01E10 - By Govt (In-House)	$ 0	
01M00 – Contingency (15%)		$ 12,750.00
Total Estimated Real Estate Cost:		**$** 85,000.00

Exhibit 1

REAL ESTATE CAPABILITY ASSESSMENT

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

FOR Mount Sinai MEDICAL CENTER (SEC 14) EMERGENCY STREAMBANK PROTECTION AND SHORELINE PROTECTION

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? **YES**
b. If the answer to a. is "yes," has a reasonable plan been developed to provide such training?
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? NO
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? **No**

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? **Yes**

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **Yes**
b. With regard to this project, the sponsor is anticipated to be: highly capable/fully.

V. Coordination:

a. Has this assessment been coordinated with the sponsor? **Yes**
b. Does the sponsor concur with this assessment? **Yes**

V. Coordination:

a. Has this assessment been coordinated with the sponsor? **Yes**
b. Does the sponsor concur with this assessment? **Yes**

Date: September 19, 2016

Prepared by:

Jerome Morgan

Jerome Morgan
Realty Specialist, Acquisition Branch
Real Estate Division

Reviewed by:

Hansler A. Bealyer

Hansler A. Bealyer
Chief, Acquisition Branch
Real Estate Division

Reviewed and approved by:

Audrey C. Ormerod

Audrey C. Ormerod
Chief, Real Estate Division
Real Estate Division

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
701 SAN MARCO BLVD
JACKSONVILLE, FLORIDA 32207-8175

Real Estate Division

Mr. Charles Tear
Emergency Management Coordinator
City Of Miami Beach
1700 Convention Center Drive
Miami, FL 33133

Dear Mr. Tear:

The intent of this letter is to formally advise the City of Miami Beach, as the non-Federal sponsor for the Mount. Sinai Medical Center Continuing Authority Program (CAP) SEC 14 Emergency Streambank Protection and Shoreline Protection Feasibility Study, 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;

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 County's participation in this project. Should you have questions or concerns pertaining to this letter please feel free to contact Mr. Jerome Morgan at jerome.g.morgan@usace.army.mil (904) 232-1146.

Sincerely,

Audrey C. Ormerod

Audrey C. Ormerod
Chief, Real Estate Division