February 2003

DRAFT

Engineering – Appendix B

For the

Miami Harbor Navigation Study
General Reevaluation Report

Miami-Dade County, Florida - 010140

US Army Corps of Engineers

Jacksonville District
South Atlantic Division

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

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with the older Fort Thompson Formation. The Fort Thompson consists of tan colored, sandy limestone, calcareous sandstone and seams of sand. With deeper depths, the sand seams increase in size and are thicker than the rock strata in some places. Many solution holes are present and are either open or filled with sand or secondary limestone. In both the Miami Oolite and the Fort Thompson Formations solution activity and re-crystallization have created zones of differential rock strength that cause the rock to fragment into large pieces that makes excavation difficult.

8. Investigations. Many of the borings taken in Miami Harbor are from previous dredging projects and are of limited use as the material they represent has already been removed. These core borings and locations can be found in the Miami Harbor Channel, Florida, General Design Memorandum (GDM), Revised May 1991. Additional borings have been drilled since the last dredging event. Borings were taken in 1993 to investigate a rock claim in the entrance channel from Station 8+00 to Station 40+00. To investigate the area around Dodge Island, 11 additional core borings were drilled in 1995. The cores from the borings that are useable from these sources were disposed of when the Port Authority took control of the project and are no longer available for viewing. Eighteen borings were drilled in January 2001 to further investigate the Lummus Island Turning Basin and gather additional information for the General Reevaluation Report (GRR). Additional borings will be required for Plans and Specifications. The 2001 core borings encountered primarily rock but recovered very little solid core due to the porous nature of the rock and breakage during drilling operations.

9. Previous Dredging. The last deepening was excavated in two phases using cutterhead and hydraulic excavator dredges. The entrance channel and half of Fisherman's Channel was Phase I and was dredged to –42.0 ft. using a cutterhead dredge with great difficulty. The Lummus Island Turning Basin area was Phase II and with the exception of a few places, could not be dredged below about – 35.0 ft. with a large hydraulic excavator. The excavator could not find the fractures needed to wedge the bucket into the rock for removal. An unconformity was identified in the GDM at about this depth where the rock gets harder and is believed to be the contact with the Fort Thompson Formation. The remainder of the rock is scheduled for removal to a depth of –42.0 ft.

10. Materials Encountered. A description of the materials encountered during subsurface investigations is provided as follows:

COMPONENT 1

Widening seaward portion of Cut 1 from 500 to 800 ft.

Sta. 0+00 to Sta. 20+00. The material to be removed is hard to very hard, fossiliferous limestone with coral from the surface down, with exception to the

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A. INTRODUCTION

1. General. This appendix presents the discussion of applicable design considerations and construction methods utilized to adequately address the project requirements and to establish a basis for the cost estimates. General requirements for real estate and operation and maintenance are also presented.

2. Selected Plan. The selected plan would include construction of the recommended NED plan with the addition of the locally preferred deepening option. The plan would include several components as follows:

Component 1c. The entrance channel from Station 0+00,Cut-1 to Station 10+00,Cut-1 would be widened from 500 feet to 800 feet symmetrically about the centerline. From Station 10+00,Cut-1 to Station 20+00,Cut-1 the channel width would uniformly transition back to 500 feet. The project depth would be increased from 44 feet to 52 feet.

Component 2a. A turn widener would be constructed from Station 10+00,Cut-3 (Range 400) to Station 19+00,Cut-3 (Range 505). The project depth would be increased from 42 feet to 50 feet.

Component 3b. The Fisher Island Turning Basin in Cut-3 would be increased from 1200 feet to 1500 feet , and the project depth would be increased from 42 feet to 50 feet. The northeast portion of the Turning Basin would be truncated to avoid potential impacts to the existing sea grasses.

Component 4. The western end of the main channel would be realigned approximately 200 feet to the south to provide for future construction of additional cruise ship berths along the north side of the channel. The channel would transition from Station 65+50 Cut-4 to Station 91+65 Cut-4. The project depth would remain at 36 feet and no additional dredging is anticipated.

Component 5a. Fisherman's Channel along the south side of Lummus Island would be widened 100 feet to the south and the Lummus Island Turning Basin would be reduced to a 1500 foot diameter from the currently authorized diameter of 1600 feet. The project depth would be increased from 42 feet to 50 feet.

An overall view of the Miami Harbor Project with the proposed alternatives is presented on Plate B-1. Detailed plan views of the project channel are provided on Plates B-3 through B-15. An index of these plan views is shown on Plate B-2.

A discussion of the plan formulation involved in the selection of the selected plan is presented in the main portion of this report. All soundings presented in this report are at Mean Lower Low Water.

B. HYDROLOGY AND HYDRAULICS

3. General. A detailed discussion of the natural forces affecting the study area was presented in the Miami Harbor Feasibility Report and Environmental Impact Statement, dated June 1989. The areas of discussion include waves, winds, tides, currents, tropical storms, and hurricanes.

In general, however, the currents and water surface elevations in Miami Harbor are subject to the astronomical Atlantic Ocean and Gulf Stream eddies, the effects of winds, upland drainage, and the variations in barometric pressure. The tidal currents in Government Cut cause the greatest influence on navigation. The highest currents are during flood tide, but currents during both ebb and flood present a navigation problem.

4. Velocity and Salinity Assessment. The Coastal and Hydraulics Laboratory (CHL) at the Engineering Research and Development Center (ERDC) in Vicksburg, Mississippi prepared a report summarizing the findings from a depth-averaged two-dimensional finite element hydrodynamic circulation modeling study investigating velocities and salinity in the harbor and on velocities along the coastal ocean shoreline in the vicinity of Government Cut. The report details the boundary conditions used to drive the simulation, and the existing harbor configuration, to those obtained for the proposed harbor configuration. The report is included as Attachment A to this Appendix.

5. Ship Simulator Modeling. a. Previous. The Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi conducted a ship simulator study in support of preparation of the Miami Harbor Design Memorandum, dated October 1991. The final report was published in April 1991

b. Recent. During the Fall of 2000, a navigation study consisting of real-time ship simulation modeling was conducted by the Simulation, Training, Assessment and Research (STAR) Center in Dania, Florida. The results and recommendations of this latest study are included in Attachment B to this Appendix.

6. Projected Impacts to Channel Shoaling. Recent sediment budget studies[1] have been performed along the length of the Dade County Beach Erosion Control project, which extends along the length of the Dade County Atlantic shoreline from northern Sunny Isles southward to Government Cut. These sediment budget studies indicate that the net littoral transport in the vicinity of

Government Cut is about 24,000 cy/yr to the south, which represents the maximum potential sediment transport rate into the channel. The most recently calculated sediment budgets conclude that an average of 15,000 cy/yr is deposited in the interior channels, while 9,000 cy/yr is deposited in shoals along the outer reaches of the channel. These values agree closely with observed shoaling rates as determined from dredging records.

The proposed widening and deepening of the entrance channel would tend to further decrease any sediment bypassing, but under the existing conditions the Miami Harbor entrance channel already forms a complete littoral barrier. Examination of the sediment budget for Government Cut shows that the entire volume of southward-directed sediment transport is deposited into the interior and exterior reaches of the channel, and the volume of sediment bypassed across the entrance channel to downdrift beaches is essentially zero. The proposed deepening and widening of the existing project cannot therefore further increase the rate of channel shoaling or decrease the volume of sediment bypassing.

Numerical modeling of the proposed channel improvements has been performed, and the results of these simulations show that negligible changes to current velocities and salinity levels will occur throughout the extent of the project as a result of the proposed improvements.

Due to the lack of sediment bypassing under the existing conditions, and due to the negligible changes in tidal current velocities as determined by numerical modeling, no significant changes to the existing shoaling rates and patterns of deposition are expected due to construction of the proposed channel improvements at Miami Harbor.

[1] Dade County Regional Sediment Budget, Coastal Systems International, January 1997; Dade County Evaluation Report, Jacksonville District,COE, October 2001

C. GEOTECHNICAL INVESTIGATIONS

7. Geologic History. Due to previous dredging projects of the harbor and entrance channel, the majority of the project area is exposed rock. A few localized areas are mantled by a few feet of sand due to shoaling. The sand is usually tan or gray, contains some fines and also fills solution holes in the underlying rock. A portion of Cut 1 in the Entrance Channel, between the reefs, is sand with no rock. In areas not previously dredged, yellow to white massive limestone and sandstone units of the Miami Oolite Formation are overlain by sand and silts. The Miami Oolite Formation has many solution channels and is very permeable. It has a maximum thickness of 30 feet in the project area and has its base at an approximate elevation of –35.0 ft. MLW. The presence of a hard basal conglomerate at this elevation signifies the unconformable contact

western end of the transition zone, outside of the reef area, which is sand. The limestone is porous and massive, containing many voids and vugs. The rock was highly broken due to the nature of the rock and the drilling process resulting in little or no recovery of solid core.

Channel Deepening from -44 feet to -52 ft. MLLW.

Sta. 0+00 to Sta. 14+00. This is a reef area where limestone and sandstone is exposed at the channel surface. The seaward 500 feet of the channel is in increasingly deep water that is below the depths considered for deepening. The limestone is moderately hard to hard, very porous, massive and vuggy with cavities throughout the rock due to the formation of the rock in a reef environment and/or through solution activity and replacement. Divers reports have confirmed rock fragments up to 20 inches covering the channel bottom. These fragments are present due to rock breaking off of the reef and previous dredging episodes where the larger fragments could not be picked by the hopper dredge and were actually pushed up in rows along the channel. The bottom of the channel was reported to undulate by over 3 feet due to furrows produced by past dredging operations.

Sta. 14+00 to Sta. 34+00. Carbonate and quartz sand and shell is the dominant material between the reefs with little or no rock being present except scattered rock fragments throughout and in areas in close proximity to the reefs. Initial core borings indicate that the sand is continuous to approximately –59.0 ft.

Sta. 34+00 to Sta. 55+00. This is an area that requires further delineation. The divers report confirmed an area of continuous limestone with rock fragments ranging in size from gravel to boulders up to 20 inches. This area was characterized as having “wind rows” with a 1-foot height difference on the surface of the channel due to cutterhead dredging activities. The report indicated an adjacent sand area with rock fragments primarily 1-6 in. with no continuous rock. The area had boulders 4-5 feet in diameter strewn about. Recent core borings in the reef area shows sand to –52.0 ft. with a 1-foot layer of limestone that was disturbed by dredging, as reported by the diver survey. Data is very sparse in this area and older borings show that the material removed previously was rock in most of this area. The borings did not go deep enough to indicate what material was below that. Until further data is collected, based on old borings and the diver survey, the majority of this area is considered rock. An area of sand does occur to –53.0 ft. in the southern end of the channel at Sta. 46+00 extending to the northern side of the channel at Sta. 52+00. The sand then continues on the northern half of the channel to Sta. 67+00. The sand on the North side of the channel may go deeper than –54 ft. as that is where the borings terminated.

Sta. 55+00 to Sta. 83+00. The reach primarily consists of hard sandstone from the surface to at least –54.0 ft. with one area of sand in the area of boring CB-

MH89-12 on the North side of the channel from Sta. 55+00 to Sta. 67+00, as described in the above paragraph. The sandstone is porous, fossiliferous, and vuggy and contains many cavities. The rock also contains many small seams (< 1 foot) of moderately hard sandstone and sand with shell within the unit. Coral with calcite deposits were encountered from –51.2 to –53.2 ft. in boring CB-MH89-121.

Sta. 83+00 to Cut 2 Sta. 13+00. The materials in the bend joining Cuts 1 and 2 and widener are represented by hard limestone and moderately hard to hard sandstone from the surface down. All of the rock is porous, vuggy, and fossiliferous and contains cavities. The rock units contain thin seams of moderately hard and hard limestone and loose or poorly cemented sand. Sections of solid core (4 foot) representing more competent rock were recovered in core borings CB-MH89-21 and 128. This area may prove more resistant to dredging.

Cut 2 Sta. 13+00 to Cut 3 Sta. 0+00. The materials in the channel are represented by hard limestone, moderately hard and hard sandstone. A 1-2 foot layer of sand at the surface is present throughout, on average to –48 ft. Transitioning West from the dogleg to Cut 3, the rock becomes primarily moderately hard sandstone with thin lenses of hard sandstone. Hard limestone and sandstone units occur but in lesser amounts. Larger sand and shell layers up to approximately 2 feet thick also become prevalent. The rock in this reach is porous, vuggy, massive and fossiliferous containing cavities and sand seams.

COMPONENT 2

Add turn widener at Buoy #15, deepen to –50.0 ft. MLLW.

Cut 3 Sta. 12+00 to Sta. 19+00. The widener is a triangular cut along Fisher Island at the junction of the Cut 3 Entrance Channel and Fisherman's Channel alignments. The water depths vary from –46.0 ft., near the channel, to -9.0 ft. near Fisher Island. Materials to be dredged from the surface to –24.0 feet include moderately hard to hard limestone. The limestone is massive, very fossiliferous and permeable with approximately 1.0 foot solid core pieces occurring between -10.5 and -16.5 ft. (hard limestone area). From –24.0 to –50.0 ft., a clean sand (SP) is the dominant lithology. The sand contains thin seams of hard sandstone to –32.5 ft. From –32.5 to –36.0 ft., a moderately hard sandstone with seams of sand and hard limestone occurs. From –36.0 to –50.0 ft., the sand contains thin seams of hard sandstone and limestone with occasional layers of hard limestone that are approximately one foot thick. Rock is present below –50.0 ft.

COMPONENT 3

Deepen remainder of Cut 3 from –42.0 to –50.0 ft. MLLW.

Cut 3 Sta. 0+00 to Sta. 26+00. The materials to be removed are moderately hard sandstone with seams of loose sand and clean sand with thin sandstone lenses. A one-foot layer of hard limestone occurs between –47.0 and –48.0 ft. in the southern part of the channel. Hard limestone exists at approximately –50.0 ft..

Expand Fisher Island Turning Basin.

Cut 3 Sta. 26+00 to Sta. 42+00, North Expansion. Surface depths range from -11.0 to -47.0 ft. From the surface to depths of approximately -30.0 ft., the materials are predominantly sand, both clean and silty, with areas of soft to moderately hard limestone beginning at –15.0. Below 30.0 ft., are units of hard to very hard, fossiliferous limestone and sandstone with seams of loose sand and poorly cemented rock. Ranging between –45.0 ft. and –48.0 to –50.0 ft., the lithology is clean sand with many thin lenses of sandstone with hard limestone below –50.0 ft.

Fisher Island Turning Basin Deepening to –50.0 ft. MLLW.

Surface depths vary from –43.0 to –48.0 ft. with the extreme western end having a high area of –31.0 ft. This area is characterized with an intermittent 0.5-1.0 foot layer of clean sand at the surface followed by moderately hard, porous sandstone with thin seams of loose sand, poorly cemented rock and hard sandstone to approximately –48.0 ft. Below –48.0 ft. is a hard to very hard limestone. The limestone is massive and permeable containing many cavities that have been filled and solidified. Secondary recrystallization of the limestone is present in addition to hard coral. This area requires further investigation to define the limits of the hard rock.

COMPONENT 5

Fisherman's Channel extension 100 feet to the South.

Existing surface depths vary from –3.0 to –46.0 ft. MLW. From Sta. 0+00 to Sta. 20+00, the rock contact from the surface is at –41.0 ft. grading up to –12.0 ft. at Sta. 20+00. The rock contact in the shallow area from Sta. 20+00 westward continues at approximately –12.0 ft., fluctuating to –17.0 ft. where Fisherman's Channel opens into the Lumus Island turning widener. The unconsolidated material above the rock is shelly, silty or clayey sand at the surface underlain by clay, silt, shell and/or clean sand. The rock, in general, is a moderately hard to hard limestone or sandstone, depending on the sand content. The rock is massive, porous, sandy, fossiliferous and is riddled with partially filled voids or cavities. Sand layers occur throughout the rock but is more

prevalent on the eastern end of Fisherman's Channel between Sta. 3+00 and 40+00. A 10-12 ft. layer of sand exists between the rock units dipping to the east from Sta. 40+00 beginning at –23.5 ft. to Sta. 13+00 at –32.5 ft.

The rock is initially about 10 foot thick before a one to three foot sand layer and or cavity separates it from a very hard and dense limestone layer that varies from 2-4 feet thick. This layer occurs at elevations varying between –27.0 to –32.0 ft. from Sta. 30+00 to the western end of the extension. The limestone contains hard coral and re-deposited crystalline limestone. Although solid cores were taken from this layer during drilling operations, the layer does contain voids and is permeable. This may represent the contact between the Miami Oolite and Fort Thompson Formations. Below this rock is a hard, massive limestone that is very porous and contains many cavities and solution holes that are partially filled with secondary, soft to moderately hard limestone. At about –43.0 ft., the rock becomes harder more solid and coralline with crystalline secondary deposits.

Fisherman's Channel Deepening from –42.0 to –50.0 ft. MLLW.

The materials underlying Fisherman's Channel are hard to very hard, massive sandy limestone and calcareous sandstone. The rock is fossiliferous, permeable and porous containing many solution channels. Some areas have undergone secondary recrystallization and are very hard and dense, while certain areas have seams of sand intermixed throughout the rock. Sta. 15+00 – Sta. 21+00 is predominantly sand to about –47.0 ft. where the borings end or rock is encountered. The majority of the channel has been cut to approximately –46.0 ft. with exception to the extreme western section where removal of the rock to –42.0 ft. is scheduled to occur.

Lumus Island Turning Basin Deepening from –42.0 to –50.0 ft. MLLW.

The turning basin is scheduled to be deepened to –42.0 ft. in 2002. The materials below –42.0 are similar to that in Fisherman's channel, consisting of moderately hard to very hard limestone and sandstone. A 1-4 ft. sand layer is continuous throughout most of the turning basin. The sand layer varies in depth from approximately –45.0 to –53.0 ft.. The sand layer was exposed on the eastern portion of the turning basin that had been dredged to –45.0 ft. The sand layer is not found in the southwestern portion of the turning basin. It is difficult to predict the amount of limestone overlying the sand layer until the deepening of the basin to –42.0 ft. is complete as the depth of dredging in the past has been well below the project depth.

11. Laboratory Analyses. Representative samples of unconsolidated materials from selected core logs were sent to Law Engineering and Environmental Services in Jacksonville, Florida for analysis. The applicable logs, and laboratory reports of specific gravity, unconfined compression tests, grain

size distribution curves, and settling rates testing are included in Attachment C to this Appendix.

12. Blasting and Excavation. The majority of the material to be removed is rock and most of that rock is moderately hard to hard to very hard and will require blasting. Also, from previous dredging experience, gravel, cobbles and boulders are expected to be present throughout the project. The following requirements for blasting would be included in the construction contract plans and specifications:

Blasting shall conform to the requirements specified within the Plans and Specifications. The contractor is required to follow all regulations regarding the transporting, handling and storage of explosives, safety, and any state, county, municipal, Port Authority and Coast guard laws or codes. The contractor must hold a public meeting to answer, by a blasting specialist, any questions concerning blasting prior to blasting. The contractor is required to make the necessary plans, examinations, pre-blast vibration surveys and test blasts. Blasting shall only be performed in conjunction with an Endangered Species Watch Plan as discussed in the EIS. Prior to the commencement of blasting operations, the contractor is required to submit a detailed blasting plan including, the location, size, spacing, type of explosives, sequence and pattern of delays, anticipated peak particle velocity, maximum peak positive airblast overpressure at the nearest structure to the blast and a description of and purpose for special methods. The plan must be approved by the contracting officer. A specialist in vibration control will monitor the seismograph readings to verify vibrations from blasting. If underground utilities have not been removed at the time of blasting, a 50-foot no-blast radius around the utility should be observed. The Contractor shall coordinate blasting operations with the Miami Harbor Port Authority and the U.S. Coast Guard.

D. DESIGN AND CONSTRUCTION

13. General. A project plan and plan plate index with location map are shown on Plate B-1 and Plate B-2, respectively. The proposed project plan with channel wideners and turning basins is shown on Plates B-3 through B-15. The diked upland disposal area on Virginia Key (Plate B-16) would be used for the placement of the excavated sands. Some typical sections of the proposed project excavation are provided on Plates B-19, B-20, and B-21.

14. Channel Wideners. The channel wideners in Cut-1 would be constructed from Station 0+00 to Station 10+00 to a width of 150 feet each side of the existing channel limits. A uniform transition would be constructed from Station 10+00 to Station 20+00. The wideners would be excavated to a project depth of 52 feet plus applicable overdepths.

15. Turning Basins. The proposed Fisher Island Turning Basin (approximately 1500-foot diameter) would be located on the centerline of the channel at approximately Station 21+30. The turning basin would be excavated to a project depth of 50 feet plus applicable overdepths.

16. Side Slopes. For estimating purposes, the average side slope for the proposed excavation was determined to be 1 vertical on 3 horizontal (1V:3H) in sand and approximately 1vertical on 1 horizontal (1V:1H) in rock.

17. Environmental Considerations. The environmental impacts of the project, including the proposed mitigation plan, are discussed in detail in the main report and in the Environmental Impact Statement.

The dredging in sand or unconfined material would be performed as a box cut. Most of the cut in rock should remain vertical after dredging. However, it is anticipated that the sediment above the rock will fall in at slopes as flat as 1V:5H to 1V:7H. It is anticipate that in time (1 to 5 years) the typical slope along the subject channel will become 1V:7H due to wave action and ongoing settlement of materials. The materials from this long-term sloughing will settle in the bottom of the channel adjacent to the vertical rock cut making the rock cut appear to be non-vertical in future surveys.

18. Overdepths. An additional 1-foot of overdepth is included in the excavation quantities to allow for dredging inaccuracies.

19. Disposal Areas. The existing diked upland disposal area located on Virginia Key would be used for placement of the sand material from construction of the project. A minimal cost for preparation of the disposal area is included in the project cost estimate. The rock would be placed in the mitigation areas located offshore and in Biscayne Bay north of the Julia Tuttle Causeway. Refer to Plates B-1, B-16, and B-17.

20. Construction Procedure. For cost estimating purposes, it is anticipated that a cutterhead pipeline dredge would be used for excavation of the sands from the Fisher Island Turning Basin and Fisherman's Channel expansions. A hydraulic excavator would be used to dredge the rock. A detailed discussion of the estimate assumptions is included in the project cost estimate.

E. RELOCATIONS

21. General. The project sponsor will be required to assume the costs of all relocations and alterations. Two utilities likely to be relocated prior to construction of this project would be affected if they remain in their current

locations. The utilities are WASD 54-inch sewer line crossing Component 2 and one 24-inch water main crossing Fisherman's Channel in Component 5.

22. Utilities. The location of utilities within the project area is shown on Plate B-18. The Miami-Dade Water and Sewer Department (WASD) owns a force sewer main in a submarine crossing within Component 2 leading from Miami Beach to its Fisher Island treatment plant. The crossing consists of a 54-inch ductile iron pipe running under the riverbed with top of pipe elevation at elevation –50 feet. If relocation were required, SAJ estimates that design and construction would cost $5 million to $6 million and take two years to complete using the directional drilling method. Installation and removal of the 54-inch sewer main using the trenching method resulted in a lower cost and, therefore, is included as the relocation cost in the project cost estimate in Table B-1.

Additionally, WASD owns a water main in a submarine crossing within Component 5 leading from Fisher Island to Lummus Island. This crossing consists of a 20-inch concrete pipe running under the riverbed with top of pipe elevation at elevation –53.0 feet. If relocation were required, SAJ estimates that design and construction would cost $2.5 million to $5 million and take two years to complete using the directional drilling method. Installation and removal of the 20-inch water main using the trenching method resulted in a lower cost and, therefore, is included as the relocation cost in the project cost estimate in Table B-1.

The Florida Power and Light Company (FP&L) owns two transmission lines in a submarine crossing within Component 5 leading from its Fisher Island plant to Lummus Island. The crossing consists of one 69 kV circuit and one 138 kV circuit each inside 24-inch pipe conduits with top of pipe elevation at elevation –45.8 feet and 45.6 feet Local Mean Low Water (LMLW). These transmission lines will be relocated as part of the continued construction of the currently authorized project. Further discussion is presented in the main report.

23. Berthing Areas. As an item of local cooperation, the Port of Miami would be responsible for the dredging of the project berthing areas to provide the appropriate depths. It is proposed in this report to increase the width of the berthing areas in Fisherman's Channel to 160 feet. The current width is 100 feet. A discussion of this topic is presented in the main report.

F. OPERATION AND MAINTENANCE

24. General. The Federal Government would be responsible for operation and maintenance of the navigation improvements proposed in this report upon completion of the construction contract. The Federal Government currently

maintains the existing project. The contractor would be responsible for all maintenance during the construction contract.

25. Maintenance Dredging. Miami Harbor experiences very little shoaling. Since construction of the 36-foot project in 1973, the harbor has been maintained only once to remove an estimated 250,000 cubic yards of shoal material. This was in 1989, resulting in an average shoaling rate of about 15,000 cubic yards. Based on this shoaling history, it is anticipated that implementation of the selected plan would have only minimal effect on the average annual maintenance costs. A discussion of the sediment budget studies and numerical modeling in Miami Harbor is presented in paragraphs 170 through 173 in the main report.

26. Dredged Material Management Plan (DMMP). A preliminary dredged material management plan assessment has been prepared and a discussion is provided in the main report. See Appendix E to the main report.

27. Navigation Aids. The U.S. Coast Guard would be responsible for providing and maintaining navigation aids. Additional aids to navigation would be required for this project, and the estimated cost is included in the project cost estimate. The U.S. Coast Guard anticipates that the following changes would be required.

Component 1c. No Change.

Component 2a. Relocate several buoys at no cost. Relocate Light 15 to the center of the widener. The estimated cost would be $150,000.

Component 3b. Relocate one Light at an estimated cost of $7,500.

Component 4. No Change.

Component 5a. Relocate one Light at an estimated cost of $7,500, and discontinue one Light at an estimated cost of $1,000.

G. QUANTITIES AND COST ESTIMATES

28. Summary of Costs. The estimates of first cost for construction of the both the NED plan and the Selected Plan were prepared using M-CACES software and are presented in Table B –1. The estimate includes a narrative, a summary cost, and a detailed cost showing quantity, unit cost, and the amount for contingencies for each cost item. The costs of the non-construction features of the project are also included in the cost estimate.

The costs have been prepared for an effective date of October 2002.

TABLE B-1

Miami Harbor GRR - FY2003
Draft Recommended Plan -
(49' and 51' Project Depth)
Draft Locally Preferred Plan -
(50' and 52' Project Depth)

Designed By: Jacksonville District
Estimated By: CESAJ-EN-C

Prepared By: B. Blake

Preparation Date: 01/29/03
Effective Date of Pricing: 10/01/02

Sales Tax: 7.30%

Planning Estimate for General Reevaluation Report (GRR), including Profit and Contingency

Miami Harbor, Florida - Draft Final Plans

Recommended Plan - 49'(*) and 51'(**) Project Depths
Locally Preferred Plan - 50'(*) and 52'(**) Project Depths

* - Inner Channel Segments
** - Outer Channel Segments

Reference Email message from CESAJ-DP-C/B. Schwichtenberg dated 8 March 2002, requesting revised cost estimate for final plan alternatives at specific incremental depths.

* - Reference subsequent discussions between PD-PN, PD-D, EN-DL, and EN-C conerning the need to correct the previous plan incremental depth quantities by accurately deducting the existing Phase II volumes. Also, the need to provide the cost for constructing the project improvements (widenings) to the existing project depths (42' and 44').

** - Reference project Team meeting held by the Project Manager on 27 June 2002 to discuss further revisions to the project costs resulting from additional information and final adjustments to the NED Plan Alternatives for revised formulation. Subsequent CESAJ-PD-PN memorandum dated 7 July 2002 requesting PED cost estimate for the Recommended Plan MCACES.

*** - Email message 1 August 2002 from CESAJ-PD-PN/R. Powell requesting new cost estimates for the utility removal and relocations. This following the meeting held 29 July 2002 with representatives of the Port of Miami and Miami-Dade County Water and Sewer Department (WASD). The removal and relocations involve a 54" Sewer Force Main existing across Government Cut between South Miami Beach and Fisher Island and a 20" Water Main across Fisherman Channel.

**** - Email message 4 December 2002 from CESAJ-PD-PN/R. Powell requesting revised cost estimates for the NED Plan alternatives based on revised geotechnical evaluation submitted by CESAJ-EN-GG/G. Holem. The revised geotechnical evaluation indicates that some reaches within NED Plan Segment 1C (Cut-1 and Cut-2) and Segment 2A (Cut-3 new Widener) contain rock material that can be dredged without drilling and blasting. Only one remaining section of Segment 1C (Cut-1/2 PI and Widener) will require drilling and blasting prior to dredging.

Revised quantity computations covering Plan Segments 1C and 2A were provided by CESAJ-EN-DL/J. McRae on 12 December 2002. This included separation of the dredge materials into rock not requiring drilling and blasting and non-rock materials. It is assumed that the balance of material will be rock requiring drilling and blasting located in the Cut-1/2 PI-Widener section of Segment 1C.

***** - During discussions between CESAJ-PD-PN/R. Powell and CESAJ-EN-DL/R. Henderson with this office concerning the most recent cost estimate for Segment 2A, it was realized that the revised quantities used were not supposed to have changed and that the previous quantities for Segment 2A should be used. The cost estimate is thereby revised for this change.

Final Revised NED Alternatives as follows:

1C - Cuts 1 and 2: 45'-52' Required Depth + 1' Allowable Overdepth and the proposed channel widenings at 44' + 1' (existing project).

2A - Cut 3 New Widener: 43'-50' Required Depth + 1' Allowable Overdepth and to 42' + 1' (existing project) to widen only.

3B - Cut 3 (Fisher Island T. Basin): 43'-50' Required Depth + 1' Allowable Overdepth and the proposed channel widenings at 42' + 1' (existing project).

5A - Fisherman's Channel and Lummus Island T. Basin: 43'-50' Required Depth + 1' Allowable Overdepth. Also, designated Port Berthing Areas adjacent to Fisherman's Channel to 43'-50' Required Depth + 1' Allowable Overdepth and the proposed channel widenings at 42' + 1' (existing project).

Rock material dredged will be placed in the designated offshore ODMDS for Miami Harbor.

**** - All the dredge material within Plan Segments 1C and 2A will now be dredged using a 30-inch cutter-suction dredge and will now go into the Upland disposal area at Virginia Key.

Sand material dredged will be placed in the upland disposal site located at the northern end of Virginia Key.

Mitigation Requirements as follows:

Construct Offshore Reefs - One Low Relief Low Complexity (LRLC) north of Cut-1 Entrance Channel and one High Relief High Complexity (HRHC) south of Cut-1 Entrance Channel with dredged rock from the project.

Fill existing holes located in Northern Biscayne Bay with dredged rock and sand from the project.

* - Preconstruction, Construction, and Post Construction Monitoring added to the estimate based on the costs and requirements provided by Mr. Steve Dial of Dial-Cordy Associates via CESAJ-PD-E/Terri Jordan.

Estimate Assumptions:

1. Dredging of rock material will be accomplished using a hydraulic excavator dredge loading scow barges. Drilling and blasting will be required of all rock prior to dredging.

**** - Dredging of rock material as well as non-rock material located within Plan Segments 1C and 2A will now be dredged using a 30-inch cuttersuction pipeline dredge with rock cutting capability. Only the portion of Segment 1C at the Cut-1/2 PI and widener will require drilling and blasting prior to dredging.

2. Dredging of non-rock (unclassified) material will be accomplished using a 30-inch cuttersuction pipeline dredge with boosters.

3. The dredging costs were computed using the Cost Engineering Dredge Estimating Program (CEDEP) in accordance with ER 1110-2-1302. Dredge production used in CEDEP was derived from historic contract production for similar work.

4. The construction of the offshore mitigation reefs will use rock material dredged from the project utilizing the same dredge and scow barges. An additional clamshell dredge or barge mounted crane capable of offshore operations will be required for precise placement of the rock specified for the construction the HRHC reef.

5. The cost estimate for the mitigation constructon is the added cost only. This is based on the assumption that all the material used to construct the offshore reef and for filling the bay holes will come from the dredging. If the dredge material is later found not to be satisfactory for mitigation purposes, the cost estimate will have to be revised upward to account for obtaining offsite material. This could result in a substantial cost increase for the mitigation.

The filling of the holes in Northern Biscayne Bay will use rock material dredged from the project utilizing the same dredge but requiring the use of smaller scow barges due to the limited depths along the Waterway route accessing the holes. The sand material for capping the holes following the placement of the rock material will require the use of a smaller crane barge to offload the material from the Virginia Key upland disposal site into the same small scow barges. The loaded scow barges will then be hauled to the holes and place the sand on top of the previously placed rock.

NOTE: The design requirement for filling the holes in Northern Biscayne Bay per CESAJ-EN-DL is for 375,000 cubic yards of rock covered with 25,000 cubic yards of sandy material for capping. For the proposed channel improvements widening plan alternative at the 42'/44' existing project depths, there is not enough rock available from the project to provide the total 375,000 cubic yards required. There is approximately 232,000 cubic yards of rock from the 42'/44' existing project volume for filling the holes included in the estimate for Mitigation.

If the total 375,000 cubic yards of rock is later determined to be required for the 42'/44' project widening improvements only alternative, then additional cost would need be added to the estimate for Mitigation to bring in rock from an off project source (quarry) to make up the balance required. There is adequate rock quantity available from the project for the remaining incremental depth alternatives.

*** 6. The removal of the existing utilities crossing the channel impacted by the new project construction will follow the relocation (installation) of the replacement utilities as part of the construction dredging for the new project. The existing utilities are a 54" concrete force main crossing Government Cut-2 and a 20" ductile iron water main crossing Fisherman Channel, according to the WASD asbuilts.

The relocation will include cleaning and inspection of the abandoned lines prior to removal. The excavated/removed pipeline and dredged material will be disposed of in a specified offshore disposal location (either the Miami Harbor ODMDS or for reef creation).

The relocation (installation) of the replacement pipelines (54" Concrete Sewer Force Main and 20" Ductile Iron Water Main) will involve the excavation by hydraulic excavator dredge and scow barges of a 100 foot wide open trench following drilling and blasting for the cover area and a 20 foot wide trench for the pipeline placement. New lines to be same type pipeline and construction as the original lines for the estimate.

The new lines will then be placed within the trench and covered and compacted with specified backfill material which will either consist of a portion of the excavation material along with disposal material already located at Virginia Key upland disposal site if needed. This will be accomplished using a small clamshell crane barge with scow barges. The remaining excavation material not used for backfilling the trenches will be disposed of in designated offshore location (either the Miami Harbor ODMDS or for reef creation).

The new lines with then be pressure tested and inspected by the WASD.

Most of the construction equipment required for the utility relocation work will already be on site to be used for the dredging work. This will significantly reduce the mobilization cost for the utility relocation work.

7. Turbidity Monitoring and Endangered Species Monitoring costs are included in the dredging unit costs.

Estimate Parameters:

1. Contractor Field Overhead, Home Office G&A, Profit, and Bond indirect costs are included in the estimate computed in MCACES based on historic contractor rates for similar work.

2. Used 20 percent contigency on the estimated construction costs which is appropriate for the level of project design.

3. PED and S&A non-construction costs ARE included in the estimate. The percenatage of total construction cost as indicated by CESAJ-EN-DL/R. Henderson is 3 percent for PED and by CESAJ-CO-CS/S. Anderson is 8.5 percent for S&A.

4. Real Estate/Lands and Damages costs ARE included in the estimate. These costs were provided separately by Real Estate Division (CESAJ-RE).

5. Aids To Navigation costs ARE included in the estimate and were provided by the U.S. Coast Guard, 7th District, Mr. Joe Embress via his letter dated 31 October 2001.

*** 6. Utility Relocation costs for existing utility crossings impacted by the new project ARE included in the estimate. The applicable depths of impact and the diminsions for the new utility trenches were provided by CESAJ-EN-DM/G. Deloach and CESAJ-PD-PN/R. Powell.

7. Port Bulkheads ARE included in the estimate and were provided by the Miami Port Authority via their letter to CESAJ-DP-C/Mr. Bradd Schwichtenberg dated 8 March 2002.

8. Preconstruction, Construction, and Post-Construction monitoring of the mitigation areas is included in the estimate based on the cost and requirements provided by Mr. Steve Dial, Dial-Cordy Associates.

**** Final Revised Estimated Construction Times:
***** - Revised for Segment 2A

42'/44' Existing Project Depths (proposed channel widenings only).
Alternative 1C = 1 month mob/demob + 1.94 months construction = 2.94 months
Alternative 2A = 0 month mob/demob + 0.05 months construction = 0.05 months
Alternative 3B = 0 month mob/demob + 4.31 months construction = 4.31 months
Alternative 5A = 1 month mob/demob +12.10 months construction = 13.10 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 1.00 months construction = 2.00 months

Total Estimated Construction Time 42'/44' Project (widenings) = 26.40 months

43'/45' Project Depths:
Alternative 1C = 1 month mob/demob + 3.69 months construction = 4.69 months
Alternative 2A = 0 month mob/demob + 0.05 months construction = 0.05 months
Alternative 3B = 0 month mob/demob + 5.73 months construction = 5.73 months
Alternative 5A = 1 month mob/demob +13.43 months construction = 14.43 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 3.00 months construction = 4.00 months

Total Estimated Construction Time 43'/45' Project Depths = 32.90 months

44'/46' Project Depths:
Alternative 1C = 1 month mob/demob + 7.15 months construction = 8.15 months
Alternative 2A = 0 month mob/demob + 0.05 months construction = 0.05 months
Alternative 3B = 0 month mob/demob + 5.61 months construction = 5.61 months
Alternative 5A = 1 month mob/demob +14.73 months construction = 15.73 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 3.00 months construction = 4.00 months

Total Estimated Construction Time 44'/46' Project Depths = 37.54 months

45'/47' Project Depths:
Alternative 1C = 1 month mob/demob +10.07 months construction = 11.07 months
Alternative 2A = 0 month mob/demob + 0.06 months construction = 0.06 months
Alternative 3B = 0 month mob/demob + 5.82 months construction = 5.82 months
Alternative 5A = 1 month mob/demob +15.64 months construction = 16.64 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 3.00 months construction = 4.00 months

Total Estimated Construction Time 45'/47' Project Depths = 41.57 months

46'/48' Project Depths:
Alternative 1C = 1 month mob/demob +12.88 months construction = 13.88 months
Alternative 2A = 0 month mob/demob + 0.07 months construction = 0.07 months
Alternative 3B = 0 month mob/demob + 5.86 months construction = 5.86 months
Alternative 5A = 1 month mob/demob +16.64 months construction = 17.64 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 3.00 months construction = 4.00 months

Total Estimated Construction Time 46'/48' Project Depths = 45.45 months

47'/49' Project Depths:
Alternative 1C = 1 month mob/demob +14.59 months construction = 15.59 months
Alternative 2A = 0 month mob/demob + 0.08 months construction = 0.08 months
Alternative 3B = 0 month mob/demob + 5.93 months construction = 5.93 months
Alternative 5A = 1 month mob/demob +18.04 months construction = 19.04 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 3.00 months construction = 4.00 months

Total Estimated Construction Time 47'/49' Project Depths = 48.64 months

48'/50' Project Depths:
Alternative 1C = 1 month mob/demob +16.70 months construction = 17.70 months
Alternative 2A = 0 month mob/demob + 0.09 months construction = 0.09 months
Alternative 3B = 0 month mob/demob + 6.67 months construction = 6.67 months
Alternative 5A = 1 month mob/demob +18.04 months construction = 19.04 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 3.00 months construction = 4.00 months

Total Estimated Construction Time 48'/50' Project Depths = 51.50 months

49'/51' Project Depths:
Alternative 1C = 1 month mob/demob +17.63 months construction = 18.63 months
Alternative 2A = 0 month mob/demob + 0.09 months construction = 0.09 months
Alternative 3B = 0 month mob/demob + 7.37 months construction = 7.37 months
Alternative 5A = 1 month mob/demob +20.18 months construction = 21.18 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 3.00 months construction = 4.00 months

Total Estimated Construction Time 49'/51' Project Depths = 55.27 months

50'/52' Project Depths:
Alternative 1C = 1 month mob/demob +18.31 months construction = 19.31 months
Alternative 2A = 0 month mob/demob + 0.10 months construction = 0.10 months
Alternative 3B = 0 month mob/demob + 8.08 months construction = 8.08 months
Alternative 5A = 1 month mob/demob +21.28 months construction = 22.28 months
Offshore Reefs = 1 month mob/demob + 3.00 months construction = 4.00 months
Fill Bay Holes = 1 month mob/demob + 3.00 months construction = 4.00 months

Total Estimated Construction Time 50'/52' Project Depths = 57.77 months

* - Other project construction such as the Port's Bulkheads, Mitigation Areas, Utility Relocations and Aids to Navigation could be assumed to be done concurrently with the above dredging work.

SUMMARY REPORTS SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

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** PROJECT OWNER SUMMARY - Contract **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
08	DRAFT RECOMMENDED PLAN (49'&51')			137,692,997	24,611,539	162,304,536	
09	DRAFT LOCAL PREF. PLAN (50'&52')			146,507,371	26,206,414	172,713,785	

** PROJECT OWNER SUMMARY - Category **

	QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
08 DRAFT RECOMMENDED PLAN (49'&51')						
08_ A Construction Cost			123,032,697	24,606,539	147,639,236	
08_ B Non-Construction Cost			14,660,300	5,000	14,665,300	
TOTAL DRAFT RECOMMENDED PLAN (49'&51')			137,692,997	24,611,539	162,304,536	
09 DRAFT LOCAL PREF. PLAN (50'&52')						
09_ A Construction Cost			131,007,071	26,201,414	157,208,485	
09_ B Non-Construction Cost			15,500,300	5,000	15,505,300	
TOTAL DRAFT LOCAL PREF. PLAN (50'&52')			146,507,371	26,206,414	172,713,785	

** PROJECT OWNER SUMMARY - Task **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
08	DRAFT RECOMMENDED PLAN (49'&51')						
08_ A	Construction Cost						
08_ A\02	Relocations						
08_ A\02.03	Cemetery, Utilities, & Structure						
08_ A\02.03.01	Mob, Demob & Preparatory Work						
08_ A\02.03.01\ 01	Drilling & Blasting Mob/Demob			65,399	13,080	78,479	
08_ A\02.03.01\ 02	Hydraulic Dredge Mob/Demob			47,087	9,417	56,505	
08_ A\02.03.01\ 03	Clamshell Crane Barge Mob/Demob			12,949	2,590	15,539	
08_ A\02.03.01\ 04	Pipeline Installation			45,779	9,156	54,935	
	TOTAL Mob, Demob & Preparatory Work			171,215	34,243	205,457	
08_ A\02.03.18	Utilities						
08_ A\02.03.18\ 01	Trench Excavation - 20" Water	53830	CY	1,834,239	366,848	2,201,087	40.89
08_ A\02.03.18\ 02	Trench Excavation - 54" Sewer	55926	CY	1,902,723	380,545	2,283,267	40.83
08_ A\02.03.18\ 03	Pipeline Installation 20" Line	1000.00	LF	208,637	41,727	250,364	250.36
08_ A\02.03.18\ 04	Pipeline Installation 54" Line	1000.00	LF	201,227	40,245	241,472	241.47
08_ A\02.03.18\ 05	Backfill Trench - 20" Water Line	27904	CY	364,095	72,819	436,915	15.66
08_ A\02.03.18\ 06	Backfill Trench - 54" Sewer Line	30000	CY	385,778	77,156	462,934	15.43
08_ A\02.03.18\ 07	Test - Inspect New 20" Pipeline	1000.00	LF	1,387	277	1,665	1.66
08_ A\02.03.18\ 08	Test - Inspect New 54" Pipeline	1000.00	LF	2,204	441	2,645	2.64
08_ A\02.03.18\ 09	Clean & Abandon Old 20" Pipeline	1000.00	LF	5,663	1,133	6,795	6.80
08_ A\02.03.18\ 10	Clean & Abandon Old 54" Pipeline	1000.00	LF	11,199	2,240	13,439	13.44
	TOTAL Utilities			4,917,153	983,431	5,900,583	
08_ A\02.03.28	Credits for Salvaged Material						
	TOTAL Cemetery, Utilities, & Structure			5,088,367	1,017,673	6,106,041	
	TOTAL Relocations			5,088,367	1,017,673	6,106,041	
08_ A\12	Navigation Ports and Harbors						
08_ A\12.02	Harbors						
08_ A\12.02. 1	Mobil, Demobil & Prep Work						
08_ A\12.02. 1\ 1	Mechanical Dredge Mob/Demob			476,105	95,221	571,326	
08_ A\12.02. 1\ 2	Pipeline Dredge Mob/Demob			868,499	173,700	1,042,198	
08_ A\12.02. 1\ 3	Drilling & Blasting Mob/Demob			653,990	130,798	784,788	

** PROJECT OWNER SUMMARY - Task **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
	TOTAL Mobil, Demobil & Prep Work			1,998,593	399,719	2,398,312	
08_ A\12.02. 2	Drilling and Blasting						
08_ A\12.02. 2\ 1	Alternative 1C - Cut 1/2 PI WID.	446119	CY	8,366,872	1,673,374	10,040,246	22.51
08_ A\12.02. 2\ 3	Alternative 2A - Cut 3 Widener	10715	CY	153,438	30,688	184,126	17.18
08_ A\12.02. 2\ 4	Alternative 3B - Cut 3	538705	CY	9,121,871	1,824,374	10,946,245	20.32
08_ A\12.02. 2\ 5	Alternative 5A - Fisherman Chan.	929428	CY	14,234,651	2,846,930	17,081,582	18.38
08_ A\12.02. 2\ 6	Alternative 5A - Port Berths	228617	CY	3,501,380	700,276	4,201,656	18.38
08_ A\12.02. 2\ 7	Alternative 5A - Lummus Isl. TB.	420228	CY	11,465,457	2,293,091	13,758,549	32.74
	TOTAL Drilling and Blasting	2573812	CY	46,843,669	9,368,734	56,212,403	21.84
08_ A\12.02. 3	Mechanical Dredging						
08_ A\12.02. 3\ 3	Alternative 2A - Cut 3 Widener	10715	CY	87,734	17,547	105,281	9.83
08_ A\12.02. 3\ 4	Alternative 3B - Cut 3	538705	CY	4,453,168	890,634	5,343,802	9.92
08_ A\12.02. 3\ 5	Alternative 5A - Fisherman Chan.	929428	CY	6,783,455	1,356,691	8,140,146	8.76
08_ A\12.02. 3\ 6	Alternative 5A - Port Berths	228617	CY	1,668,567	333,713	2,002,281	8.76
08_ A\12.02. 3\ 7	Alternative 5A - Lummus Isl. TB.	420228	CY	6,205,545	1,241,109	7,446,654	17.72
	TOTAL Mechanical Dredging	2127693	CY	19,198,470	3,839,694	23,038,164	10.83
08_ A\12.02. 4	Pipeline Dredging						
08_ A\12.02. 4\ 0	Alternative 1C - Cut 1/2 PI WID.	536700	CY	6,338,994	1,267,799	7,606,793	14.17
08_ A\12.02. 4\ 1	Alternative 1C - Cut 1	768704	CY	10,245,528	2,049,106	12,294,634	15.99
08_ A\12.02. 4\ 2	Alternative 1C - Cut 2	454888	CY	5,676,150	1,135,230	6,811,380	14.97
08_ A\12.02. 4\ 4	Alternative 3B - Cut 3	353775	CY	1,860,177	372,035	2,232,212	6.31
08_ A\12.02. 4\ 5	Alternative 5A - Fisherman Chan.	250000	CY	1,157,562	231,512	1,389,074	5.56
08_ A\12.02. 4\ 6	Alternative 5A - Port Berths	47036	CY	217,788	43,558	261,346	5.56
08_ A\12.02. 4\ 7	Alternative 5A - Lummus Isl. TB.	343791	CY	3,215,152	643,030	3,858,183	11.22
	TOTAL Pipeline Dredging	2754894	CY	28,711,352	5,742,270	34,453,623	12.51
08_ A\12.02. 5	Disposal Areas (Virginia Key)						
08_ A\12.02. 5\ 1	Replace Dike Material	50000	BCY	265,220	53,044	318,265	6.37
08_ A\12.02. 5\ 2	Excavation for CMP			24,516	4,903	29,419	
08_ A\12.02. 5\ 3	Wood Piles, 50 lf each	18.00	EA	7,510	1,502	9,013	500.69
08_ A\12.02. 5\ 4	Driving Wood Piles	18.00	EA	28,819	5,764	34,582	1921.23
08_ A\12.02. 5\ 5	Metal Hardware			392	78	471	
08_ A\12.02. 5\ 6	CMP Materials			176,941	35,388	212,329	
08_ A\12.02. 5\ 7	Positioning Weirs	3.00	EA	4,803	961	5,764	1921.23
08_ A\12.02. 5\ 8	Attaching Weirs to Piles	3.00	EA	1,131	226	1,357	452.44
08_ A\12.02. 5\ 9	Pipeline Placement	16.00	EA	5,065	1,013	6,078	379.86
08_ A\12.02. 5\ !0	Transport material			6,195	1,239	7,434	

** PROJECT OWNER SUMMARY - Task **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
08_ A\12.02. 5\ !1	Precise Material Placement	3000.00	CY	6,325	1,265	7,590	2.53
08_ A\12.02. 5\ !2	Compaction around Pipeline			7,848	1,570	9,418	
08_ A\12.02. 5\ !3	Other Compaction			4,736	947	5,683	
TOTAL	Disposal Areas (Virginia Key)			539,501	107,900	647,402	
08_ A\12.02. 7	Environmental Mitigation						
08_ A\12.02. 7\ 1	Low Relief Low Complexity Reef	5000.00	CY	0	0	0	0.00
08_ A\12.02. 7\ 2	High Relief High Complexity Reef	50000	CY	744,894	148,979	893,873	17.88
08_ A\12.02. 7\ 3	Fill North Biscayne Bay Holes	375000	CY	543,249	108,650	651,899	1.74
08_ A\12.02. 7\ 4	Capping Material For Bay Holes	25000	CY	364,599	72,920	437,519	17.50
TOTAL	Environmental Mitigation			1,652,743	330,549	1,983,292	
08_ A\12.02. 8	Associated General Items						
08_ A\12.02. 8\ 4	Port Bulkhead Construction			19,000,000	3,800,000	22,800,000	
TOTAL	Associated General Items			19,000,000	3,800,000	22,800,000	
TOTAL	Harbors			117,944,329	23,588,866	141,533,195	
TOTAL	Navigation Ports and Harbors			117,944,329	23,588,866	141,533,195	
TOTAL	Construction Cost			123,032,697	24,606,539	147,639,236	
08_ B	Non-Construction Cost						
08_ B\01	Lands and Damages						
08_ B\01.01	Acquisition/Administration Costs						
08_ B\01.01. 1	Federal			10,000	2,500	12,500	
08_ B\01.01. 2	Non-Federal			10,000	2,500	12,500	
TOTAL	Acquisition/Administration Costs			20,000	5,000	25,000	
TOTAL	Lands and Damages			20,000	5,000	25,000	
08_ B\20	Mitigation Monitoring						
08_ B\20.01	Pre-Reef Deployment Site Surveys			25,000	0	25,000	
08_ B\20.02	Baseline Biological Surveys			25,000	0	25,000	
08_ B\20.03	Construction Monitoring	10.00	DY	50,000	0	50,000	5000.00
08_ B\20.04	Completion Report			20,000	0	20,000	

** PROJECT OWNER SUMMARY - Task **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
08_ B\20.05	Post-Construction Monitoring	3.00	YR	150,000	0	150,000	50000
	TOTAL Mitigation Monitoring			270,000	0	270,000	
08_ B\30	Planning, Engineering & Design			3,690,000	0	3,690,000	
08_ B\31	Construction Management (S&I)			10,500,000	0	10,500,000	
08_ B\99	Aids to Navigation						
08_ B\99. 1	Alternate 2A						
08_ B\99. 1. 1	Relocated Light 15			150,000	0	150,000	
08_ B\99. 1. 2	Light 15 Annual Maintenance			15,000	0	15,000	
	TOTAL Alternate 2A			165,000	0	165,000	
08_ B\99. 2	Alternative 3B						
08_ B\99. 2. 1	Relocate One Light			7,100	0	7,100	
	TOTAL Alternative 3B			7,100	0	7,100	
08_ B\99. 3	Alternative 5A						
08_ B\99. 3. 1	Relocate One Light			7,100	0	7,100	
08_ B\99. 3. 2	Discontinue One Light			1,100	0	1,100	
	TOTAL Alternative 5A			8,200	0	8,200	
	TOTAL Aids to Navigation			180,300	0	180,300	
	TOTAL Non-Construction Cost			14,660,300	5,000	14,665,300	
	TOTAL DRAFT RECOMMENDED PLAN (49'&51')			137,692,997	24,611,539	162,304,536	
09	DRAFT LOCAL PREF. PLAN (50'&52')						
09_ A	Construction Cost						
09_ A\02	Relocations						
09_ A\02.03	Cemetery, Utilities, & Structure						
09_ A\02.03.01	Mob, Demob & Preparatory Work						
09_ A\02.03.01\ 01	Drilling & Blasting Mob/Demob			65,399	13,080	78,479	
09_ A\02.03.01\ 02	Hydraulic Dredge Mob/Demob			47,087	9,417	56,505	
09_ A\02.03.01\ 03	Clamshell Crane Barge Mob/Demob			12,949	2,590	15,539	

** PROJECT OWNER SUMMARY - Task **

		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
09_ A\02.03.01\ 04	Pipeline Installation			45,779	9,156	54,935	
	TOTAL Mob, Demob & Preparatory Work			171,215	34,243	205,457	
09_ A\02.03.18	Utilities						
09_ A\02.03.18\ 01	Trench Excavation - 20" Water	57533	CY	1,955,229	391,046	2,346,274	40.78
09_ A\02.03.18\ 02	Trench Excavation - 54" Sewer	59630	CY	2,023,745	404,749	2,428,494	40.73
09_ A\02.03.18\ 03	Pipeline Installation 20" Line	1000.00	LF	208,637	41,727	250,364	250.36
09_ A\02.03.18\ 04	Pipeline Installation 54" Line	1000.00	LF	201,227	40,245	241,472	241.47
09_ A\02.03.18\ 05	Backfill Trench - 20" Water Line	27904	CY	364,095	72,819	436,915	15.66
09_ A\02.03.18\ 06	Backfill Trench - 54" Sewer Line	30000	CY	385,778	77,156	462,934	15.43
09_ A\02.03.18\ 07	Test - Inspect New 20" Pipeline	1000.00	LF	1,387	277	1,665	1.66
09_ A\02.03.18\ 08	Test - Inspect New 54" Pipeline	1000.00	LF	2,204	441	2,645	2.64
09_ A\02.03.18\ 09	Clean & Abandon Old 20" Pipeline	1000.00	LF	5,663	1,133	6,795	6.80
09_ A\02.03.18\ 10	Clean & Abandon Old 54" Pipeline	1000.00	LF	11,199	2,240	13,439	13.44
	TOTAL Utilities			5,159,164	1,031,833	6,190,997	
09_ A\02.03.28	Credits for Salvaged Material						
	TOTAL Cemetery, Utilities, & Structure			5,330,379	1,066,076	6,396,455	
	TOTAL Relocations			5,330,379	1,066,076	6,396,455	
09_ A\12	Navigation Ports and Harbors						
09_ A\12.02	Harbors						
09_ A\12.02. 1	Mobil, Demobil & Prep Work						
09_ A\12.02. 1\ 1	Mechanical Dredge Mob/Demob			476,105	95,221	571,326	
09_ A\12.02. 1\ 2	Pipeline Dredge Mob/Demob			868,499	173,700	1,042,198	
09_ A\12.02. 1\ 3	Drilling & Blasting Mob/Demob			653,990	130,798	784,788	
	TOTAL Mobil, Demobil & Prep Work			1,998,593	399,719	2,398,312	
09_ A\12.02. 2	Drilling and Blasting						
09_ A\12.02. 2\ 1	Alternative 1C - Cut 1/2 PI WID.	536922	CY	9,432,664	1,886,533	11,319,197	21.08
09_ A\12.02. 2\ 3	Alternative 2A - Cut 3 Widener	11628	CY	163,291	32,658	195,950	16.85
09_ A\12.02. 2\ 4	Alternative 3B - Cut 3	616816	CY	10,023,962	2,004,792	12,028,755	19.50
09_ A\12.02. 2\ 5	Alternative 5A - Fisherman Chan.	1034940	CY	15,410,721	3,082,144	18,492,865	17.87
09_ A\12.02. 2\ 6	Alternative 5A - Port Berths	254725	CY	3,792,977	758,595	4,551,573	17.87
09_ A\12.02. 2\ 7	Alternative 5A - Lummus Isl. TB.	516036	CY	12,653,912	2,530,782	15,184,694	29.43
	TOTAL Drilling and Blasting	2971067	CY	51,477,528	10,295,506	61,773,033	20.79

** PROJECT OWNER SUMMARY - Task **

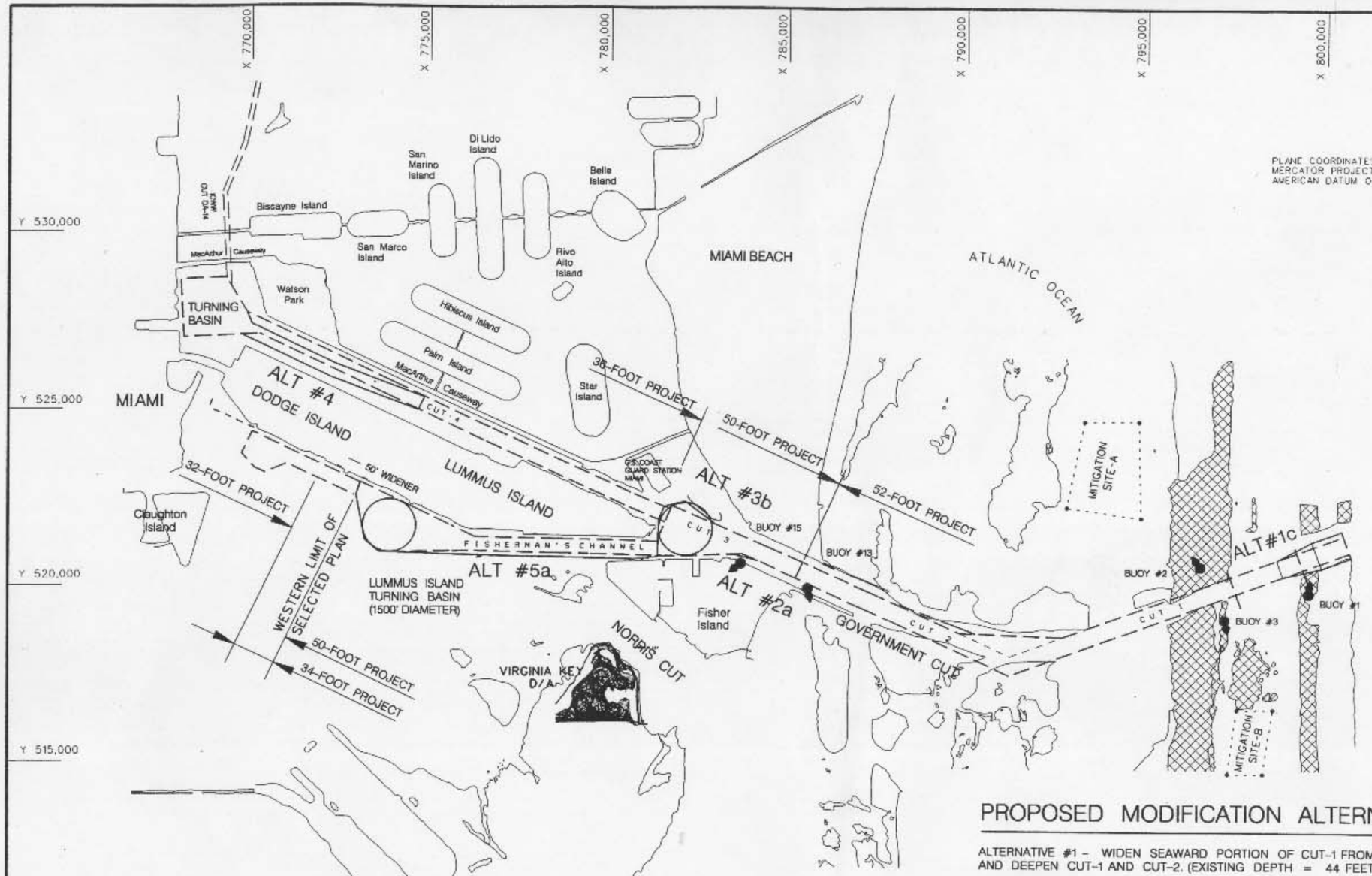
		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
09_ A\12.02. 3	Mechanical Dredging						
09_ A\12.02. 3\ 3	Alternative 2A - Cut 3 Widener	11628	CY	95,970	19,194	115,164	9.90
09_ A\12.02. 3\ 4	Alternative 3B - Cut 3	616816	CY	4,977,850	995,570	5,973,420	9.68
09_ A\12.02. 3\ 5	Alternative 5A - Fisherman Chan.	1034940	CY	7,499,390	1,499,878	8,999,268	8.70
09_ A\12.02. 3\ 6	Alternative 5A - Port Berths	254725	CY	1,845,790	369,158	2,214,948	8.70
09_ A\12.02. 3\ 7	Alternative 5A - Lummus Isl. TB.	516036	CY	6,270,421	1,254,084	7,524,506	14.58
TOTAL	Mechanical Dredging	2434145	CY	20,689,422	4,137,884	24,827,307	10.20
09_ A\12.02. 4	Pipeline Dredging						
09_ A\12.02. 4\ 0	Alternative 1C - Cut 1/2 PI WID.	643358	CY	6,698,334	1,339,667	8,038,001	12.49
09_ A\12.02. 4\ 1	Alternative 1C - Cut 1	1068412	CY	11,151,741	2,230,348	13,382,089	12.53
09_ A\12.02. 4\ 2	Alternative 1C - Cut 2	543779	CY	5,946,066	1,189,213	7,135,279	13.12
09_ A\12.02. 4\ 4	Alternative 3B - Cut 3	405848	CY	1,932,261	386,452	2,318,713	5.71
09_ A\12.02. 4\ 5	Alternative 5A - Fisherman Chan.	250000	CY	1,157,562	231,512	1,389,074	5.56
09_ A\12.02. 4\ 6	Alternative 5A - Port Berths	47036	CY	217,788	43,558	261,346	5.56
09_ A\12.02. 4\ 7	Alternative 5A - Lummus Isl. TB.	343791	CY	3,215,152	643,030	3,858,183	11.22
TOTAL	Pipeline Dredging	3302224	CY	30,318,905	6,063,781	36,382,686	11.02
09_ A\12.02. 5	Disposal Areas (Virginia Key)						
09_ A\12.02. 5\ 1	Replace Dike Material	50000	BCY	265,220	53,044	318,265	6.37
09_ A\12.02. 5\ 2	Excavation for CMP			24,516	4,903	29,419	
09_ A\12.02. 5\ 3	Wood Piles, 50 lf each	18.00	EA	7,510	1,502	9,013	500.69
09_ A\12.02. 5\ 4	Driving Wood Piles	18.00	EA	28,819	5,764	34,582	1921.23
09_ A\12.02. 5\ 5	Metal Hardware			392	78	471	
09_ A\12.02. 5\ 6	CMP Materials			176,941	35,388	212,329	
09_ A\12.02. 5\ 7	Positioning Weirs	3.00	EA	4,803	961	5,764	1921.23
09_ A\12.02. 5\ 8	Attaching Weirs to Piles	3.00	EA	1,131	226	1,357	452.44
09_ A\12.02. 5\ 9	Pipeline Placement	16.00	EA	5,065	1,013	6,078	379.86
09_ A\12.02. 5\ !0	Transport material			6,195	1,239	7,434	
09_ A\12.02. 5\ !1	Precise Material Placement	3000.00	CY	6,325	1,265	7,590	2.53
09_ A\12.02. 5\ !2	Compaction around Pipeline			7,848	1,570	9,418	
09_ A\12.02. 5\ !3	Other Compaction			4,736	947	5,683	
TOTAL	Disposal Areas (Virginia Key)			539,501	107,900	647,402	
09_ A\12.02. 7	Environmental Mitigation						
09_ A\12.02. 7\ 1	Low Relief Low Complexity Reef	5000.00	CY	0	0	0	0.00
09_ A\12.02. 7\ 2	High Relief High Complexity Reef	50000	CY	744,894	148,979	893,873	17.88
09_ A\12.02. 7\ 3	Fill North Biscayne Bay Holes	375000	CY	543,249	108,650	651,899	1.74
09_ A\12.02. 7\ 4	Capping Material For Bay Holes	25000	CY	364,599	72,920	437,519	17.50
TOTAL	Environmental Mitigation			1,652,743	330,549	1,983,292	

** PROJECT OWNER SUMMARY - Task **

	QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
09_ A\12.02. 8 Associated General Items						
09_ A\12.02. 8\ 4 Port Bulkhead Construction			19,000,000	3,800,000	22,800,000	
TOTAL Associated General Items			19,000,000	3,800,000	22,800,000	
TOTAL Harbors			125,676,692	25,135,338	150,812,031	
TOTAL Navigation Ports and Harbors			125,676,692	25,135,338	150,812,031	
TOTAL Construction Cost			131,007,071	26,201,414	157,208,485	
09_ B Non-Construction Cost						
09_ B\01 Lands and Damages						
09_ B\01.01 Acquisition/Administration Costs						
09_ B\01.01. 1 Federal			10,000	2,500	12,500	
09_ B\01.01. 2 Non-Federal			10,000	2,500	12,500	
TOTAL Acquisition/Administration Costs			20,000	5,000	25,000	
TOTAL Lands and Damages			20,000	5,000	25,000	
09_ B\20 Mitigation Monitoring						
09_ B\20.01 Pre-Reef Deployment Site Surveys			25,000	0	25,000	
09_ B\20.02 Baseline Biological Surveys			25,000	0	25,000	
09_ B\20.03 Construction Monitoring	10.00	DY	50,000	0	50,000	5000.00
09_ B\20.04 Completion Report			20,000	0	20,000	
09_ B\20.05 Post-Construction Monitoring	3.00	YR	150,000	0	150,000	50000
TOTAL Mitigation Monitoring			270,000	0	270,000	
09_ B\30 Planning, Engineering & Design			3,930,000	0	3,930,000	
09_ B\31 Construction Management (S&I)			11,100,000	0	11,100,000	
09_ B\99 Aids to Navigation						
09_ B\99. 1 Alternate 2A						
09_ B\99. 1. 1 Relocated Light 15			150,000	0	150,000	
09_ B\99. 1. 2 Light 15 Annual Maintenance			15,000	0	15,000	
TOTAL Alternate 2A			165,000	0	165,000	
09_ B\99. 2 Alternative 3B						

** PROJECT OWNER SUMMARY - Task **

	QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COST	UNIT
09_ B\99. 2. 1 Relocate One Light			7,100	0	7,100	
TOTAL Alternative 3B			7,100	0	7,100	
09_ B\99. 3 Alternative 5A						
09_ B\99. 3. 1 Relocate One Light			7,100	0	7,100	
09_ B\99. 3. 2 Discontinue One Light			1,100	0	1,100	
TOTAL Alternative 5A			8,200	0	8,200	
TOTAL Aids to Navigation			180,300	0	180,300	
TOTAL Non-Construction Cost			15,500,300	5,000	15,505,300	
TOTAL DRAFT LOCAL PREF. PLAN (50'&52')			146,507,371	26,206,414	172,713,785	



PROPOSED MODIFICATION ALTERNATIVES (See Note)

ALTERNATIVE #1 – WIDEN SEAWARD PORTION OF CUT-1 FROM 500 FEET TO 800 FEET AND DEEPEN CUT-1 AND CUT-2. (EXISTING DEPTH = 44 FEET, DEEPEN TO 52 FEET)

ALTERNATIVE #2 – ADD TURN WIDENER BETWEEN BUOY #13 AND BUOY #15. (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET)

ALTERNATIVE #3 – EXPAND FISHER ISLAND TURNING BASIN FROM 1200 FEET TO 1500 FEET. (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET)

ALTERNATIVE #4 – RELOCATE THE WESTERN END OF THE MAIN CHANNEL TO ALLOW FOR ADDITIONAL CRUISE SHIP BERTHS.

ALTERNATIVE #5 – WIDEN FISHERMAN'S CHANNEL APPROXIMATELY 100 FEET TO THE SOUTH. (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET) DEEPENING WOULD INCLUDE CUT-3, STA. 0+00 TO CUT-3, STA. 42+00.

Note: The Alternatives identified on the following plates are referred to as Components in the Report text and Environmental Impact Statement (EIS)

US Army Corps of Engineers
Jacksonville District

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

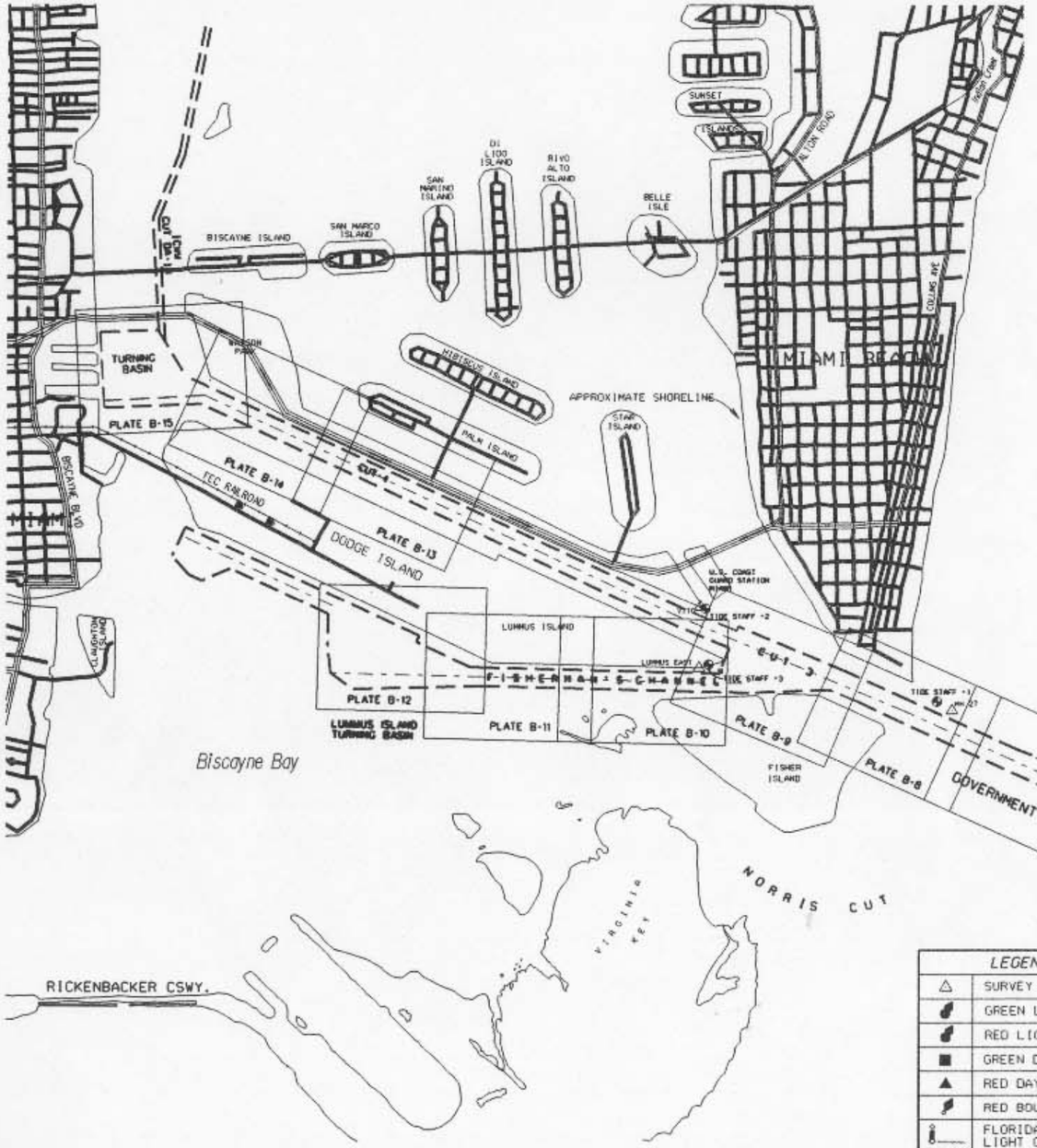
Designed by R.E.H.
Drawn by R.E.H.
Checked by
Date AUGUST 2002
GRR-ENGINEERING APPENDIX
Scale AS SHOWN
Plot date 8/05/02
Plot scale
File name
Reference files

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

SELECTED PROJECT PLAN

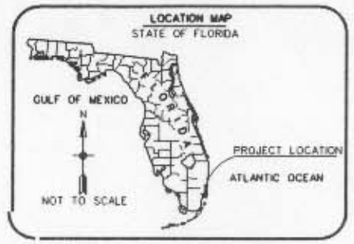
NED PLAN WITH ADDITIONAL 2 FEET LOCAL OPTION

PLATE
B-1

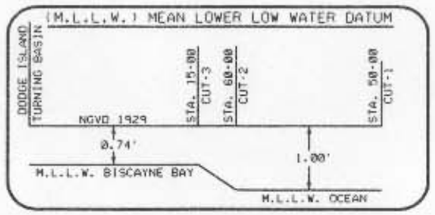


SURVEY NOTES:

1. REFER TO SURVEY NO. 01-097.
2. THIS HYDROGRAPHIC SURVEY WAS OBTAINED FROM FEB 27, 2001 THROUGH MAR 26, 2001.
3. ELEVATIONS WERE OBTAINED USING AN ECHOTRAC MKII SURVEY ECHO SOUNDER ON VESSEL SEABAT POSITIONING WAS OBTAINED VIA A DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS) USING U.S. COAST GUARD BEACON AT MIAMI, FLORIDA.
4. TIDE REDUCTIONS WERE MADE FROM OBSERVATIONS AT 3 TIDE STAFFS ESTABLISHED NEAR AND RELATIVE TO THE FOLLOWING MONUMENTS:
   TIDE STAFF #1 - COE "MH 27" EL. 12.04' NGVD
   TIDE STAFF #2 - COE "VITO 93 JAX DIST" EL. 8.78' NGVD.
   TIDE STAFF #3 - COE "LUMMUS EAST" EL. 11.66' NGVD
5. ELEVATIONS ARE IN FEET AND TENTHS AND REFER TO MEAN LOWER LOW WATER WHICH IS 1.00 FEET BELOW NGVD 1929 (NATIONAL GEODETIC VERTICAL DATUM OF 1929) FOR CUTS 1 AND 2 (OCEAN), TRANSITIONS FROM 1.00 FEET BELOW NGVD AT CUT 3 STA 0+00 TO 0.74 FEET BELOW NGVD 1929 AT CUT 3 STA 15+00, AND CONTINUES AT 0.74 FEET BELOW NGVD 1929 THROUGH DODGE ISLAND CUT 6 THROUGH CUT-4 & TURNING BASIN.
6. ALL ELEVATIONS ARE BELOW THE REFERENCE PLANE UNLESS PRECEEDED BY A (+) SIGN.
7. PLANE COORDINATES ARE IN FEET AND BASED ON THE NORTH AMERICAN DATUM 1927 (NAD27) TRANSVERSE MERCATOR PROJECTION FOR FLORIDA.
8. AIDS TO NAVIGATION IN AND ADJACENT TO THE PROJECT WERE LOCATED DURING THE CONDUCT OF THIS SURVEY.
9. FEATURES DEPICTED WITHIN AND ADJACENT TO THE SURVEY AREA INCLUDING DOCKS, DOLPHIN PILINGS, BUILDINGS, ROADWAYS, SHORELINES, AND/OR OTHER TOPOGRAPHIC FEATURES ARE SHOWN FOR GRAPHIC PURPOSES ONLY.
10. UNDERGROUND AND SUBAQUEOUS IMPROVEMENTS OTHER THAN THOSE SHOWN HEREON WERE NOT LOCATED DURING THIS SURVEY.
11. THIS PROJECT AREA WAS NOT ABSTRACTED FOR EASEMENTS, OWNERSHIP, OR RIGHTS-OF-WAY OF RECORD.
12. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF THE SURVEY ON THE DATE INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THE TIME.
13. REFER TO RAW FIELD DATA:
    A. SIX SURVEY ECHO SOUNDER ROLLS DATED: MARCH 1-26, 2001.
    B. FIELD BOOK2 NUMBER 00 DADE CO. NO..



LEGEND	
△	SURVEY MONUMENT
	GREEN LIGHTED BOUY
	RED LIGHTED BOUY
■	GREEN DAYBEACON
▲	RED DAYBEACON
	RED BOUY
	FLORIDA POWER AND LIGHT CABLE CROSSING
	TIDE STAFF
□	GENERAL BEACON
	MARINA



ABBREVIATIONS	
NGVD	NATIONAL GEODETIC VERTICAL DATUM OF 1929
M.L.W.	MEAN LOW WATER
P.I.	POINT OF INTERSECTION
EL.	ELEVATION (FEET)
DNR	FLORIDA DEPARTMENT OF NATURAL RESOURCES
RGE.	RANGE
STA.	STATION
ICWW	INTRACOASTAL WATERWAY
NGS	NATIONAL GEODETIC SURVEY
FC	FISHERMAN'S CHANNEL
LITB	LUMMUS ISLAND TURNING BASIN
T.B.	TURNING BASIN

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
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Plot scale:
Date: JULY 2002
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MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT
ENGINEERING APPENDIX

PLAN PLATES INDEX

PLATE
B-2

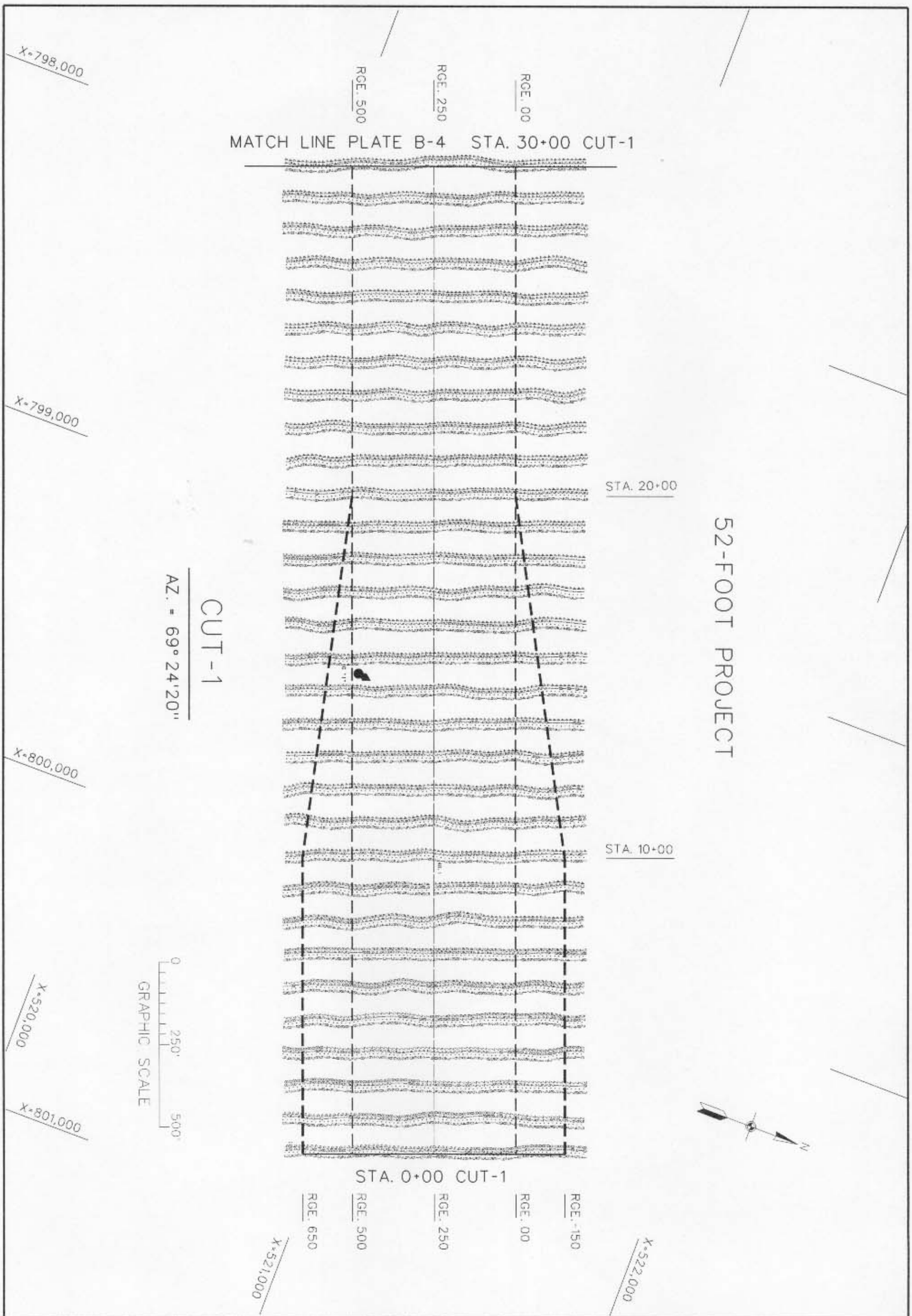

PLATE B-3

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN - CUT 1 (ALT#1C)

STA. 0+00 CUT1 TO STA. 30+00 CUT1

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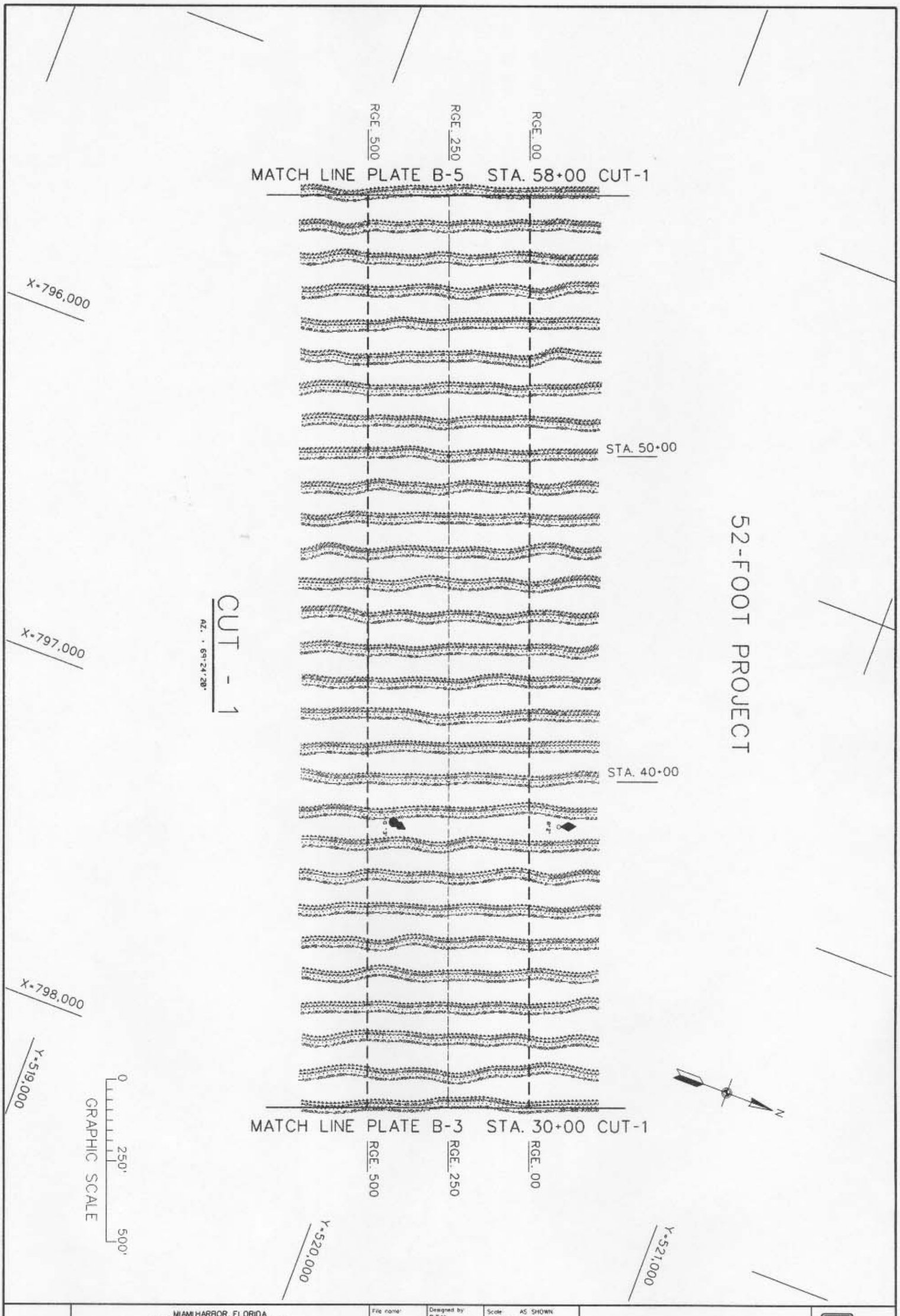

PLATE B-4

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN - CUT1

STA. 30+00 CUT1 TO STA. 58+00 CUT1

File name:
Reference files:

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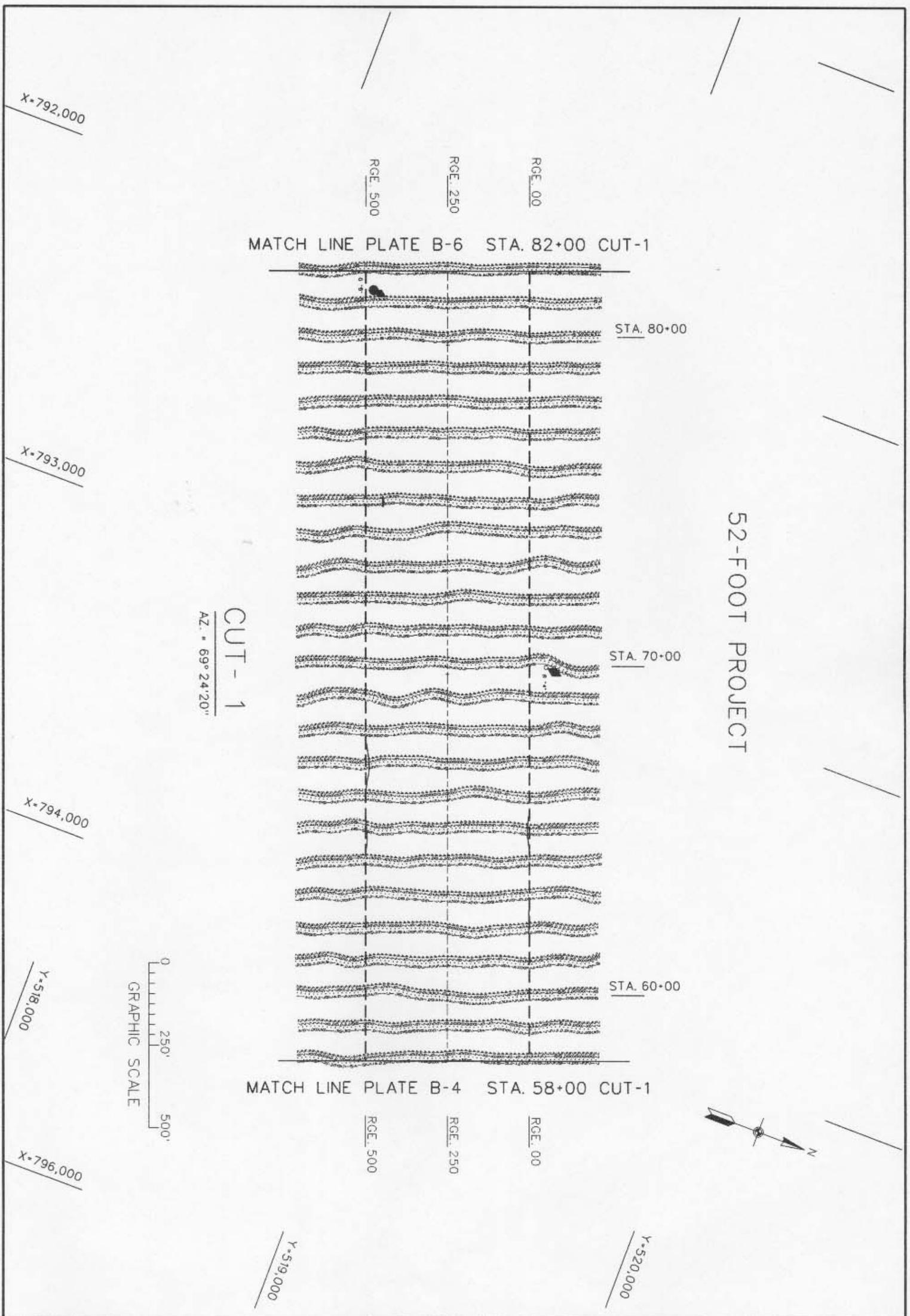

PLATE B-5

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN - CUT 1

STA. 58+00 CUT1 TO STA. 82+00 CUT1

File name:
Reference files:

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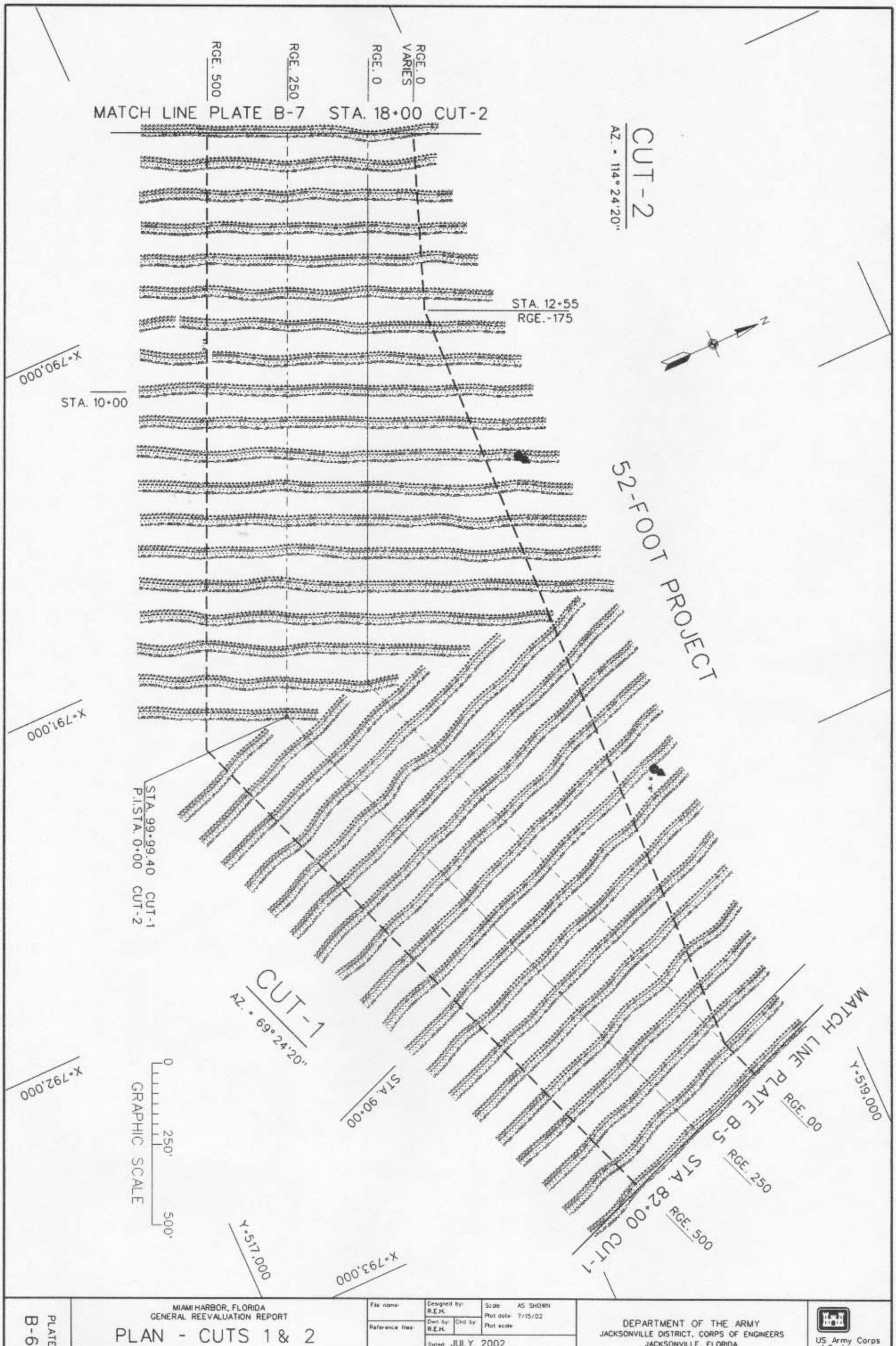

PLATE B-6

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN - CUTS 1 & 2

STA. 82+00 CUT1 TO STA. 18+00 CUT2

File name:
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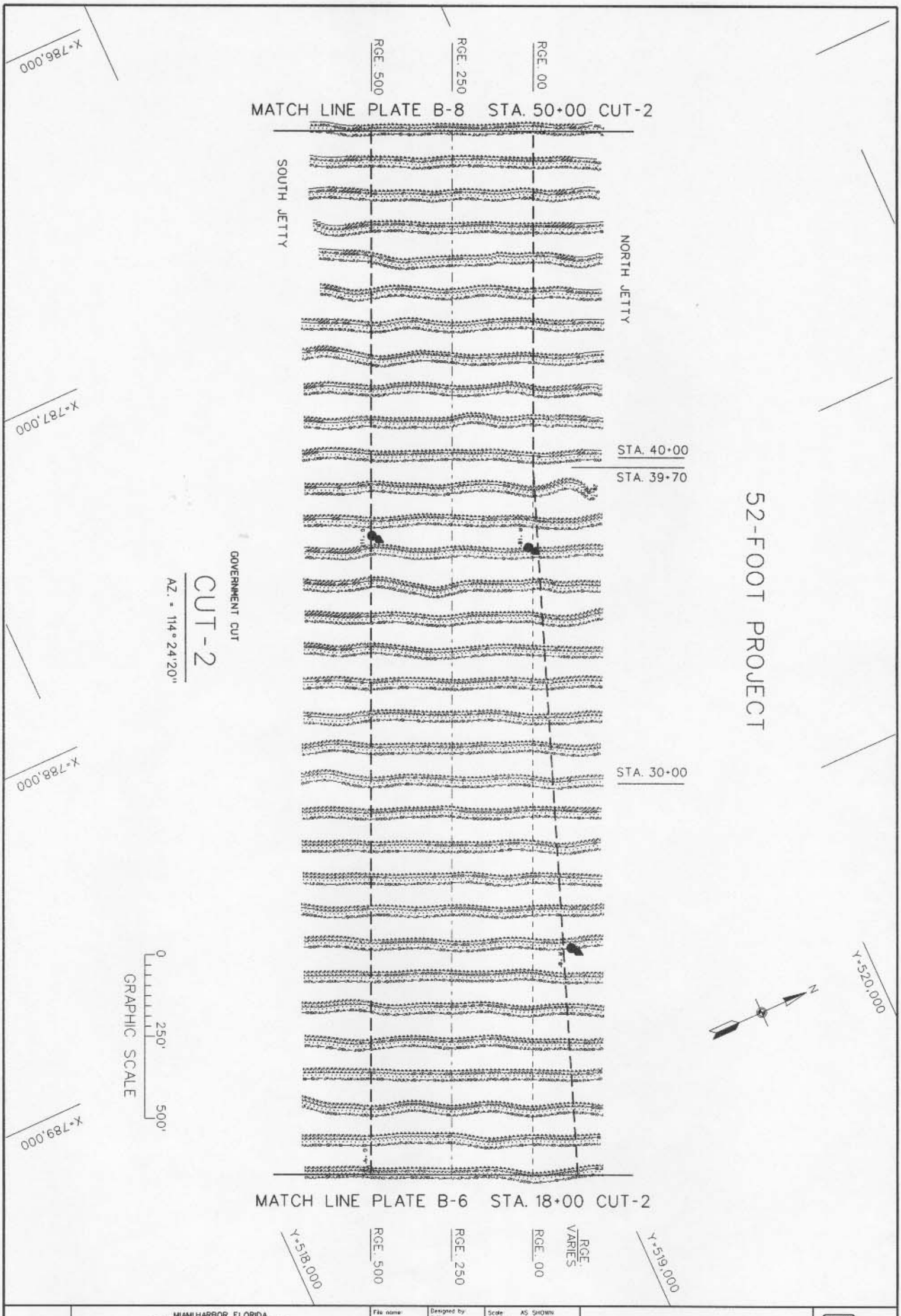

PLATE B-7

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN - CUT 2

STA. 18+00 CUT2 TO STA. 50+00 CUT2

File name:
Reference files:

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Drawn by: R.E.H.
Ckd by:
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Plot date: 7/15/02
Plot scale:

Dated: JULY 2002
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US Army Corps of Engineers
Jacksonville District

Y-522,000

GOVERNMENT CUT

APPROXIMATE SHORELINE

P.I. STA.0+00 CUT-3
STA. 65+00 CUT-2

Y-521,000

N

ATLANTIC OCEAN

STA.10+00

TRANSITION

STA. 60+00

NORTH JETTY

MATCH LINE PLATE B-9 STA. 15+00 CUT-3

RGE.-100

RGE. 00

RGE. 200

RGE. 400

RGE. 457.4

MATCH LINE PLATE B-7 STA. 50+00 CUT-2

RGE. 00

RGE. 250

RGE. 500

APPROXIMATE SHORELINE

SOUTH JETTY

CUT-3

AZ. = 112°36'07"

CUT-2

AZ. = 114°24'20"

Y-519,000

50-FOOT PROJECT

52-FOOT PROJECT

0 250' 500'

GRAPHIC SCALE

Y-520,000

X-784,000

X-785,000

X-786,000

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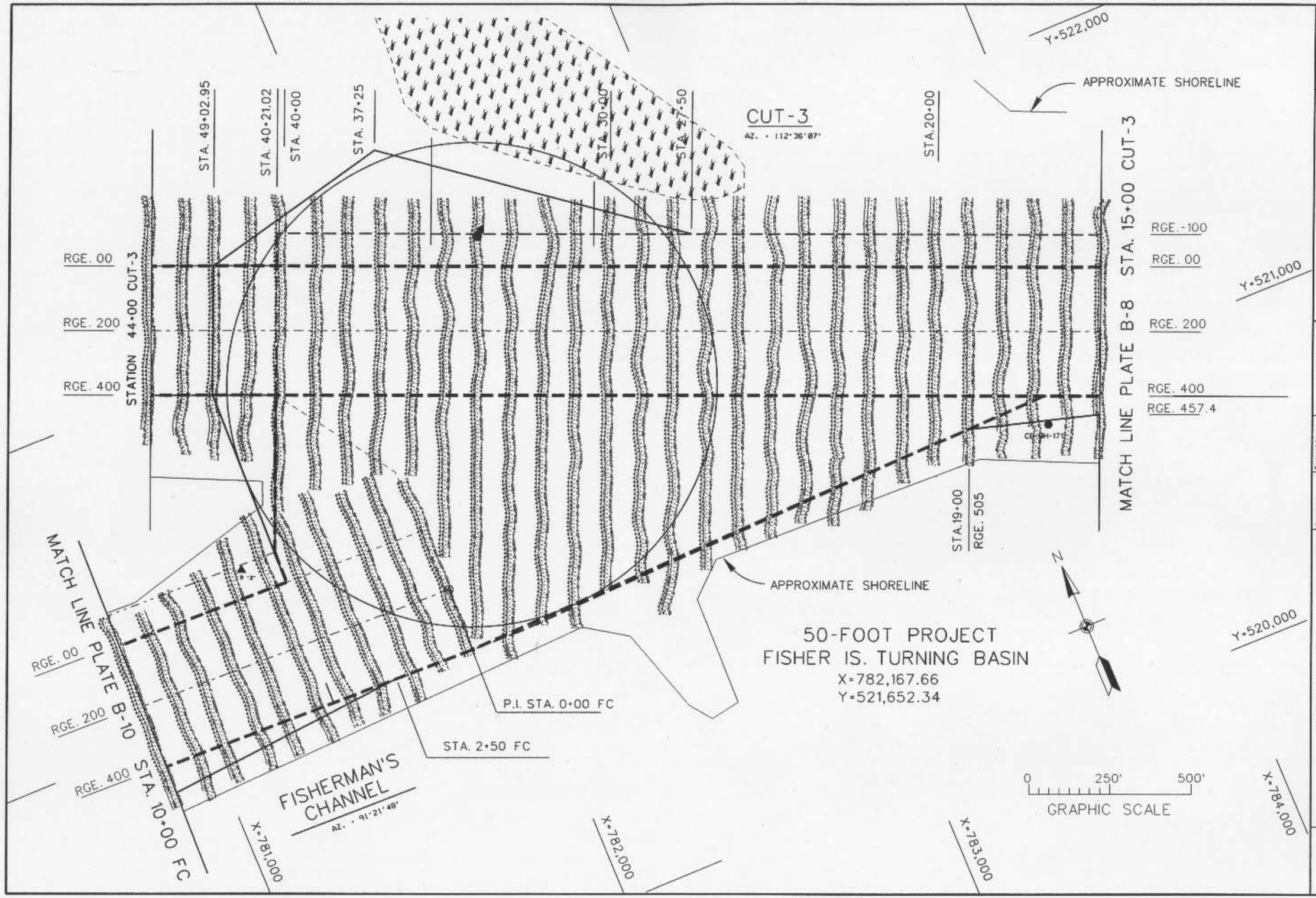
GRR-ENGINEERING APPENDIX
File name:
Reference files:

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN - CUTS 2 & 3

STA. 50+00 CUT2 TO STA. 15+00 CUT3

PLATE
B-8


Y-522,000
APPROXIMATE SHORELINE
CUT-3
AZ. = 112°36'07"
STA. 49+02.95
STA. 40+21.02
STA. 40+00
STA. 37+25
STA. 30+00
STA. 27+50
STA. 20+00
RGE. 00
RGE. 200
RGE. 400
STATION 44+00 CUT-3
RGE. -100
RGE. 00
RGE. 200
RGE. 400
RGE. 457.4
Y-521,000
MATCH LINE PLATE B-8 STA. 15+00 CUT-3
CB-9H-171
STA. 19+00
RGE. 505
APPROXIMATE SHORELINE
50-FOOT PROJECT
FISHER IS. TURNING BASIN
X=782,167.66
Y=521,652.34
Y-520,000
MATCH LINE PLATE B-10 STA. 10+00 FC
RGE. 00
RGE. 200
RGE. 400
P.I. STA. 0+00 FC
STA. 2+50 FC
FISHERMAN'S CHANNEL
AZ. = 91°21'48"
X-781,000
X-782,000
X-783,000
X-784,000
0
250'
500'
GRAPHIC SCALE
US Army Corps of Engineers Jacksonville District
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
Designed by: R.E.M.
Drawn by: R.E.M.
Checked by:
Scale: AS SHOWN
Plot date: 7/15/02
Plot scale:
File name:
Reference files:
Dated: JULY 2002
GRR-ENGINEERING APPENDIX
MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT
PLAN-CUT3 & FISHMN'S CH.
STA. 15+00 CUT3 TO STA. 10+00 FC
PLATE
B-9

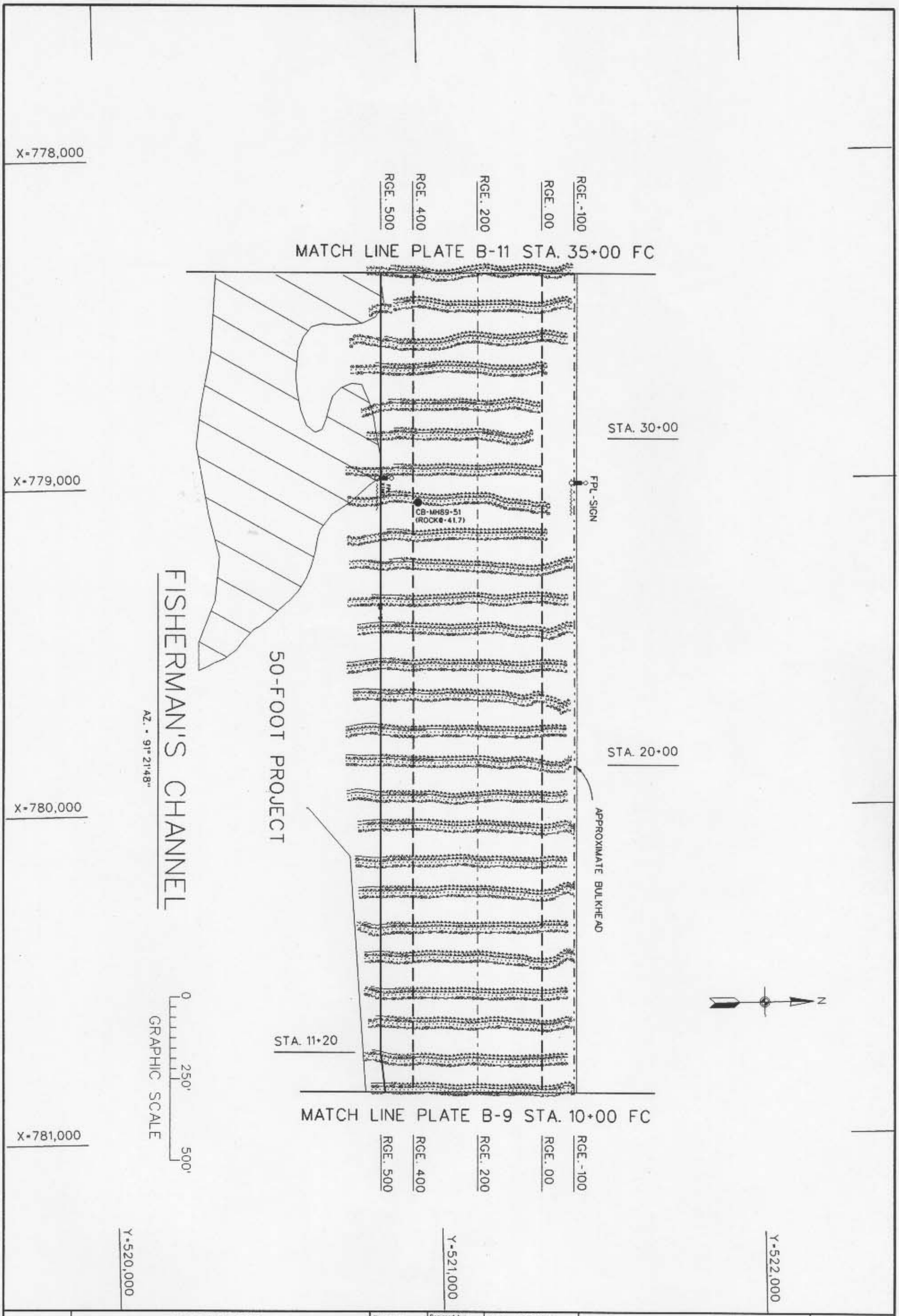


PLATE B-10

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT
PLAN - FC (ALT#5)
STA. 10+00 FC TO STA. 35+00 FC

File name:
Reference files:
Designed by: R.E.H.
Drawn by: R.E.H.
Chkd by:
Scale: AS SHOWN
Plot date: 7/15/02
Plot scale
Dated: JULY 2002
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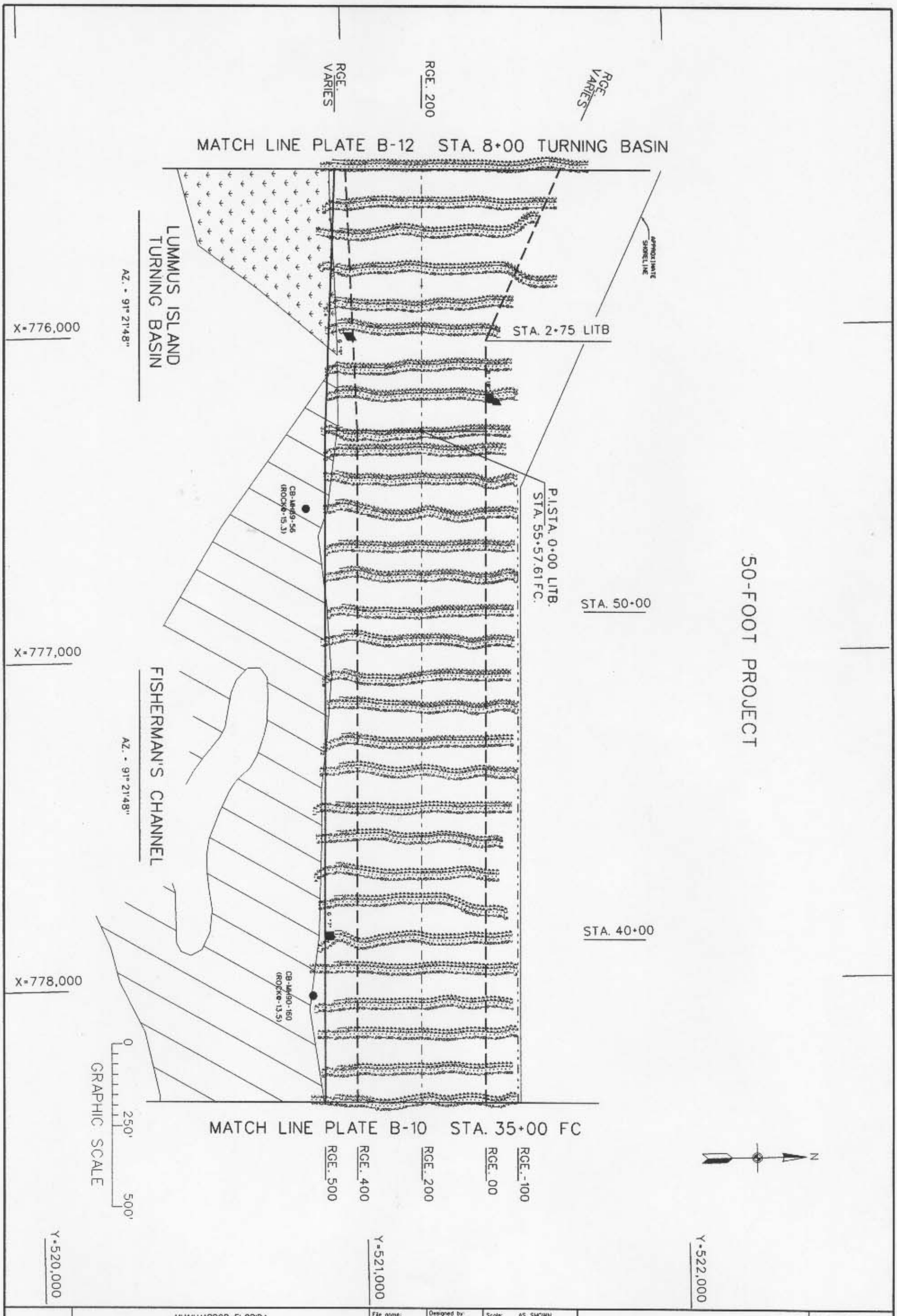

PLATE B-11

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN - FISHERMAN'S CHANNEL & LUMMUS ISLAND TB

STA. 35+00FC TO STA. 8+00 LITB

File name:
Reference files:
Designed by: R.E.H.
Drawn by: R.E.H. Ckd by:
Dated: JULY 2002
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Scale: AS SHOWN
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Plot scale:

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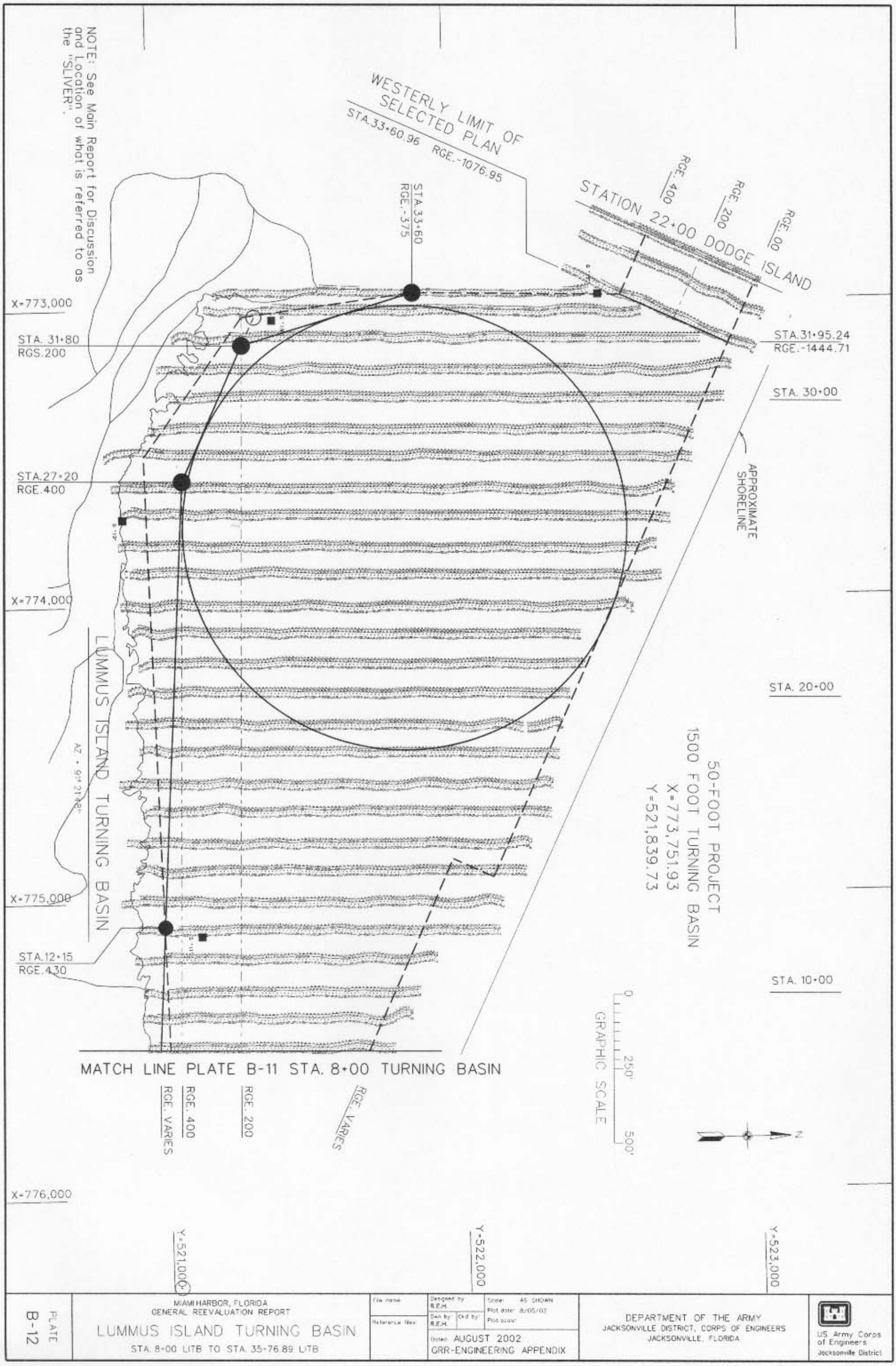

PLATE B-12

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

LUMMUS ISLAND TURNING BASIN

STA. 8+00 LITB TO STA. 35+76.89 LITB

File name:
Reference files:
Designed by R.E.H.
Drawn by: R.E.H. Ckd by:
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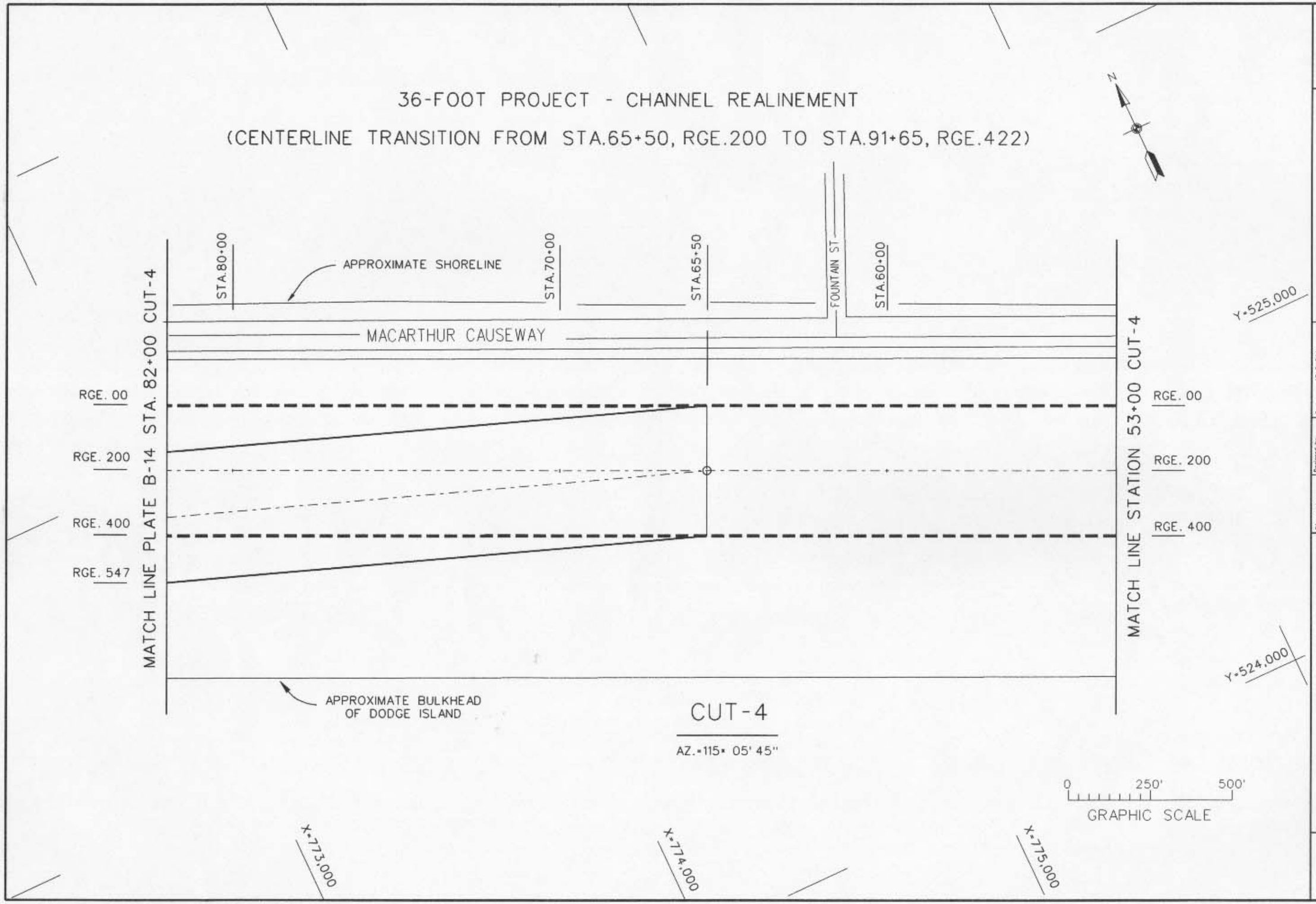
36-FOOT PROJECT - CHANNEL REALINEMENT

(CENTERLINE TRANSITION FROM STA.65+50, RGE.200 TO STA.91+65, RGE.422)



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Dated: JULY 2002
GRR-ENGINEERING APPENDIX
File name: | Reference files:

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN CUT-4

STA. 53+00 CUT4 TO STA. 82+00 CUT4

PLATE
B-13

MACARTHUR CAUSEWAY

STA.100+00

PI STA.91+65

STA.90+00

APPROXIMATE SHORELINE

APPROXIMATE BULKHEAD

Y=527,000

Y=526,000

Y=525,000

RGE. 00

RGE. 200

RGE. 400

MATCH LINE PLATE B-15 STA.110+00 CUT-4

MATCH LINE PLATE B-13 STA. 82+00 CUT-4

RGE. 00

RGE. 200

RGE. 316 (RGE. 547)

RGE. 400

APPROXIMATE BULKHEAD

CUT-4

AZ. = 115° 05'45"

36-FOOT PROJECT - CHANNEL REALIGNMENT

0 250' 500'

GRAPHIC SCALE

X=770,000

X=771,000

X=772,000

X=773,000

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Plot scale
Dated: JULY 2002
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File name:
Reference files:

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN - CUT 4

STA. 82+00 CUT4 TO STA. 110+00 CUT4

PLATE
B-14

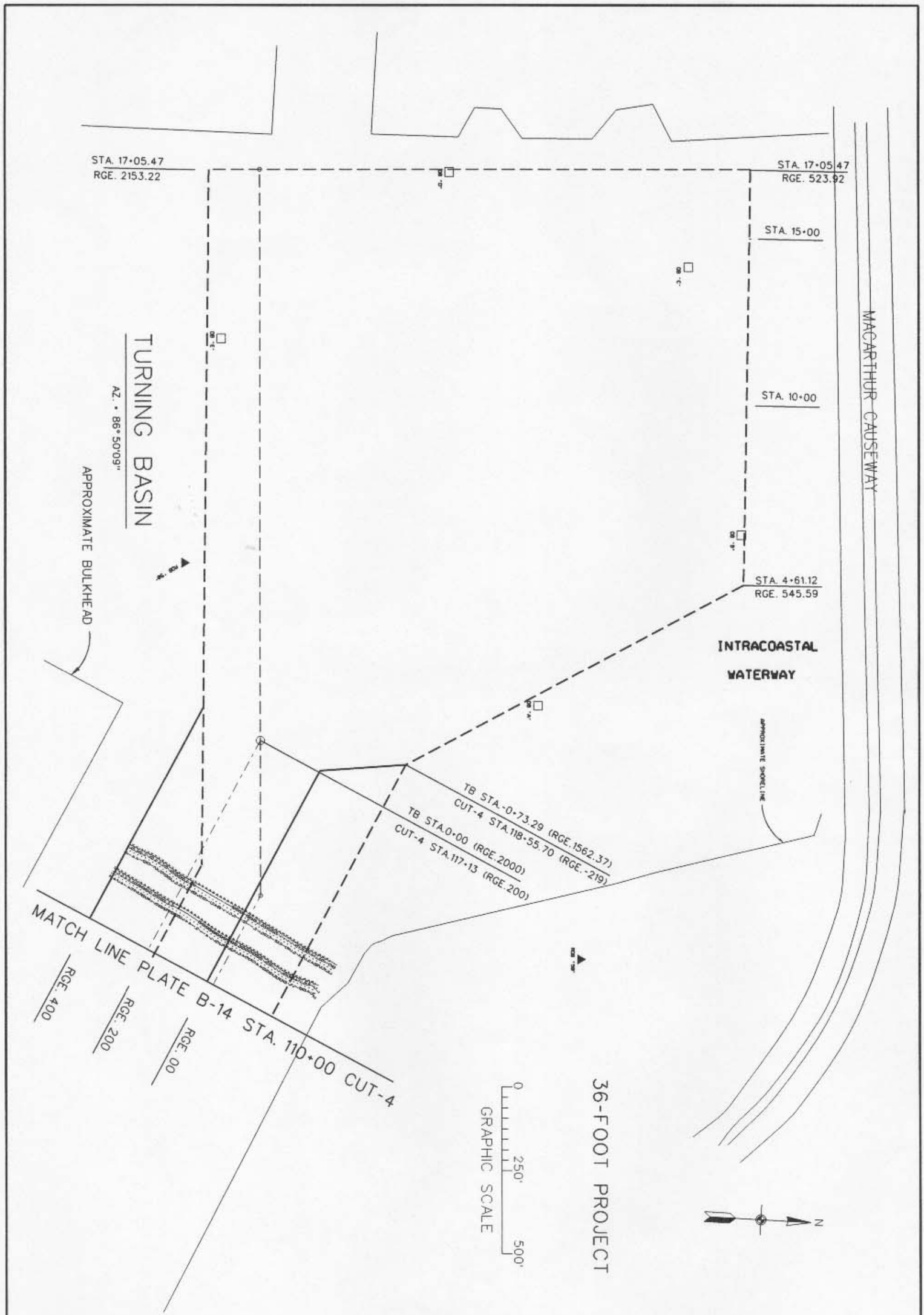

PLATE B-15

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

PLAN-CUT4 & TURNING BASIN

ENGINEERING APPENDIX

File name:
Reference files:

Designed by: R.E.H.
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Plot scale:
Dated: JULY 2002
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US Army Corps of Engineers
Jacksonville District

PLATE B-16

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT
VIRGINIA KEY DISPOSAL AREA

File name:
Reference files:
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Drawn by: R.E.H.
Checked by:
Scale: AS SHOWN
Plot date: 8/05/02
Plot scale: ——
Dated: AUGUST 2002
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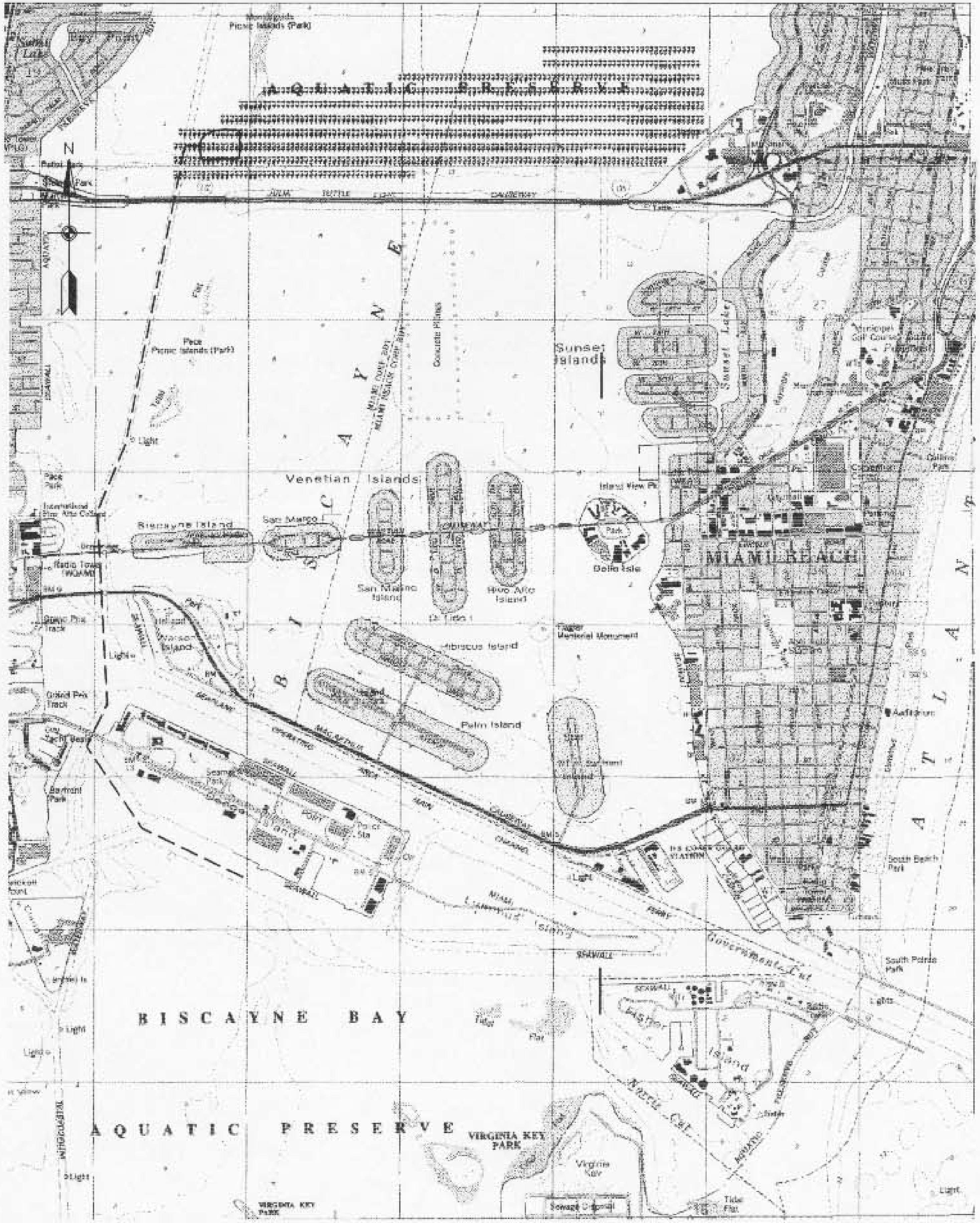
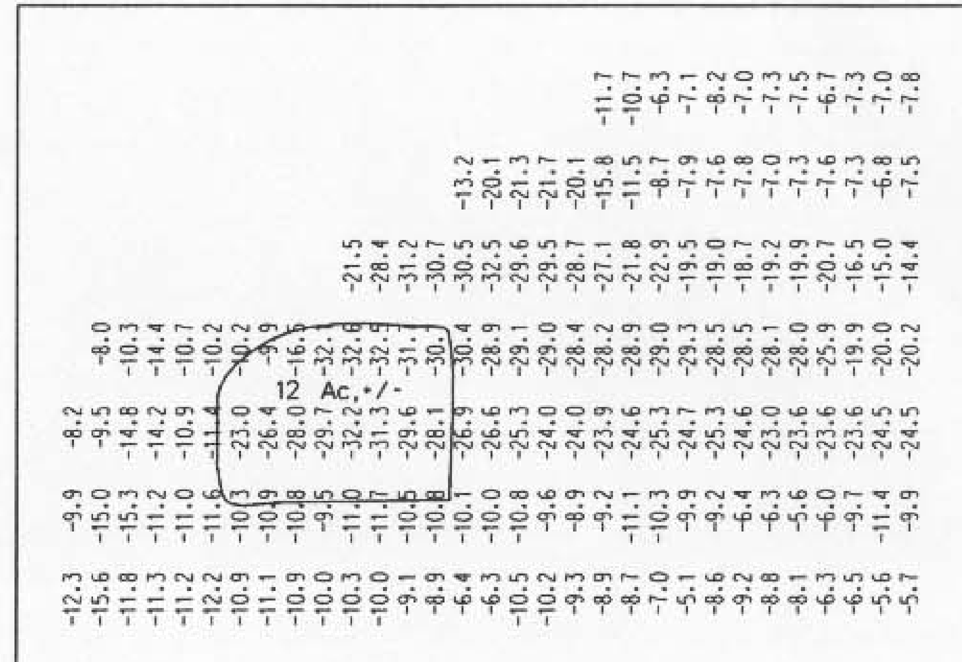
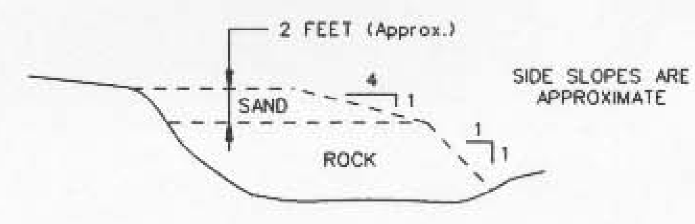




MITIGATION AREA INSET
(Not to Scale)



MITIGATION AREA SECTION
(NOT TO SCALE)

5000'

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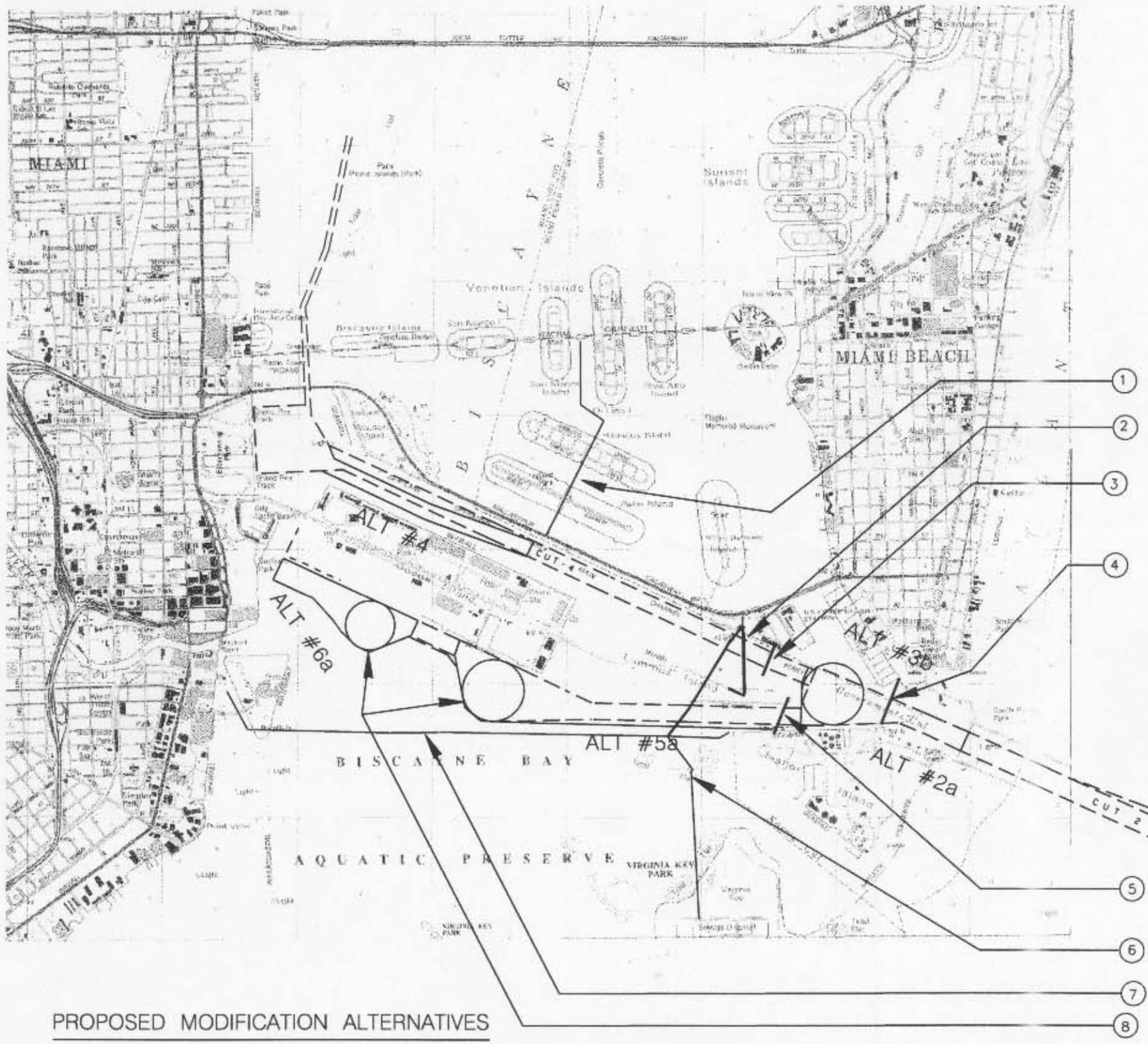
Dwn by: R.E.H.
Scale: AS SHOWN
Plot date: 8/05/02
Dated: AUGUST 2002
GRR-ENGINEERING APPENDIX

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT
BISCAYNE BAY MITIGATION AREA

PLATE
B-17



PROPOSED MODIFICATION ALTERNATIVES

ALTERNATIVE #1 – WIDEN SEAWARD PORTION OF CUT-1 FROM 500 FEET TO 800 FEET AND DEEPEN CUT-1 AND CUT-2. (EXISTING DEPTH = 44 FEET, DEEPEN TO 52 FEET)

ALTERNATIVE #2 – ADD TURN WIDENER BETWEEN BUOY #13 AND BUOY #15 (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET)

ALTERNATIVE #3 – EXPAND FISHER ISLAND TURNING BASIN FROM 1200 FEET TO 1500 FEET. (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET)

ALTERNATIVE #4 – RELOCATE THE WESTERN END OF THE MAIN CHANNEL TO ALLOW FOR ADDITIONAL CRUISE SHIP BERTHS.

ALTERNATIVE #5 – WIDEN FISHERMAN'S CHANNEL APPROXIMATELY 100 FEET TO THE SOUTH. (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET) DEEPENING WOULD INCLUDE CUT-3, STA. 0+00 TO CUT-3, STA. 42+00.

ALTERNATIVE #6 – DEEPEN DODGE ISLAND CUT AND THE PROPOSED 1200 FOOT DIAMETER TURNING BASIN FROM 32 & 34 FEET TO 36 FEET AND RELOCATE WESTERN END OF DODGE ISLAND CUT TO ACCOMODATE PROPOSED PORT EXPANSION.

KEYED NOTES:

(1) NO UTILITY CONFLICT
FP&L 15 KV FEEDER CABLES ALONG MACARTHUR CAUSEWAY. RELOCATING WESTERN END OF CHANNEL WOULD NOT CAUSE CONFLICT. CABLE WOULD NOT HAVE TO BE RELOCATED

(2) NO WORK PROPOSED.
FP&L 69 KV AND 138 KV TRANSMISSION CABLES IN CUT 4. CABLES WILL NOT HAVE TO BE RELOCATED.

(3) NO WORK PROPOSED
MIAMI-DADE WASD WATER MAIN IN CUT 3. TOP OF PIPE ELEVATION AT MINUS 48-FT. PROPOSED CHANNEL DEPTH MINUS 40-FT

(4) UTILITY CONFLICT - RELOCATION REQUIRED
WASD 54-IN SEWER FORCE MAIN IN ALT #2A AND ALT #3B TOP OF PIPE ELEVATION AT MINUS 50-FT. WIDENING THE CHANNEL WOULD CAUSE CONFLICT. PIPE WILL REQUIRE RELOCATING TO 6-FT BELOW PROJECT DEPTH PLUS ALLOWED OVERDEPTH.

(5) UTILITY CONFLICT - RELOCATION REQUIRED.
WASD WATER MAIN IN ALT #5. TOP OF PIPE ELEVATION AT MINUS 52.8-FT. WIDENING THE CHANNEL WOULD CAUSE CONFLICT. PIPE WOULD REQUIRE RELOCATING TO 6-FT BELOW PROJECT DEPTH PLUS ALLOWED OVERDEPTH.

(6) UTILITY CONFLICT - PREVIOUS PROJECT TO RELOCATE
FP&L 138 KV FEEDER CABLES IN ALT #5. CHANNEL DEEPENING WOULD CAUSE CONFLICT. TOP OF CABLE ELEVATION AT MINUS 45.8-FT. PROPOSED CHANNEL DEPTH MINUS 50-FT. CABLE WOULD REQUIRE RELOCATING TO 6-FT BELOW PROJECT DEPTH PLUS ALLOWED OVERDEPTH.

(7) UTILITY CONFLICT - PREVIOUS PROJECT TO RELOCATE
FP&L 69 KV FEEDER CABLES IN ALT #5. CHANNEL DEEPENING WOULD CAUSE CONFLICT. TOP OF CABLE ELEVATION AT MINUS 45.5-FT. PROPOSED CHANNEL DEPTH MINUS 50-FT. CABLE WOULD REQUIRE RELOCATING TO 6-FT BELOW PROJECT DEPTH PLUS ALLOWED OVERDEPTH.

(8) NO UTILITY CONFLICT
BELLSOUTH TELEPHONE CABLES IN ALT #5 AND ALT #3B APPROXIMATELY 30-FT BELOW BAY FLOOR. DEEPENING WOULD NOT CAUSE CONFLICT. CABLE WOULD NOT HAVE TO BE RELOCATED.

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Designed by: C.D.
Drawn by: C.D.
Checked by: C.D.
Scale:
Plot date:
Plot scale:
Dated: JULY 2002
GRR-ENGINEERING APPENDIX

File name: GRR-PLATE.dgn
Reference files: MIAMIHARBOR.DGN ALTERNATIVES.DGN G1502_SE.JPG S0236_CHOP.JPG

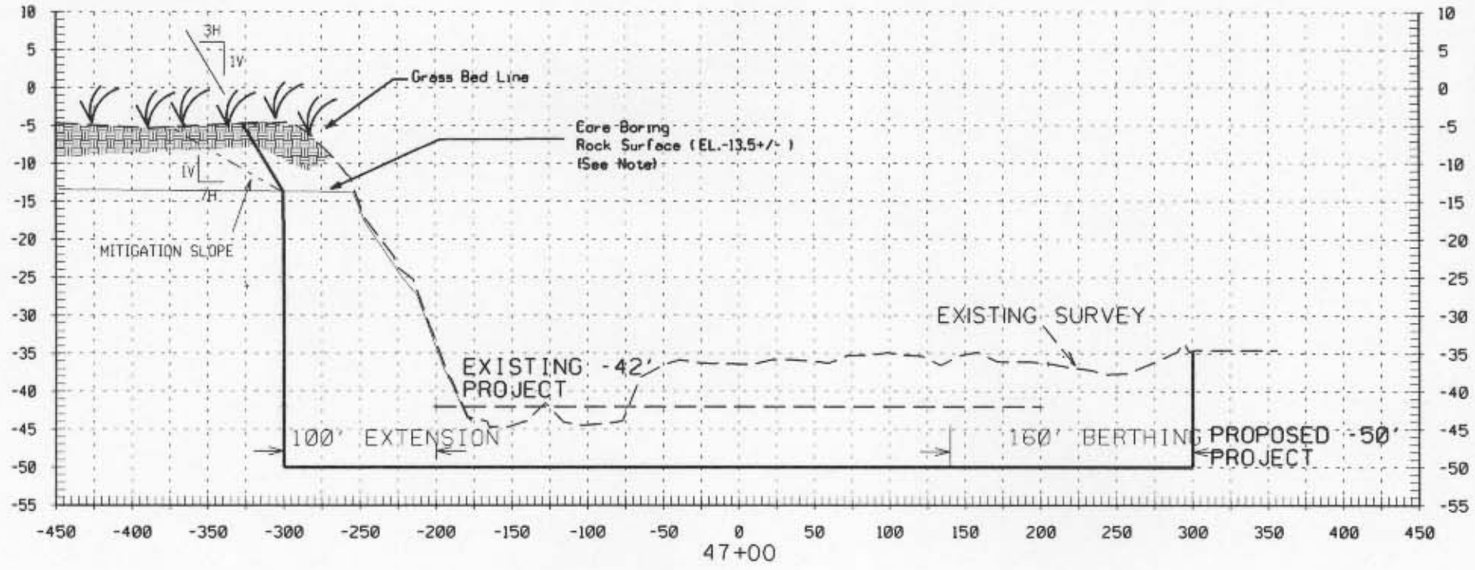
MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

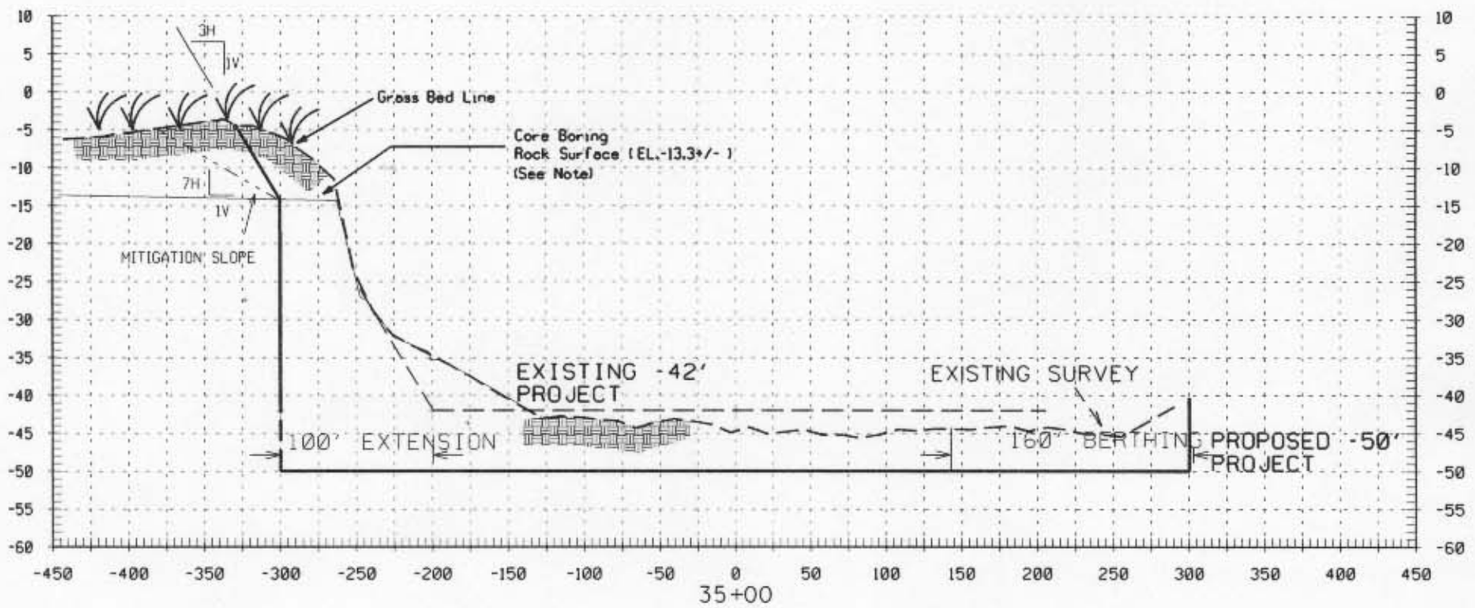
UTILITIES PRESENT BY PROJECT SEGMENT

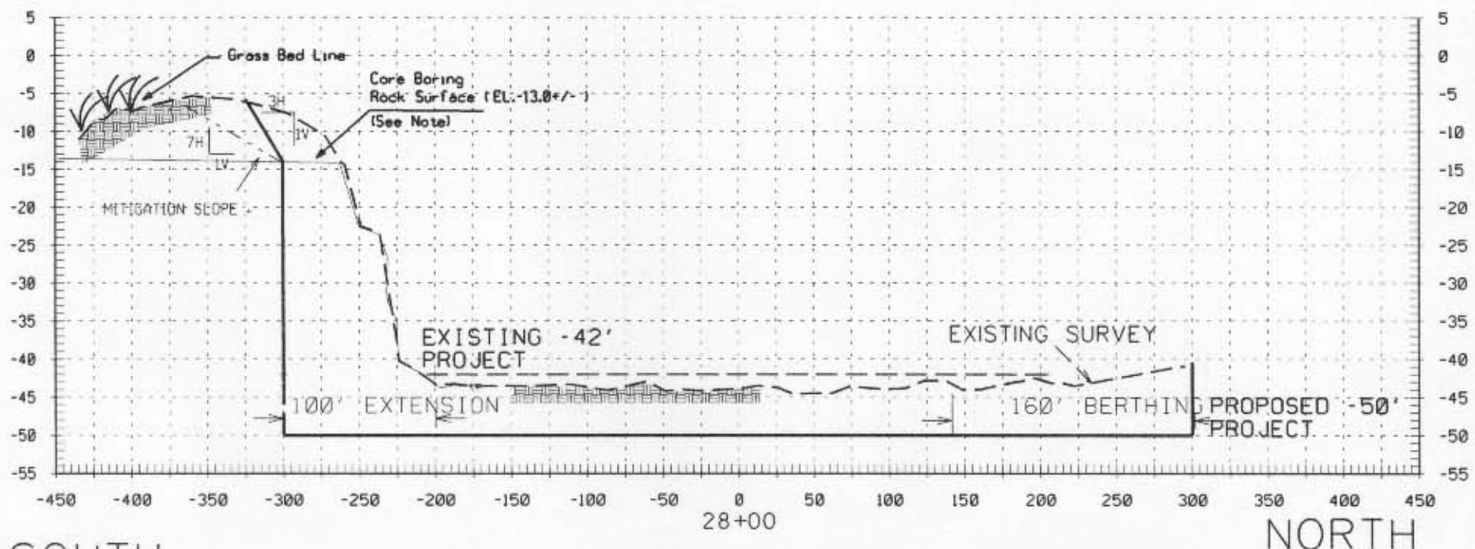
MECHANICAL AND ELECTRICAL

PLATE
B-18

SOUTH NORTH







SOUTH NORTH

FISHERMAN'S CHANNEL

Note: Approximate rock elevations estimated from core borings located in the vicinity of the typical sections. The approximate average elevation along Fisherman's Channel is estimated at El.- 12.

PLATE B-19

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT
TYPICAL SECTIONS
FISHERMAN'S CHANNEL

File name: TYP-XSCT.DGN
Reference files: TYPDR11X17.DGN
Designed by: R.E.H.
Drawn by: R.E.H.
Checked by:
Scale: AS SHOWN
Plot date:
Plot scale:
Dated:
D.C. FILE NO.

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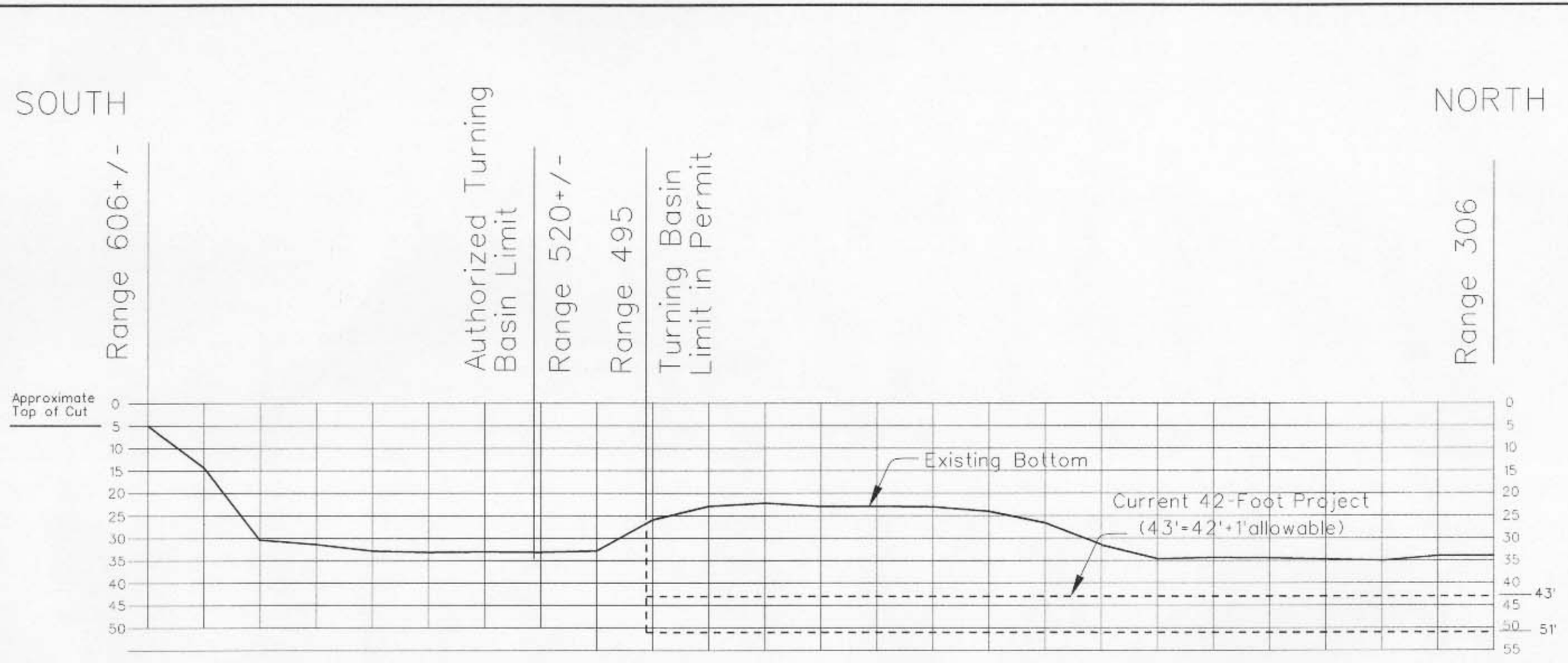

1500' - LUMMUS ISLAND TURNING BASIN
(STATION 22+95)

MIAMI HARBOR - PROPOSED DEEPENING PROJECT
(51' Depth = 50' Project Depth +1' Allowable Overdepth)

NOTE:
1. Deepening would be in rock, side slope would be generally vertical.
2. All depths refer to Mean Low Water (MLW) which is 0.81 feet below Mean Sea Level (MSL) NGVD 29.

0 25 50
SCALE IN FEET

US Army Corps of Engineers
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Designed by: W.E.H.
Drawn by: W.E.H.
Checked by:
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Scale: AS SHOWN
Plot date: 8/29/02
Plot scale:
File name:
Reference files:

Date: AUGUST 2002
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MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

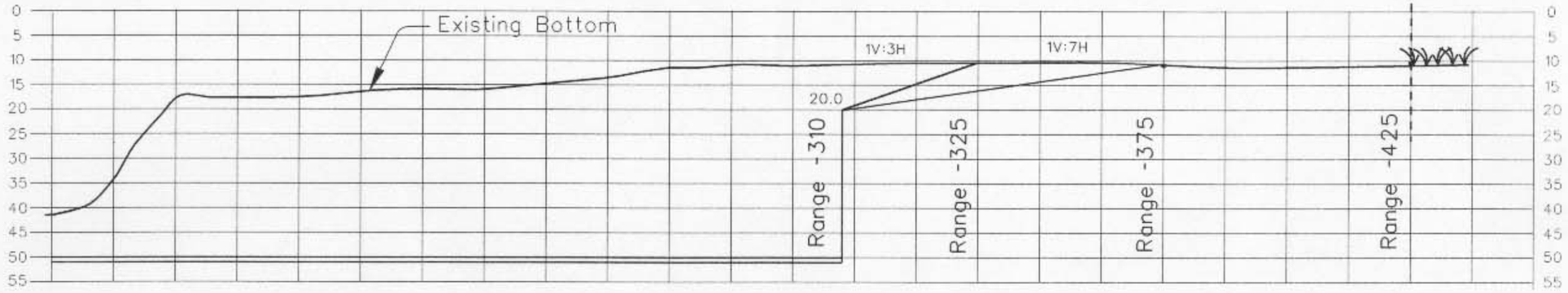
TYPICAL PARTIAL SECTION

LUMMUS ISLAND TURNING BASIN

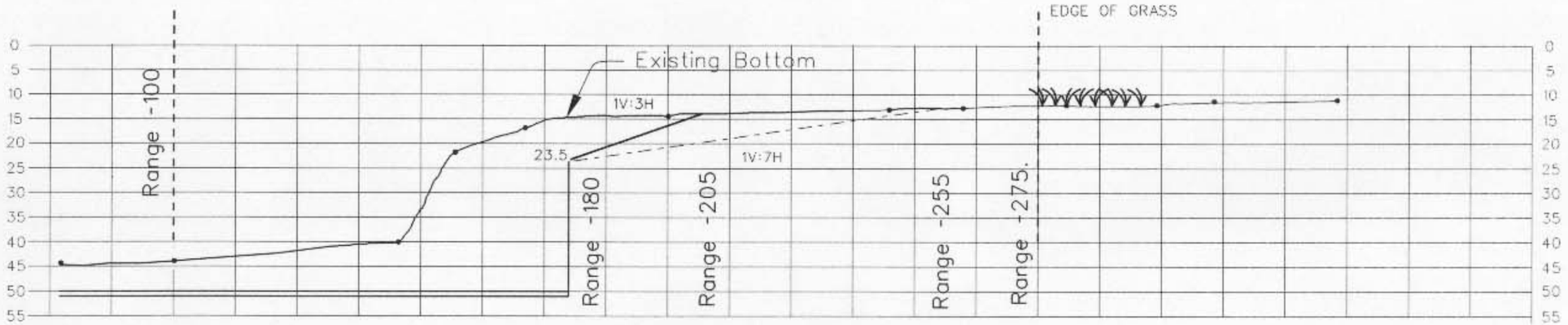
PLATE
B-20

South

EDGE OF GRASS North



1500' - FISHER ISLAND TURNING BASIN
(STATION 35+50)



1500' - FISHER ISLAND TURNING BASIN
(STATION 30+50)

50-FOOT PROJECT DEPTH + 1-FOOT ALLOWABLE OVERDEPTH

NOTE:
1. The side slope in rock would be approximately vertical.
2. All depths refer to Mean Low Water (MLW) which is 0.81 feet below Mean Sea Level (MSL) NGVD 29.

0 25 50
SCALE IN FEET

US Army Corps of Engineers
Jacksonville District

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JACKSONVILLE, FLORIDA

Scale: AS SHOWN
Plot date: 8/05/02
Plot scale
Designed by: R.E.H.
Drawn by: R.E.H.
Checked by:
Date: AUGUST 2002
GRR-ENGINEERING APPENDIX
File name
Reference files

MIAMI HARBOR, FLORIDA
GENERAL REEVALUATION REPORT

TYPICAL PARTIAL SECTION
FISHER ISLAND TURNING BASIN

PLATE
B-21

ATTACHMENT A

Velocity and Salinity Assessment

Miami Harbor Channel Deepening Velocity and Salinity Assessment
Phase 1: 2D Assessment

Investigators: Gary L. Brown (ERDC-CHL-MS)
William L. Boyt (ERDC-CHL-MS)
Mitch A. Granat (CESAJ-EN-HI)

Introduction

The Coastal and Hydraulics Laboratory (CHL) at ERDC has been tasked by the Army Corps of Engineers, Jacksonville District (CESAJ-EN-H) to perform a 2D numerical model study of the impacts of the proposed Miami Harbor deepening on velocities and salinity in Miami Harbor, and on velocities along the coastal ocean shoreline in the vicinity of Government Cut. The study had been conducted using a previously verified 2-dimensional TABS-MDS numerical model of Biscayne Bay and Miami Harbor. The computational mesh used for the Biscayne Bay study was refined in the vicinity of Miami Harbor, in order to more effectively capture the local bathymetry and currents.

This report details the boundary conditions used to drive the simulation, and the results of comparing the velocity and salinity fields obtained for the existing harbor configuration, to those obtained for the planned harbor configuration.

Model Mesh and Boundary Conditions

The model mesh for the entire model domain is given in Figure 1. The refined model mesh in the vicinity of Miami Harbor is given in Figure 2. The existing bathymetry in the harbor was updated to reflect the most recent survey data, given in Survey No. 01-097 (February-March 2001). Figure 3 shows the locations of the various harbor improvements. All 6 alternatives were implemented in the plan condition for this study. The specific changes associated with each alternative are given as follows:

- *Alternative 1:* widen seaward portion of Cut-1 from 500 feet to 800 feet and deepen Cut-1 and Cut-2 (existing depth = 44 feet, deepen to 52 feet)
- *Alternative 2:* Add turn widener between Buoy #13 and Buoy #15 (existing depth = 42 feet, deepen to 50 feet)
- *Alternative 3:* expand Fisher Island Turning Basin from 1200 feet to 1500 feet (existing depth = 42 feet, deepen to 50 feet)
- *Alternative 4:* relocate western end of the main channel to allow for additional cruise ship berths
- *Alternative 5:* widen Fisherman's Channel approximately 100 feet to the south (existing depth = 42 feet, deepen to 50 feet, deepening would include Cut-3 sta. 0+00 to cut-3 sta. 42+00)
- *Alternative 6:* deepen Dodge Island Cut and the proposed 1200 foot diameter turning basin from 32 and 34 feet to 36 feet and relocate western end of Dodge Island Cut to accommodate proposed port expansion.

The boundary conditions applied to the model represent typical conditions for the harbor. They do not represent a specific historical event. The boundary conditions consist of a tidal boundary specified at the ocean, a flow boundary specified at the Miami River, and a wind boundary specified at the water surface. There was no flow specified at any of the other 13 coastal structures: these flows were not deemed significant with respect to the investigation of changes in circulation and salinity in the vicinity of Miami Harbor.

The tidal boundary is taken from the NOAA tidal prediction at Virginia Key for August 2001 (this can be obtained at http://www.noaa.gov). The selection of August 2001 is arbitrary; the goal was merely to obtain a spring-neap sequence for the simulation. The NOAA tide data were multiplied by a factor of 1.27, in order to extrapolate the tide from Virginia Key to the offshore ocean boundary (this factor was obtained from the Biscayne Bay Feasibility Study, Brown et al., 2001). A time-series of the tide used for the investigation period is given in Figure 4 (note that this figure does not contain the tide used for the spin-up period, which consists of 14 days of simulation prior to the investigation period). A salinity boundary of 36 ppt was applied at the offshore ocean boundary.

There are 2 separate boundary conditions given for the flow boundary at the Miami River; a long term average flow condition (approximately 475 cfs) and a high flow hydrograph (6-day duration, with a maximum flow of 1,200 cfs). These are synthetic river hydrographs, estimated from historical data at salinity control structures S-25, S-25B and S-26, which control freshwater inflow to the Miami River. These flow boundary conditions are given in Figure 5. The inflow at the Miami River was assigned a salinity of 0 ppt.

A constant southeast wind of 10 mph was applied over the model.

Model Simulations

There were 5 simulations conducted for this study. They are as follows:

- *Run 1:* Average Flow, Existing Conditions, Original Geometry
- *Run 2A:* Average Flow, Existing Conditions, Refined Geometry
- *Run 2B:* Average Flow, Plan Conditions, Refined Geometry
- *Run 3A:* High Flow, Existing Conditions, Refined Geometry
- *Run 3B:* High Flow, Plan Conditions, Refined Geometry

The original geometry represents the grid geometry for the Biscayne Bay study (i.e. before refinement in Miami Harbor). The original geometry consists of 24,527 nodes and 8,536 elements. The refined geometry consists of 28,613 nodes and 10,003 elements (i.e., +4,086 nodes and +1,467 elements)

The simulations were conducted for a total of 28 days. The first 14 days were used for model "spin-up", and the remaining 14 days were used for model comparisons. Only

data related to the last 14 days of the simulation (the investigation period) are illustrated and analyzed in this report.

Results

The model was run for all 5 simulations. Data were extracted for the following quantities, and used to generate vector and contour plots:

- A representative maximum ebb condition (chosen at hour 65)
- A representative maximum flood condition (chosen at hour 71)
- The velocity residuals, or the time-averaged velocities, averaged over the 14 day simulation
- The salinity residuals, or the time-averaged salinities, averaged over the 14 day simulation

The representative maximum ebb and flood conditions were chosen at a period mid-way between the neap and spring tides. Hence they represent an average tidal condition.

Additional data were extracted at selected locations in the vicinity of Miami Harbor, and used to generate time-history plots of velocity, water volumetric flux, and salinity. These locations were chosen as follows: the vector and contour plots were inspected to determine locations where maximum change is observed between the existing and plan conditions, and locations where volumetric flux measurements can be accurately calculated. This inspection yielded the following locations of interest:

- *Point 1 and Range 1*: These are located inside Government Cut. Velocity and salinity data were extracted at Point 1 (located at the channel centerline, with existing and plan condition depths of 44 and 52 feet MLLW, respectively), and volumetric flux data were extracted across Range 1.
- *Point 2 and Range 2*: These are located inside Fisherman's Channel. Velocity and salinity data were extracted at Point 2 (located at the channel centerline, with existing and plan condition depths of 42 and 50 feet MLLW, respectively), and volumetric flux data were extracted across Range 2.
- *Point 3 and Range 3*: These are located inside the western end of the Main Channel, north of Dodge Island. Velocity and salinity data were extracted at Point 3 (located at the channel centerline, with identical existing and plan condition depths of 40 feet MLLW), and volumetric flux data were extracted across Range 3.
- *Point 4 and Range 4*: These are located at the western end of Dodge Island northwest of the Dodge Island turning basin. Velocity and salinity data were extracted at Point 4 (located at the Intracoastal Waterway channel centerline, with identical existing and plan condition depths of approximately 10 feet MLLW), and volumetric flux data were extracted across Range 4.
- *Point 5*: This is located south of Dodge Island, near the proposed Dodge Island Cut Turning Basin. Salinity data were extracted at Point 5 (with existing and plan condition depths of 34 and 36 feet MLLW, respectively).

- *Point 6*: This is located north of Miami Harbor, just north of Biscayne Island. Salinity data were extracted at Point 6 (with identical existing and plan condition depths of 7 feet MLLW).

The locations of these points and ranges are given in Figure 6.

Verification Check

Run 1 and Run 2A were compared to determine if the refined grid adequately replicates the results obtained with the original grid. To make this determination, the maximum ebb velocities, maximum flood velocities, and residual salinities from each of the runs were compared. The average difference in the maximum ebb velocities between the runs is –0.0079 ft/sec (with a standard deviation of 0.109 ft/sec). The average difference in the maximum flood velocities is 0.0083 ft/sec (with a standard deviation of 0.126 ft/sec). The average difference in the residual salinities is 0.015 ppt (with a standard deviation of (1.41 ppt). There are some local spurious differences in the vicinity of the harbor, which are mostly due to small changes in the shoreline contour and bathymetry between the grids (note that the bathymetry was updated in the harbor for the refined grid). Since the ebb and flood velocity fields and the residual salinity field were found to be in close agreement, it was determined that the refined grid was satisfactory.

Velocity Plot Comparisons

Figures 7-18 are plots of velocities. Note that the velocity scale (vector length) for Figures 13-18 (residual velocity plots) is 3 times larger than the scale for Figures 7-12 (ebb/flood velocity plots). This was done because the residual velocities given in Figures 13-18 are of smaller magnitude than the ebb and flood velocities given in Figures 7-12.

The maximum ebb and flood velocity comparisons are given for the average flow condition only. Residual velocity comparisons are given for the average flow and the high flow conditions.

All velocity differences are given as plan minus existing.

> Maximum Ebb: The maximum ebb velocities for the existing and plan conditions are given in Figures 7 and 8, and the ebb velocity differences are given in Figure 9. The maximum difference occurs in Government Cut, with differences observable in Fisherman's Channel and Dodge Island Cut. All differences are on the order of 1 ft/sec or less. There are no observable ebb flow differences along the coastline.*

* These simulations were not designed to include coastal processes such as littoral currents, and hence any assessment of the impact of harbor deepening on coastal currents should be made with an understanding of this limitation.

Two points of interest regarding maximum ebb velocity vector results include the noticeable change in ebb velocities west of Dodge Island (no deepening in this location) illustrated between Figures 7 (existing condition) and 8 (plan condition) and the resulting direction of ebb velocity differences in Figure 9. The existing and plan ebb conditions each indicate flows to the north at this location towards the north side of Dodge Island. Maximum ebb velocity magnitudes for the plan condition are reduced relative to the existing condition, possibly as a result of deeper depths and related higher transport along Fisherman Channel (south side of Dodge Island).

As illustrated in Figure 9, plan minus existing condition ebb velocity magnitude differences results in the direction of the difference vectors seeming to be in the opposite flow direction, i.e., in this case, towards the south. This is a result of the "plan minus existing condition" calculation convention, i.e., when the plan condition velocity is reduced relative to the existing condition velocity, the difference vector results in an apparent negative result, or in this case, with flow to the south.

This calculation convention artifact similarly explains the apparent direction contradiction illustrated at most of the remaining ebb vector differences illustrated in Figure 9, i.e., plan condition velocity is reduced relative to existing condition velocity. The fact that velocity did not change in the main harbor channel along the north side of Dodge and Lummus Islands (this portion of channel was not deepened for the plan condition) supports the assumption that additional transport occurs along the deepened plan channel to the south along Fisherman Channel.

Maximum Flood: The maximum flood velocities for the existing and plan conditions are given in Figures 10 and 11, and the flood velocity differences are given in Figure 12. There are differences observable in Government Cut, Fisherman's Channel and Dodge Island Cut. The differences are generally smaller than the maximum ebb differences (Figure 9). All flood differences are on the order of 1 ft/sec or less. Similar findings of interest as described above (with respect to ebb flow) are also evident in the flood flow analysis. Also, there are no observable flood flow differences along the coastline.*

Residual Velocities (Average Flow Hydrograph): The residual velocities for the existing and plan conditions are given in Figures 13 and 14, and the residual velocity differences are given in Figure 15. The residual velocity vectors illustrate the 14-day tidal cycle average, or net non-tidal circulation characteristics. Generally similar flow patterns are illustrated for the existing (Figure 13) and plan (Figure 14) conditions, i.e., Government Cut has a net outflow while Norris Cut has a net inflow and the locations of vortices (ocean north of Government Cut and west of Dodge Island) are similarly located. The vortices on the south side of

* These simulations were not designed to include coastal processes such as littoral currents, and hence any assessment of the impact of harbor deepening on coastal currents should be made with an understanding of this limitation.

Dodge Island, however, appear to be better formed or resolved in the plan condition. As indicated in Figure 15 (residual velocity differences, average flow condition), a weak vortex is observable in the Fisher Island Turning Basin and the proposed Dodge Island Turning Basin. All the differences are on the order of 0.2 ft/sec or less. Again, no observable differences are identified along the coastline*.

Residual Velocities (High Flow Hydrograph): The residual velocities for the existing and plan conditions are given in Figures 16 and 17, and the residual velocity differences are given in Figure 18. The differences are nearly identical to those observed for the average flow hydrograph (Figure 15).

Velocity and Volumetric Flux Time-History Comparisons

Figures 19 – 22 give velocity time-history comparisons between the existing and plan conditions for Points 1 – 4, and volumetric flux time-history comparisons between the existing and plan conditions for Ranges 1 – 4 (as depicted in Figure 6). In order make it easy to observe differences between the existing condition and plan condition, the time-history plots are only given for days 4 – 10 of the investigation period. The time-history plots are given for the average flow condition only. For each plot, ebb velocity is defined as positive, and flood velocity is defined as negative.

A summary of some of the observed differences between the time-histories for the existing and plan conditions in Figures 19 – 22 are given in Table 1:

Table 1: Approximate Changes In Maximum Velocity and Volumetric Flux (Plan Minus Existing) at Points 1 – 4 and Ranges 1 – 4

Point/Range	Maximum Ebb Velocity Change (ft/sec)	Maximum Flood Velocity Change (ft/sec)	Maximum Ebb Volumetric Flux Change (cfs)	Maximum Flood Volumetric Flux Change (cfs)
1	-0.4	-0.1	+10000	+12000
2	---	+0.4	+15000	+19000
3	-0.1	-0.3	-2000	-7000
4	-0.7	-0.5	-2000	-3000

The time-history analysis indicates that the proposed deepening will result in slightly reduced maximum ebb velocity at Point 1 in Government Cut and a slightly increased flood velocity at Point 2 in Fisherman's channel. The proposed deepening will also result in a slight increase in the volume of flow through Government Cut (Range 1; an increase of about 5%) and Fisherman's Channel (Range 2; an increase of about 25%). Also, it will serve to divert water fluxing through the western side of Dodge Island (Range 4) and the Main Channel (Range 3) to Fisherman's Channel. The maximum velocity changes are observed at Point 4/Range 4, where a local stagnation effect appears to be amplified by the proposed deepening. Also, a phase difference between the existing and plan conditions is apparent at Point 4/Range 4, with the phase for the plan condition lagging the phase for the existing condition by approximately 2 hours.

Salinity Plot Comparisons

Figures 23 –28 are plots of residual (average) salinity and residual salinity differences. Note that the salinity scale for Figures 23, 24, 26, and 27 ranges from 0 to 36 ppt, whereas the scale for Figures 25 and 28 (the difference plots) range from –0.5 to 0.5 ppt.

Average Flow Condition: The residual salinities (i.e. 14-day average salinities) for the existing and plan conditions are given in Figures 23 and 24, and the salinity differences are given in Figure 25. The maximum differences are observed just west of Dodge Island Cut, with differences observable in Fisherman's Channel, the western end of the main channel, and to the northwest of the main channel. The maximum and minimum salinity differences for the average flow condition are 0.97 ppt and -0.90 ppt, respectively.

Based on Figures 23 and 24, residual salinity conditions indicate that for the plan condition residual salinity appears to intrude further west along the main navigation channel on the north side of Lummus and Dodge Island and north of Watson Island into Northern Biscayne Bay. Residual salinity intrusion on the south side of Lummus/Dodge Island appears to be somewhat reduced for the plan condition. This affect is better illustrated in Figure 25 (residual salinity differences) where residual salinity difference increases up to +0.3 to +0.4 ppt are indicated north of Lummus/Dodge and Watson Islands and +0.2 to +0.3 ppt north of Biscayne Island. The largest reduced residual salinity difference, -0.4 to –0.5 ppt, is indicated along the south and west side of Dodge/Lummus Island. The largest increased salinity differences are located just north of Miami River further to the west of Dodge Island.

High Flow Condition: The residual salinities for the existing and plan conditions are given in Figures 26 and 27, and the salinity differences are given in Figure 28. The salinity differences exhibit a similar pattern to that observed for the average flow condition, but the impacts are more pronounced. The maximum and minimum residual salinity differences for the high flow condition are 0.97 ppt and –1.04 ppt, respectively.

Salinity Time-History Comparisons:

Figures 29 – 34 give salinity time-history comparisons between the existing and plan conditions for Points 1 – 6 (as depicted in Figure 6). The plots contain time-history comparisons for both the average flow condition and the high flow condition. A summary of some of the observed differences between the time-histories for the existing and plan conditions in Figures 29 – 34 are given in Table 2. These are given together with residual difference values taken from Figures 25 and 28:

Table 2: Approximate Changes In Salinity (Plan Minus Existing) at Points 1 – 6

Point	Maximum salinity change, average flow (ppt)	14- day residual salinity change, average flow (ppt)	Maximum salinity change, high flow (ppt)	14- day residual salinity change, high flow (ppt)
1	---	---	-0.2	-0.1
2	-0.3	-0.05	-0.6	-0.15
3	+0.7	+0.3	+1.0	+0.45
4	+1.0	+0.5/-0.5	+3.0	+0.7/-0.7
5	-0.2	-0.1	-0.5	-0.2
6	+0.5	+0.25	+0.6	+0.35

The values given in Table 2 are useful for showing the relative impact of deepening on the salinity at Points 1 – 6. However, an examination of the plots is necessary in order to properly interpret these results. Figure 29 shows that there is negligible change observed at Point 1 (Government Cut). Figure 30 shows that some change is observed at Point 2 (Fisherman's Channel) at maximum ebb, with the plan condition exhibiting lower salinity (i.e. increased freshwater) than the existing condition. This is consistent with the diversion of flow out of the Miami River from the Main Channel to Fisherman's Channel (see previous discussion of volumetric flux). The opposite effect is observed in Figure 31 at Point 3 (western end of Main Channel), which is consistent with the decrease in flow from the Miami River observed at this location. Figure 32 (Point 4, west of Dodge Island) depicts a decrease in salinity amplitude for the plan condition, which is consistent with the decreased volumetric exchange noted in the previous discussion. Also, the phase lag noted previously is apparent here. These factors may account for the appearance of the large positive and negative residual salinity differences observed in this location (see Figures 25 and 28). Figure 33 (Point 5, south of Dodge Island) shows some decrease in the salinity and salinity amplitude for the plan condition. This is especially evident for the high flow run. Figure 34 (Point 6, North of Miami Harbor) exhibits a tendency for the salinity to increase for the plan condition, but during the spring tide the difference is negligible (there is a difference observed for the high flow runs, but this is because the peak flow in the Miami River for this run coincides with the spring tide). Evidently, the additional tidal exchange that occurs during spring tide tends to increase mixing, and hence the impacts of the planned deepening on the salinity north of the harbor are less pronounced for the spring tide.

Conclusions:

The maximum ebb and flood velocity comparisons yield maximum differences between the existing and plan conditions that are on the order of 0.5 ft/sec. These differences occur primarily in Government Cut, Fisherman's Channel and Dodge Island Cut. The residual velocity difference comparisons show that a weak residual vortex appears in both the Fisher Island and proposed Dodge Island Turning Basins. These vortices have velocities of less than 0.2 ft/sec. The time-history analysis indicates that the channel deepening tends to divert some tidal flow from the Main Channel to Fisherman's channel. Also, a tidal amplitude attenuation and a phase lag of approximately 2 hours are observed

for the plan condition west of Dodge Island. There is no observable impact on the Atlantic Ocean shoreline tidal velocities in any of the simulations.*

Subtle differences in salinity were identified between existing and plan channel conditions. These changes are close to detection limits and confidence levels of present field data collection capability and associated model assessments. The salinity comparisons yielded maximum salinity differences on the order of 1.0 ppt. The maximum differences occur just west of Dodge Island Cut, with differences observable in Fisherman's Channel, the western end of the main channel, and to the northwest of Miami Harbor. The differences observed west of Dodge Island may be influenced by the attenuated tidal amplitude and tidal phase lag induced by the channel deepening. The influence of channel deepening on the salinity north of Miami Harbor appears to be most pronounced during neap tides.

* These simulations were not designed to include coastal processes such as littoral currents, and hence any assessment of the impact of harbor deepening on coastal currents should be made with an understanding of this limitation.

Figure 1: Entire TABS-MDS Mesh

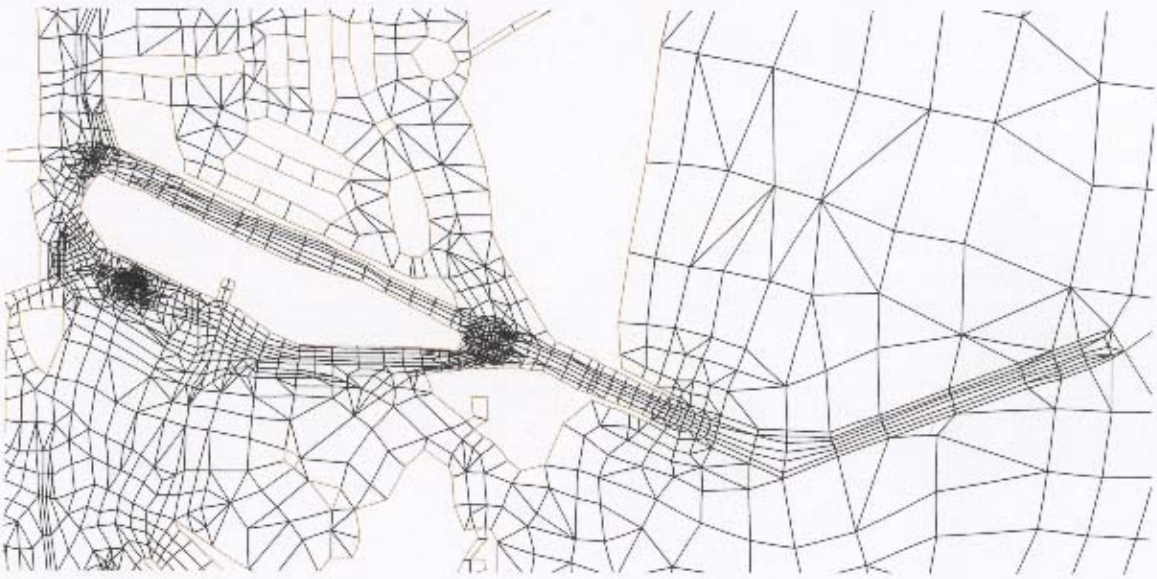


Figure 2: Finite Element Grid in the Vicinity of Miami Harbor

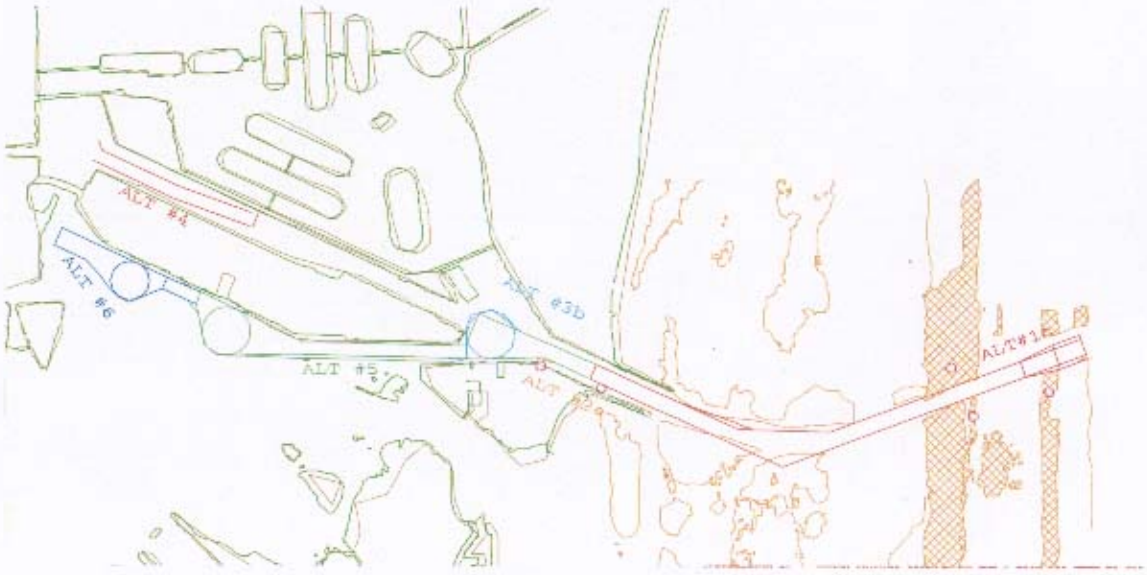


Figure 3: Deepening Plan for Miami Harbor

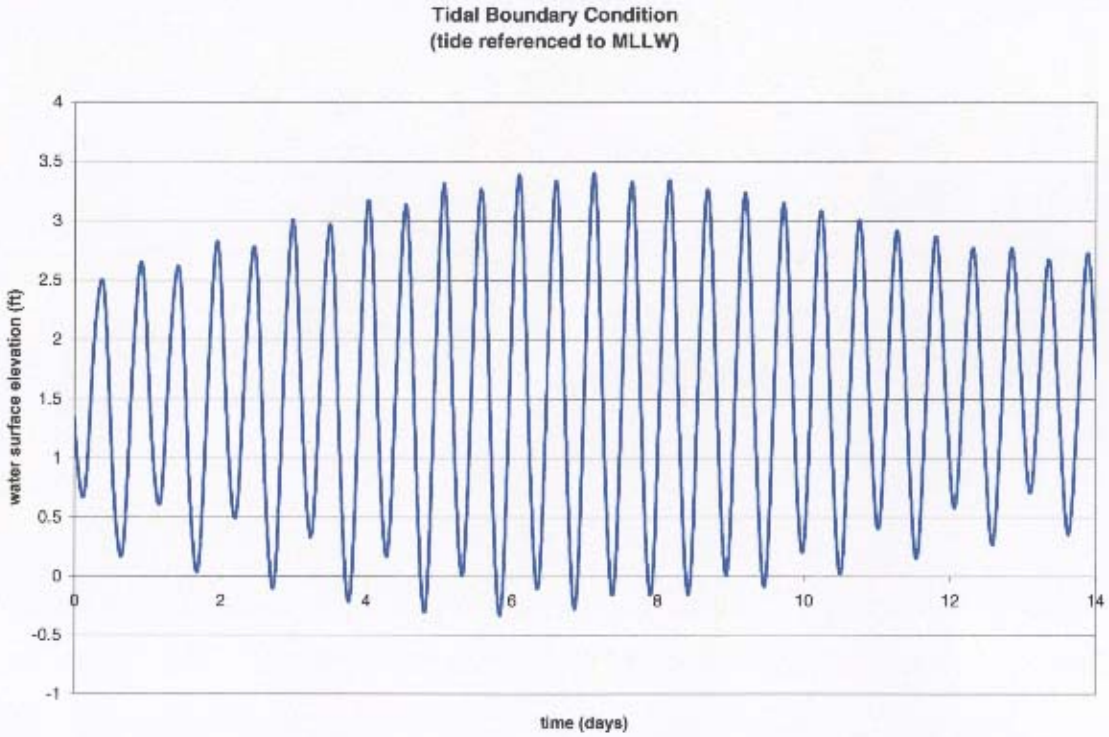


Figure 4: Tidal Boundary Condition for Miami Harbor Deepening Study

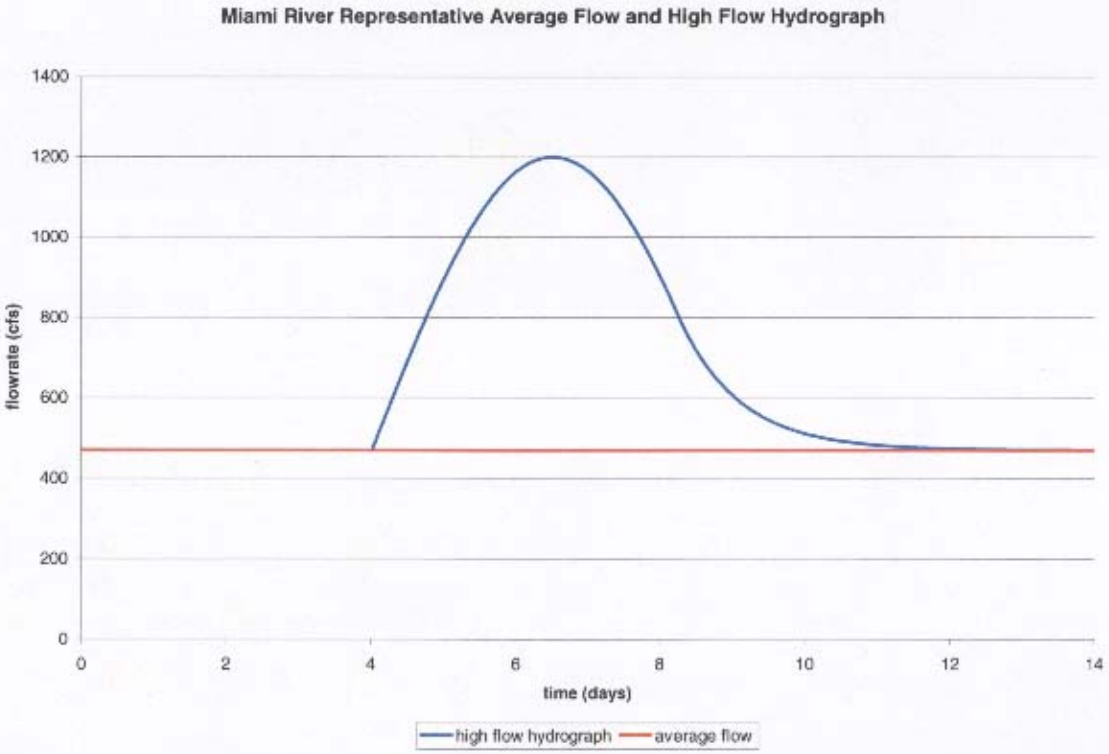


Figure 5: Miami River Flow Boundary Conditions for Miami Harbor Deepening Study

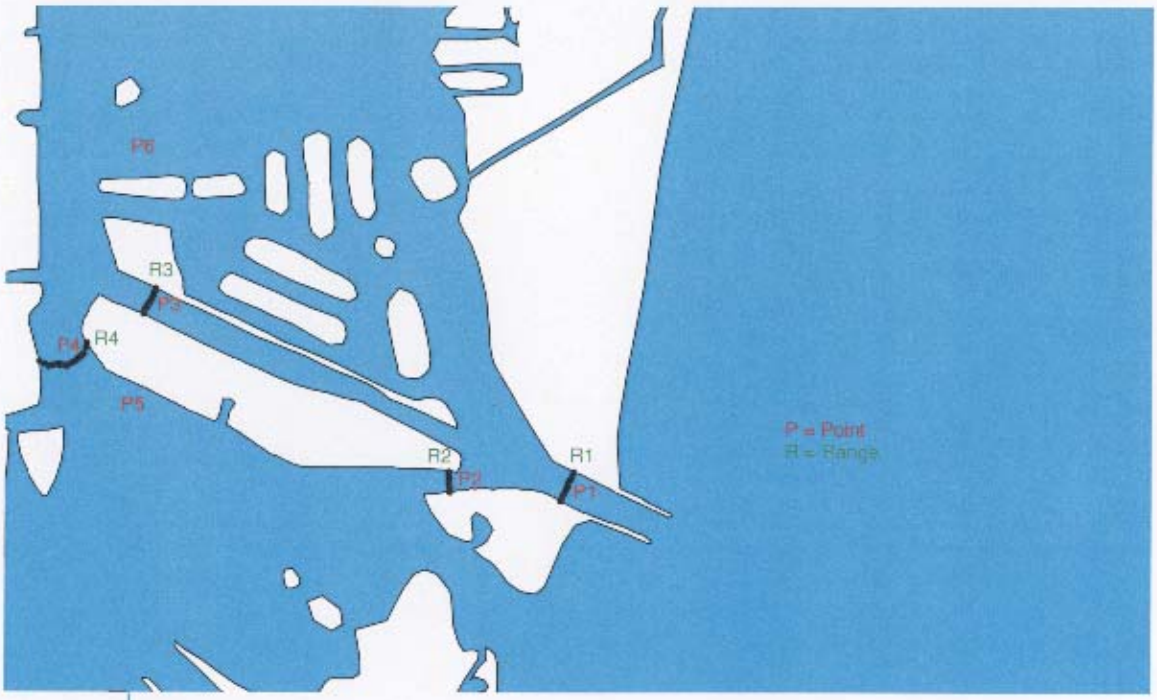


Figure 6: Locations of Observation Points and Ranges

Figure 7: Maximum Ebb, Existing Conditions

Figure 8: Maximum Ebb, Plan Conditions

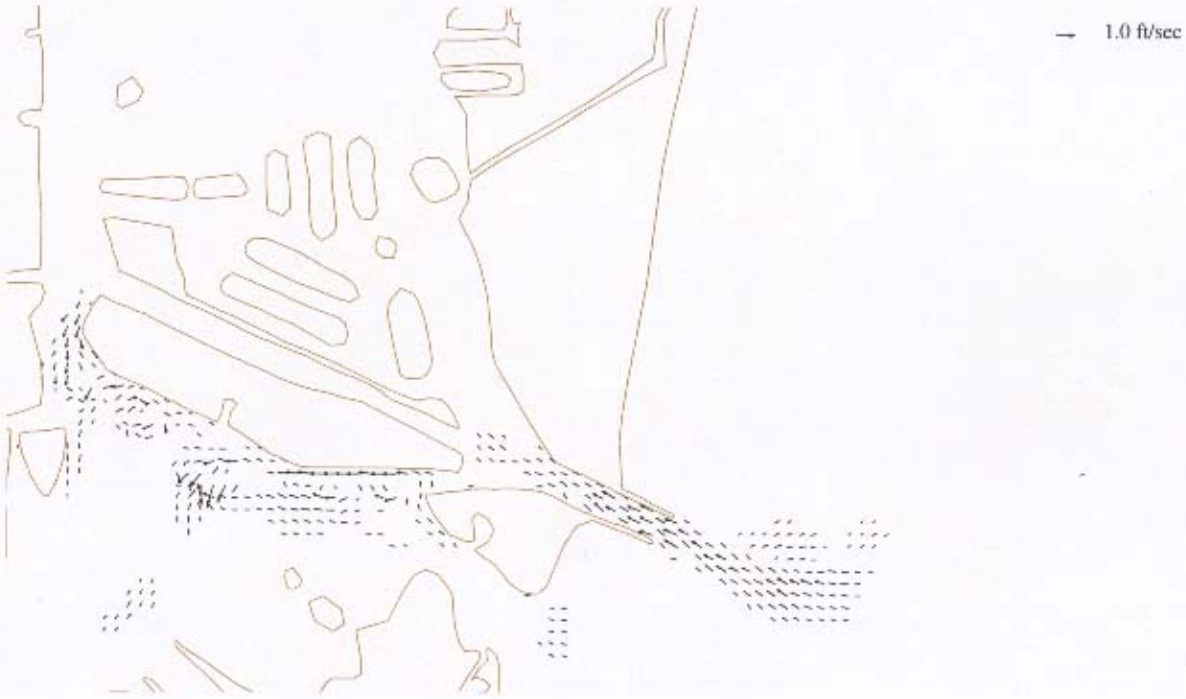


Figure 9: Ebb Velocity Difference (Plan – Existing)

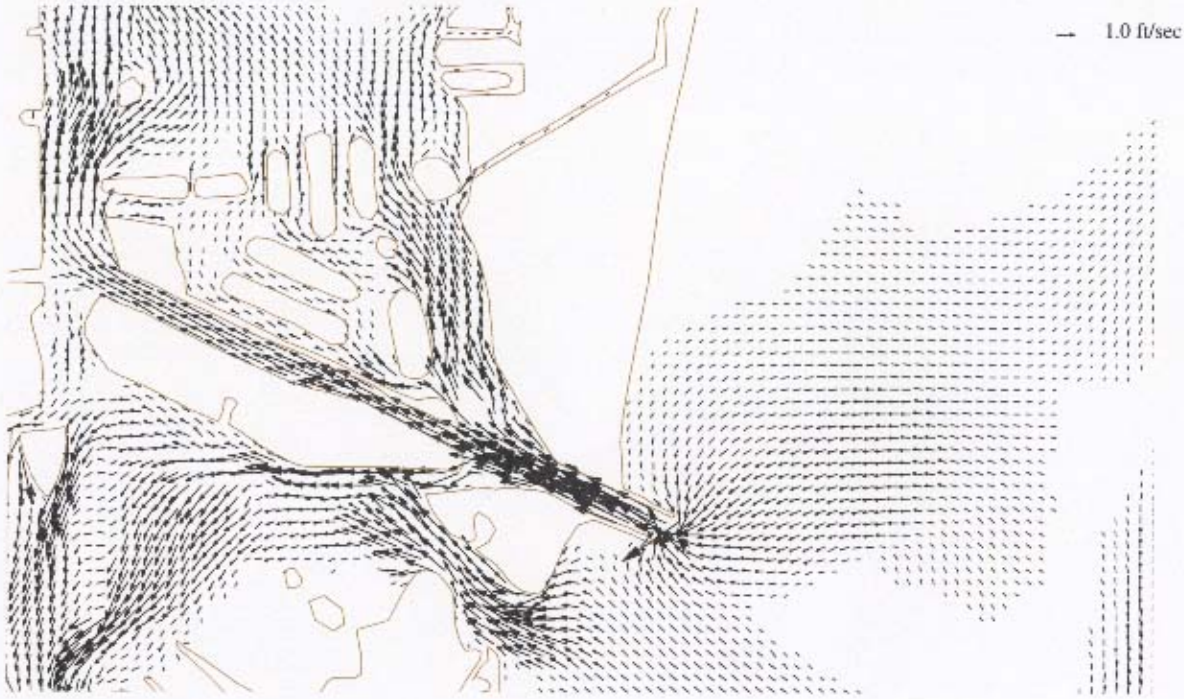


Figure 10: Maximum Flood, Existing Conditions

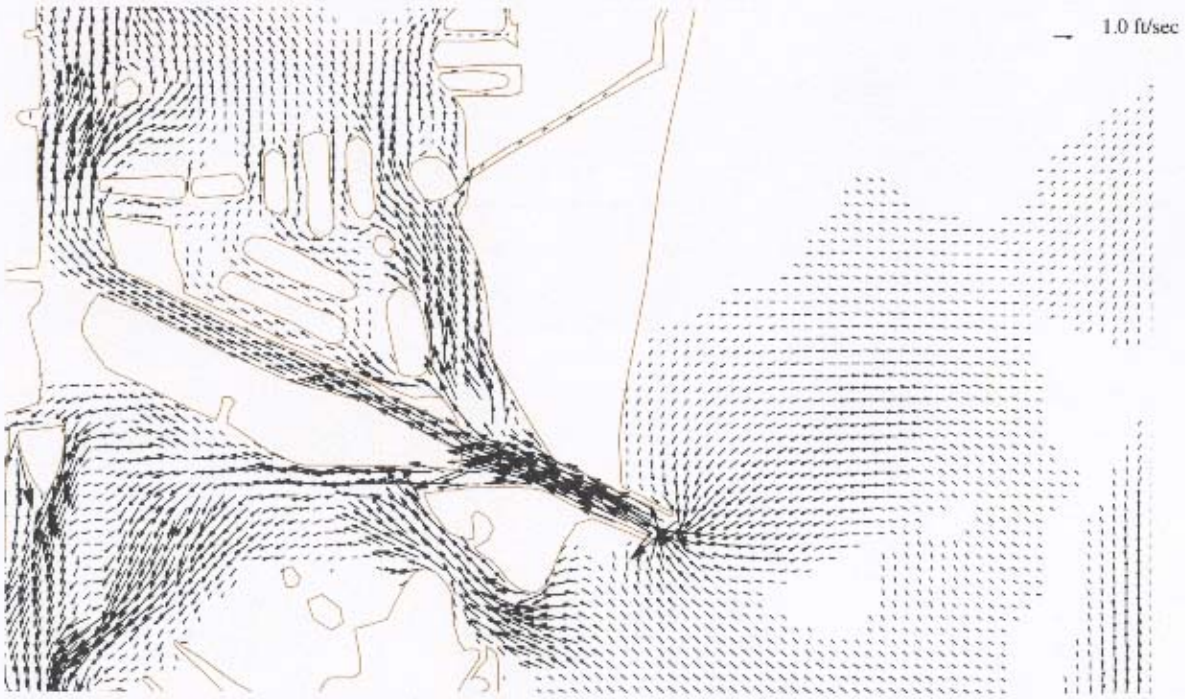


Figure 11: Maximum Flood, Plan Conditions

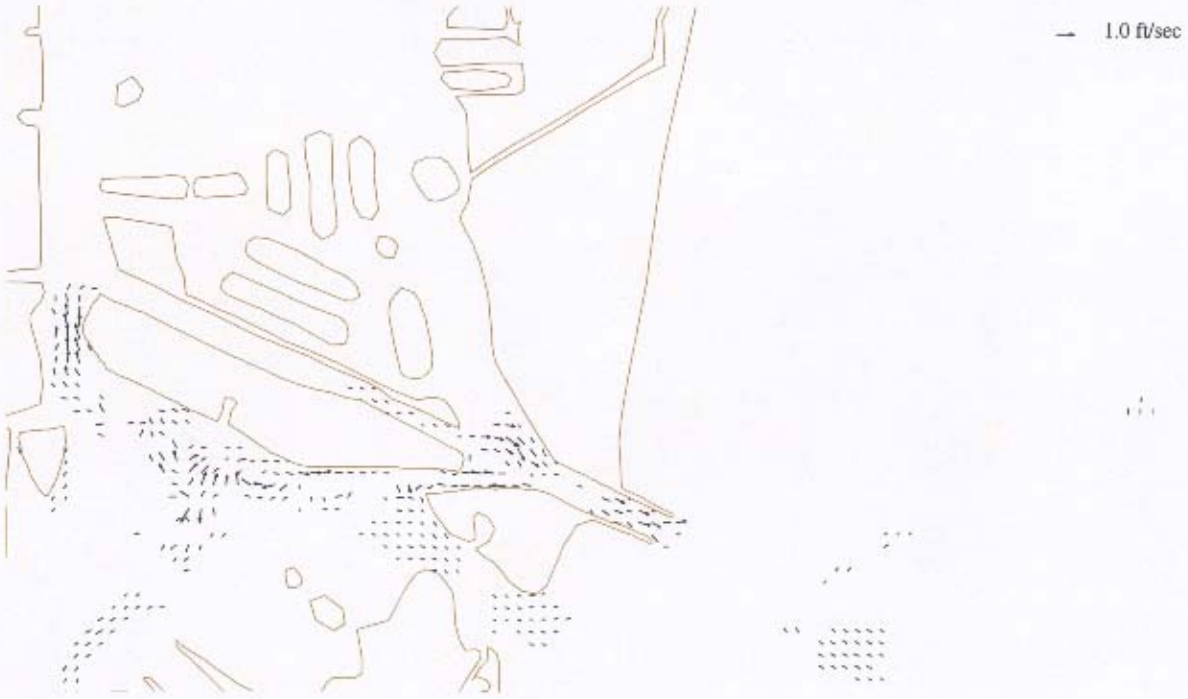


Figure 12: Flood Velocity Difference (Plan – Existing)

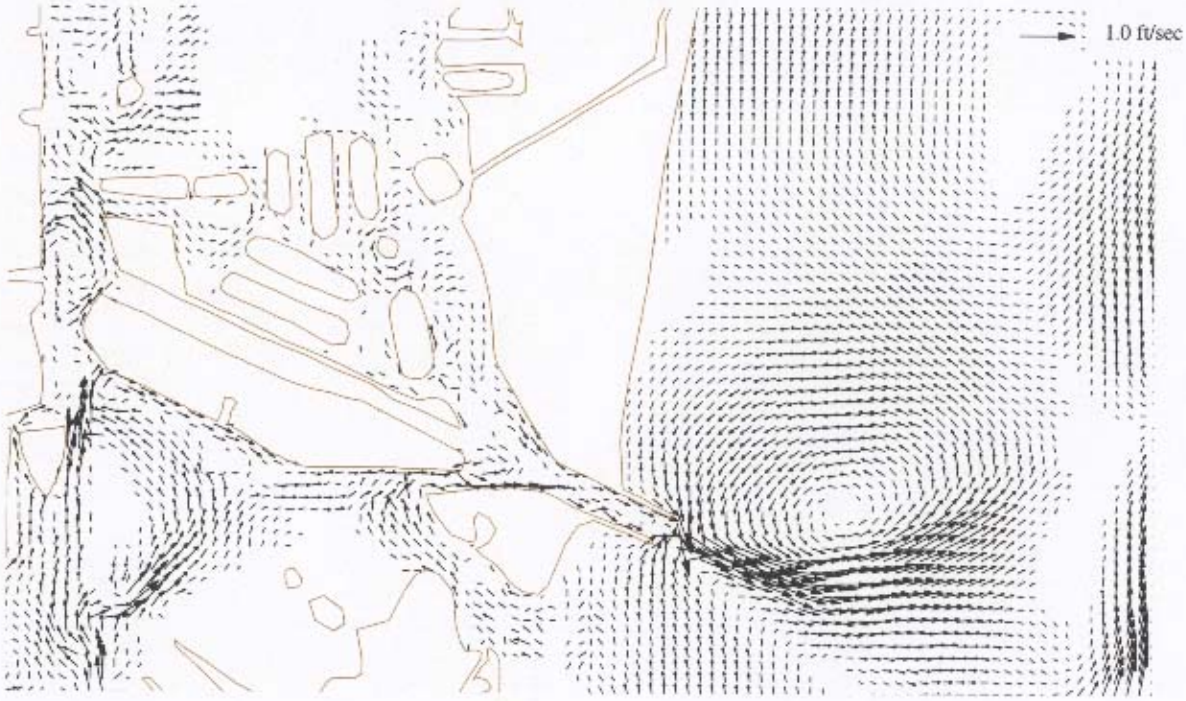


Figure 13: Residual Velocities, Existing Conditions, Average Flow Hydrograph

Figure 14: Residual Velocities, Plan Conditions, Average Flow Hydrograph

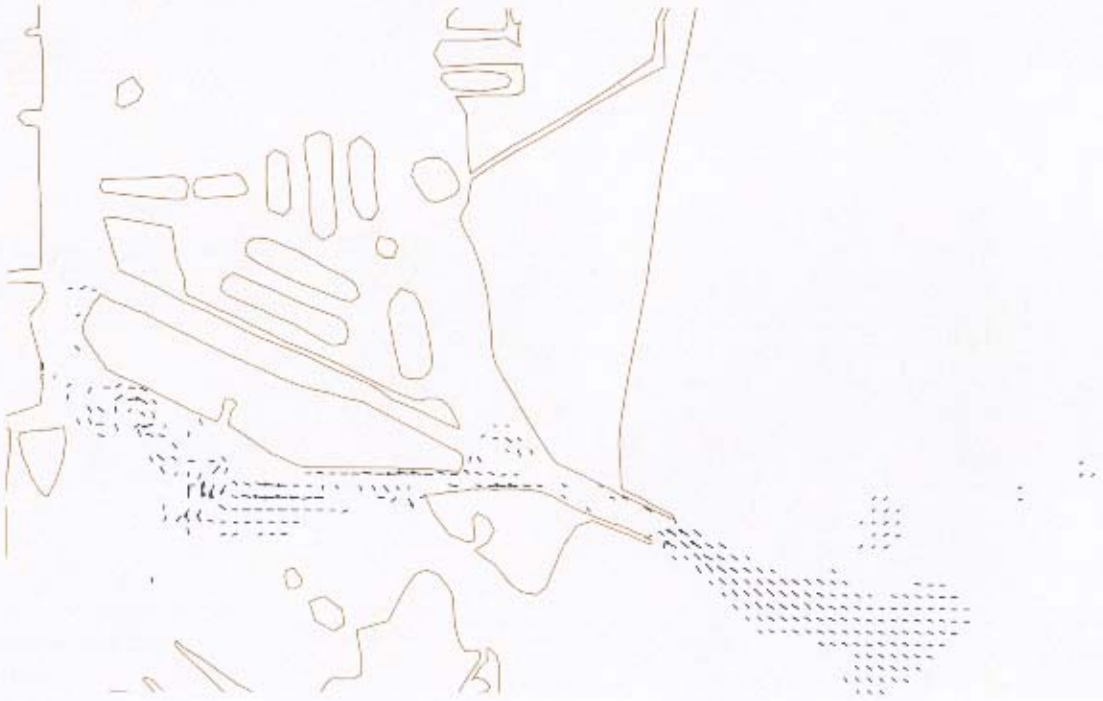


Figure 15: Residual Velocity Difference, Average Flow Hydrograph

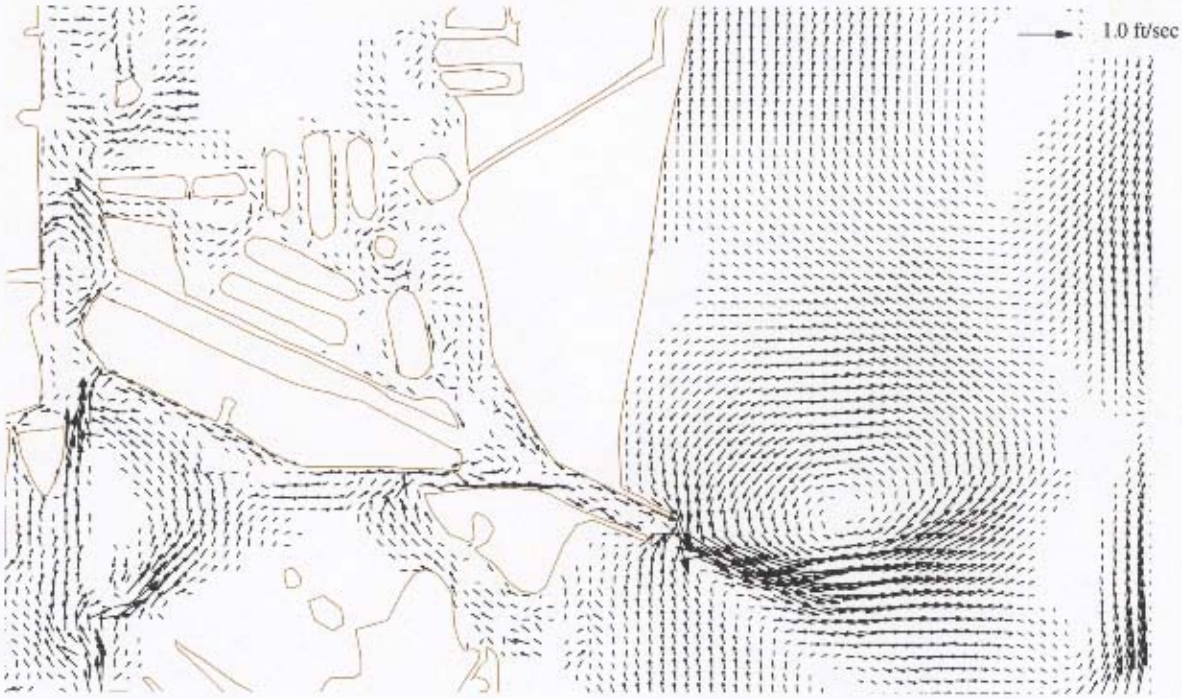


Figure 16: Residual Velocities, Existing Conditions, High Flow Hydrograph

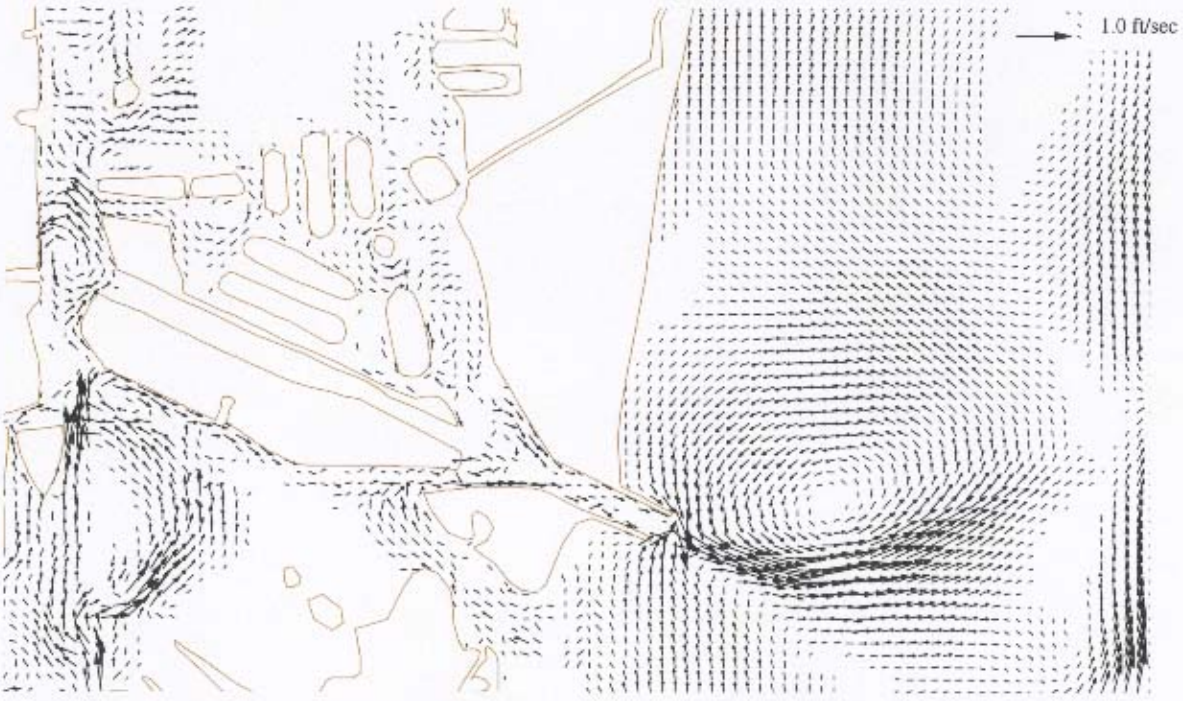


Figure 17: Residual Velocities, Plan Condition, High Flow Hydrograph

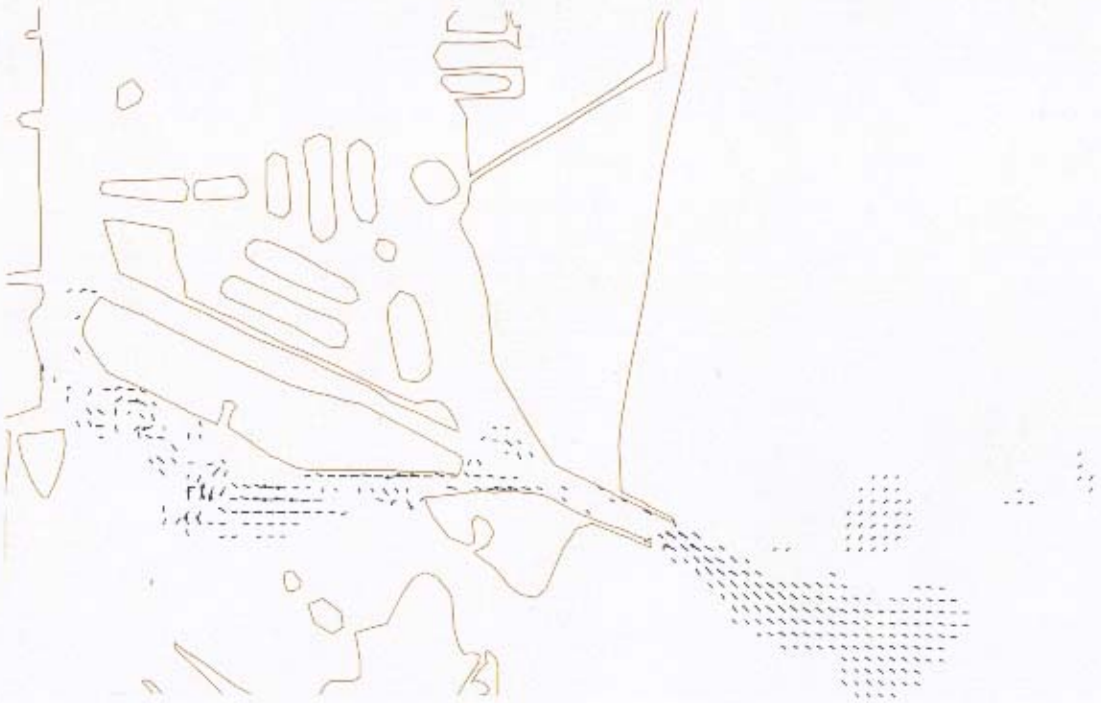


Figure 18: Residual Velocity Difference, High Flow Hydrograph

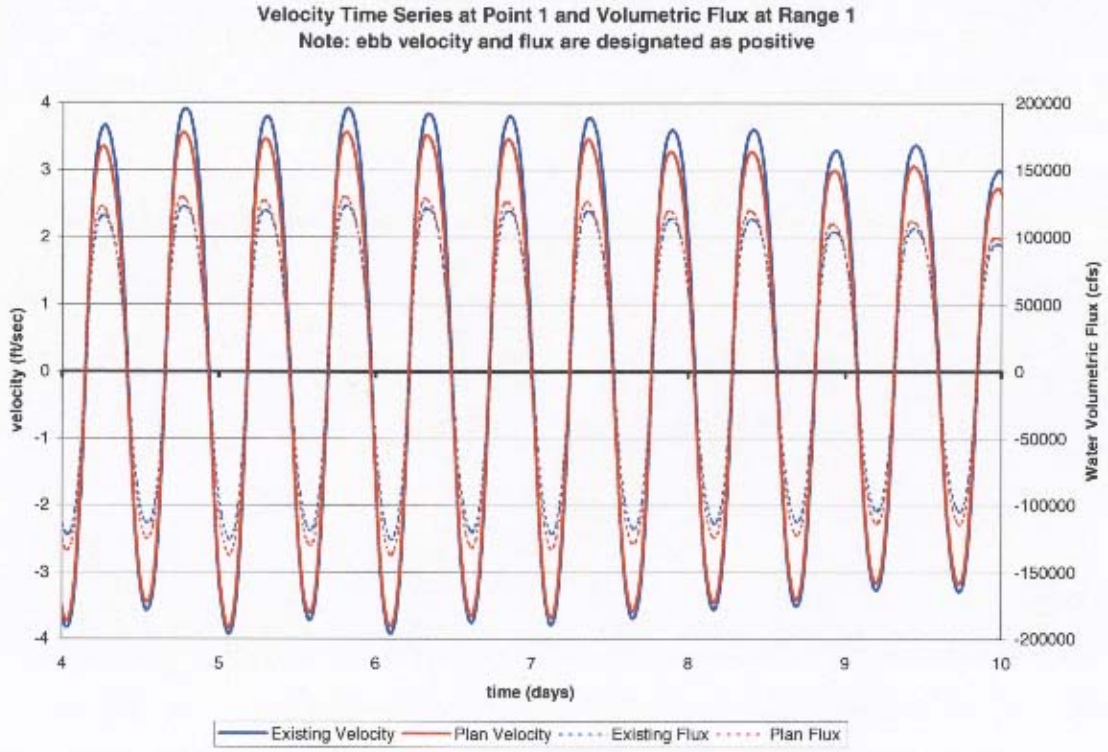


Figure 19: Velocity and Volumetric Flux Time History for Point/Range 1

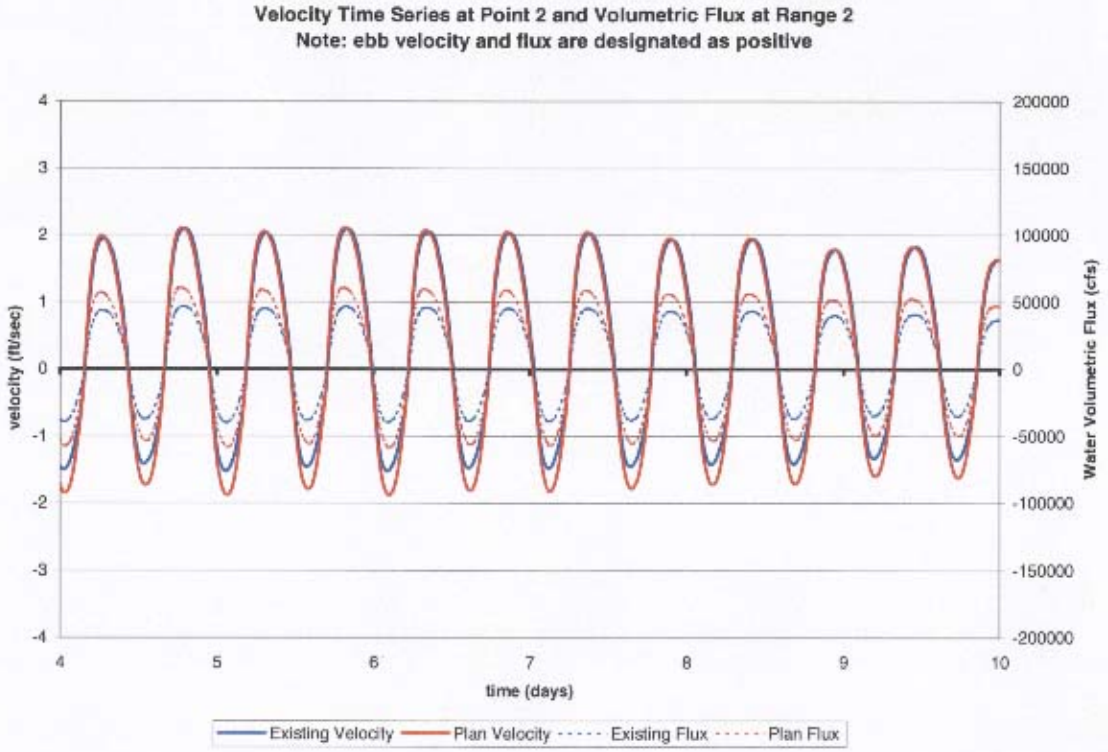


Figure 20: Velocity and Volumetric Flux Time History for Point/Range 2

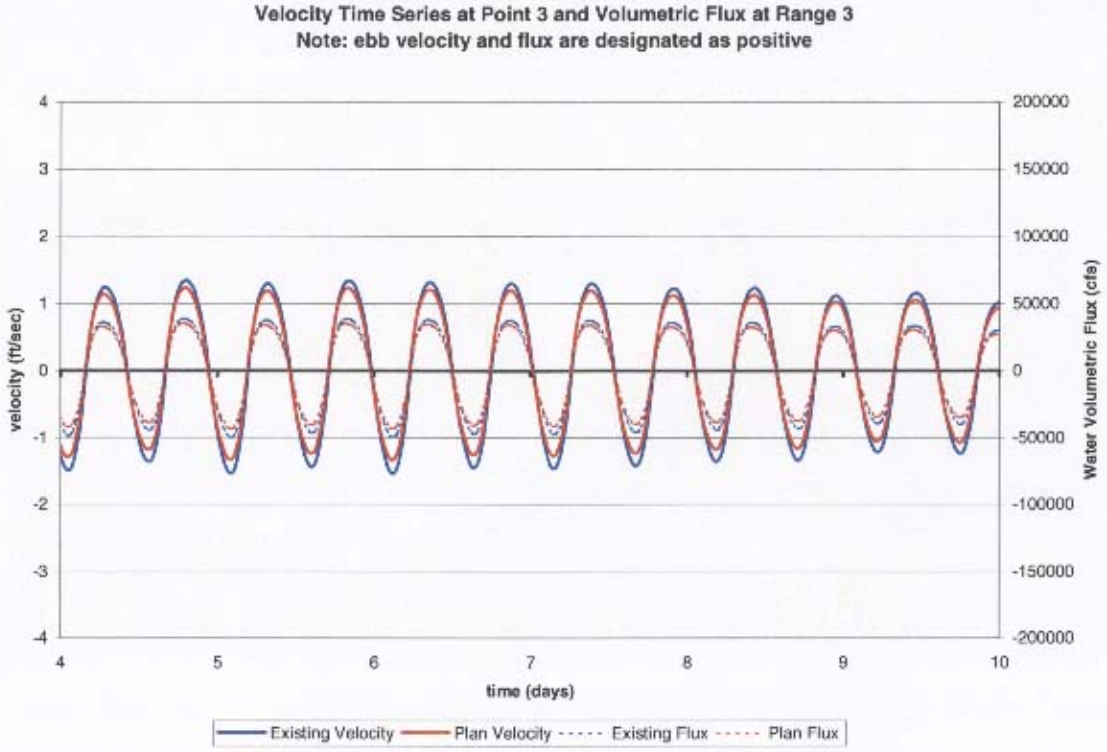


Figure 21: Velocity and Volumetric Flux Time History for Point/Range 3

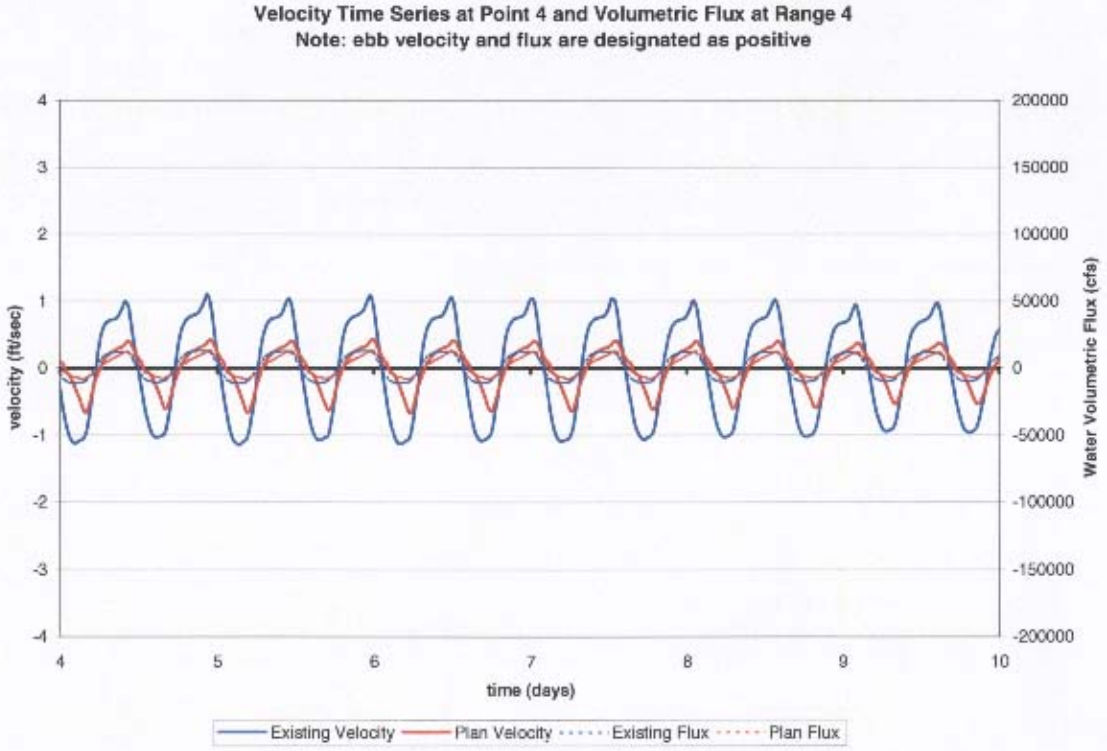


Figure 22: Velocity and Volumetric Flux Time History for Point/Range 4

Figure 23: Residual Salinity, Existing Condition, Average Flow Hydrograph

Figure 24: Residual Salinity, Plan Condition, Average Flow Hydrograph

Figure 25: Residual Salinity Difference, Average Flow Hydrograph

Figure 26: Residual Salinity, Existing Condition, High Flow Hydrograph

Figure 27: Residual Salinity, Plan Condition, High Flow Hydrograph

Figure 28: Salinity Difference, High Flow Hydrograph

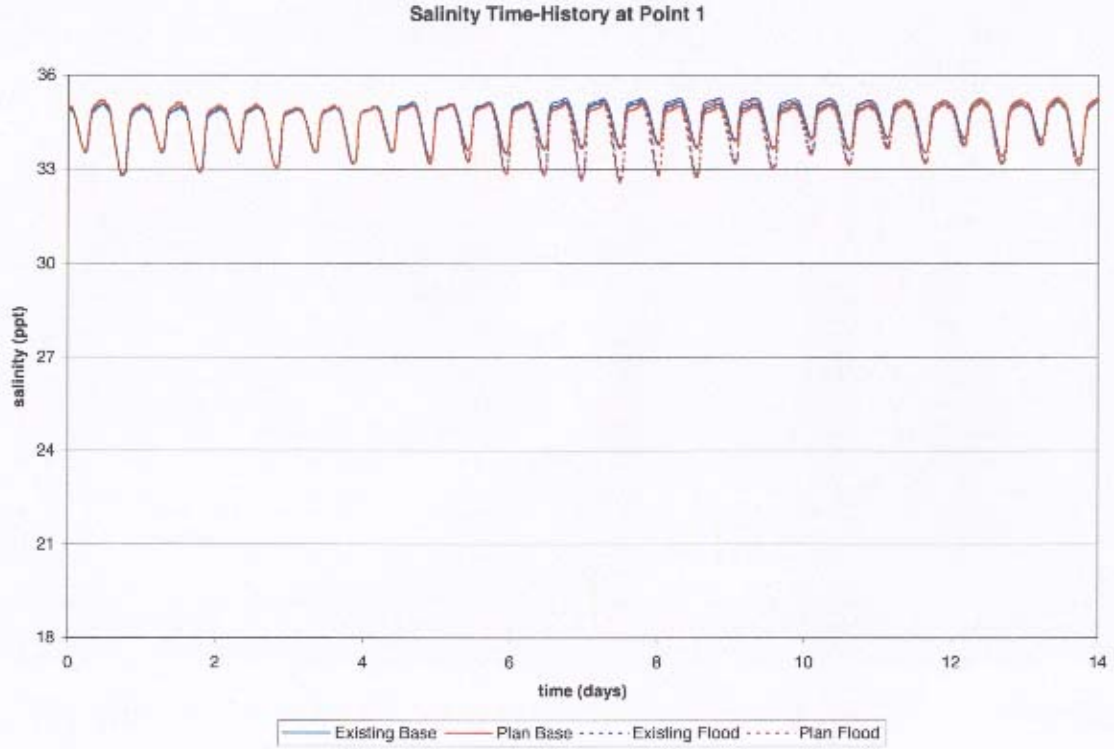


Figure 29: Salinity Time-History at Point 1

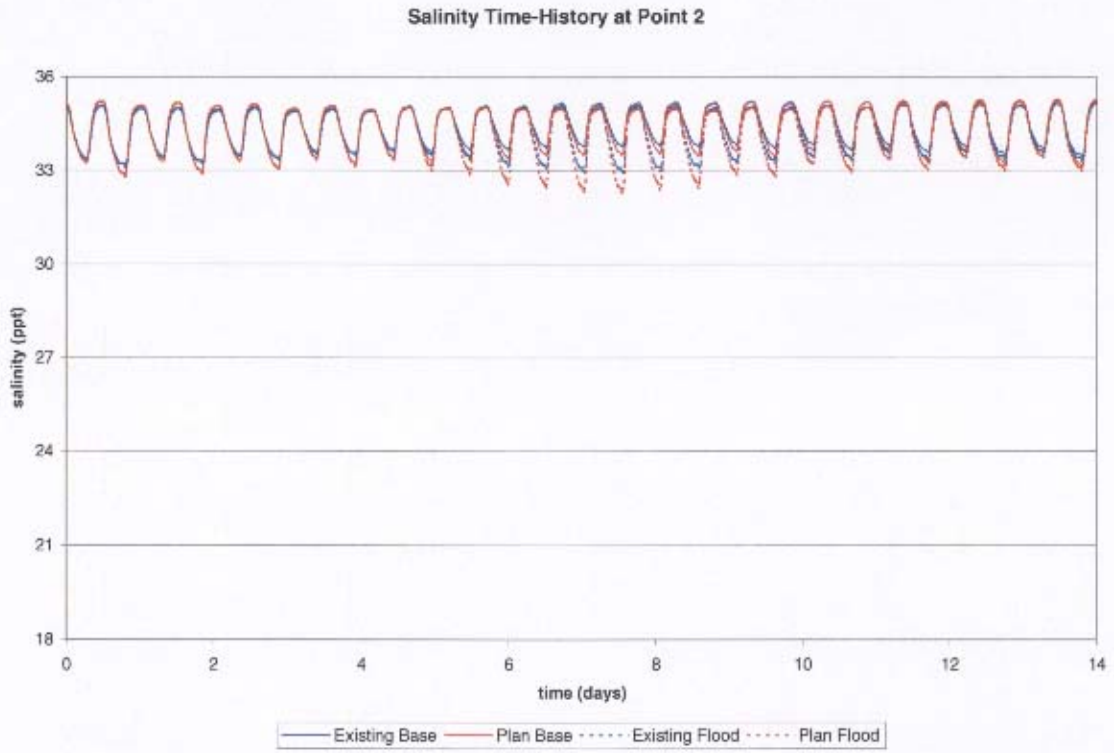


Figure 30: Salinity Time-History at Point 2

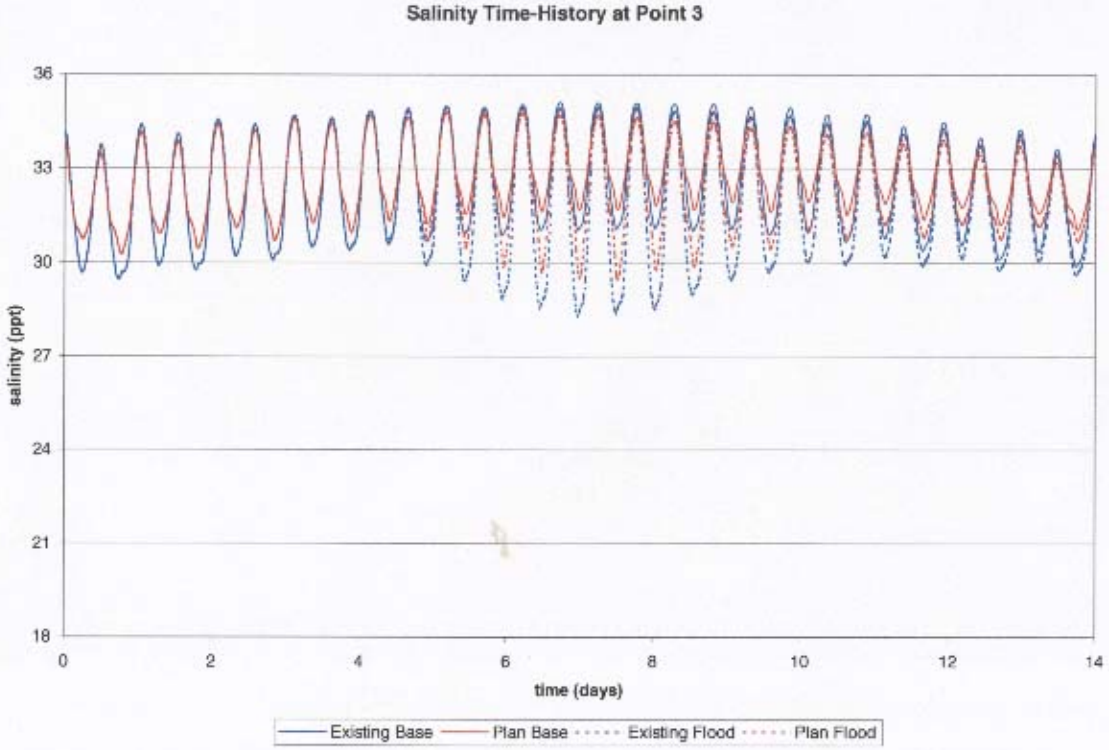


Figure 31: Salinity Time-History at Point 3

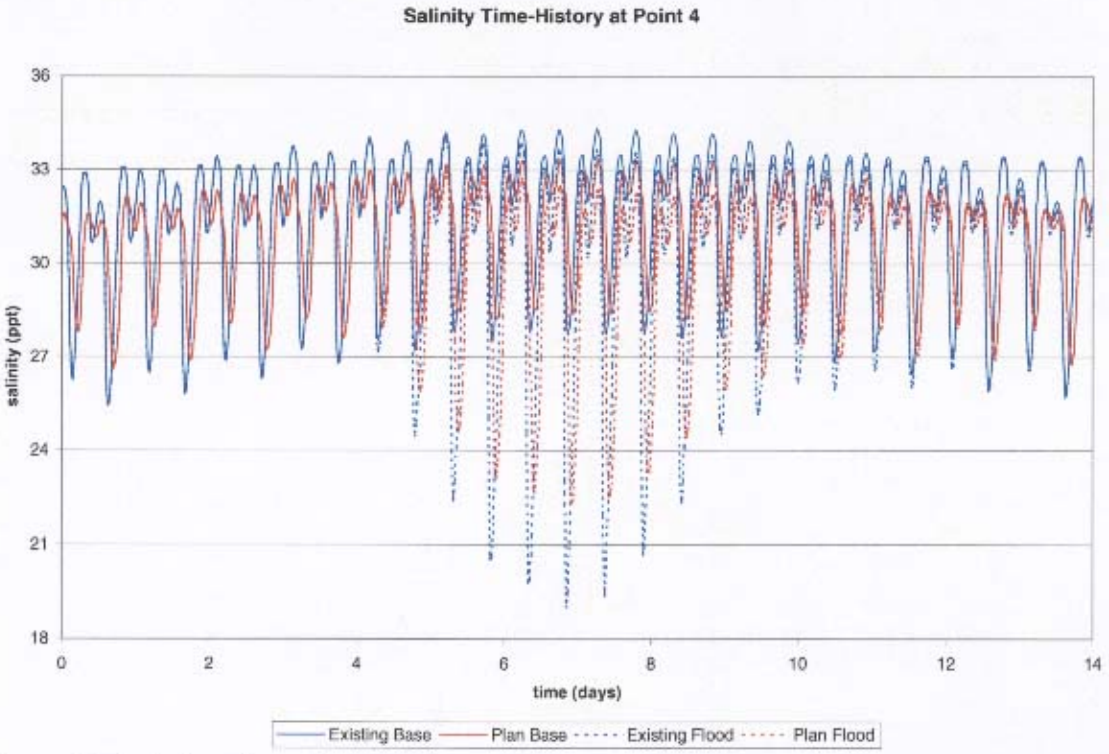


Figure 32: Salinity Time-History at Point 4

Figure 33: Salinity Time-History at Point 5

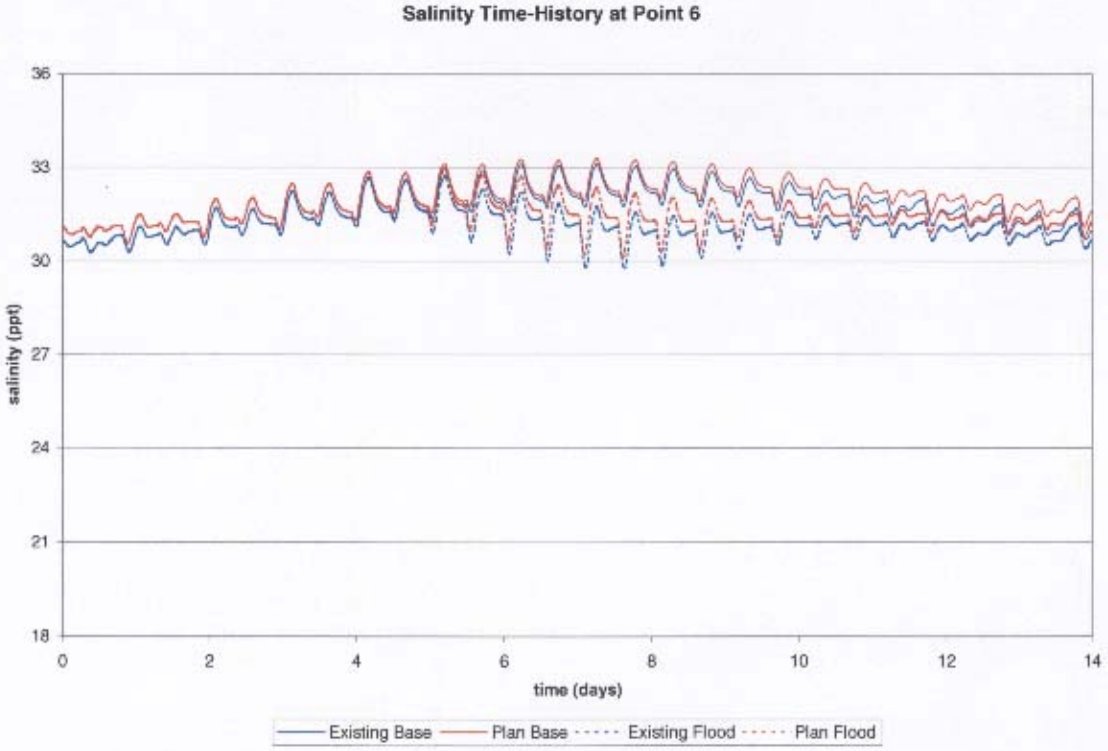


Figure 34: Salinity Time-History at Point 6

ATTACHMENT B

Ship Simulation Modeling Report

DRAFT

DRAFT REPORT OF THE MIAMI, FLORIDA NAVIGATION STUDY RESULTS AND RECOMMENDATIONS

1. Introduction. The Port of Miami is located on the eastern side of the southern tip of the Florida peninsula, Figure 1. Port traffic is primarily cruise ship or container vessels.

2. The Miami-Dade County Seaport Department has provided correspondence from the Biscayne Bay Pilots, outlining their concerns associated with the need to widen and deepen navigation channels and turning basins at the Port of Miami. The Harbor Pilots have reported groundings of container vessels near buoy "1", at the outer portion of the entrance channel to the harbor. Vessels approaching the harbor that are transitioning from the open waters to an alignment with the outer section of the entrance channel, encounter a 180 degree change in current direction, near buoy "1". This dramatic current shift creates a dangerous situation for vessels approaching the harbor. The pilots have requested widening the entrance channel from an existing 500-foot width to an 800-foot tapered entrance. The second location of proposed widening includes an area south of Government Cut between beacons 13 and 15. That portion of the channel is where vessels realign their heading as they transit from the entrance channel into Fisherman's Channel, or make the transit in the opposite direction. Strong currents at that intersection, where three channels converge, create dangerous conditions for vessels that have reduced their speed in preparation for turning. A third location for widening recommended by the harbor pilots, is along the southern edge of Fisherman's Channel. Vessels docked along Lummus Island adjacent to Fisherman's Channel swing their onboard cranes 90 degrees out into the channel. The cranes protrude beyond the vessel beam dimension into the adjacent navigation channel. Under different conditions of wind, current, ship size and draft, vessels that are passing the berthed vessels must transit a restricted, unsafe channel. The berthed vessels can be subject to dangerous surging effects as the transiting vessels pass with minimum clearance. The pilots suggest widening the southern edge of Fisherman's Channel 100 feet to the south. Other alternatives for channel modifications relate to requests by the Miami-Dade County Seaport Department associated with their plans for expansion of cruise ship terminals. Consequently, to allow larger cruise ships and container vessels the opportunity for safer transits into and out of the Port of Miami, the U.S. Army Engineer District, Jacksonville (CESAJ) has proposed a series of improvements to the navigation channels and turning basins at the Port. These improvements, or alternatives, are shown in Figure 2 and are described as follows:

Alternative 1. Government Cut serves as the entrance channel for the port. It consists of a series of channel segments. It is proposed to deepen Government Cut from 44 to 52 ft. The deepest any of the inner harbor channels are proposed to be is 50 ft. The additional 2 ft is to allow for vertical motion due to waves. This alternative also widens the seaward portion of Cut 1 from 500 to 800 ft. An additional bend widener, on the northern side of the turn between Cuts 1 and 2 is also proposed.

Alternative 2. To ease the turn between Government Cut and Fisherman's Channel, a widener on the south side of Government Cut, just inside the jetties, was proposed. The proposed maximum channel depth would be 50 ft.

Alternative 3. Expand Fisher Island Turning Basin from 1200 ft to 1500 ft. Ships turning to back into Fisherman's Channel will use the enlarged turning basin. The proposed turning area will have a maximum depth of 50 ft.

Alternative 4. To allow additional cruise ship berths on the north side of the main channel, CESAJ proposes to shift the western end of the main channel south. This will allow ships transiting to the turning basin to pass ships docked at the proposed berths. This improvement would not be deepened and will remain at 36 ft.

Alternative 5. Widen Fisherman's Channel 100 ft to the south. This will allow beamier containerships to pass vessels docked along the Fisherman's Channels piers.

Alternative 6. Deepen Dodge Island Cut and the proposed 1200 ft turning basin to 36 ft. The western end of Dodge Island Cut will be swung southward to accommodate proposed port expansion.

3. In order to evaluate the six improvements proposed for Miami Harbor, a navigation study consisting of real-time ship simulation modeling was undertaken. Because of their proximity to the project site, the study was contracted to the Simulation Research Analysis and Training (STAR) Center in Fort Lauderdale, FL. The online testing for the simulation study was conducted during the fall of 2000.

4. The design vessels used during the simulation runs are shown in Table 1.

Table 1. Design Vessels for Miami Simulation Runs				
Name	Type	Length (ft)	Beam (ft)	Draft (ft)
Susan Mærsk	Container Ship	1139	141	44
Jutlandia	Container Ship	965	106	38
Atlantic Class	Container Ship	950	106	38
Nordic Empress	Cruise Ship	692	113	22.5
Destiny	Cruise Ship	894	117	27
Voyager of The Seas	Cruise Ship	1020	158	29

5. Results. Results of the real-time simulation testing are presented as track plots in Figures 3 – 31. These track plots and pilot ratings (Appendix A) constitute the data analyzed in this report.

6. Container ships, Inbound to Berth 110. Track plots for container ships inbound to Berth 110 are presented in Figures 3 – 6. The composite track plot of the Jutlandia inbound to Berth 110 with flood tide and 15 knots wind from the northwest is shown in Figure 3. This scenario corresponds to STAR run M02. Two of the ships left the channel while transiting the Government Cut. One ship left the north side of the channel when entering the bend widener between Cuts 1 and 2. The other ship left the channel on the north side when leaving the same bend widener. One ship left the south side of Fisherman's Channel while backing towards the berth.

7. The composite track plot of the Susan Maersk transiting the proposed channel under the same conditions is shown in Figure 4. Alternatives 1, 2, 3 and 5 were tested in this exercise, which corresponds to STAR run M01. One ship left the north side of the Government Cut channel when entering the bend widener between Cuts 1 and 2. Two ships utilized the extra widener on the northeast side of Cut 2. The ships took advantage of the extra 100 ft on the south side of Fisherman's Channel provided by Alternate 5. None of the ships left Fisherman's Channel while backing to Berth 110.

8. The composite track plot of the Jutlandia inbound to Berth 110 with ebb tide and 15 knots wind from the northwest is shown in Figure 5. This scenario corresponds to STAR run M04. One ship left the south side of Cut 1 and several ships left the south side of Fisherman's Channel while either turning or backing to Berth 110.

9. The composite track plot of the Susan Maersk transiting the proposed channel under the same conditions is shown in Figure 6. Alternatives 1, 2 and 5 were tested in this exercise, which corresponds to STAR run M03. One ship crossed the south side of Cut 1 by about 15 ft, but in general, the Susan Maersk runs remained in the channel while transiting the Government cut due to the flare proposed in Alternative 1. The tracks of the ships transiting Cut 1 are consistent, rather than erratic as the runs shown in Figure 5 were. None of the ships left the channel while turning in the Fisher Island Turning Basin, or while backing to Berth 110.

10. Container ships, Inbound to Berth 120. Track plots for container ships inbound to Berth 120 are presented in Figures 7 – 11. The runs were started with the ship inside the jetties to save simulation time and allow more conditions to be tested. This was possible because the Government Cut was tested in the scenarios shown in Figures 3 – 6. The composite track plot of the Jutlandia inbound to Berth 120 with flood tide and 15 knots wind from the northwest is shown in Figure 7. This scenario corresponds to STAR run M06. None of the vessels left the authorized channel limits while transiting Fisherman's Channel. One ship crossed the channel limits while turning in the Lummus Island Turning Basin.

11. The composite track plot of the Susan Maersk transiting the proposed channel under the same conditions is shown in Figure 8. Alternatives 2 and 5 were tested in this exercise, which corresponds to STAR run M05. None of the vessels left the authorized channel limits while transiting Fisherman's Channel. One ship crossed the channel limits while turning in the Lummus Island Turning Basin. The simulation observer reported this was due to excess speed.

12. The composite track plot of the Jutlandia inbound to Berth 120 with ebb tide and 15 knots wind from the northwest is shown in Figure 9. This scenario corresponds to STAR run M08. One ship left the south side of Fisherman's Channel while passing the ships docked at Berths 100 and 110. The simulation observer reported this was due to the pilot increasing ship speed in anticipation of a stronger ebb tide. Two ships crossed the channel limits while turning in the Lummus Island Turning Basin.

13. The composite track plot of the Susan Maersk transiting the proposed channel under the same conditions is shown in Figure 10. This scenario corresponds to STAR run M07 and examines Alternatives 2 and 5. Although two ships came within 10 ft of the southern edge of Fisherman's Channel, none of the vessels left the authorized channel during this exercise.

14. Cruise Ships to Watson Island Turning Basin. Composite Track plots of cruise ships transiting Government Cut to call at berths near the Watson Island Turning Basin are shown in Figures 12– 15. The Voyager of the Seas, an Eagle Class

cruise ship drawing 29 ft was used for all simulations of this scenario. The main purpose of this scenario was to evaluate Alternative 4.

15. The composite track plot of the Voyager of the Seas inbound, in the existing channel, with flood tide and a 15 knot wind from the northeast is shown in Figure 12. This scenario corresponds to STAR exercise M13. Several of the runs left the north side of the bend widener in the Entrance Channel. However, none of the ships would have grounded due to their draft of 29 ft. Two of the ships left the south side of the channel as they approached the turning basin. However, none would have grounded because this area is as deep as the navigation channel.

16. The composite track plot of the Voyager of the Seas, transiting the proposed channel, under the same environmental conditions, is shown in Figure 13. Alternatives 1 and 4 were tested in this exercise which corresponds to STAR test M14. Although this vessel is not restricted to the authorized channel limits in Cuts 1 and 2, the ship did not leave north side of the bend widener by as much as the runs shown in Figure 12. Although several ships came close to the channel limits, none of the ships left the Main Channel.

17. The composite track plot of the Voyager of the Seas inbound, in the existing channel, with an ebb tide and a 15 knot wind from the northeast is shown in Figure 14. This scenario corresponds to STAR exercise M15. Several of the ships left the Government Cut, but this is not significant due to their 29 ft draft. Several runs also left the southwest portion of the authorized limits Main Channel. This is the berthing area. None of the ships would have run aground.

18. The composite track plot of the Voyager of the Seas inbound, in the proposed channel, with an ebb tide and a 15 knot wind from the northeast is shown in Figure 15. This scenario tested Alternatives 1 and 4 and corresponds to STAR exercise M16. One pilot began his approach to the Government Cut further north than the other pilots. This was done at his request because it is his experience that it is more realistic to start the approach further north. Other than the ship that began the simulation further north, none of the ships left the Government Cut. None of ships had any difficulties maneuvering through the Main Channel.

19. Cruise Ships to Berth 195. Composite Track plots of the Nordic Empress and the Destiny transiting Government Cut to call at berth 195 are shown in Figures 16–19. The Nordic Empress draws 22.5 ft and the Destiny draws 27 ft. This scenario evaluates Alternatives 2, 5 and 6.

20. The composite track plot of the Nordic Empress inbound, in the existing channel, with ebb tide and a 15 knot wind from the southeast is shown in Figure 16. This scenario corresponds to STAR exercise M10. Three of the four ships left the south side of Fisherman's Channel across from Berth 110. One of the ships left the turning basin.

21. The composite track plot of the Destiny inbound, in the proposed channel, with ebb tide and a 15 knot wind from the southeast is shown in Figure 17. This scenario tested Alternatives 2, 5 and 6 and corresponds to STAR exercise M09. None of the ships used Alternative 2 while making the turn from Government Cut to Fisherman's Channel. None of the ships left Fisherman's Channel while passing the ships at Berths 100 and 110. One pilot chose to turn his ship in the Lummus Island Turning Basin and back to the berth. Two of the ships left the channel between the Lummus Island Turning Basin and the Dodge Island Turning Basin. Both ships left the channel by about 50 ft. One of the ships leaving the channel was the ship backing to the berth. One of the ships turned too far east and left the Dodge Island Turning basin by about 30 ft while turning. The other two ships easily turned in the area provided.

22. The composite track plot of the Nordic Empress inbound, in the existing channel, with flood tide and a 15 knot wind from the southeast is shown in Figure 18. This scenario corresponds to STAR exercise M12. One of the ships left Fisherman's Channel while passing the ships at Berths 100 and 110. One pilot (the same pilot as in Figure 17) chose to turn his ship in the Lummus Island Turning Basin and back to the berth. Two of the ships left the Dodge Island Turning Basin.

23. The composite track plot of the Destiny inbound, in the proposed channel, with flood tide and a 15 knot wind from the southeast is shown in Figure 19. This scenario tested Alternatives 2, 5 and 6 and corresponds to STAR exercise M11. None of the ships used Alternative 2 while making the turn from Government Cut to Fisherman's Channel. None of the ships left Fisherman's Channel while passing the ships at Berths 100 and 110. One pilot (the same pilot as in Figures 17 and 18) chose to turn his ship in the Lummus Island Turning Basin and back to the berth. One of the ships left the channel between the Lummus Island Turning Basin and the Dodge Island Turning Basin, by about 40 ft. One of the ships turned too far north and left the Dodge Island Turning basin by about 60 ft while turning. The other two ships easily turned in the area provided.

24. Container ships, Outbound from Berth 120. Track plots for container ships outbound from Berth 120 with flood tide are presented in Figures 20 - 23. The runs were stopped with the ship inside the jetties. This was done to save simulation time because outbound ships do not have problems transiting Government Cut.

25. The composite track plot of the Jutlandia outbound from Berth 120 with flood tide and 15 knots wind from the southeast is shown in Figure 20. This scenario corresponds to STAR run M18. Two of the ships left Fisherman's Channel while passing the ships docked at Berths 100 and 110. The composite track plot of the Susan Maersk transiting the proposed channel in the same conditions (Fig re 21) shows none of the ships left the channel. The Susan Maersk did not use Alternative 2.

26. The composite track plot of the Jutlandia outbound from Berth 120 with ebb tide and 15 knots wind from the southeast is shown in Figure 22. This scenario corresponds to STAR run M20. Three of the four ships left Fisherman's Channel while passing the ships docked at Berths 100 and 110. The composite track plot of the Susan Maersk transiting the proposed channel in the same conditions (Fig re 23) shows none of the ships left the channel. The Susan Maersk did not use Alternative 2.

27. Cruise Ships, Outbound through the Main Channel. Track plots of cruise ships, outbound through the Main Channel are presented in Figures 24 – 27. This exercise examines Alternatives 2 and 4. All runs, both existing and proposed, were completed without incident. Vessels that crossed the channel limits did so in an area where the water was at least as deep as the navigation channel. Alternative 2 was not used.

28. Cruise Ships, Outbound through the Fisherman's Channel. Track plots of cruise ships, outbound through Fisherman's Channel are presented in Figures 28 – 31. This exercise tests Alternatives 2, 5, and 6.

29. The composite track plot of the Nordic Empress outbound, in the existing channel, with flood tide and a 15 knot wind from the southeast is shown in Figure 28. This scenario corresponds to STAR exercise M26. One ship crossed the channel limits between the Dodge Island and Lummus Island Turning Basins. One ship crossed the limits of Fisherman's Channel while passing the ships docked at Berths 100 and 110.

30. The composite track plot of the Destiny outbound, in the proposed channel, with flood tide and a 15 knot wind from the southeast is shown in Figure 29. This scenario corresponds to STAR exercise M25. One ship crossed the channel limits between the Dodge Island and Lummus Island Turning Basins. One ship crossed the limits of Fisherman's Channel while passing the ships docked at Berths 100 and 110.

31. The composite track plot of the Nordic Empress outbound, in the existing channel, with ebb tide and a 15 knot wind from the southeast is shown in Figure 30. This scenario corresponds to STAR exercise M28. One ship touched the edge of the channel on the northwest end of Lummus Island Turning Basin. One ship crossed the limits of Fisherman's Channel.

32. The composite track plot of the Destiny outbound, in the proposed channel, with ebb tide and a 15 knot wind from the southeast is shown in Figure 31. This scenario corresponds to STAR exercise M27. One ship crossed the channel limits between the Dodge Island and Lummus Island Turning Basins. One ship crossed the limits of Fisherman's Channel while passing the ships docked at Berths 100 and 110.

33. Pilot Questionnaires. The pilots' final questionnaires are included as Appendix A. The pilots were supportive of the channel improvements tested, but did have some concerns about wind/current combinations not tested.

34. Conclusions and Recommendations. Based upon the results of the simulator study, the following conclusions and recommendations are given.

35. Alternative 1. Widening the seaward end of Government Cut 1 allowed additional room for the vessel to adjust to Gulfstream currents and greatly reduced the number of containerships leaving the authorized channel during simulation runs. Alternative 1 is recommended. Modifications to Alternative 1 may be considered, provided they are examined in real-time simulation exercises, or recommended and approved in writing with no additional simulations required, by the Biscayne Bay Pilots.

36. Alternative 2. Alternative 2 was not used during any of the simulated exercises. Alternative 2 is not recommended.

37. Alternative 3. Alternative 3 provided adequate room for the Susan Maersk to turn and back into Fisherman's Channel and is recommended. The ships did not use the northernmost portion of the basin. However, additional simulation runs should be conducted prior to considering any reduction in Alternative 3. Additional simulations associated with changes to Alternative 3 may be waived with the recommendation and written approval of the Biscayne Bay Pilots.

38. Alternative 4. Alternative 4 is recommended to allow addition cruise ship docks on the western end of the main channel.

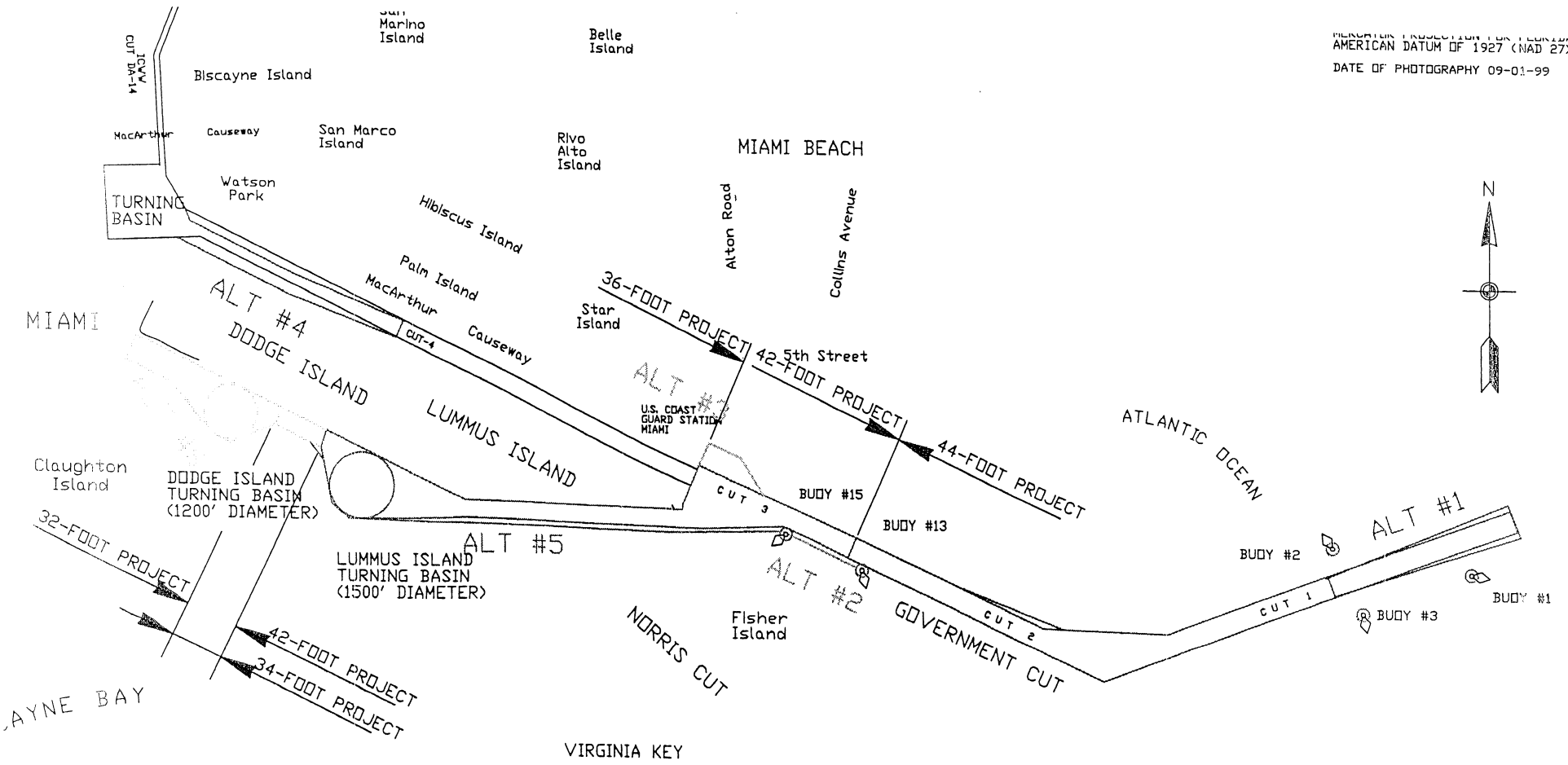
39. Alternative 5. Alternative 5 provided additional room while passing berthed ships and was used during nearly every proposed condition test in Fisherman's Channel. Existing condition runs showed frequent grounding across from Berth 100 and 110. Alternative 5 eliminated those grounding, even with the larger containership. Alternative 5 is strongly recommended.

40. Alternative 6. The Dodge Island Turning Basin provided adequate turning area for the Destiny. However, a number of ships left the south side of the channel segment between Lummus Island Turning Basin and Dodge Island Turning Basin. We recommend Alternative 6 on the condition that the southern edge of that segment is widened by 50 ft. The widening is shown in Figure 32.

Appendix A

Figure 1. Port Miami Location Map

Figure 1



PROPOSED MODIFICATION ALTERNATIVES

ALTERNATIVE #1 - WIDEN SEAWARD PORTION OF CUT-1 FROM 500 FEET TO 800 FEET AND DEEPEN CUT-1 AND CUT-2. (EXISTING DEPTH = 44 FEET, DEEPEN TO 52 FEET)

ALTERNATIVE #2 - ADD TURN WIDENER BETWEEN BUOY #13 AND BUOY #15. (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET)

ALTERNATIVE #3 - EXPAND FISHER ISLAND TURNING BASIN FROM 1200 FEET TO 1500 FEET. (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET)

ALTERNATIVE #4 - RELOCATE THE WESTERN END OF THE MAIN CHANNEL TO ALLOW FO ADDITIONAL CRUISE SHIP BERTHS.

ALTERNATIVE #5 - WIDEN FISHERMAN'S CHANNEL APPROXIMATELY 100 FEET TO THE SOUTH. (EXISTING DEPTH = 42 FEET, DEEPEN TO 50 FEET) DEEPENING WOULD INCLUDE CUT-3, STA. 0+00 TO CUT-3, STA. 42+00.

Figure 2

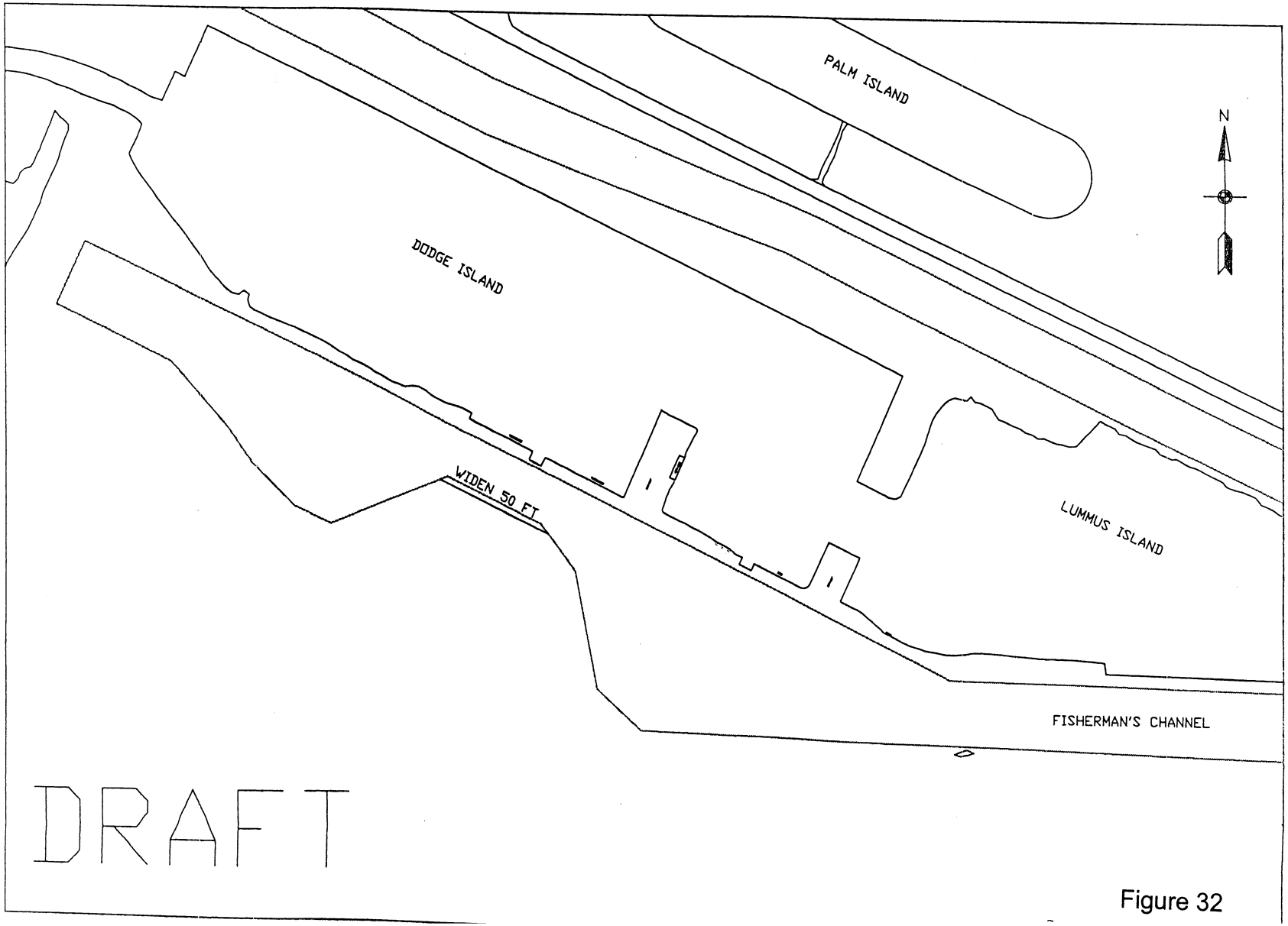

PALM ISLAND
N
DODGE ISLAND
WIDEN 50 FT
LUMMUS ISLAND
FISHERMAN'S CHANNEL
DRAFT

Figure 32

Miami Operational Operation
Final Evaluation Comments

Name_____ **Date**_____

1) Were there any differences in the response of the simulated ship model when compared to your experience with the actual ship. If so, please indicate how this difference has affected the results of the simulation study. If you have never maneuvered the actual vessel, please respond with "N/A"

2) The entrance channel between buoys 1 and 2 was widened at the seaward end. Did it help to funnel inbound and outbound traffic into and out of the channel ? Did you notice any significant handling difference in Cut #1 or #2 channel deepening?

3) The Fisher Island turning basin was widened by 400 feet to 1600 feet and dredged to 50 feet. Do you feel that this improvement better facilitated turning in the basin? Do you prefer the use of this turning basin or Lummus Island basin for container vessels? Why?

4) Fisherman's Channel was widened about 100' to the South, deepened to 50 feet. Do you feel this will easier passage with ships alongside the dock. Higher maneuvering speeds and less surge at the dock?

5) Western end of the Main channel was relocated south to allow berthing at Watson Island. Did you think this provides ample room to and from the turning basin? Please explain.

6) With the improvements Dodge Island Cut and Dodge Island turning basin, do you think this provides ample room to maneuver vessel to and from berth 12? Please explain.

7) Additional Comments:

Phone: 601-634-2455
Fax: 601-634-3218

facsimile transmittal

To:	Phil Sylvester	**From:**	Dennis W. Webb
Fax:	(904) 232-1772	**Date:**	February 8, 2001
Phone:		**Pages:**	8
Re:		**CC:**	

☐ Urgent ☐ For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

Notes: Miami Pilot comments

Miami Operational Operation
Final Evaluation Comments

Name Michael McDonnell **Date** September 1, 2000

1) Were there any differences in the response of the simulated ship model when compared to your experience with the actual ship. If so, please indicate how this difference has affected the results of the simulation study. If you have never maneuvered the actual vessel, please respond with "N/A"

SUSAN MAERSK - N/A
JET LAURIA - N/A
DESTINY
NORDIC EMPRESS } THERE WAS NO DIFFERENCE
EAGLE CLASS

2) The entrance channel between buoys 1 and 2 was widened at the seaward end. Did it help to funnel inbound and outbound traffic into and out of the channel ? Did you notice any significant handling difference in Cut #1 or #2 channel deepening?

TO HAVE THE ENTRANCE CHANNEL WIDENED AND DEEPENED WAS A NOTICABLE DIFFERENCE IN THE HANDLING OF THE VESSELS. IT WAS A MUCH SAFER MANEUVER AND ALLOWED ME TIME TO ADJUST FOR STRONG CROSS CURRENTS.

3) The Fisher Island turning basin was widened by 400 feet to 1600 feet and dredged to 50 feet. Do you feel that this improvement better facilitated turning in the basin? Do you prefer the use of this turning basin or Lummus Island basin for container vessels? Why?

THE FISHER ISLAND TURNING BASIN WIDENED AND DREDGED TO 50' IS A MUST IMPROVEMENT. THIS IMPROVEMENT MADE FOR A MUCH SAFER MANEUVER. I PREFER TURNING IN FISHER IS. BECAUSE IT EXPEDITES THE MANEUVER, AND WHEN I BACK DOWN TO MY BERTH ON TO THE BASIN I AM GOING AT A SLOWER SPEED PAST THE SHIPS AT DOCK IS. WHICH PREVENTS SURGE AND I HAVE

4) Fisherman's Channel was widened about 100' to the South, deepened to 50 feet. Do you feel this will easier passage with ships alongside the dock. Higher maneuvering speeds and less surge at the dock?

BUTTON CO MOLE OF A TUGS.

YES, THIS A VERY IMPORTANT MODIFICATION AND SHOULD NOT BE DELETED. THIS IS ESPECIALLY GOODNESS SINCE THE POINT IS LOOKING TO FINISH, THE WEST END OF THE BERTHS. ALSO YOU NEED TO LOOK AT SHIP AT DOCK IS. WITH 135' BEAM, A SHIP DOCKING AND GOING PAST THIS SHIP WITH 135' BEAM AND A TUG 100' LONG ALONG SIDE THE DOCKING SHIP THIS EQUALS 375' WITH THE EXISTING CHANN

5) Western end of the Main channel was relocated south to allow berthing at Watson Island. Did you think this provides ample room to and from the turning basin? Please explain.

YES, WITH TWO EAGLE CLASS SHIPS, ONE AT WATSON/ AND THE OTHER AT DODGE IS. THIS STILL GIVES ANOTHER VESSEL A 580' CHANNEL TO WORK IN. WHICH IS MORE THAN ENOUGH CHANNEL TO WORK WITH FOR TWO WAY

6) With the improvements Dodge Island Cut and Dodge Island turning basin, do you think this provides ample room to maneuver vessel to and from berth 12? Please explain.

YES. THE PROPOSED CUT [redacted] ALLOWS YOU TO GET FURTHER TO THE SOUTH AND AWAY FROM THE BERTHS AT DODGE IS. THIS WILL REDUCE ANY SURGE. THE PROPOSED TURNING BASIN ALLOWS YOU TO SAFELY TURN THE VESSEL OFF THE BERTH. THE ONLY AREA THAT I WOULD LIKE TO SEE CHANGED IS THE CHANNEL BETWEEN LUMMUS IS TURNING BASIN AND DODGE IS. TURNING BASIN. THIS SHOULD BE WIDENED 100 FEET. BECAUSE SHIPS DO DOCK AT DODGE IS. ABEAM OF THIS CHANNEL AND WITH A SOUTH WIND THIS COULD BE A PROBLEM AREA.

7) Additional Comments:

Miami Operational Operation
Final Evaluation Comments

Name Stuart Lilly **Date** August 23, 2000

1) Were there any differences in the response of the simulated ship model when compared to your experience with the actual ship. If so, please indicate how this difference has affected the results of the simulation study. If you have never maneuvered the actual vessel, please respond with "N/A"

SUSAN MAERSK - N/A
JUTLANDIA N/A
NORDIC EMPRESS
CARNIVAL DESTINY Vessels responded in a manner acceptable for the purposes of
VOYAGER OF THE SEAS this SIMULATION
* During transits passing berthed vessels, this vessel experienced sudden shearing. ALSO ABEAM of USCG BASE Miami LB #17
This is unrealistic. THIS Apparent "interaction" does not occur.

2) The entrance channel between buoys 1 and 2 was widened at the seaward end. Did it help to funnel inbound and outbound traffic into and out of the channel ? Did you notice any significant handling difference in Cut #1 or #2 channel deepening?

Yes, the widened channel would help funnel two-way traffic at the sea Buoy,
No, there was no noticeable handling difference among the vessels in Cut 1 or
Cut 2

3) The Fisher Island turning basin was widened by 400 feet to 1600 feet and dredged to 50 feet. Do you feel that this improvement better facilitated turning in the basin? Do you prefer the use of this turning basin or Lummus Island basin for container vessels? Why?

YES, turning is better facilitated for the Susan Maersk and Jutlandia. This improvement may allow the Pilots to relay turning restrictions for similar sized vessels.
The use of this enlarged basin will be dictated by the following: berth assignments, other vessel movements, efficiency of vessel movements and availability of suitable tugs.

4) Fisherman's Channel was widened about 100' to the South, deepened to 50 feet. Do you feel this will easier passage with ships alongside the dock. Higher maneuvering speeds and less surge at the dock?

This widening does provide for more safe transits, however any estimation of less surge is inconclusive. The transits of the Nordic Empress and Destiny were successful at 6 & 7 knots. The critical factor is leeway. More wind, more leeway, or thus increased Track Beam, thus less clearance between ship and cranes.
7 knots for a cruise ship in the existing channel is borderline safe.
In scenarios of higher winds, these transits would be unsafe.

5) Western end of the Main channel was relocated south to allow berthing at Watson Island. Did you think this provides ample room to and from the turning basin? Please explain.

YES - there is ample room for vessels in and out of the WITB. At this point in the channel, there is never two way traffic, only one way. Vessels entering and leaving the Basin are at slow, safe speeds as it is. The addition of an EAGLE Class vessel at Watson Island will not significantly impact on those vessels in transit.

6) With the improvements Dodge Island Cut and Dodge Island turning basin, do you think this provides ample room to maneuver vessel to and from berth 12? Please explain.

Based on the simulated runs, I think there is safe room for transit of the Nordic Empress. However, in scenarios of higher Northerly and Southerly winds, these transits would not be safe

7) Additional Comments:

2) Entries

3) Tanker

In order to simulate the most realistic harbor conditions, the two following changes must be made:

- Addition of a berthed tanker at Fisher Island dock with beam of 105 ft
- Removal of shipboard cranes on berthed ACC vessel at container pier and replace with extended booms of landside gantry cranes.

The extended shipboard cranes on the berthed ACC vessels are unrealistic.

Miami Operational Operation
Final Evaluation Comments

Name: Stephen Nadeau Date: September 29, 2000

1) Were there any differences in the response of the simulated ship model when compared to your experience with the actual ship. If so, please indicate how this difference has affected the results of the simulation study. If you have never maneuvered the actual vessel, please respond with "N/A"

The Voyager & Nordic Empress models React Fairly Typical To To Real Ships None of the Models were so Far From the Realship, that it might Effect the Study

Suson Maersk & Tutlandia N/A

2) The entrance channel between buoys 1 and 2 was widened at the seaward end. Did it help to funnel inbound and outbound traffic into and out of the channel ? Did you notice any significant handling difference in Cut #1 or #2 channel deepening?

1. No Buoys are use Yet outside The Channel Return Then to the Channel edge.
2) after deepening Vessels Handled better in all Cases Widening of Cut I was great improvement

3) The Fisher Island turning basin was widened by 400 feet to 1600 feet and dredged to 50 feet. Do you feel that this improvement better facilitated turning in the basin? Do you prefer the use of this turning basin or Lummus Island basin for container vessels? Why?

Yes, The Widening and To The Ports Ability To Serve The Larger Ships Restrictions will be Lifted due to the Two Basins, More Manuevers capable for Larger Ships.
Both Basins are Useful Lummus Will have Little Restrictions & More Flexability But Fi Could Be USED For Larger Ships & Towboats as well.

4) Fisherman's Channel was widened about 100' to the South, deepened to 50 feet. Do you feel this will easier passage with ships alongside the dock. Higher maneuvering speeds and less surge at the dock?

Yes, Absolutely Also Reduced Stress, More Flexability & Higher Safety Margins

5) Western end of the Main channel was relocated south to allow berthing at Watson Island. Did you think this provides ample room to and from the turning basin? Please explain.

Yes The re-Drawing of the Channel Limits will in No Way Affect Navigation & will Allow Berthing on North Side of Watson Is.

6) With the improvements Dodge Island Cut and Dodge Island turning basin, do you think this provides ample room to maneuver vessel to and from berth 12? Please explain.

Yes This will Give the Port The Much Needed Space to Turn Larger Vessels and utilize The South Channel Terminal. A wider Channel at the Approach will allow easier access.

7) Additional Comments:

The Long range planning to 50', Wider Channels and added Turning Space will give the Port The Need Depth & the Larger ships that are being built for Panamax & US Ports.

The Cut I widening is essential for safer Maneuvers. ALT 1

Widening ALT 5 will give Larger Ships the Chance to Pass Moored Vessels with a Larger Chance of Safety.

Should any questions arise on this report or any other Aspect of the project do not hesitate To contact us.

MIAMI OPERATIONAL OPERATION FINAL EVALUATION COMMENTS

Name Michael Jaccoma
Date September 15,2000

1) Jutlandia-N/A
Susan Maersk- N/A
Nordic Empress – Seemed similar to my recollection. *
Voyager of the Seas – Similar*
Destiny – Similar*
*Note: All cruise vessels seemed to maintain more lateral momentum in the simulator then my actual experience. This should not effect the results of this study.

2) I did not feel this portion of the project was adequately addressed in the simulated exercises. However any increase in channel width would definitely improve the flow of inbound and outbound traffic in safety and expedience. See item 7).

3) It definitely improved turning in the basin for all size vessels. It is essential for turning the Susan Maersk in that basin. I prefer this basin for vessels berthing at the East End of the container dock if current velocity is not excessive. Turning at Fisher Island is more expedient and potential surging of deep container vessels at the berths is minimized if not eliminated. For strong currents and depending on the location and number of deep draft vessels at the berths I would prefer the Lummus Island basin.

4) Definitely it will help. I don't know that it alone will be sufficient. On windy days maneuvering may require tug assistance and the practical limits may at times be exceeded for light draft high-sided vessels.

5) Yes. With the vessels and situations simulated I always felt I had ample room to control the vessel.

6) Yes. During simulations there was adequate room for maneuvering the vessels here. My concern was more in passing any vessels berthed at the container pier at Lummus Island.

7) The influence of the Gulfstream very frequently impacts the entrance to the channel. The effect usually results in a north current from 1 ½ to 3 ½ knots as far in as buoys #2 and #3. A counter current can occasionally occur just as strong to the south. This requires boarding the larger deep draft vessels from 1 to 3 miles east of the sea buoy. This condition was not simulated. Two known grounding of "M" class Maersk vessels have occurred in the vicinity of the #1 buoy. One during a strong North current with the outbound vessel brushing the North bank. The other was during a strong south current and the inbound vessel brushed the South bank.

Correspondence

BISCAYNE BAY PILOTS
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4/7/99 -
Nancy -
This was given to me by Capt. Fernandez at yesterdays Waterways Committee meeting. They (the Pilots) consider it valid.
Y.I.
John Pearce
(4857)

October 23, 1997

Mr. Claude Bullock
Assistant Port Director
1015 N. America Way
Miami, Florida 33132

Dear Claude,

In order to assist the seaport in determining its needs for future dredging projects, the Biscayne Bay Pilots Association submits the following recommendations. We believe that as the channel is deepened it is vitally important that the channel also be widened. As you know Miami is one of the busiest ports in the nation. Last year our association handled over 9800 ship movements. The worlds largest cruise and container ships call here on a regular basis.

We have identified three specific areas in the channel that need to be widened. I have enclosed charts for each of these areas and highlighted that portion of the channel we feel should be widened.

The first and most critical area is the main channel entrance at Outer Bar Cut. The currents in this area are variable and unpredictable, putting large deep draft vessels are at risk when making their approach to Miami. Several Maersk container vessels have already grounded off of buoy "1". Our recommendation is to create a tapered entrance channel with an 800 foot wide entrance.

The second area of concern is on the south side of government cut between beacon 13 and beacon 15. This is an area where ships are turning from one channel into another. The strong currents in this area compounded by the necessity for the ship to have as little speed as possible, makes it important for the ship to have as much swinging room as possible. On at least three occasions that I know of, tugboats assisting ships in this area have grounded and sustained damage. Our recommendation is to widen the channel as much as possible between beacons 13 and 15.

Finally, Lummus Island Cut just south of the gantry crane area should be widened. At the present time ships transiting this area pass extremely close to vessels docked at the gantry berths. This results in a "surging" effect on the ships at the dock. Also, all too frequently, we are encountering vessels docked at Lummus Island with their cranes swung outboard 90 degrees

thereby blocking a portion of the channel. Given the variables of wind, current, ship size, draft, etc., this creates an unsafe condition. Our recommendation is to extend the southern edge of Lummus Island Cut 100 feet further to the south.

I am certain that these critical channel improvements will enhance the commercial viability of the Port of Miami. Please feel free to call me if you have any questions.

Sincerely,

Robert K. Brownell

Robert K. Brownell
Chairman
Biscayne Bay Pilots

Encl.: 2
cc: Captain of the Port

JUL 16 2001

Planning Division
Plan Formulation Branch

Captain John R. Fernandez
Biscayne Bay Pilots
2911 Port Boulevard
Miami, Florida 33132

Dear Captain Fernandez:

The enclosed drawing contains modifications to the proposed study alternatives based on the recommendations of you and Captain Stephen McDonald at the Port of Miami offices on May 16, 2001. The enclosed drawing includes modifications to alternatives1, 2, 3, and 5 that will either avoid or reduce impacts to environmental resources.

Approval of those proposed changes by the Biscayne Bay Pilots association will allow us to continue calculations for our quantity and cost estimates. Please provide a written response by July 23, 2001.

Contact Jerry Scarborough at 904-232-2042 or Philip Sylvester at 904-232-1142 if you have any questions concerning the proposed changes. Thank you for your continued support and assistance.

Sincerely,

Richard E. Bonner, P.E.
Deputy District Engineer
for Project Management

Enclosure

Copy Furnished:

Ms. Amy Kimball-Murley, AICP, The Curtis & Kimball Company, 4101 Laguna Street, Coral Gables, Florida 33146

Carl E. Fielland, Port Engineer, Port of Miami, 1015 N. America Way, 2nd Floor, Miami, FL 33132

bcc:
CESAJ-PD-PN (D. Powell)
CESAJ-EN-HI (Choate)
CESAJ-EN-HI (Sylvester)
CESAJ-EN-DL (Henderson)

7-9-01 RBP Powell/PD-PN/SLW 7/5/01
Schmidt/PD-PN
Strain/PD-P
Sylvester/EN-HI
Choate/EN-HI
Henderson/EN-DL
Duck/PD
Scarborough/DP-I
Dollar/DP-A
Bonner/DP

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J5
1

July 20, 2001

Richard E. Bonner, P.E.
Deputy District Engineer
For Project Management
Department of the Army
P.O. Box 4970
Jacksonville, Fl. 32232-0019

Dear Mr. Bonner,

Please be advised that the Biscayne Bay Pilots approve the proposed modifications to the alternatives 1,2,3 and 5.

Should you need further assistance please feel free to call on Captain McDonald or myself.

Sincerely,

John R. Fernandez,
Chairman
Biscayne Bay Pilots

ATTACHMENT C

Geotechnical – Boring Logs and Laboratory Reports

TABLE OF CONTENTS

PLATES

REPRESENTATIVE AND NEW BORINGS

NOTE: Alternative 6 is not included in the selected plan presented in this General Reevaluation Report.

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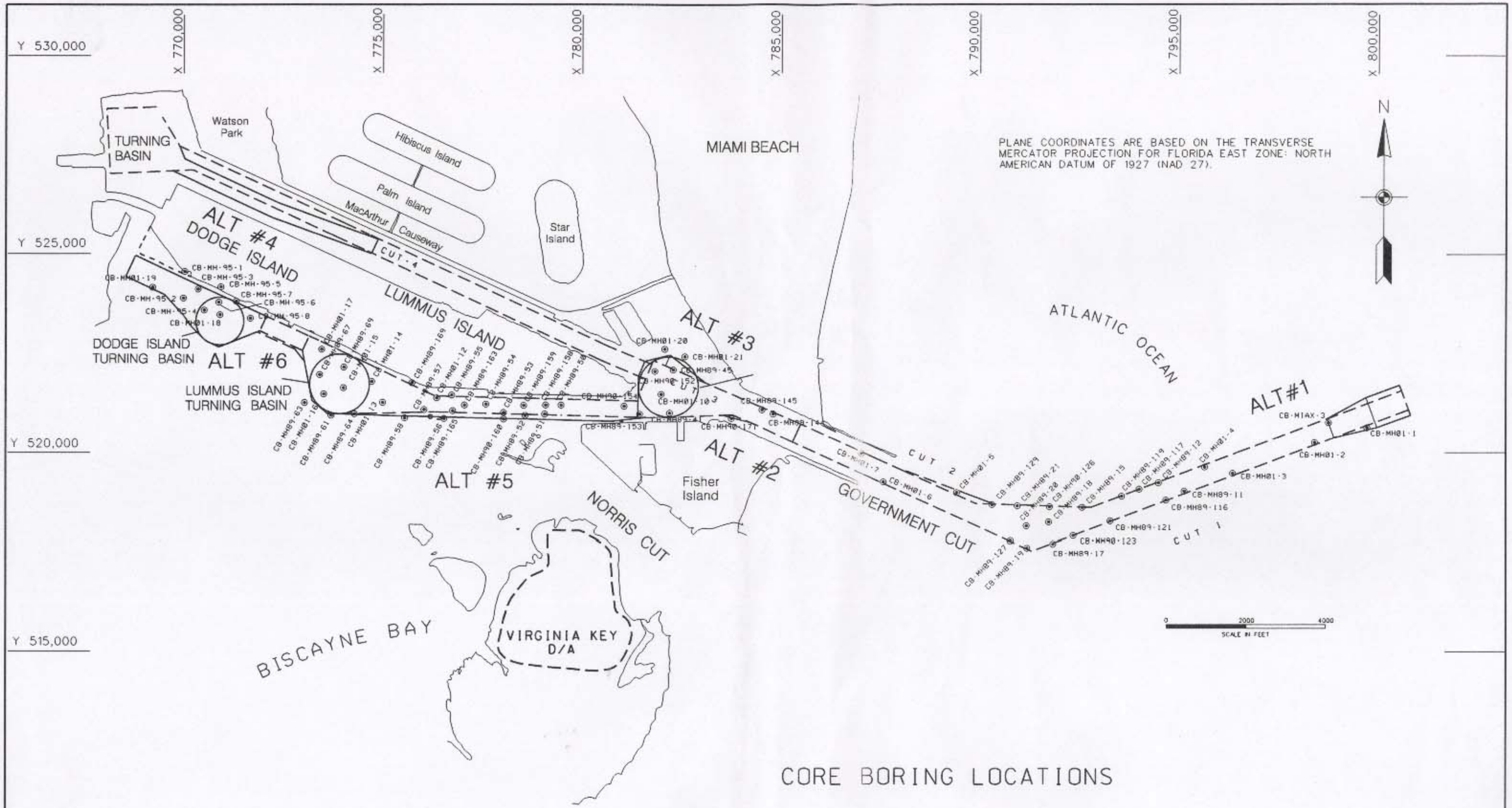
COMPRESSIVE STRENGTH

GRAIN SIZE DISTRIBUTION CURVES

SETTLING RATE TEST

SPECIFIC GRAVITY



CORE BORING LOCATIONS

ATTACHMENT C PLATE-1

BORINGS

Hole No.CB-MH01-02

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=954,633 Y=520,416	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-02	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 2 undisturbed: 0
5. NAME OF DRILLER: Pickett	14. TOTAL NUMBER OF CORE BOXES: 1 of 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
7. THICKNESS OF BURDEN: 4.5 Ft.	16. DATE HOLE STARTED: 03/01/01 COMPLETED: 03/01/01
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.	17. ELEVATION TOP OF HOLE: -48.4 Ft.
9. TOTAL DEPTH OF HOLE: 4.5 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 20 %
	19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-48.4	0.0					-48.4	
			SAND, fine to medium, poorly graded, calcareous, light gray. (SP)	33	1	SPT	18
							16
						-49.9	17
				27	2	SPT	8
							8
						-51.4	9
				0		SPT	12
							11
-52.9	4.5					-52.9	10

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Miami Harbor Deepening and Widening	CB-MH01-02

Hole No.CB-MH01-03

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=952,569 Y=519,642
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-03
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 4.1 Ft.
8. DEPTH DRILLED INTO ROCK: 5.4 Ft.
9. TOTAL DEPTH OF HOLE: 9.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizonatal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1 of 1
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 03/01/01 COMPLETED: 03/01/01
17. ELEVATION TOP OF HOLE: -48.4 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 21.1 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-48.4	0.0					-48.4	
			Silty SAND, fine to medium grained, occasional thin layers of limestone, calcareous, gray. (SM)	33	1	SPT	14 18 28
			Light gray, medium to coarse grained, thin layer of limestone at 1.5 ft.	67	2	SPT	40 41 52
-52.5	4.1			46	3	SPT	33 60
			LIMESTONE, no recovery.	0		Hyd. Press: 200 PSI H20 Return: 0%	
				0		Hyd. Press: 175 PSI H20 Return: 0% Hole blocked	
-57.9	9.5					-57.9	

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

4"X 5.5' core barrel with diamond bit.

Note: Bouncing rods may have been on well packed sand rather than rock.

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-MIAX-3

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening - Rock Claim
2. LOCATION *(Coordinates or Station)*: X=798750, Y=520755
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. *(As shown on drawing title and file number)*: CB-MIAX-3
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 12.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: Mean Low Water, 1.31 ft. below NGVD
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 1 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1
15. ELEVATION GROUND WATER: Tide +1.4
16. DATE HOLE STARTED: 4/13/93 COMPLETED: 4/13/93
17. ELEVATION TOP OF HOLE: -47.1 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 40 %
19. SIGNATURE OF GEOLOGIST: J. Gentile

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/1'
-47.1	0.0					-47.1	
			CARBONATE SAND, Fine to coarse, sand sized shell and limestone fragments, trace of silt, tan, little gravel sized shell fragments, trace of gravel sized limestone fragments. (SW)	40	1	2 inch Sampler	1 9 13 11 14
-52.1	5.0					-52.1	
			No Sample, washed to top of rock.	NoRec	-	Washed with open rods and water	
-59.6	12.5					-59.6	
			Hard Rock below -59.6 Soils are field visually classified in accordance with the Unified Soils Classification System.			Refusal at -59.6 300# Hammer With 18" Drop Used On 2" x 5" Sampler	

7 10 12 15 17 20 22

Hole No.CB-MH01-01

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=955,950 Y=520,793
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-01
6. NAME OF DRILLER: Pickett
8. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 1.0 Ft.
8. DEPTH DRILLED INTO ROCK: 10.2 Ft.
9. TOTAL DEPTH OF HOLE: 11.2 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 1 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1 of 1
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE STARTED: 01/28/01 COMPLETED: 01/28/01
17. ELEVATION TOP OF HOLE: -39.5 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 80.4 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-39.5	0.0					-39.5	
-40.5	1.0		LIMESTONE, broken, lt. brownish gray.	53	1	Split Spoon -40.5	60 / 65
			LIMESTONE, fossiliferous, some coral, mod. to highly weathered, hard to very hard, highly pitted and vuggy with small to large vugs, lt. gray.				35
			Fragmented: 1.0' - 1.4', 2.0' - 2.7', 3.3' - 6.0', 6.3' - 6.8', 7.1' - 7.7', 8.4' - 9.2'.	100		SPT 0.5 ft into rock. Hyd. Press: 300 PSI, H20 Return: 0% D.T.= 13 min., RQD=22% Note: Used modified RQD rock sections less than 4" were counted if they were part of a hard rock area broken because of vugs.	
			Low angle breaks with irregular surfaces: 1.4', 2.0', 2.7', 3.3', 6.0', 6.3', 6.8', 7.1', 7.7', 8.4'. 9.2 to 11.2 ft core loss.			-45.5	
				80	BOX 1	Hyd. Press: 300 PSI, H20 Return: 0% D.T. = 23 min RQD= 1.5/4.0 = 37.5%	
						-49.5	
-50.7	11.2			0		Hyd. Press: 300 PSI, H20 Return: 0% Drilling Time: 11 min -50.7	
			Notes: 1. Soils are field visually classified in accordance with the Unified Soils Clasification System.			140# hammer w/30" drop used with 2.0' split spoon (1 3/8" I.D. X 2" O.D.). 4"X 5.5' core barrel with diamond bit	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Miami Harbor Deepening and Widening | HOLE NUMBER: CB-MH01-01

Hole No.CB-MH01-04

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=951,875 Y=519,801
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-04
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 4.4 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.
9. TOTAL DEPTH OF HOLE: 4.4 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1 of 1
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 03/01/01 COMPLETED: 03/01/01
17. ELEVATION TOP OF HOLE: -47.8 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 34.1 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-47.8	0.0					-47.8	
-49.3	1.5		LIMESTONE, mod. hard, some fine to medium sand seams, calcareous, lt. gray	47	1	SPT -49.3	8, 22, 27
-52.2	4.4		Silty SAND, fine to medium grained, some small shell fragments, thin layer of limestone at 3.0 ft., light gray. (SM)	33	2	SPT -50.8	22, 20, 23
				36	3	SPT -52.2	43, 50, 50

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: Miami Harbor Deepening and Widening | HOLE NUMBER: CB-MH01-04

Hole No. CB-MH89-1

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1 SHEE

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x = 794,000 y = 519,086
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH89-117
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 12'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
12. MANUFACTURER'S DESIGNATION OF DRILL: Failings 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED | UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 10-3-89 | COMPLETED 10-3-89
17. ELEVATION TOP OF HOLE: -40.0
18. TOTAL CORE RECOVERY FOR BORING: 76
19. SIGNATURE OF INSPECTOR: Geologist, Joe Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-40.0	0.0					-40.0 BLS/0.5'
			SAND, fine to medium quartz & shell fragments, little silt, gray, wet, shelly (SM)	33	1	Split Spoon Settled
-43.3	3.3					-43.0
			SAND, fine to medium quartz & shell fragments, trace silt, gray, few thin SAND-STONE lenses, shelly (SP)	88	2	Split Spoon 3 5 5
-44.5	4.5					-44.5
			SANDSTONE, moderately hard, porous, very fossiliferous, many seams of loose sand & shell, light gray	88	3	Split Spoon 12 10 17
-45.9	5.9					-46.0
			SANDSTONE, hard, porous permeable, some seams poorly cemented SANDSTONE, massive, tan, vuggy	100	-	DIA 4" x 5-1/2" D.T. 40 min H.P. 75 psi
						-51.0
-52.0	12.0			50	-	DIA 4"x5½" H.P. 60 psi D.T. 7 min -52.0
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0' SPLIT SPOON (1-3/8"I.D. x 2.0"O.D.)

PROJECT | HOLE NO.

Hole No. CB-MH89-

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET OF 1 SH

1. PROJECT	Miami Harbor Deepening
2. LOCATION (Coordinates or Station)	x = 791,165 y = 518,167
3. DRILLING AGENCY	Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number)	CB-MH89-20
5. NAME OF DRILLER	R. Gordon
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	8.0'
10. SIZE AND TYPE OF BIT	See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLW
12. MANUFACTURER'S DESIGNATION OF DRILL	Failings 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	1
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 9-26-89 COMPLETED 9-26-89
17. ELEVATION TOP OF HOLE	-44.0'
18. TOTAL CORE RECOVERY FOR BORING	78
19. SIGNATURE OF ~~INSPECTOR~~	Geologist, Joe Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-44.0	0.0					-44.0 BLS/0.5'
-44.3	0.3		SAND, fine to medium quartz, silty, gray, little shell (SM)	80	1	-45.0 1/3
-44.7	0.7		Bed of moderately hard SANDSTONE with silty sand lenses from -44.3 to -44.7	88	-	DIA 4" x 5-1/2" D.T. 28 min H.P. 50 psi
			LIMESTONE, hard, very porous, slightly permeable, very fossiliferous (cemented shell), partly altered, tan, unevenly bedded, isolated seams poorly shell, sandy			-49.0
-52.0	8.0			63	-	DIA 4" x 5-1/2" D.T. 23 min H.P. 40 psi
						-52.0
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0' SPLIT SPOON (1-3/8"I.D. x 2"O.D.)

Hole No.CB-MH01-05

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=945,654 Y=519,157	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-05	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 5 undisturbed: 0
5. NAME OF DRILLER: Pickett	14. TOTAL NUMBER OF CORE BOXES: 1 of 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER:
7. THICKNESS OF BURDEN: 7.5 Ft.	16. DATE HOLE STARTED: 03/01/01 COMPLETED: 03/01/01
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.	17. ELEVATION TOP OF HOLE: -45.8 Ft.
9. TOTAL DEPTH OF HOLE: 7.5 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 42.7 %
	19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-45.8	0.0					-45.8	
			Silty SAND, fine to medium grained, thin lense of limestone, calcareous, gray (SM)	53	1	SPT	8 25 33
-47.3	1.5					-47.3	
			LIMESTONE, mod. hard, some fine to medium sand, calcareous, lt. gray	40	2	SPT	14 17 37
						-48.8	
				53	3	SPT	26 36 50
						-50.3	
				33	4	SPT	14 15 14
						-51.8	
				33	5	SPT	10 13 23
-53.3	7.5					-53.3	

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-MH01-06

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=943,811 Y=519,428
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-06
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 6.0 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.
9. TOTAL DEPTH OF HOLE: 6.0 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 4 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1 of 1
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 03/02/01 COMPLETED: 03/02/01
17. ELEVATION TOP OF HOLE: -47.1 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 26.7 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-47.1	0.0					-47.1	
			LIMESTONE, mod. hard, some fine to medium sand seams, calcareous, lt. brownish gray	40	1	SPT	11 18 40
						-48.6	
				27	2	SPT	22 20 10
						-50.1	
				20	3	SPT	13 15 12
						-51.6	
				20	4	SPT	10 12 14
-53.1	6.0					-53.1	

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-MH01-07

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=943,259 Y=520,140
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-07
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 4.5 Ft.
8. DEPTH DRILLED INTO ROCK: 0.0 Ft.
9. TOTAL DEPTH OF HOLE: 4.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1 of 1
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 03/02/01 COMPLETED: 03/02/01
17. ELEVATION TOP OF HOLE: -47.8 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 24.4 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-47.8	0.0					-47.8	
			LIMESTONE, mod. hard, some fine to medium sand, calcareous, lt. grayish brown		1	SPT	12
							26
						-49.3	20
					2	SPT	10
							17
						-50.8	27
					3	SPT	15
							16
-52.3	4.5					-52.3	30

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No. CB-MH90-

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET: OF 2 SH

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x = 783,747 y = 520,865
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH90-171
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 41.5'
10. SIZE AND TYPE OF BIT: See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M L W
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED _____ UNDISTURB
14. TOTAL NUMBER CORE BOXES: 3
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 7/24/90 COMPLETED 7/25/90
17. ELEVATION TOP OF HOLE: -8.5'
18. TOTAL CORE RECOVERY FOR BORING: 63
19. SIGNATURE OF INSPECTOR: Geologist, J. Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-8.5	0.0					Bit or Barrel -8.5 Blows/0.5
-10.5	2.0		LIMESTONE, moderately hard, porous, permeable, very fossiliferous (cemented shell), tan, massive bedded	66	1	Split Spoon -10.0
				NO REC		-10.5 "
-16.5	8.0		LIMESTONE, hard, porous, slightly permeable, massive bedded, very fossiliferous (cemented shell & little sand), sandy in composition, tan-gray, solid core samples (1.0' pieces), brecciated, cemented angular fragments of very hard brown limestone, fossiliferous, tan, massive bedded from -13.5 to -16.5	100		4x5½ Dia DT 17 min HP wt tools -13.5
				100		4x5½ Dia DT 19 min HP 75 psi -16.5
-22.0	13.5		LIMESTONE, moderately hard, porous, permeable, very fossiliferous, oolitic, granular, tan, clean, massive bedded, seams poorly cemented oolites	93		4x5½ Dia DT 10 min HP 50 psi -19.5
				100		4x5½ Dia DT 11 min HP wt of tools -22.5
-22.5	14.0		bed hard limestone from -22.0 to -22.5			
-24.0	15.5		SAND, fine to medium, quartz, clean, trace shell, tan, isolated sandstone lenses (SP)	NO REC		4x5½ Dia DT 11 min HP wt of tools -25.5
				56	2	Split Spoon 23 25 45 -27.0
			clean, no limestone lenses below -28.5	80	3	" settled 10 20 -28.5

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE -8.5' | **Hole No.** CB-MH90-171

PROJECT: Miami Harbor Deepening | INSTALLATION: Jacksonville District | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						Bit or Barrel
						-28.5 Blows/0.5 F
				50	4	Split Spoon settle
-31.5	23.0		many lenses moderately hard sandstone from -31.5 to -32.5			-31.5 2
-32.5	24.0			88	5	" 2 2
			SANDSTONE, moderately hard, porous, permeable, many seams hard sandy limestone, seams friable poorly cemented sandstone, seams loose sand, fossiliferous, tan, massive bedded, isolated hard SS lenses			-33.0 1
				60		" 3 2
						-34.5 2
						" 1
-36.0	27.5		riddled seams loose sand from -34.5 to -36.0	66	6	-36.0
			SAND, fine to medium quartz, tan, clean, few sandstone lenses (SP)	88	7	" 1! 2(
-37.5	29.0					-37.5 2
			LIMESTONE, hard, porous, tan, fossiliferous, sandy in composition, moderately hard sandstone from -38.5 to -39.	40		2x2-7/8 Dia DT 6 min HP 50 psi
-38.5	30.0					-39.5
-39.0	30.5		SAND, fine to medium quartz, clean, tan, trace shell, isolated sandstone lenses (SP), bed hard porous limestone, tan, solution holes from -41.3 to -42.0, sand (SP), trace silt, limy, riddled with lenses hard limestone from -42.0 to -46.	60	8	Split Spoon 7 7
						-41.0 8
-41.3	32.8			80	9	-41.5 " 50
-42.0	33.5			NO REC	10	2x2-7/8 Dia DT 11 min HP 50 psi
						-44.0
				66	11	Split Spoon 15 22
						-45.5 20
			45% hard limestone from -46.0 to -47.0	88	12	" 15 56
-47.0	38.5					-47.0 47
			LIMESTONE, hard, porous, tan, solid core sample, very fossiliferous (cemented shell), sandy	50		2x2-7/8 Dia DT 6 min HP 75 psi
-48.0	39.5					-49.0
			SAND, fine to medium, quartz, tan, slightly limy, many lenses hard sandstone (SP)	80	13	Split Spoon 100
-50.0	41.5					-50.0 100
			LIMESTONE, hard			Refusal
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# hammer with 30" drop used on 2.0' split spoon. (1-3/8" ID x 2" OD)

Hole No.CB-MH01-10

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=938,226 Y=521,630	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-10	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: Pickett	14. TOTAL NUMBER OF CORE BOXES: 1 of 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER:
7. THICKNESS OF BURDEN: 3.2 Ft.	16. DATE HOLE STARTED: 02/26/01 COMPLETED: 02/26/01
8. DEPTH DRILLED INTO ROCK: 8.0 Ft.	17. ELEVATION TOP OF HOLE: -45.3 Ft.
9. TOTAL DEPTH OF HOLE: 11.2 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 17.5 %
	19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-45.3	0.0					-45.3	
			LIMESTONE, mod. hard, some sand, calcareous, lt. brownish gray	27	1	SPT	5 5 6
-46.8	1.5					-46.8	
			SAND, fine to medium poorly graded, trace of limestone, calcareous, lt. gray (SP)	25	2	SPT	10 10 30
-48.3	3.0					-48.3	
			LIMESTONE, very hard, fossiliferous, highly wea., pitted, lt. yellow brown stains, badly broken at 3.2 – 3.6 ft., gray	100		-48.5	10
-50.5	5.2		3.2 – 3.6 ft, 4.6 – 5.2 ft, Coral, very hard.			Hyd. Press: 250 PSI H20 Return: 0% RQD = 20% D.T.: 4 min	
			SAND, no recovery	40	Box 1		
-53.5	8.2					-53.5	
			LIMESTONE, fossilferous, highly wea., pitted, very hard, medium to coarse grained, few light yellow brown stains, gray Badly broken at 9.0 – 10.0 ft. Low angle irregular breaks at 9.0 and 9.3 ft.	60		Hyd. Press: 400 PSI H20 Return: 0%	
-56.5	11.2					-56.5	

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

4"X 5.5' core barrel with diamond bit.

Casing and rod bent and broke while pulling out barrel. 20' of casing dropped on the channel bottom.

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: Miami Harbor Deepening and Widening | HOLE NUMBER: CB-MH01-10

Hole No.CB-MH01-20

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 2

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=938314,.02 Y=522761,.41
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-20
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 18.7 Ft.
8. DEPTH DRILLED INTO ROCK: 9.8 Ft.
9. TOTAL DEPTH OF HOLE: 28.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 12 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1 of 1
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 01/26/01 COMPLETED: 01/26/01
17. ELEVATION TOP OF HOLE: -10.7 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 55 %
19. SIGNATURE OFINSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-10.7	0.0					-10.7	
			SAND, fine to medium poorly graded, some small shell fragments, light gray. (SP)	0		SPT	WOH
							WOH
						-12.2	4
				100	1	SPT	12
							20
-13.7	3.0					-13.7	25
			Silty SAND, fine to medium grained, some small shell fragments, calcareous, light gray. (SM)	100	2	SPT	21
							27
-15.2	4.5					-15.2	24
			LIMESTONE, some shell fragments, moderately hard, some sand, lt. gray	100	3	SPT	13
							26
						-16.7	23
				100	4	SPT	35
							4
						-18.2	8
				100	5	SPT	24
							66
						-19.7	34
				87	6	SPT	14
							16
-21.2	10.5					-21.2	16
			SAND, fine poorly graded, some limestone gravel, white to light gray. (SP)	20	7	SPT	6
							6
						-22.7	5
				20	8	SPT	3
							6
			thin lense of limestone at 13.5 ft.			-24.2	9
				13	9	SPT	5
							5
						-25.7	5
				20	10	SPT	6
							8
						-27.2	10
				20	11	SPT	10
							8
			limestone lense from 18.0 - 18.7 ft.			-28.7	19
-29.4	18.7			100	12	-29.4 SPT	65
							100
			LIMESTONE, fossiliferous, mod. to highly wea., highly porous, pitted and vuggy with small to large vugs, very hard, dark gray	100		-30.4 Hyd. Press: 350 PSI H2O Return: 0% RQD = 100%	
			19.1 - 19.7 ft, fragmented. Low angle irregular open joints: 19.1, 19.8, 20.4, 20.8, 21.6, 22.0, 22.5.	100	Box 1	Hyd. Press: 300 PSI H2O Return: 0% RQD = 57.9%	

(continued)

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

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PROJECT: Miami Harbor Deepening and Widening | HOLE NUMBER: CB-MH01-20

Hole No.CB-MH01-21

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=938,817 Y=522,569
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-21
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 12.0 Ft.
8. DEPTH DRILLED INTO ROCK: 31.8 Ft.
9. TOTAL DEPTH OF HOLE: 43.8 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 15 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 3 of 3
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 02/27/01 COMPLETED: 02/28/01
17. ELEVATION TOP OF HOLE: -11.3 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 90 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-11.3	0.0					-11.3	
			Silty SAND, fine to medium grained, some small shell fragments, calcareous, lt. gray (SM)	67	1	SPT	3, 3, 4
						-12.8	
				33	2	SPT	4, 10, 15
						-14.3	
				27	3	SPT	4, 13, 10
			trace limestone at 4.5 ft.			-15.8	
				33	4	SPT	10, 13, 7
			trace limestone at 6.0 ft.			-17.3	
				67	5	SPT	14, 28, 27
			white, fine grained, no clay at 7.5 ft.			-18.8	
				33	6	SPT	13, 15, 40
			trace limestone at 9.0 ft.			-20.3	
				33	7	SPT	9, 18, 15
			medium to coarse grained at 12.0 ft.			-21.8	
				27	8	SPT	10, 12, 11
-23.3	12.0					-23.3	
			LIMESTONE, mod. hard, some coarse sand and small shell fragments, lt. gray	27	9	SPT	6, 4, 6
-24.8	13.5					-24.8	
			SAND, medium to coarse grained, poorly graded, trace limestone, small shell fragments, lt. gray (SP)	53	10	SPT	6, 7, 11
-26.3	15.0					-26.3	
			LIMESTONE, mod. hard, some fine sand, trace of shell fragments, lt. gray	20	11	SPT	11, 10, 10
-27.8	16.5					-27.8	
			Silty SAND, fine to medium grained, trace limestone, calcareous, lt. gray (SM)	33	12	SPT	22, 18, 40
						-29.3	
-30.5	19.2			67	13	SPT	40, 40, 60
						-30.5	
			LIMESTONE, gray, fossiliferous and sandy, fine to medium grained, slightly to mod. wea., hard, highly porous and pitted. Low angle open joints: 19.2, 19.8, 20.3, 20.8, 21.5, 21.9, 22.4, 22.8 ft.	100	Box 1	Hyd. Press: 400 PSI H20 Return: 0% RQD = 100% D.T. = 7 min.	
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Miami Harbor Deepening and Widening

HOLE NUMBER: CB-MH01-21

Hole No.CB-MH01-20

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: -10.7 Ft.

SHEET 2 OF 2

PROJECT: Miami Harbor Deepening and Widening

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-33.2	22.5						22.5
			20.5 - 21.6 ft, highly wea., vuggy, badly broken.	100		Hyd. Press: 300 PSI H20 Return: 0% -34.2 RQD = 57.9%	
			23.4 - 23.8 ft, highly wea., soft to mod. hard, sandy.				
			no recovery from 23.5 - 28.5 ft.	0	Box 1	Hyd. Press: 300 PSI H20 Return: 0% RQD = 0%	25
						-38.2	
				0		Hyd. Press: 200 PSI H20 Return: 0% -39.2 RQD = 0%	27.5
-39.2	28.5						
			Notes: 1. Soils are field visually classified in accordance with the Unified Soils Clasification System.			140# hammer w/30" drop used with 2.0' split spoon (1 3/8" I.D. X 2" O.D.). 4"X 5.5' core barrel with diamond bit.	30 32.5 35 37.5 40 42.5 45 47.5 50

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: Miami Harbor Deepening and Widening

HOLE NUMBER: CB-MH01-20

Hole No.CB-MH01-21

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: -11.3 Ft.

SHEET 2 OF 2

PROJECT: Miami Harbor Deepening and Widening

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-33.8	22.5						
			Near verical open joint: 21.5 - 23.8 ft.	100	Box 1	Hyd. Press: 400 PSI H20 Return: 0% RQD = 100% D.T. = 7 min.	
			Fragmented: 23.8 - 24.2 ft.			-35.1	
			25.0 - 25.3 ft, soft, clayey, some fine to medium sand, poorly cemented, badly broken and fragmented.	100		Hyd. Press: 500 PSI H20 Return: 0% RQD = 100% D.T. = 6 min.	
-37.6	26.3					-37.6	
			Silty SAND,fine grained, calcareous, olive gray (SM)	47	1	SPT	8, 19, 36
			trace limestone 27.8 ft.			-39.1	
-39.8	28.5			100	2	SPT -39.8	62, 33
			LIMESTONE, fossiliferous, sandy, mod. to highly wea., highly porous and pitted, some small vugs, mod. hard	100	Box 1	Hyd. Press: 250 PSI H20 Return: 100% RQD = 61% D.T. = 4 min	
			hard to very hard 29.5 - 30.6 ft.			-43.1	
			hard, fragmented 30.6 - 31.8 ft.				
			low angle open joints: 28.6, 28.8, 29.2, 29.3, 29.5, 30.3, 30.6 ft.	90		Hyd. Press: 200 PSI H20 Return: 100% RQD = 64%	
			mod. hard and highly vuggy with small to larger vugs: 31.8 - 33.2 ft.				
			mod. porous and pitted: 33.2 - 34.9 ft.				
-47.6	36.3					-48.1	
			Silty SAND, fine grained, trace limestone, calcareous, lt. brown, (SM)			Hyd. Press: 350 PSI H20 Return: 75% RQD = 20%	
-49.7	38.4						
-50.5	39.2		LIMESTONE, fossiliferous, highly wea., pitted and vuggy, sandy, soft to mod. hard, lt. brown	80	Box 2		
-51.5	40.2		Silty SAND, fine grained, trace limestone, lt. brown (SM)				
			LIMESTONE, highly wea., pitted and vuggy, hard, fossiliferous, highly broken			-53.1	
			low angle open joints: 38.4, 38.8, 39.8, 40.3, 40.6, 40.9, 41.9, 42.2, 43.1, 43.5 ft.	75			
-55.1	43.8					-55.1	

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

SAMPLE NO.	SAMPLE ELEVATION	LAB CLASS.
1	-11.3/-12.8	SP-SM
2	-12.8/14.3	SM

*Lab visual classification based on gradation curve. No Atterburg Limits.

140# hammer w/30" drop used with 2.0' split spoon (1 3/8" I.D. X 2" O.D.). 4" X 5.5'core barrel with diamond bit

Note: Hole terminated at -37.6. Drilled next day from -37.6 to -55.1. Second setup at X=938,823, Y=522,556. Two logs combined into one.

22.5 25 27.5 30 32.5 35 37.5 40 42.5 45 47.5 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Miami Harbor Deepening and Widening

HOLE NUMBER: CB-MH01-21

Hole No. CB-MH90-

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville

SHEET 1 OF 1 SHEETS

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x = 781,832 y = 522,046
3. DRILLING AGENCY: US Army Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH90-152
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 11.0'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M L W
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 3/15/90 COMPLETED 3/15/90
17. ELEVATION TOP OF HOLE: -41.0
18. TOTAL CORE RECOVERY FOR BORING: 34
19. SIGNATURE OF INSPECTOR: Geologist, J. Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						Bit or Barrel
-41.0	0.0					-41.0 Blows/0.5 FT
			SAND, medium to fine, quartz, trace gravel, trace shell, light gray, trace clay (SP)	27	1	settled Split Spoon 3
-42.0	1.0					-42.5 1
			SANDSTONE, moderately hard	NO	REC	-43.0 Split Spoon 15
-44.0	3.0					4 x 5½ Dia D.T. 7 min H.P. 25 psi
-44.5	3.5		LIMESTONE, hard, very fossiliferous (cemented shell) porous	16		
			SANDSTONE, moderately hard, alternate beds of hard sandstone and limy (SP) sand, tan, thin bedded, porous, slightly permeable			-46.0
-48.5	7.5			16		4 x 5½ Dia D.T. 22 min H.P. 75 psi
			LIMESTONE, very hard, crystalline limestone, riddled with large open solution holes, some unaltered coral heads, tan-gray, massive bedded, very permeable			-49.0
-52.0	11.0			94		4 x 5½ Dia D.T. 17 min H.P. 50 psi
						-52.0
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140 pound hammer with 30 inch drop used on 2.0' split spoon (1-3/8" ID x 2" OD)

Hole No. CB-MH89-4

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET 1 OF 1 SHEE

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x = 782,594 y = 520,936
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH89-41
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 7.9'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
12. MANUFACTURER'S DESIGNATION OF DRILL: Failings 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 7/20/89 COMPLETED 7/20/89
17. ELEVATION TOP OF HOLE: -37.7'
18. TOTAL CORE RECOVERY FOR BORING: 71
19. SIGNATURE OF INSPECTOR: Geologist
Joe Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-37.7	0.0					-37.7 BLS/0.5'
			SAND, fine to medium, quartz, very silty, gray, wet (SM)	100	1	SPLIT SPOON Settled 1
-39.2	1.5					-39.2 2
			SANDSTONE, moderately hard, porous, permeable, many seams, loose or poorly cemented SAND, gray, some fossils	80	2	" 2 3
						-40.7 11
-41.6	3.9			0	-	" 9 -41.6 11
			SANDSTONE, hard porous, permeable, massive bedded, fossiliferous with coral heads, gray, vuggy, seams poorly cemented SANDSTONE	75	-	DIA 4" x 5½" D.T. 13 min H.P. 50 psi
-45.6	7.9					-45.6
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0' SPLIT SPOON (1 3/8"I.D. x 2.0"O.D.)
			SAMPLE ELEVATION / LABORATORY CLASSIFICATION -37.7 to -39.2 (SM-SC) *			
			NOTE: * Visual classification based on Gradation Curve. No Atterberg Limits.			

Hole No. CB-MH89-4

DRILLING LOG

DIVISION: South Atlantic
INSTALLATION: Jacksonville District
SHEET 1 OF 1 SHEE

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x = 782,290 y = 522,078
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH89-45
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: XX VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 14.0'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
12. MANUFACTURER'S DESIGNATION OF DRILL: Failings 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 8/11/89 COMPLETED 8/11/89
17. ELEVATION TOP OF HOLE: -37.5
18. TOTAL CORE RECOVERY FOR BORING: 40
19. SIGNATURE OF ~~INSPECTOR~~: Geologist Joe Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-37.5	0.0					BIT OR BARREL -37.5 BLS/0.5'
-38.2	0.7		SAND, fine to medium quartz and shell fragments, gray, trace of silt (SP)	80	1	SPLIT SPOON 5
-39.0	1.5				2	-39.0 32 33
			SANDSTONE, hard, porous, permeable, friable, many seams poorly cemented SANDSTONE, some seams loose sand, fossiliferous, light gray, massive, moderately hard, many loose sand seams from -38.2 to -39.0	66	3	" 8 7 -40.5 12
				66	4	" 6 8 -42.0 12
-43.5	6.0			40	5	" 6 9 -43.5 10
			SANDSTONE, moderately hard, porous, permeable, fossiliferous, light gray, many seams of very poorly cemented rock and seams loose sand Thin lenses HARD SANDSTONE from -47.0 to -48.5	0	---	OVERDROVE CASING
				0		DIA 4" x 5½" D.T. 4 min H.P. 30 psi -47.0
-48.5	11.0			33	6	SPLIT SPOON 4 -48.5 15 17
			SAND, fine to medium quartz, light gray, clean, 20% thin sandstone lenses, damp (SP)	56	7	" 14 -50.0 16 23
-51.5	14.0			46	8	" 8 -51.5 14 20
			Soils are field visually classified in accordance with the Unified Soils Classification System. SAMPLE ELEVATION / LABORATORY CLASSIFICATION -37.5 to -38.2 (SP) * Note: * Visual classification based on Gradation Curve. No Atterberg Limits.			140# HAMMER WITH 30" DROP USED ON 2.0' SPLIT SPOON (1 3/8"I.D. x 2.0"O.D.)

Hole No. CB-MH89-14

DRILLING LOG

DIVISION	South Atlantic
INSTALLATION	Jacksonville District
SHEET	1 OF 1 SHEETS
1. PROJECT	Miami Harbor Deepening
2. LOCATION (Coordinates or Station)	x = 784,521 y = 521,083
3. DRILLING AGENCY	Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number)	CB-MH89-145
5. NAME OF DRILLER	R. Gordon
6. DIRECTION OF HOLE	XX VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	12'
10. SIZE AND TYPE OF BIT	See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLW
12. MANUFACTURER'S DESIGNATION OF DRILL	Failings 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	1
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 8/1/89 COMPLETED 8/1/89
17. ELEVATION TOP OF HOLE	-37.9
18. TOTAL CORE RECOVERY FOR BORING	51 %
19. SIGNATURE OF ~~INSPECTOR~~	Geologist Joe Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-37.9	0.0					-37.9 BLS/0.5'
			SAND, fine to medium quartz and sand size shell fragments, tan, wet, (SP)	56	1	Split Spoon 2, 1, 2
-39.9	2.0					-39.4
			LIMESTONE (oolitic) very fossiliferous, tan, porous, riddled with seams loose sand and shell, seams poorly cemented SAND and SHELL, moderately hard, thin lenses hard SANDSTONE	93	2	" 1, 4, 6
						-40.9
-42.4	4.5			80	3	" 2, 6, 3
			SANDSTONE, moderately hard, porous, permeable, thin bedded, riddled with seams loose sand, seams poorly consolidated SANDSTONE, light gray			-42.4
				46	4	" 9, 9, 20
						-43.9
-45.4	7.5			54	5	" 22, 18, 13
						-45.4
-46.4	8.5		Bed (SP) SAND with SAND-STONE lenses from -45.4 to -46.4	33	6	" 2, 5, 12
						-46.9
				12	7	" 9, 20, 33
						-48.4
				33	8	" 6, 12, 23
-49.9	12.0		LIMESTONE, hard			-49.9 REFUSAL
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# HAMMER WITH 30" DROP USED ON 2.0' SPLIT SPOON (1 3/8"I.D. x 2.0"O.D.)

Hole No. CB-MH90-1

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 1 SHEE

1. PROJECT	Miami Harbor Deepening
2. LOCATION (Coordinates or Station)	x = 781,059 y = 521,174
3. DRILLING AGENCY	US Army Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number)	CB-MH90-154
5. NAME OF DRILLER	R. Gordon
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	11.5'
10. SIZE AND TYPE OF BIT	See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	M L W
12. MANUFACTURER'S DESIGNATION OF DRILL	Failing 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBE
14. TOTAL NUMBER CORE BOXES	2
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 3/14/90 COMPLETED 3/14/90
17. ELEVATION TOP OF HOLE	-39.9
18. TOTAL CORE RECOVERY FOR BORING	86
19. SIGNATURE OF INSPECTOR	Geologist, J. Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						Bit or Barrel
-39.9	0.0					-39.9 Blows/0.5 F
-41.4	1.5		SANDSTONE, moderately hard, very porous, permeable, honey-combed with voids partly filled with loose sand, riddled with seams loose sand, light gray	33	1	Split Spoon -41.4
-42.9	3.0			56	2	Split Spoon -42.9
-43.4	3.5		SAND, fine to medium, quartz, riddled with lenses moderately hard sandstone, clean, light gray, moderately hard sandstone from -42.9 to -43.4	100	3	-43.4 " "
			LIMESTONE, very hard, crystalline, brittle, riddled with solution holes partly filled with secondary moderately hard limestone, vuggy, tan, massive bedded, a few fossils	100		4 x 5½ Dia D.T. 25 min H.P. 60 psi -46.4
-51.4	11.5			100		4 x 5½ Dia D.T. 38 min H.P. 50 psi -51.4
			Soils are field visually classified in accordance with the Unified Soils Classification System.			140# hammer with 30" drop used on 2.0' split spoon (1-3/8" ID x 2" OD)

Hole No. CB-MH89-51

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

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x = 779,056 y = 520,975
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH89-51
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 13'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
12. MANUFACTURER'S DESIGNATION OF DRILL: Failings 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 8-28-89 COMPLETED:
17. ELEVATION TOP OF HOLE: -39.2
18. TOTAL CORE RECOVERY FOR BORING: 80 %
19. SIGNATURE OF ~~INSPECTOR~~ Geologist: Joe Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-39.2	0.0					BIT OR BARREL -39.2 BLS/0.5'
-41.7	2.5		SAND, fine to medium quartz, light gray (SP)	80	1	SPLIT SPOON Settlec 4 -40.7 5 2
-43.0	3.8		LIMESTONE, hard, very permeable, riddled with large solution holes, fossiliferous, tan, massive, bed of (SP)	88	2	Split Spoon 4 -42.2 12
-44.2	5.0		SAND with many lenses of hard SANDSTONE, from -43.0' to -44.2'	43	-	DIA 4" x 5-1/2" D.T. 18 min H.P. 30 psi -45.2
			hard, very porous, riddled with solution holes, tan, massive, solid core from -44.2 to -45.2 sandy, large solution holes partly filled with secondary porous hard LIMESTONE from -45.2' to -51.2'	100	-	DIA 4" x 5-1/2" D.T. 35 min H.P. 45 psi -48.2
				82	-	DIA 4" x 5-1/2" D.T. 27 min H.P. 40 psi -50.2
-52.2	13.0			100	-	DIA 4" x 5-1/2" D.T. 16 min H.P. 45 psi -52.2
			Soils are field visually classified in accordance with the Unified Soils Classification System. SAMPLE ELEVATION / LABORATORY CLASSIFICATION -39.2 to -40.7 (SP) * NOTE: *Visual Classification based on Gradation Curve. No Atterberg Limits.			140# Hammer with 30" DROP USED ON 2.0' SPLIT SPOON (1-3/8" I.D. x 2" O.D.)

Hole No. CB-MH90

DRILLING LOG	DIVISION	INSTALLATION	SHEET
	South Atlantic	Jacksonville District	OF 3 SH

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x = 778,028 y = 520,847
3. DRILLING AGENCY: US Army Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH90-160
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 47.0'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): M L W
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: UNDISTURB
14. TOTAL NUMBER CORE BOXES: 3
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 4/16/90 COMPLETED 4/17/90
17. ELEVATION TOP OF HOLE: -3.0
18. TOTAL CORE RECOVERY FOR BORING: 66
19. SIGNATURE OF INSPECTOR: Geologist, J. Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-3.0	0.0					Bit or Barrel -3.0 Blows/0.5 F
-4.0	1.0		SAND, fine to medium, quartz and shell fragments, little silt, gray, little shell (SM)	46	1	Split Spoon settl -4.5
			CLAY, slightly plastic, trace silt, trace to little shell, gray (CL)	60	2	Split Spoon settl -6.0
-7.5	4.5			0		Split Spoon settle -7.5
			CLAY, plastic, gray, little shell, trace silt (CH)	93	3	Split Spoon settle -9.0
				100	4	Split Spoon settle -10.5
				100	5	Split Spoon settle -12.0
-13.5	10.5			20	6	Split Spoon settle -13.5
-15.0	12.0		LIMESTONE, moderately hard, porous, slightly permeable, very fossiliferous, sandy, riddled with voids filled with limy sandy silt, fractured voids filled with soft clay from -13.5 to -15.0	26	7	Split Spoon 4 4 3 -15.0
-16.0	13.0			93	8	Split Spoon 2 22 32 -16.5
-19.5	16.5		LIMESTONE, hard, porous, slightly permeable, very fossiliferous, vuggy, hard limestone, sandy with voids filled with secondary moderately hard to soft, very fossiliferous, buff limestone; solid core; completely riddled with large solution holes filled with secondary soft fossiliferous limestone from -19.5 to -22.5	100		4" x 5½" Dia D.T. 14 min psi wt of rods -19.5
-22.5	19.5			100		4" x 5½" Dia D.T. 21 min psi wt of rods -22.5

ENG FORM ... PROJECT HOLE NO

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE -3.0 | **Hole No.** CB-MH90-16(

PROJECT: Miami Harbor Deepening | INSTALLATION: Jacksonville District | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						Bit or Barrel
-22.5	19.5					-22.5 Blows/0.5
-23.5	20.5		moderately hard limestone from -22.5 to -23.5			4" x 5½" Dia D.T. 3 min psi wt of rods dropped -23.5
		Cavity	large open cavity from -23.5 to -24.5	0		to -24.5
-24.5	21.5					-24.5
			SAND, fine to medium, quartz, many thin lenses hard sandstone, light gray (SP)	33	9	Split Spoon -26.0
				40	10	Split Spoon -27.5
				66	11	Split Spoon -29.0
				56	12	Split Spoon -30.5
				40	13	Split Spoon -32.0
-32.1	29.1					-32.1
			LIMESTONE, very hard, many solution holes partly filled with secondary moderately hard fossiliferous limestone, tan-gray, massive bedded, permeable, isolated coral, solid core	100		-32.7
				97		4" x 5½" Dia D.T. 33 min H.P. 50 psi -35.5
-36.1	33.1					
			completely riddled with large open solution holes, very permeable, tan, limonitic stain from -36.1 to -39.8	100		4" x 5½" Dia D.T. 26 min H.P. 50 psi -37.5
-39.8	36.8		solution holes and voids filled with secondary, porous, fossiliferous, moderately hard limestone from -39.8 to -43.5	50		2" x 2-7/8" Dia D.T. 26 min H.P. 50 psi -40.5
				69		2" x 2-7/8" Dia D.T. 22 min H.P. 100 psi -43.5
-43.5	40.5		very fossiliferous (cemented shell), porous, tan, massive bedded	94		2" x 2-7/8" Dia D.T. 7 min H.P. 120 psi -45.5
				66		2" x 2-7/8" Dia D.T. 10 min H.P. 120 psi -47.5
-47.5	44.5					

Hole No.CB-MH01-12

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 2

1. PROJECT: Miami Harbor Deepening and Widening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=932,593 Y=521,535	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-12	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
5. NAME OF DRILLER: Pickett	14. TOTAL NUMBER OF CORE BOXES: 2 of 2
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
7. THICKNESS OF BURDEN: 0.0 Ft.	16. DATE HOLE STARTED: 01/31/01 COMPLETED: 01/31/01
8. DEPTH DRILLED INTO ROCK: 19.5 Ft.	17. ELEVATION TOP OF HOLE: -32.4 Ft.
9. TOTAL DEPTH OF HOLE: 22.6 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 84.5 %
	19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel
-32.4	0.0					-32.4
			LIMESTONE, lt. gr. with brn. stains, fossiliferous, mod. to highly wea., hard to very hard, highly vuggy, fragmented 0.9 – 1.5 ft, highly wea., mod. hard, badly broken. 1.5 – 1.8 ft, mod. wea., very hard, highly vuggy. 1.8 – 3.0 ft, highly wea., soft to mod. hard, badly broken. 3.4 – 4.5 ft, highly wea., mod. hard, fragmented to badly broken. 4.5 – 7.4 ft, mod. to highly wea., highly vuggy. 5.0 – 5.4 ft, mod. hard to hard. 5.4 – 5.8 ft, hard. 5.8 – 7.4 ft, soft to mod. hard, badly broken.	88		Hyd. Press: 500 PSI H20 Return: 0% D.T. = 13 min. RQD = 13.3%
				100	Box 1	Hyd. Press: 700 PSI H20 Return: 0% D.T. = 19 min. RQD = 27.5%
			7.4 – 9.9 ft, some lt. brn. sand filled vugs, highly vuggy, mod. to highly wea., hard to very hard, fragmented and badly broken. 9.9 – 12.4 ft, no sand, highly wea., mod. hard to hard, fragmented. Fragmented: 9.9 – 12.4, 13.8 – 14.2, 19.2 – 19.3 ft. sl. wea., highly pitted and vuggy with small vugs, very hard at 12.4 ft. Low angle open joints: 13.5, 13.8, 14.0, 14.2, 16.1, 16.7, 16.8, 17.1, 17.2, 17.4, 17.6, 18.1, 18.6, 18.8, 19.3 ft. sl. to mod. wea., small to large vugs at 17.4 ft. Mod.to highly wea. at 18.6 ft. Badly broken: 18.6 – 18.8 ft. 18.8 – 19.3 ft, highly vuggy with large vugs.	100		Hyd. Press: 700 PSI H20 Return: 0% D.T. = 17 min. RQD = 40%
				100	Box 2	Hyd. Press: 550 PSI H20 Return: 0% D.T. = 15 min. RQD = 96.2%
-51.9	19.5		SAND, no recovey	38		Hyd. Press: 500 PSI H20 Return: 0% D.T. = 7 min. RQD = 34%

-39.8 -44.8 -50.0

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

(continued)

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PROJECT: Miami Harbor Deepening and Widening | HOLE NUMBER: CB-MH01-12

Hole No.CB-MH01-12

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -32.4 Ft.

SHEET 2 OF 2

PROJECT: Miami Harbor Deepening and Widening

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel
~~-54.8~~ -55.0	~~22.5~~ 22.6					-55.0

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

4"X 5.5'core barrel with diamond bit.

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5
50

Hole No. CB-MH89-5

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

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x=776,536 y=520,860
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH89-56
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 47'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
12. MANUFACTURER'S DESIGNATION OF DRILL: Failings 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: — UNDISTURBED:
14. TOTAL NUMBER CORE BOXES: 3
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE — STARTED: 9-18-89 COMPLETED: 9-18-89
17. ELEVATION TOP OF HOLE: -2.8
18. TOTAL CORE RECOVERY FOR BORING: 63
19. SIGNATURE OF INSPECTOR: Geologist Joe Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						Bit or Barrel
-2.8'	0.0					-2.8' BLS/0.5'
			SAND, fine quartz, shelly, silty, gray, wet (SM)		1	Settled Split Spoon
-4.8	2.0					
			SILT, gray, damp, little clay (ML)	27		
					2	
-10.3	7.5					-10.3
			Silt, slightly plastic, clayey, trace shell from -10.3 to -14.8	33	3	Settled Split Spoon
-14.8	12.0		bed of silty shell from -14.8 to -15.3			-14.8
-15.3	12.5					1
			LIMESTONE, moderately hard, porous, permeable, vuggy, voids filled with poorly cemented SANDSTONE and loose sand, massive, fossiliferous, very sandy, tan-gray.	73	4	Split Spoon 12 -16.3 15
						" 2
				80	5	12 -17.8 18
				80	6	" 18 -18.8 50
-18.8	16.0					
			LIMESTONE, hard, solid core, porous, permeable, vuggy, solution holes filled with friable SANDSTONE, tan-gray massive fossiliferous, very sandy.	100	-	DIA 4" x 5-1/2" D.T. 10 min H.P. 20 psi
						-21.8
-22.3	19.5					

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE -2.8 | **Hole No.** CB-MH89-56

PROJECT Miami Harbor Deepening | INSTALLATION Jacksonville District | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-22.3	19.5					BLS/0.5'
-24.8	22.0		SANDSTONE, moderately hard, porous, permeable, riddled with seams poorly cemented SANDSTONE and seams of loose sand, light gray.	53	-	DIA 4" x 5-1/2" D.T. 34 min H.P. 70 psi -24.8
-27.3	24.5		SAND, fine to medium quartz, clean, tan, trace shell, wet (SP)	60	7	Split Spoon Settle -27.3
-28.9	26.1		LIMESTONE, very hard, dense, slightly fossiliferous, tan, redeposited crystalline LIMESTONE	100	-	-27.8 DIA 4" x 5-1/2"
-31.1	28.3		LIMESTONE, soft, weathered, chalky, friable, fossiliferous, white, massive, porous, non-permeable bed quartz, SAND (SP) from -31.1 to -32.3.	90	-	DIA 4" x 5-1/2" D.T. 11 min H.P. 40 psi 30.8
-32.3	29.5			25	8	DIA 4" x 5-1/2" D.T. 19 min H.P. 30 psi -32.8
-35.3	32.5		LIMESTONE, moderately hard, porous, permeable, weathered, fossiliferous, completely riddled with solution holes, tan, massive.	33	-	Split Spoon 5 8 12 -34.3
				73	-	Split Spoon 15 21 50 -35.8
			LIMESTONE, hard, porous, permeable, vuggy, riddled with large open solution holes, slightly fossiliferous, tan, massive.	76	-	DIA 4" x 5-1/2" D.T. 36 min H.P. 50 psi -40.8
-43.8	41.0			66	-	DIA 4" x 5-1/2" D.T. 21 min H.P. 70 psi -43.8
			SANDSTONE, hard, porous slightly permeable, well cemented, very fossiliferous, tan, massive, solid core.	100	-	DIA 4" x 5-1/2" D.T. 15 min H.P. 50 psi -46.8

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE -2.8 | **Hole No.** CB-MH89-56

PROJECT: Miami Harbor Deepening | INSTALLATION: Jacksonville District | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL -46.8 BLS/0.5'
						DIA 4" x 5-1/2" D.T. 12 min H.P. 40 psi
-49.8	47.0			100	-	-49.8
			Soils are field visually classified in accordance with the Unified Soils Classification System. SAMPLE ELEVATION / LABORATORY ANALYSIS -2.8 to-4.8 (SC)* -4.8 to-10.3 (CL)* Note: *Visual Classification based on Gradation Curve. No Atterberg Limits.			140# Hammer with 30" DROP USED ON 2.0' Split Spoon (1-3/8" I.D. x 2" O.D.)

Hole No.CB-MH01-13

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=931,232 Y=521,423	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizonatal Datum: NAD83, FLE
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-13	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: Pickett	14. TOTAL NUMBER OF CORE BOXES: 2 of 2
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
7. THICKNESS OF BURDEN: 2.4 Ft.	16. DATE HOLE STARTED COMPLETED: 03/06/01 03/06/01
8. DEPTH DRILLED INTO ROCK: 13.9 Ft.	17. ELEVATION TOP OF HOLE: -38.6 Ft.
9. TOTAL DEPTH OF HOLE: 16.3 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 85.4 %
	19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-38.6	0.0				-38.6	
		Silty SAND, fine grained, trace of small shells fragments, calcareous, gray. (SM)	35	1	SPT	WOH WOH WOH WOH
-40.6	2.0				-40.6	
		LIMESTONE, fossilferous, mod. to highly wea., very hard, highly vuggy, lt. gray.	42	2	-41.0 SPT	17 35 65
		2.4 – 3.1 ft, badly broken.				
		3.1 – 7.4 ft, clay filled vugs with fine crystal coating, mod. weathered.	100		Hyd. Press: 300 PSI H20 Return: 0% D.T. = 23 min. RQD = 84%	
		Low angle irregular open joints: 3.1, 3.5, 3.7, 4.4, 4.9, 5.2, 5.3, 5.9, 6.1, 6.4, 6.8, 6.9, 7.1, 7.4, 8.1, 8.8 and 9.6 ft.		Box 1	-46.0	
		7.4 – 12.1 ft, no clay in vugs.	100		Hyd. Press: 200 PSI H20 Return: 0% RQD = 100%	
		Low angle irregular open joints: 10.2, 10.9, 11.5, 12.1, 12.5, 12.7, 13.2, 13.7, 14.0, 14.2 and 14.4 ft.			-50.7	
		12.1 – 14.4 ft, mod. vuggy with small vugs, fine crystal coating inside vugs, sl. to mod. wea.	100	Box 2	Hyd. Press: 200 PSI H20 Return: 0% RQD = 91.3%	
		14.0 – 14.4 ft, mod. wea., mod. hard, few small to large vugs.			-53.0	
-53.4	14.8	14.4 – 14.7 ft, low angle open joint.	100		-53.4 HP: 200, H20: 0%, RQD: 100%	
		SAND, fine poorly graded, calcareous, light gray. (SP)	67	3	SPT	WOH WOH WOH
-54.9	16.3				-54.9	
		Notes: 1. Soils are field visually classified in accordance with the Unified Soils Clasification System.			140# hammer w/30" drop used with 2.0' split spoon (1 3/8" I.D. X 2" O.D.). 4"X5.5'core barrel with diamond bit	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

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PROJECT	HOLE NUMBER
Miami Harbor Deepening and Widening	CB-MH01-13

Hole No.CB-MH01-14

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening and Widening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=930,960 Y=521,947	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-14	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
6. NAME OF DRILLER: Pickett	14. TOTAL NUMBER OF CORE BOXES: 2 of 2
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
7. THICKNESS OF BURDEN: 0.0 Ft.	16. DATE HOLE STARTED: 02/25/01 COMPLETED: 02/25/01
8. DEPTH DRILLED INTO ROCK: 18.5 Ft.	17. ELEVATION TOP OF HOLE: -37.2 Ft.
9. TOTAL DEPTH OF HOLE: 18.8 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 70.7 %
	19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel
-37.2	0.0					-37.2
			LIMESTONE, fossiliferous, mod. to highly wea., hard, highly vuggy with large vugs, some pale yellow fine crystal coatings, lt. gray Low angle irregular breaks: 0.2, 0.8, 1.2, 1.7, 1.9 ft. Badly broken: 0.2 – 0.8, 1.2 – 1.7, 1.9 – 3.5, 5.8 – 9.3 ft.	100		Hyd. Press: 200 PSI H2O Return: 0% RQD = 20% D.T. = 19 min.
						-41.2
				100	Box 1	Hyd. Press: 700 PSI H2O Return: 0% RQD = 0% D.T. = 26 min.
						-44.0
			Fragmented: 3.5 – 5.8, 6.8 – 9.3 ft. 5.8 – 6.8 ft, highly wea., soft to mod. hard, sandy. Low angle irregular breaks: 9.3, 9.8 ft.	75		Hyd. Press: 700 PSI H2O Return: 0% RQD = 12.5% D.T. = 36 min.
						-48.0
			10.8 – 13.8, mod. wea., hard to very hard. 10.8 – 11.7, broke core to remove from drill bit. Fragmented: 12.1 – 13.0 ft. Badly broken: 13.0 – 13.8 ft.	60	Box 2	Hyd. Press: 300 PSI H2O Return: 0% RQD = 44% D.T. = 12 min.
-51.0	13.8		SAND, no recovery			
-53.0	15.8					-53.0
-53.5	16.3		LIMESTONE, fossiliferous, fine to medium gr., highly vuggy with small to large vugs, some pale yellow, fine crystal coatings, fragmented, lt. gray	17		Hyd. Press: 100 PSI H2O Return: 0% RQD = 0% D.T. = 3 min.
			SAND, no recovery			
-56.0	18.8					-56.0
			Notes: 1. Soils are field visually classified in accordance with the Unified Soils Clasification System.			4"X 5.5'core barrel with diamond bit

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

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PROJECT: Miami Harbor Deepening and Widening | HOLE NUMBER: CB-MH01-14

Hole No.CB-MH01-15

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=930247,.53 Y=521787,.70
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-15
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 1.5 Ft.
8. DEPTH DRILLED INTO ROCK: 20.0 Ft.
9. TOTAL DEPTH OF HOLE: 21.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 1 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 2 of 2
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 01/30/01 COMPLETED: 01/30/01
17. ELEVATION TOP OF HOLE: -34.0 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 90.5 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-34.0	0.0					-34.0	
			LIMESTONE, soft to mod. hard, light gray	47	1	SPT	0 0 27
-35.5	1.5					-35.5	
			LIMESTONE, brown stains, fossiliferous, mod. to highly wea., hard, fragmented, lt. gray 2.0 – 3.2 ft, moderately hard, badly broken. 3.2 – 4.0 ft, hard to very hard, highly pitted, vuggy, fragmented. Low angle irregular breaks: 4.0, 4.2, 4.4, 4.7 ft. 5.7 – 10.7 ft, hard to very hard, some vugs, fragmented.	100	Box 1	Hyd. Press: 500 PSI H20 Return: 0% RQD = 42.9% D.T. = 20 min.	
						-39.0	
				100		Hyd. Press: 700 PSI H20 Return: 0% RQD = 76.6 D.T. = 17 min.	
						-43.7	
			10.7 – 13.6 ft, lt. grayish brown, mod. wea., very hard, highly porous, pitted, mod. vuggy. Low angle slightly irregular breaks: 10.7, 11.1, 11.8, 12.3, 12.4, 12.7, 13.1 ft. Fragmented: 13.1 – 13.6 ft, 17.3 – 17.4 ft, 17.8 – 21.5 ft.	67		Hyd. Press: 400 PSI H20 Return: 0% RQD = 55.2% D.T. = 11 min.	
			15.5 – 16.8 ft, highly wea., mod. hard, fragmented. 16.8 – 17.3 ft, mod. wea., mod. vuggy, very hard. 17.3 – 17.8 ft, highly vuggy with large vugs, hard to very hard. Low angle open joints, 16.8, 17.3 ft. Machine breaks: 17.3, 17.4, 17.8 ft. 17.8 – 21.5 ft, hard.	100	Box 2	Hyd. Press: 500 PSI H20 Return: 0% RQD = 43.5% D.T. = 10 min.	
						-51.8	
				100		Hyd. Press: 500 PSI H20 Return: 0% RQD = 10.8% D.T. = 10 min.	
-55.5	21.5					-55.5	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

(continued)

Hole No.CB-MH01-15

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE -34.0 Ft.	SHEET 2 OF 2
PROJECT Miami Harbor Deepening and Widening	INSTALLATION Jacksonville District	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/ .5'
			Notes: 1. Soils are field visually classified in accordance with the Unified Soils Clasification System.			140# hammer w/30" drop used with 2.0' split spoon (1 3/8" I.D. X 2" O.D.). 4"X 5.5' core barrel with diamond bit.	

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5

Hole No.CB-MH01-16

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 2

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=929,753 Y=521,634
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-16
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 4.2 Ft.
8. DEPTH DRILLED INTO ROCK: 16.3 Ft.
9. TOTAL DEPTH OF HOLE: 20.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 2 of 2
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 01/29/01 COMPLETED: 01/29/01
17. ELEVATION TOP OF HOLE: -33.6 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 68.7 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-33.6	0.0					-33.6	
			SILT, lean, some fine sand, gray. (ML)	40	1	SPT	0 0 1
-35.1	1.5					-35.1	
			Silty SAND, fine to medium grained, trace limestone, lt. gray. (SM)	73	2	SPT	0 6 13
-36.6	3.0					-36.6	
			LIMESTONE, mod. hard, some fine sand, lt. gray	92	3	SPT	10 64 36
-37.8	4.2					-37.8	
			LIMESTONE, sandy, highly wea., soft to mod. hard, gray	100		HP: 400 PSI, H20 Ret.: 0% RQD = 60%, D.T.= 5 min	
			Poorly cemented, badly broken: 4.2 – 4.6 ft.			-38.8	
			Fossiliferous, mod. to highly wea., hard to very hard, mod. vuggy at 4.6 ft.	100		Hyd. Press: 850 PSI H20 Return: 80% RQD = 77.5% D.T. = 15 min.	
			Fragmented: 4.6–5.2, 6.2–7.0, 8.1–8.4, 10.9–11.0 ft. 7.7–11.0 ft, highly vuggy, very hard, brown stains.			-40.6	
			Low angle irregular breaks: 7.0, 7.3, 7.7, 8.1, 8.4, 9.1, 9.6, 10.5, 10.9 ft.	100	Box 1	Hyd. Press: 350 PSI H20 Return: 0% RQD = 77.5% D.T. = 19 min.	
						-44.6	
			11.0 – 11.2 ft, lt. brownish gray, mod. wea., highly porous and pitted, few small vugs.				
			11.2 – 11.5 ft, lt. gray, highly wea., soft to mod. hard, badly broken.				
			Very hard, mod. vuggy at 11.5 Fragmented: 11.5 – 11.9, 12.3 – 12.5, 16.2 – 16.8, 17.3 – 18.5 ft.	30		Hyd. Press: 350 PSI H20 Return: 0% RQD = 24% D.T. = 10 min	
-48.6	15.0		Low angle irregular breaks: 11.9, 12.3 ft.				
-49.6	16.0		SAND, no recovery			-49.6	
			LIMESTONE, ft, hard to very hard, mod. vuggy, highly pitted, mod. wea., lt. gray	100		Hyd. Press: 400 PSI H20 Return: 0% RQD = 40% D.T. = 13 min.	
			16.8 – 17.3 ft, highly wea., mod. hard to hard, badly broken.			-52.1	
				15	Box 2	Hyd. Press: 450 PSI H20 Return: 0% RQD = 15% D.T. = 6 min.	
-54.1	20.5					-54.1	

(continued)

Hole No.CB-MH01-16

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -33.6 Ft.

PROJECT: Miami Harbor Deepening and Widening

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
			Notes: 1. Soils are field visually classified in accordance with the Unified Soils Clasification System.			140# hammer w/30" drop used with 2.0' split spoon (1 3/8" I.D. X 2" O.D.). 4"X 5.5' core barrel with diamond bit. Used Modified RQD. Rock sections less than 4" were counted if they were part of a hard rock area broken because of vugs.	

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: Miami Harbor Deepening and Widening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=929,714 Y=522,721	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-17	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
5. NAME OF DRILLER: Pickett	14. TOTAL NUMBER OF CORE BOXES: 2 of 2
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
7. THICKNESS OF BURDEN: 0.0 Ft.	16. DATE HOLE STARTED: 02/25/01 COMPLETED: 02/26/01
8. DEPTH DRILLED INTO ROCK: 22.5 Ft.	17. ELEVATION TOP OF HOLE: -33.0 Ft.
9. TOTAL DEPTH OF HOLE: 22.5 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 64 %
	19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-33.0	0.0				-33.0	
		LIMESTONE, mod. hard, some sand, lt. gray	20	1	SPT	10 10 11
-34.5						
			33	2	SPT	15 14 26
-36.0	3.0				-36.0	
		LIMESTONE, fossiliferous, mod. to highly wea., mod. hard to hard, highly vuggy with small to large vugs, lt. gray lt. brown, highly wea. at 2.9 ft. 2.9-4.7 ft., poorly cemented, badly broken. 4.7 - 8.7 ft, lt. yellow brown stains. 4.7 - 6.7 ft, mod. hard to hard, badly broken. 6.7 - 7.5 ft, fragmented, hard. 7.5 - 8.7 ft, lt. gray, some lt. brown stains. 7.5 - 7.9 ft, mod. wea., hard to very hard fragments. 7.9 - 8.7 ft, poorly cemented, badly broken. Fragmented: 8.7-10.0, 10.5-11.2, 11.6-12.5 ft. 8.7-12.5 ft, lt. brown fine crystal coatings. Fragmented: 12.5 - 15.0 ft. 12.5 - 13.0 ft, hard to very hard. 13.0 - 15.0 ft, highly wea.	100		Hyd. Press: 700 PSI H2O Return: 0% RQD = 16% D.T. = 36 min.	23 16 23 20 30 70
-40.5						
			100		Hyd. Press: 700 PSI H2O Return: 0% RQD = 32% D.T. = 13 min.	
-45.5						
-48.0	15.0				Hyd. Press: None H2O Return: 0% RQD = 10% D.T. = 5 min.	
		SAND, no recovery	50			
-50.5	17.5				-50.5	
-50.8	17.8	LIMESTONE, fossiliferous, mod. to highly wea., very hard, highly pitted, few small to large vugs, lt. gray				
		SAND, no recovery	67		Hyd. Press: 200 PSI H2O Return: 0% RQD = 6% D.T. = 4 min.	
-55.5	22.5				-55.5	

(continued)

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-MH01-17

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: -33.0 Ft.

PROJECT: Miami Harbor Deepening and Widening

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/ .5'
						-55.5	

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

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

4"X 5.5' core barrel with diamond bit

Hole terminated at -40.4. SPT first 6.0'. Drilled next day from -33.0 to -55.5. Cored after first 3.0'. Second setup X=929,714 Y=522,724

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5

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PROJECT: Miami Harbor Deepening and Widening

HOLE NUMBER: CB-MH01-17

Hole No. CB-MH89

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET OF 2 SHE

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): x = 774,020 y = 522,147
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH89-69
5. NAME OF DRILLER: R. Gordon
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 22.5'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
12. MANUFACTURER'S DESIGNATION OF DRILL: Failings 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: UNDISTURB
14. TOTAL NUMBER CORE BOXES: 2
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 9-28-89 COMPLETED 9-28-89
17. ELEVATION TOP OF HOLE: -27.5
18. TOTAL CORE RECOVERY FOR BORING: 66
19. SIGNATURE OF ~~INSPECTOR~~: Geologist, Joe Gentile

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX NO. OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-27.5	0.0					-27.5 BLS/0.5
-28.2	0.7		SAND, fine to medium quartz, shelly, gray (SP)	88	1	Split Spoon Settl
-29.0	1.5		LIMESTONE, tan, soft, weathered, loosely cemented seams with compacted calcareous silt from -30.5 to -33.5		2	-29.0
				80	-	-29.5 "
-30.5	3.0			100	-	DIA 4" x 5-1/2" D.T -30.5 7 min H.P. 20 ps
				0	-	DIA 4" x 5-1/2" D.T. 5 min H.P. 20 psi
-33.5	6.0		moderately hard, porous permeable, riddled with solution holes, fossiliferous, tan, massive from -33.5 to -35.5			-33.5
				60	4	Split Spoon 10 5
-35.5	8.0					-35.0 9
				100	5	-35.5 " 25
			LIMESTONE, very hard, crystalline, dense, solid, solid core, few fossils	100	-	DIA 4" x 5-1/2" D.T. 58 min H.P. 60 psi
			Many large open solution holes lined with calcite crystals, tan, massive, solid core from -36.3 to -37.5			-39.5
				100	-	DIA 4" x 5-1/2" D.T. 18 min H.P. 75 psi
						-41.5
			riddled with large open solution holes from -37.5 to -41.5	73	-	DIA 4" x 5-1/2" D.T. 32 min H.P. 80 psi
						-44.5
-45.8	18.3			33	-	DIA 4" x 5-1/2" D.T. 26 min H.P. 30 psi
-47.0	19.5		SANDSTONE, moderately hard			
			SAND, fine to medium quartz, trace silt, tan, wet, a few SANDSTONE lenses (SP)			

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE -27.5 | **Hole No.** CB-MH89-6

PROJECT: Miami Harbor Deepening | INSTALLATION: Jacksonville District | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
						BLS/0.5'
						-48.5
-50.0	22.5			80	6	Split Spoon 10 / 11 / 12 -50.0

Soils are field visually classified in accordance with the Unified Soils Classification System.

SAMPLE ELEVATION	LABORATORY ANALYSIS
-48.5 to -50.0	(SP) *

NOTE:
* Visual classification based on Gradation Curve. No Atterberg Limits.

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

Hole No.CB-MH-95-1

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=770,027 Y=524,555	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): CB-MH-95-1	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
6. NAME OF DRILLER: C. Robbins	14. TOTAL NUMBER OF CORE BOXES: 1
8. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF BURDEN: 0 Ft.	16. DATE HOLE STARTED: 4/24/95 COMPLETED: 4/24/95
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: -21.0 Ft.
9. TOTAL DEPTH OF HOLE: 21.7 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 58 %
	19. SIGNATURE OF GEOLOGIST: J.Aurthur

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/1'
-21.0	0.0					-21.0	
			CLAY, silty, fat, some fine quartz sand, gray (CH) Soils are field visually classified in accordance with the Unified soils Classification System 140 # Hammer with 30 inch drop used used on 2' Split Spoon (1 3/8" I.D. X 2" O.D.)		1	SETTLED SPLIT SPOON	
-25.3	4.3					-25.3	
			LIMESTONE, moderately hard, solution riddled, silt and sand (quartz) filled cavities, light gray		2	SPLIT SPOON	27
-26.8						-26.8	
					3	SPLIT SPOON	14
-28.3	7.3	CAVITY	open cavity from -28.3 to -31.3			-28.3	
		CAVITY				DROPPED SPLIT SPOON	
-31.3	10.3	CAVITY				-31.3	
			LIMESTONE, very hard, fossiliferious, highly pitted and vuggy with small to large vugs, moderately weathered, light gray to white, fraactured and broken zones	100		DIA 4 X 5 1/2 D.T. 13 MIN H.P. 110 PSI	
-32.4						-32.4	
				24		DIA 4 X 5 1/2 D.T. 40 MIN H.P. 100 PSI	
-36.6						-36.6	
			SAMPLE ELEVATION -24.3/-28.9 LABORATORY ANALYSIS (ML)* NOTE: *Visual classification based on grain size curve no Atterberg Limits.	31		DIA 4 X 5 1/2 D.T. 21 MIN H.P. 100 PSI	
-40.5						-40.5	
				63		D.T. 20 MIN H.P. 100 PSI	
-41.3						-41.3	
				100		DIA 4 X 5 1/2 D.T. 45 MIN H.P. 120 PSI	
-42.7	21.7					-42.7	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

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PROJECT: Miami Harbor Deepening | HOLE NUMBER: CB-MH-95-1

Hole No.CB-MH-95-2

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=769,993 Y=523,885	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): CB-MH-95-2	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
5. NAME OF DRILLER: C. Robbins	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF BURDEN: 0 Ft.	16. DATE HOLE STARTED: 4/25/94 COMPLETED: 4/25/94
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: -24.3 Ft.
9. TOTAL DEPTH OF HOLE: 10.9 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 35 %
	19. SIGNATURE OF GEOLOGIST: J.Aurthur

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-24.3	0.0					-24.3	
			CLAY, silty, fat, some fine quartz sand, gray (CH)			SETTLED	
					1	SPLIT SPOON	
-28.9	4.6					-28.9	
-29.4	5.1		LIMESTONE, moderately hard, solution riddled, silt and sand (quartz) filled cavities, light gray	100	2	-29.4 SPLIT SPOON	7
			LIMESTONE, moderately hard to hard, fossiliferious, highly pitted and vuggy with small to large vugs, moderately weathered, light gray to	19		DIA 4 X 5 1/2 D.T. 13 MIN H.P. 110 PSI -30.7	
			badly broken from -29.4 to -30.7			DIA 4 X 5 1/2 D.T. 40 MIN H.P. 100 PSI	
			fragmented from -30.7 to -31.4	0			
-35.2	10.9					-35.2	
			Note: Soils are field visually classified in accordance with the Unified Soils Classification.			140# Hammer with 30" drop used on 2' Splitspoon (1 3/8 I.D. X 2" O.D.)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

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PROJECT	HOLE NUMBER
Miami Harbor Deepening	CB-MH-95-2

Hole No.CB-MH-95-3

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=770,366 Y=524,111	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): CB-MH-95-3	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
5. NAME OF DRILLER: C. Robbins	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF BURDEN: 0 Ft.	16. DATE HOLE STARTED: 5/4/94 COMPLETED: 5/4/94
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: -26.7 Ft.
9. TOTAL DEPTH OF HOLE: 16.1 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 88 %
	19. SIGNATURE OF GEOLOGIST: J.Aurthur

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-26.7	0.0					-26.7
			LIMESTONE, very hard fossiliferious, broken, moderately weathered, and vuggy gray to light gray	100		DIA 4 X 5 1/2 D.T. 28 MIN H.P. 80 PSI
						-29.7
				100		DIA 4 X 5 1/2 D.T. 18 MIN H.P. 80 PSI
						-31.7
				100		DIA 4 X 5 1/2 D.T. 15 MIN H.P. 80 PSI
						-34.7
				49		DIA 4 X 5 1/2 D.T. 10 MIN H.P. 80 PSI
						-38.6
				100		DIA 4 X 5 1/2 D.T. 16 MIN H.P. 100 PSI
						-41.9
-42.8	16.1			100		D.T. 19 MIN H.P. 110
						-42.8

0 2.5 5 7.5 10 12.5 15 17.5 20

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PROJECT	HOLE NUMBER
Miami Harbor Deepening	CB-MH-95-3

Hole No.CB-MH-95-4

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=770,518 Y=523,584	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): CB-MH-95-4	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
5. NAME OF DRILLER: C. Robbins	14. TOTAL NUMBER OF CORE BOXES: 2
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF BURDEN: 0 Ft.	16. DATE HOLE STARTED: 5/3/95 COMPLETED: 5/3/95
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: -23.7 Ft.
9. TOTAL DEPTH OF HOLE: 19.7 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 88 %
	19. SIGNATURE OF GEOLOGIST: J.Aurthur

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/1'
-23.7	0.0					-23.7	
			CLAY, silty, fat, trace fine sand and small shell fragments, gray (CH) Soils field visually classified in accordance with the Unified Soils Classification System 140 # Hammer with 30 inch drop used on 2' Split Spoon (1 3/8" I.D. X 2' O.D.)		1	SETTLED SPLIT SPOON	0 2.5
-28.4	4.7					-28.4	
			LIMESTONE, moderately hard, fossiliferous, moderately to highly weathered, highly pitted and vuggy with small to large vugs, badly broken, some silt and clay, light gray to white	100		DIA 4 X 5 1/2 D.T. 21 MIN H.P. 80 PSI -29.9	5
				100		DIA 4 X 5 1/2 D.T. 12 MIN H.P. 100 PSI -31.8	7.5
				59		DIA 4 X 5 1/2 D.T. 25 MIN H.P. 100 PSI -34.0	10
-35.4	11.7						
			LIMESTONE, very hard, moderately weathered, moderately vuggy, fragmented and broken zones, gray	42		DIA 4 X 5 1/2 D.T. H.P. 100 PSI -37.8	12.5
				100		DIA 4 X 5 1/2 D.T. 16 MIN H.P. 80 -39.4	15
				100		DIA 4 X 5 1/2 D.T. 27 MIN H.P. 80 -41.7	17.5
				100		DIA 4 X 5 1/2 D.T. 10 MIN H.P. 80	
-43.4	19.7					-43.4	
			SAMPLE -23.7/-28.4 LABORATORY (SM)* NOTE: *Visual classification based on grain size curve No Atterberg Limits.				20 -22.5

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PROJECT: Miami Harbor Deepening | HOLE NUMBER: CB-MH-95-4

Hole No.CB-MH-95-5

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=770,938 Y=524,170	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): CB-MH-95-5	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
5. NAME OF DRILLER: C. Robbins	14. TOTAL NUMBER OF CORE BOXES: 2
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF BURDEN: 0 Ft.	16. DATE HOLE STARTED: 5/5/95 COMPLETED: 5/5/95
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: -25.2 Ft.
9. TOTAL DEPTH OF HOLE: 17.8 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 81 %
	19. SIGNATURE OFGEOLOGIST: J.Aurthur

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/1'
-25.2	0.0					-25.2	
			CLAY, silty, fat, trace fine sand, gray (CH) Soils are field visually classified in accordance with the Unified Soils Classification System 140 # Hammer with 30 inch drop used on 2" Split Spoon (1 3/8" I.D. X 2" O.D.)		1	SETTLED SPLIT SPOON	
-29.5	4.3					-29.5	
			LIMESTONE, hard, fossiliferous, moderately to highly weathered highly pitted and vuggy with small to large vugs, badly broken and fragmented, light gray to white	100		DIA 4 X 5 1/2 D.T. 13 MIN H.P. 100 PSI	
						-31.4	
						DIA 4 X 5 1/2 D.T. 10 MIN H.P. 100 PSI	
-34.0	8.8		Cavity	52			
		CAVITY					
-36.4	11.2					-36.4	
			LIMESTONE, very hard, slightly to moderately weathered, moderately to highly pitted and vuggy, light gray to white	100		DIA 4 X 5 1/2 D.T. 21 H.P. 100 PSI	
						-39.4	
				100		DIA 4 X 5 1/2 D.T. 33 MIN H.P. 80	
-43.0	17.8					-43.0	
			SAMPLE -25.2/-29.5 LABORATORY (ML)* NOTE: *Visual classification based on grain size curve No Atterberg Limits.				

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

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PROJECT	HOLE NUMBER
Miami Harbor Deepening	CB-MH-95-5

Hole No.CB-MH-95-6

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=770,887 Y=523,782	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): CB-MH-95-6	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
6. NAME OF DRILLER: C. Robbins	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF BURDEN: 0 Ft.	16. DATE HOLE STARTED: 5/7/95 COMPLETED: 5/7/95
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: -28.7 Ft.
9. TOTAL DEPTH OF HOLE: 14.4 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 57 %
	19. SIGNATURE OF GEOLOGIST: J.Aurthur

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/1'
-28.7	0.0					-28.7	
			CLAY, silty, fat, some fine quartz sand, gray (CH)			SETTLED	0
			Soils are field visually classified in accordance with the Unified Soils Classification System		1	SPLIT SPOON	
-31.8	3.1		140 # Hammer with 30 inch drop used on 2' Split Spoon (1 3/8" I.D. X 2" O.D.)			-31.8	2.5
			LIMESTONE, hard, fossiliferious, highly pitted and vuggy with small to large vugs, moderately to highly weathered, badly broken zones, light gray to white	42		DIA 4 X 5 1/2 D.T. 24 MIN H.P. 80	5
			from -38.1 to -38.7 very hard, slightly to moderately weathered, slightly to moderately pitted, moderately vuggy with small to large vugs			-35.4	
				41		DIA 4 X 5 1/2 D.T. 10 MIN H.P. 80 PSI	7.5
-38.7	10.0					-37.6	
			SANDSTONE, very hard, fine grained, some fossils, slightly to moderately weathered, highly vuggy with large to small vugs. badly broken, gray	56		DIA 4 X 5 1/2 D.T. 14 MIN H.P. 100 PSI	10
-41.0	12.3					-41.0	
			LIMESTONE, very hard, highly porous, pitted and vuggy, with small to large vugs, moderately weathered, fossiliferious, light gray to gray	100		DIA 4 X 5 1/2 D.T. 12 MIN H.P. 100	12.5
-43.1	14.4					-43.1	
			from -41.9 to -42.5, hard, highly weathered, badly broken			140 # Hammer with 30 " drop used on 2' Split Spoon (1 3/8" I.D. X 2"O.D.)	15
			Soils are field visually classified in accordance with the Unified Soils Classification System				17.5
			SAMPLE ELEVATION -28.7/-31.8 LABORATORY ANALYSIS (SM)*				20
			NOTE: *Visual classification on grain size curve No Atterberg Limits.				22.5

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PROJECT: Miami Harbor Deepening | HOLE NUMBER: CB-MH-95-6

Hole No.CB-MH-95-7

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening
2. LOCATION (Coordinates or Station): X=771,323 Y=523,803
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH-95-7
5. NAME OF DRILLER: C. Robbins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 0 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.
9. TOTAL DEPTH OF HOLE: 18.2 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 2
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE STARTED: 5/7/95 COMPLETED: 5/7/95
17. ELEVATION TOP OF HOLE: -25.4 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 58 %
19. SIGNATURE OF GEOLOGIST: J.Aurthur

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/1'
-25.4	0.0					-25.4	
			CLAY, silty, fat, some fine quartz sand, gray (CH)			SETTLED	0
					1	SPLIT SPOON	
-29.2	3.8		LIMESTONE, hard, fossiliferous, highly weathered, highly pitted and vuggy with small to large vugs, badly broken, gray			-29.2	2.5
-29.8	4.4		CLAY, fat, some limestone fragments, greenish gray (CH)			DIA 4 X 5 1/2 D.T. 7 MIN H.P. 80 PSI	
-31.0	5.6		LIMESTONE, very hard, fossiliferous, moderately weathered, slightly pitted, a few small to large vugs, gray	37			5
			from - 34.0 to -34.2 fragmented			-34.0	7.5
			from -34.6 to -34.8 moderately to highly weathered, moderately hard, badly broken, low angle breaks	100		DIA 4 X 5 1/2 D.T. 8 MIN H.P. 80 PSI	
-35.7	10.3		SANDSTONE, very hard, fine grained, some fossils, highly vuggy with small to large vugs, moderately weathered, gray from -35.7 to -35.9			-35.7	10
-35.9	10.5					DIA 4 X 5 1/2 D.T. 17 MIN H.P. 100 PSI	
			LIMESTONE, very hard, some fine quartz sand, moderately weathered, fossiliferous, moderately to highly pitted and vuggy with small to large vugs, gray	81			12.5
			from -36.1 to -39.9 light gray to white, low angle breaks			-40.9	15
			from -40.9 to -43.6 light gray to gray, moderately to highly weathered, highly pitted and vugy with large to small vugs, some light yellow coating inside vugs, low angle breaks	56		DIA 4 X 5 1/2 D.T. 10 MIN H.P. 100 PSI	
-43.6	18.2					-43.6	17.5
			Soils field visually classificated in accordance with the Unified Soils Classification System SAMPLE -25.4/-27.2 LABORATORY (SM)* NOTE:*Visual classification based on grain size curve No Atterberg Limits.			140 # Hammer with 30" drop used on 2' Split Spoon (1 3/8" I.D. x 2" O.D.)	20
							22.5

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PROJECT: Miami Harbor Deepening

HOLE NUMBER: CB-MH-95-7

Hole No.CB-MH-95-8

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1

1. PROJECT: Miami Harbor Deepening	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=771,675 Y=523,377	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW
3. DRILLING AGENCY: Corps of Engineers	12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 314
4. HOLE NO. (As shown on drawing title and file number): CB-MH-95-8	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 0 undisturbed: 0
6. NAME OF DRILLER: C. Robbins	14. TOTAL NUMBER OF CORE BOXES: 2
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF BURDEN: 0 Ft.	16. DATE HOLE STARTED: 4/26/95 COMPLETED: 4/26/95
8. DEPTH DRILLED INTO ROCK: 0 Ft.	17. ELEVATION TOP OF HOLE: -22.6 Ft.
9. TOTAL DEPTH OF HOLE: 20.8 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 70 %
	19. SIGNATURE OF GEOLOGIST: J.Aurthur

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/1"
-22.6	0.0					-22.6	
			CLAY, silty, fat, trace fine sand & small shell fragments, gray (CH) Soils are field visually classified in accordance with the Unified soils Classification System 140 # Hammer with 30 inch drop used on 2' Split Spoon (1 3/8" I.D. X 2" O.D.)		1	SETTLED SPLIT SPOON	
-28.1	5.5					-28.1	
			LIMESTONE, moderately hard, solution riddled, silt and sand (quartz) filled cavities, gray to white		2	SPLIT SPOON -29.6	12
-31.1	8.5				3	SPLIT SPOON -31.1	23
			LIMESTONE, hard, fossiliferious, highly pitted and vuggy with small to large vugs, moderately to highly weathered, fractured and broken zones, gray to white	70		DIA 4 X 5 1/2 D.T. 21 MIN H.P. 40 PSI -32.8	
				100		D.T. 15 MIN H.P. 100 PSI -33.9	
				100		D.T. 13 MIN H.P. 40 PSI -34.9	
				67		D.T. 18 MIN H.P. 40 PSI -36.7	
				100		D.T. 17 MIN H.P. 80 PSI -37.4	
			SAMPLE ELEVATION -22.6/-28.1 LABORATORY ANALYSIS (ML)* NOTE: *Visual classification based on grain size curve No Atterberg Limits	71		DIA 4 X 5 1/2 D.T. 19 MIN H.P. 80 PSI -40.9	
				60		DIA 4 X 5 1/2 D.T. 15 MIN H.P. 100 PSI	
-43.4	20.8					-43.4	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Miami Harbor Deepening | HOLE NUMBER: CB-MH-95-8

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=927,151 Y=523,629
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-18
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 16.5 Ft.
8. DEPTH DRILLED INTO ROCK: 31.8 Ft.
9. TOTAL DEPTH OF HOLE: 48.3 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 6 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 2 of 2
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED: 03/03/01 COMPLETED: 03/03/01
17. ELEVATION TOP OF HOLE: -7.3 Ft.
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-7.3	0.0					-7.3	
			Silty SAND, fine to medium grained, thin layer oflimestone, gray (SM)	22	1	SPT	WOH WOH WOH WOH WOH WOH WOH WOH WOH WOH WOH WOH
						-13.1	
			No recovery from 5.8 – 9.8 ft.	0			
-17.1	9.8					-17.1	
			LIMESTONE, mod. hard, some fine to medium grained sand, calcareous, lt. gray	73	2	SPT	4 12 16
						-18.6	
				27	3	SPT	7 6 7
						-20.1	
				27	4	SPT	5 5 9
-21.6	14.3					-21.6	
			Silty SAND, fine grained, trace of fine limestone gravel, calcareous, light gray. (SM)	20	5	SPT	9 14 11
						-23.1	
-23.8	16.5			20	6	SPT	16 45
						-23.8	
			LIMESTONE, fossiliferous, mod. to highly wea., vuggy, hard, lt. gray 18.1 – 19.5 ft, mod. hard, badly broken, some sand. 19.5 – 21.0 ft. mod. hard to hard, fragmented. Low angular irregular breaks at 17.7, 18.1 ft.	100	Box 1	Hyd. Press: 350 PSI H20 Return: 0% RQD = 55.6% D.T. = 13 min.	
						-28.3	
			21.0 – 21.6 ft, highly wea., mod., hard, badly broken. 21.6 – 24.0 ft, mod. wea., hard to very hard.	100		Hyd. Press: 400 PSI H20 Return: 0% RQD = 74% D.T. = 15 min.	
						(continued)	

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5

Hole No.CB-MH01-18

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -7.3 Ft.

SHEET 2 OF 2

PROJECT: Miami Harbor Deepening and Widening

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-29.8	22.5						
			24.0 – 26.0 ft, highly wea. 24.0 – 24.7 ft, hard, fragmented.	100	Box 1	Hyd. Press: 400 PSI H20 Return: 0% RQD = 74% D.T. = 15 min.	
			24.7 – 26.0 ft, soft to mod. hard, some fine to medium silty sand, badly broken.				
			Low angle open joints: 21.6, 22.7, 23.1, 23.5, 23.7, 24.0 ft.			-33.3	
-34.5	27.2		26.0 – 26.8 ft, highly pitted, vuggy, mod hard to hard.				
			Breaks: 26.8, 27.2 ft.	24		Hyd. Press: 350 PSI H20 Return: 0% RQD = 8% D.T. = 4 min.	
			SAND, no recovery				
-38.3	31.0					-38.3	
			Highly wea.: 31.0 – 32.3, 33.0 – 33.3, 35.3 – 35.5 ft. Soft, mod. hard: 31.0 – 32.3, 35.3 – 35.5 ft. Hard to very hard: 32.3 – 33.0, 33.3 – 35.3 ft. Mod. wea.: 32.3 – 33.0, 33.3 – 35.3 ft.	90	Box 2	Hyd. Press: 400 PSI H20 Return: 0% RQD = 54% D.T. = 12 min.	
						-43.3	
			No recovery from 36.0 – 41.0 ft.	0		Hyd. Press: 600 PSI H20 Return: 0% RQD = 0% D.T. = 6 min.	
-48.3	41.0					-48.3	

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

SAMPLE NO.	SAMPLE ELEVATION	LAB CLASS.
1	-7.3/-13.3	SM

*Lab visual classification based on gradation curve. No Atterburg Limits.

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

4" X 5.5' core barrel with diamond bit

22.5 25 27.5 30 32.5 35 37.5 40 42.5 45 47.5 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Miami Harbor Deepening and Widening

HOLE NUMBER: CB-MH01-18

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

1. PROJECT: Miami Harbor Deepening and Widening
2. LOCATION (Coordinates or Station): X=925,456 Y=524,317
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-MH01-19
5. NAME OF DRILLER: Pickett
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF BURDEN: 16.0 Ft.
8. DEPTH DRILLED INTO ROCK: 8.5 Ft.
9. TOTAL DEPTH OF HOLE: 24.5 Ft.
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLW, Horizontal Datum: NAD83, FLE
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 7 undisturbed: 0
14. TOTAL NUMBER OF CORE BOXES: 1 of 1
15. ELEVATION GROUND WATER:
16. DATE HOLE STARTED COMPLETED: 03/04/01 03/04/01
17. ELEVATION TOP OF HOLE: -6.7 Ft.
18. TOTAL CORE RECOVERY FOR BORING: 31.4 %
19. SIGNATURE OF INSPECTOR: J. Arthur, PG

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/.5'
-6.7	0.0					-6.7	
			Silty SAND, fine to medium grained, trace of small shell fragments, calcareous, dark gray. (SM)	73	1	SPT	WOH, WOH, WOH, WOH, WOH, WOH
						-9.7	
				93	2	SPT	WOH, WOH, WOH
			Trace of decayed wood at 4.5 ft.			-11.2	
				40	3	SPT	WOH, WOH, 4
			Dark grayish brown, some decayed wood, trace of limestone at 6.0 ft.			-12.7	
				47	4	SPT	4, 2, 2
			Dark brownish gray, no wood, trace of limestone at 7.5 ft.			-14.2	
				33	5	SPT	WOH, WOH, WOH
-15.7	9.0					-15.7	
			LIMESTONE, soft to mod. hard, some fine to medium sand and small shell fragments, calcareous, white.	20	6	SPT	1, 2, 1
			No recovery from 10.5 - 14.5 ft.			-17.2	
				0		SPT	2, WOH, WOH
						-21.2	WOH, WOH, 2
				20	7	SPT	6, 6, 12
-22.7	16.0					-22.7	
			LIMESTONE, fossiliferous, mod. to highly wea., highly pitted and vuggy, hard to very hard, lt. gray	49	Box 1	Hyd. Press: 250 PSI H2O Return: 0% D.T.= 4 min RQD = 25.7%	
			16.3 - 17.2, badly broken, low angle breaks: 16.2, 16.3, 17.2, 17.7 ft.			-26.2	
			No recovery from 17.7 - 24.5	0		Hyd. Press: 300 PSI H2O Return: 0% D.T. = 7 min RQD = 0%	

(continued)

Hole No.CB-MH01-19

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -6.7 Ft.

PROJECT: Miami Harbor Deepening and Widening

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit & Barrel	BLOWS/ .5'
-29.2	22.5						
-31.2	24.5			0	Box 1	Hyd. Press: 300 PSI H2O Return: 0% D.T. = 7 min RQD = 0% -31.2	

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Clasification System.

SAMPLE NO.	SAMPLE ELEVATION	LAB CLASS.
1	-6.7/-9.7	SM
2	-11.2/-12.7	SM
3	-12.7/-14.2	SP-SM

*Lab visual classification based on gradation curve. No Atterburg limits.

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

4"X 5.5' core barrel with diamond bit.

22.5
25
27.5
30
32.5
35
37.5
40
42.5
45
47.5
50

COMPRESSIVE STRENGTH

LAW
LAWGIBB Group Member
3901 Carmichael Avenue
Jacksonville, FL 32207
(904) 396-5173 • (904) 396-5703

Report of Unconfined Compression Test Results

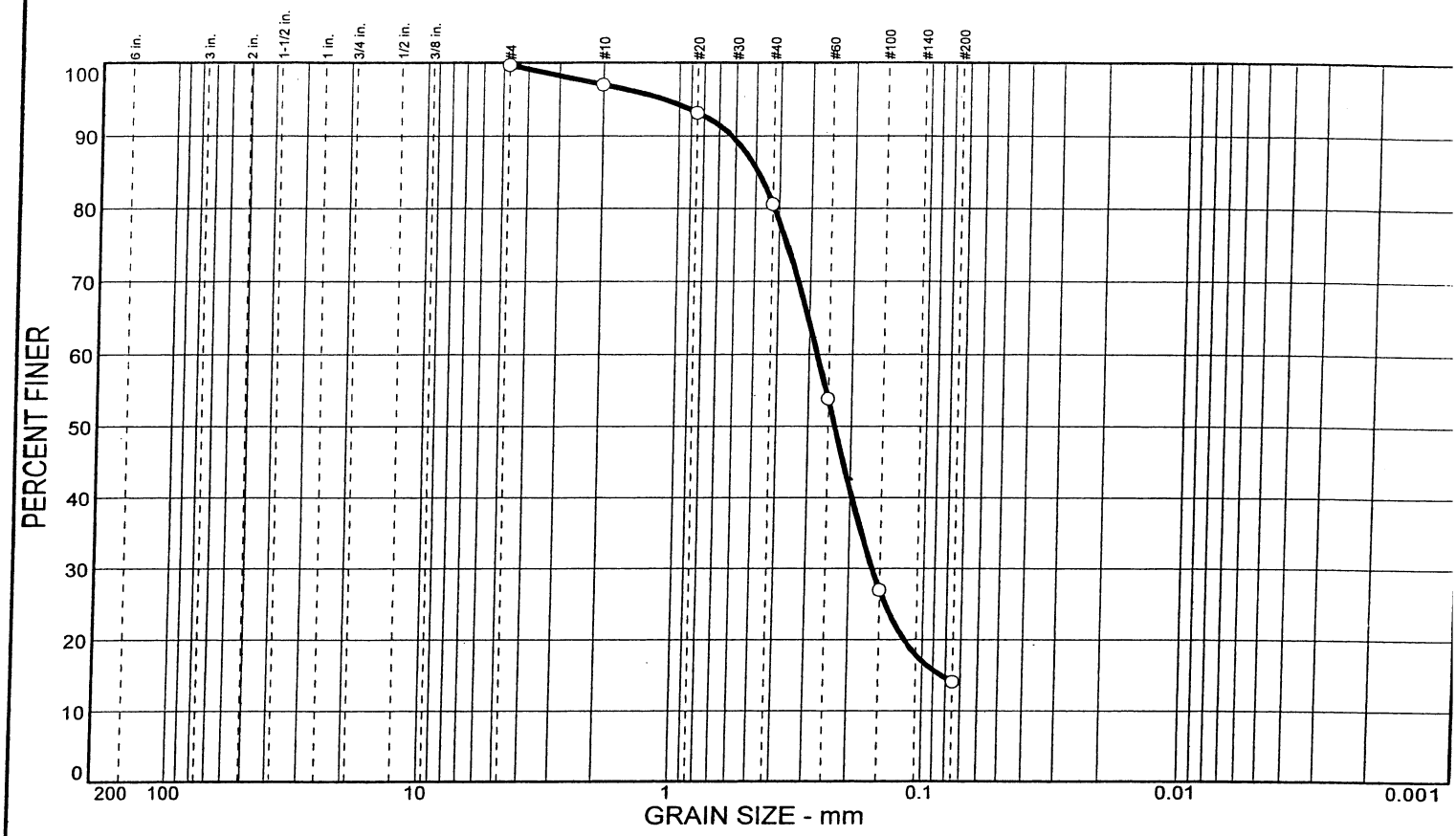
CLIENT: US Army Corp of Engineers **JOB NO.:** 40564-1-4176-02

PROJECT: Miami Harbor Deepening **DATE:** April 27, 2001

Core No.	Elevation (ft-mlw)	Diameter (inches)	Length (inches)	Area (in^2)	Load (lbs)	Compressive Strength (psi
CBMH01-1	-49.6 / -50.4	3.914	7.595	12.03	8,950	744
CBMH01-12	-44.8 / -45.9	3.955	8.125	12.29	8,050	655
CBMH01-13	-47.3 / -48.1	3.945	7.515	12.22	16,050	1313
CBMH01-18	-29.3 / -30.2	3.932	8.300	12.14	11,600	956
CBMH01-21A	-40.8 / -41.6	3.945	8.075	12.22	5,000	409
CBMH01-21A	-44.4 / -45.6	3.948	8.400	12.24	8,350	682

GRAIN SIZE DISTRIBUTION CURVES

Grain Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			85.6	14.1		SM	A-2-4(0)		

SIEVE inches size	PERCENT FINER ○		
	GRAIN SIZE		
D_{60}	0.278		
D_{30}	0.161		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○
#4	99.7
#10	97.0
#20	93.2
#40	80.6
#60	53.9
#100	27.0
#200	14.1

SOIL DESCRIPTION

○ SAND, fine quartz, little silt, trace sand-size shell fragments, gray-brown

REMARKS:

○

○ Source: Boring No. CB-MH01-19 Sample No.: 1 Elev./Depth: -6.7'/-9.7 MLW

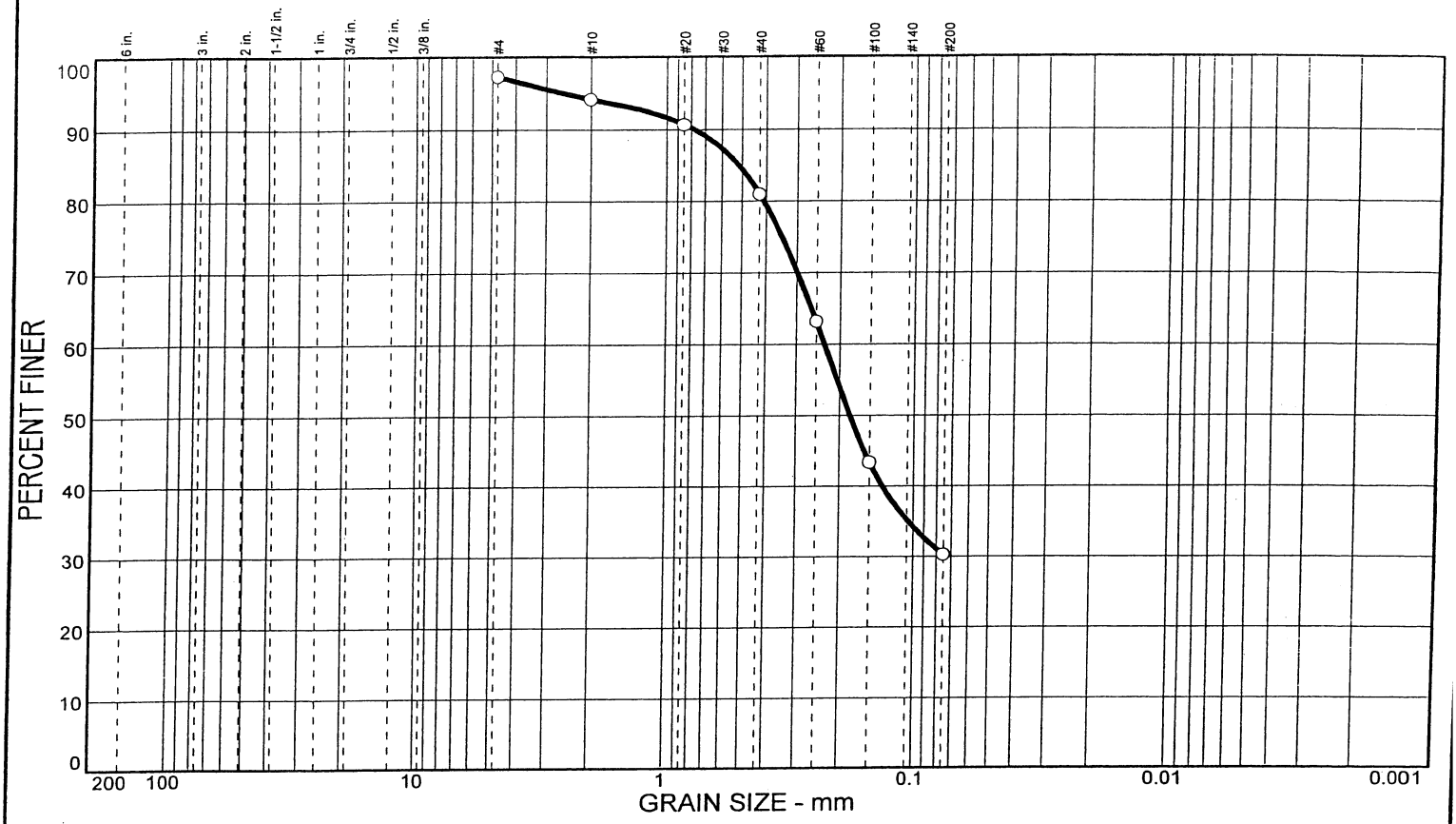
Law Engineering and Environmental Services, Inc.

Client: US Army Corp[of Engineers

Project: Miami Harbor Deepening

Project No.: 40564-1-4176-02

Grain Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			67.0	30.3		SM	A-2-4(0)		

SIEVE inches size	PERCENT FINER ○		
	GRAIN SIZE		
D_{60}	0.231		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	97.3		
#10	94.2		
#20	90.7		
#40	81.0		
#60	63.2		
#100	43.4		
#200	30.3		

SOIL DESCRIPTION

○ SAND, fine quartz, some silt, little fine gravel to medium sand-size shell fragments, gray-brown

REMARKS:

○

○ Source: Boring No. CB-MH01-19 Sample No.: 2 Elev./Depth: -11.2/-12.7 MLW

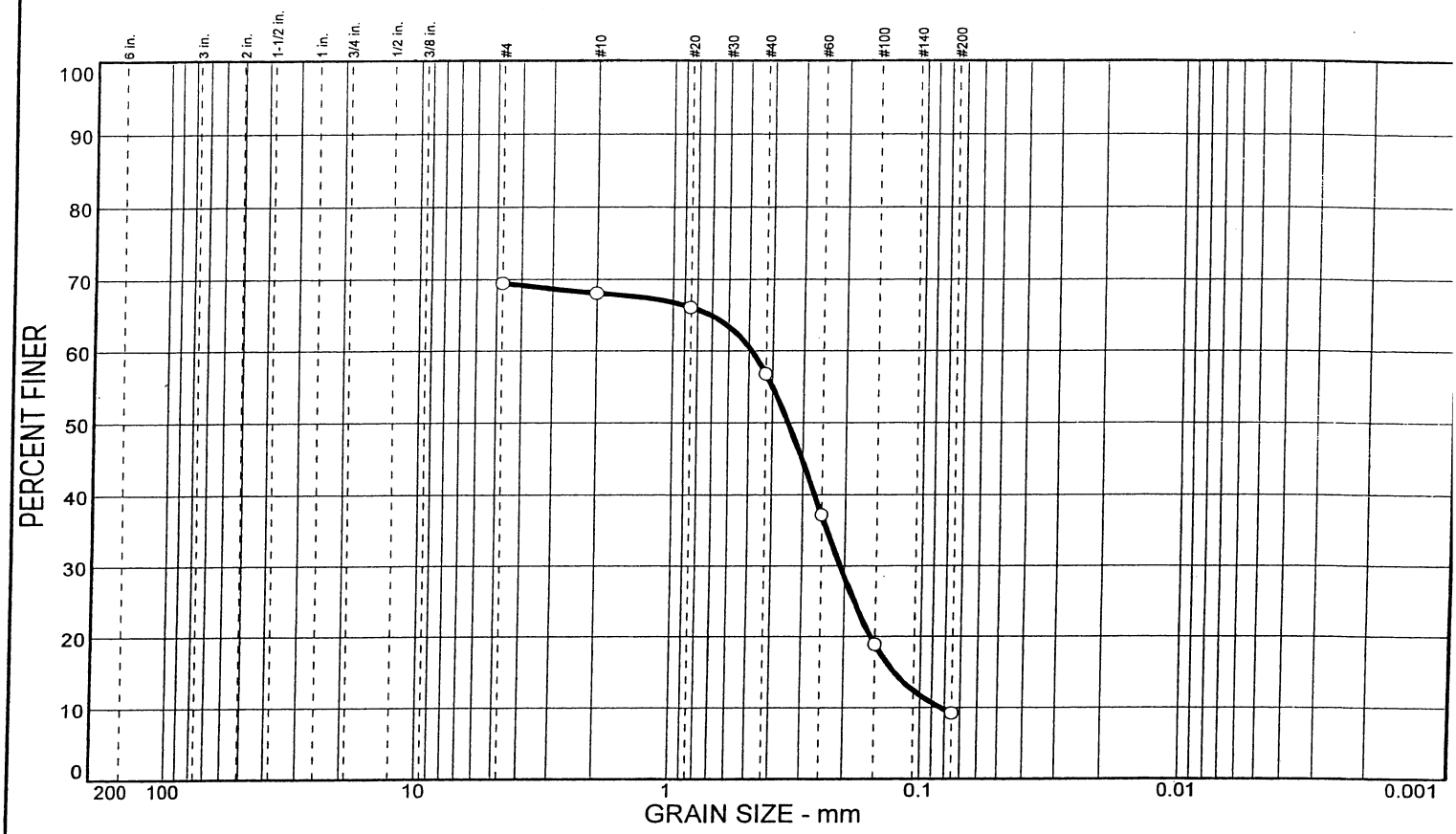
Law Engineering and Environmental Services, Inc.

Client: US Army Corp[of Engineers

Project: Miami Harbor Deepening

Project No.: 40564-1-4176-02

Grain Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			60.3	9.2		SP-SM	A-3		

SIEVE inches size	PERCENT FINER ○		
	GRAIN SIZE		
D_{60}	0.486		
D_{30}	0.209		
D_{10}	0.0829		
	COEFFICIENTS		
C_C	1.08		
C_U	5.86		

SIEVE number size	PERCENT FINER ○		
#4	69.5		
#10	68.1		
#20	66.1		
#40	56.8		
#60	37.2		
#100	18.9		
#200	9.2		

SOIL DESCRIPTION

○ SAND, fine quartz, some gravel size shell and shell fragments, trace silt, brown-black

REMARKS:

○

○ Source: Boring No. CB-MH01-19 Sample No.: 3 Elev./Depth: -12.7/-14.2 MLW

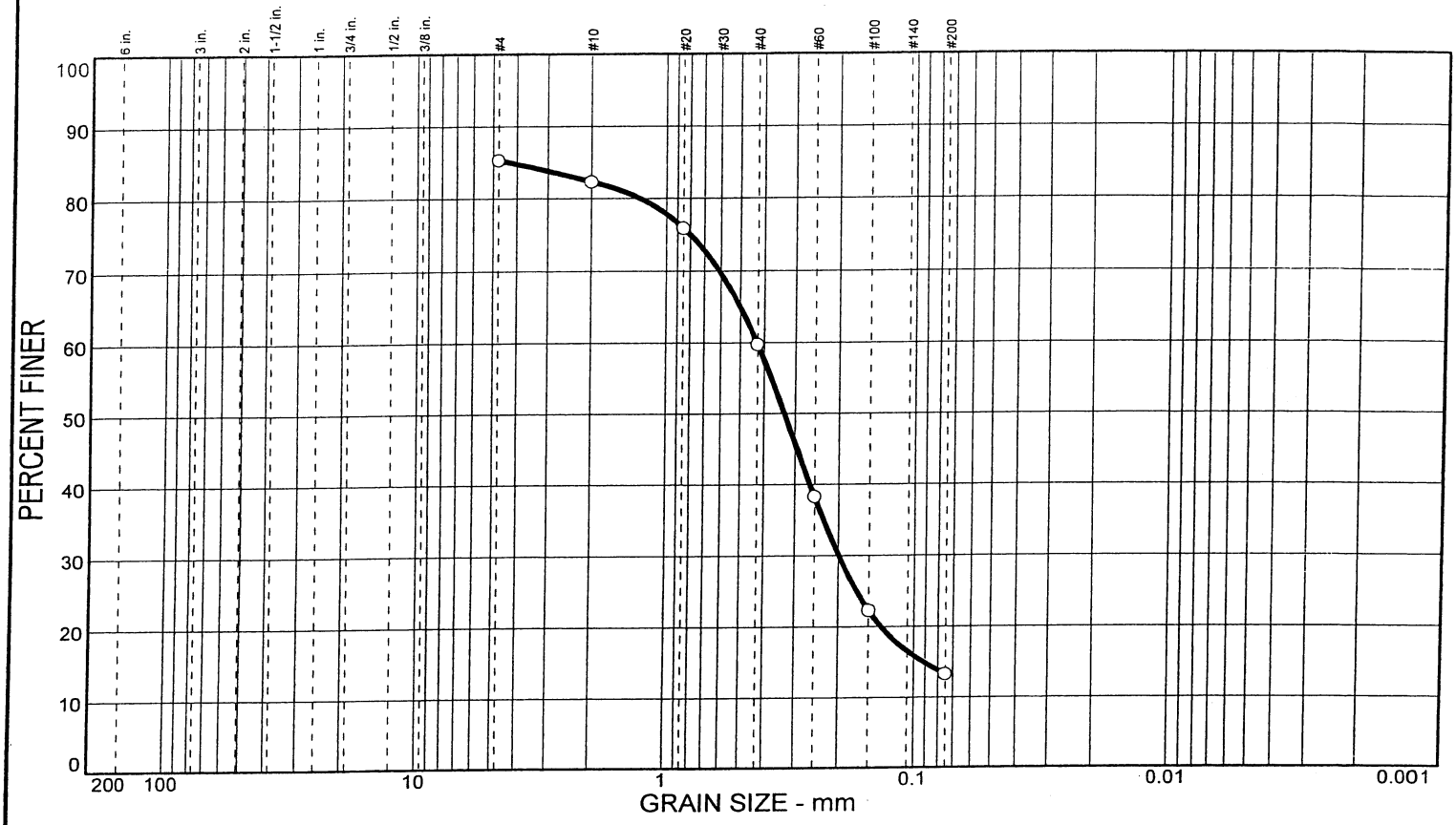
Law Engineering and Environmental Services, Inc.

Client: US Army Corp[of Engineers

Project: Miami Harbor Deepening

Project No.: 40564-1-4176-02

Grain Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			72.0	13.3		SM	A-2-4(0)		

SIEVE inches size	PERCENT FINER ○		
	GRAIN SIZE		
D_{60}	0.427		
D_{30}	0.199		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○
#4	85.3
#10	82.3
#20	75.9
#40	59.8
#60	38.3
#100	22.3
#200	13.3

SOIL DESCRIPTION

○ SAND, fine quartz, little gravel to sand-size shell fragments, little silt, gray

REMARKS:

○

○ Source: Boring No. CB-MH01-18 Sample No.: 1 Elev./Depth: -7.3/-13.3 MLW

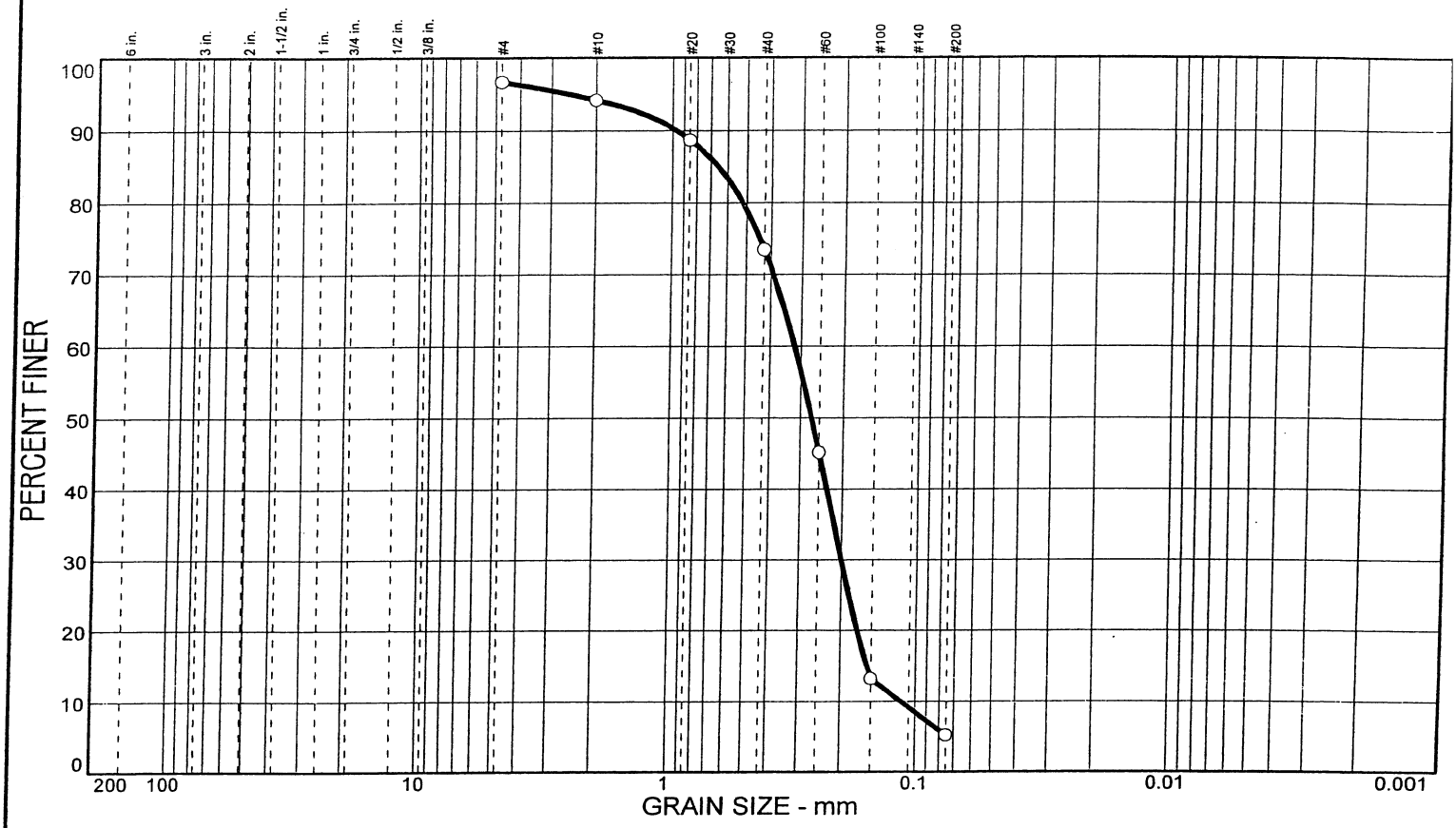
Law Engineering and Environmental Services, Inc.

Client: US Army Corp[of Engineers

Project: Miami Harbor Deepening

Project No.: 40564-1-4176-02

Grain Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			91.5	5.2		SP-SM	A-3		

SIEVE inches size	PERCENT FINER ○		
	GRAIN SIZE		
D_{60}	0.319		
D_{30}	0.200		
D_{10}	0.114		
	COEFFICIENTS		
C_C	1.11		
C_u	2.80		

SIEVE number size	PERCENT FINER ○		
#4	96.7		
#10	94.2		
#20	88.7		
#40	73.5		
#60	45.2		
#100	13.2		
#200	5.2		

SOIL DESCRIPTION

○ SAND, fine quartz, little fine gravel to sand-size shell fragments, trace silt , gray-brown

REMARKS:

○

○ Source: Boring No. CB-MH01-21 Sample No.: 1 Elev./Depth: -11.3/-12.8 MLW

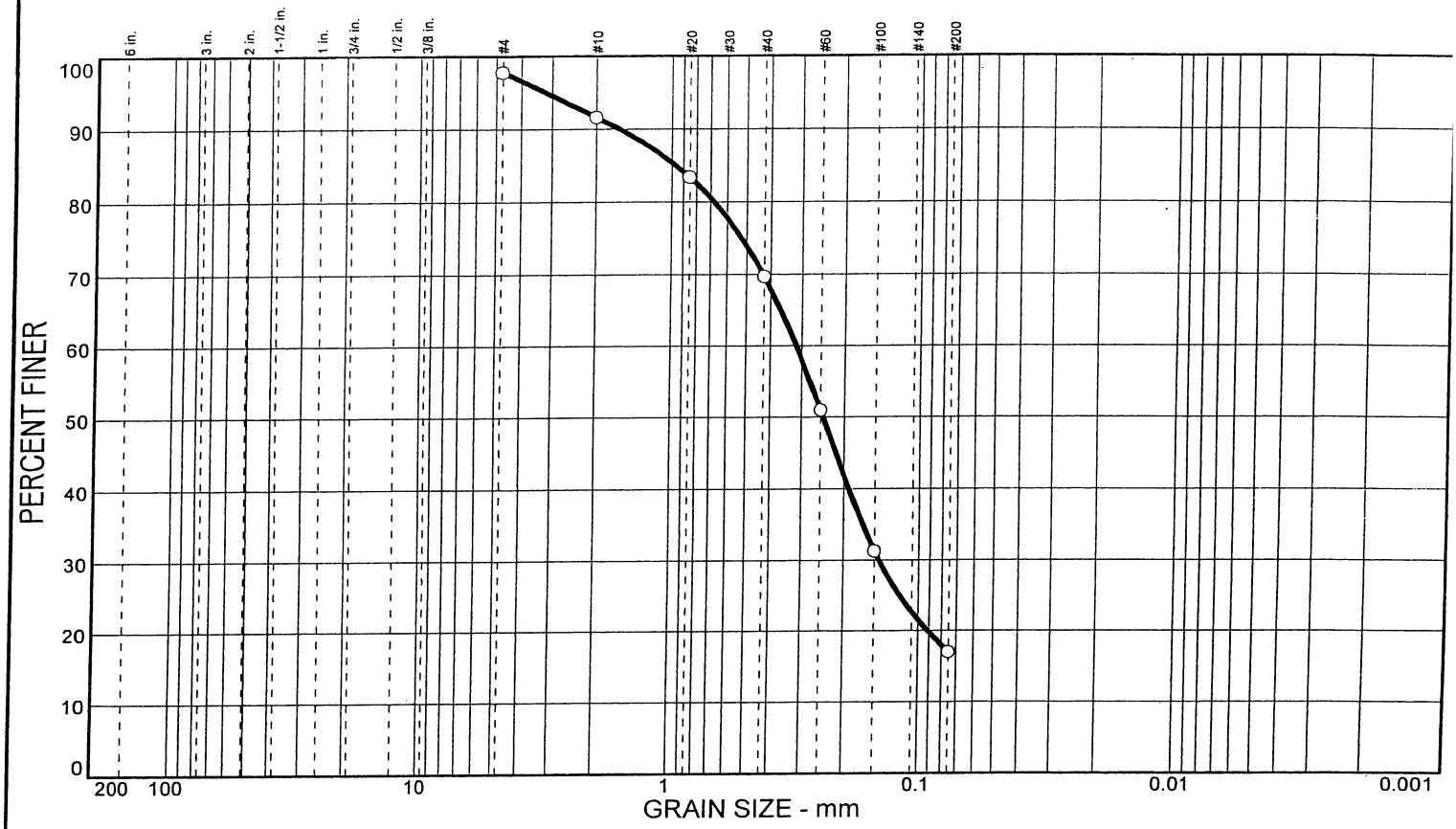
Law Engineering and Environmental Services, Inc.

Client: US Army Corp[of Engineers

Project: Miami Harbor Deepening

Project No.: 40564-1-4176-02

Grain Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			80.8	17.0		SM	A-2-4(0)		

SIEVE inches size	PERCENT FINER ○		
	GRAIN SIZE		
D_{60}	0.316		
D_{30}	0.144		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○
#4	97.8
#10	91.6
#20	83.4
#40	69.7
#60	51.0
#100	31.3
#200	17.0

SOIL DESCRIPTION

○ SAND, fine quartz, little fine gravel to sand-size shell fragments, little silt, light gray-tan

REMARKS:

○

○ Source: Boring No. CB-MH01-21 Sample No.: 2 Elev./Depth: -12.8/-14.3 MLW

Law Engineering and Environmental Services, Inc.

Client: US Army Corp[of Engineers

Project: Miami Harbor Deepening

Project No.: 40564-1-4176-02

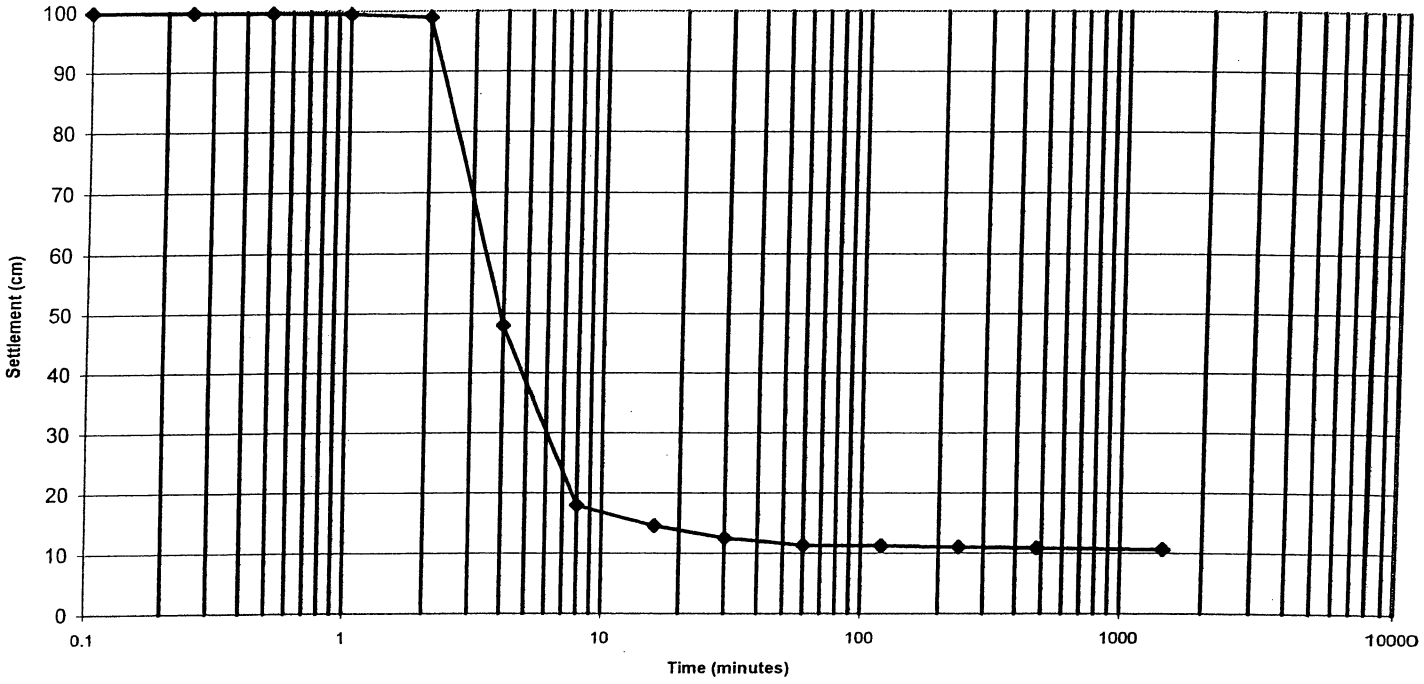
SETTLING RATE TEST

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES
3901 CARMICHAEL AVENUE
JACKSONVILLE, FLORIDA 32207
(904)396-5173

REPORT OF SETTLING RATE TESTING

LAW PROJECT NO: 40564-1-4176-02
PROJECT: Miami Harbor Deepening
CLIENT: USACE, Jacksonville District

SAMPLE : CB-MH01-19
STATION : -6.7'/-9.7' MLW
CONCENTRATION: 100g/L



TIME	INTERFACE (cm)	TIME	INTERFACE (cm)
0.1	99.9	16	14.5
0.25	99.8	30	12.5
0.5	99.7	60	11.3
1	99.5	120	11.2
2	99	240	11
4	48	480	10.8
8	18	1440	10.6

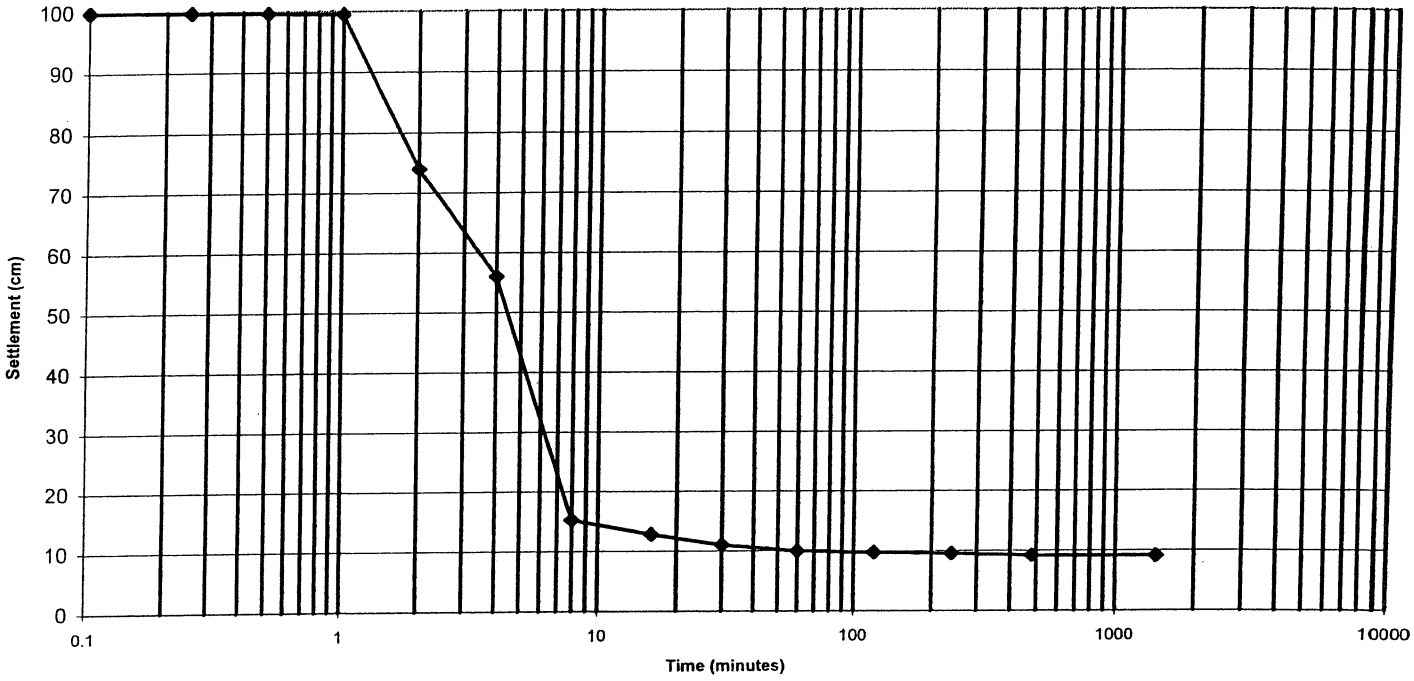
Final concentration: ·943.4 g/L

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES
3901 CARMICHAEL AVENUE
JACKSONVILLE, FLORIDA 32207
(904)396-5173

REPORT OF SETTLING RATE TESTING

LAW PROJECT NO: 40564-1-4176-02
PROJECT: Miami Harbor Deepening
CLIENT: USACE, Jacksonville District

SAMPLE : CB-MH01-18
STATION : -7.3'/-13.3' MLW
CONCENTRATION: 100g/L



TIME	INTERFACE (cm)	TIME	INTERFACE (cm)
0.1	99.9	16	12.8
0.25	99.8	30	11
0.5	99.7	60	10
1	99.5	120	9.7
2	74	240	9.5
4	56	480	9.2
8	15.2	1440	9.1

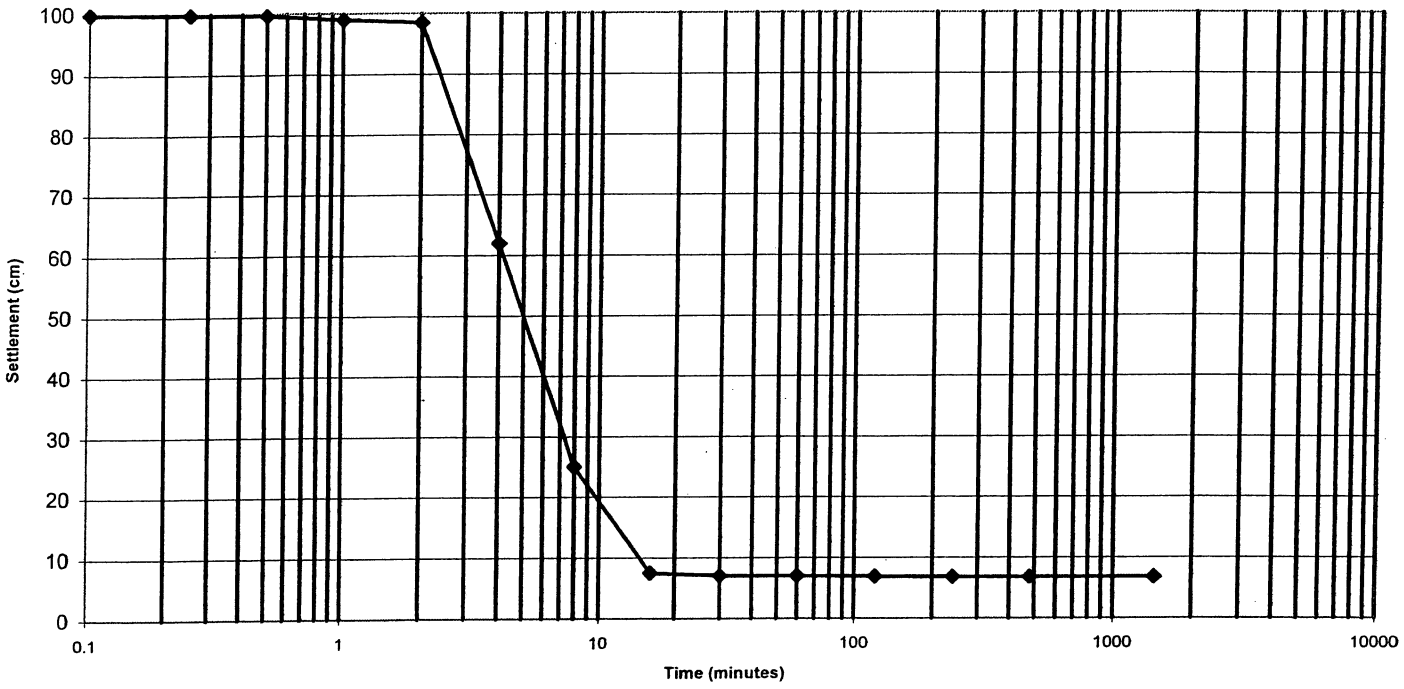
Final concentration: 1098.9 g/L

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES
3901 CARMICHAEL AVENUE
JACKSONVILLE, FLORIDA 32207
(904)396-5173

REPORT OF SETTLING RATE TESTING

LAW PROJECT NO: 40564-1-4176-02
PROJECT: Miami Harbor Deepening
CLIENT: USACE, Jacksonville District

SAMPLE : CB-MH01-21
STATION : -11.3'/-12.8' MLW
CONCENTRATION: 100g/L



TIME	INTERFACE (cm)	TIME	INTERFACE (cm)
0.1	99.9	16	7.5
0.25	99.8	30	7.1
0.5	99.7	60	7
1	99	120	6.9
2	98.5	240	6.8
4	62	480	6.8
8	25	1440	6.8

Final concentration: 1470.6 g/L

SPECIFIC GRAVITY

LAW
LAWGIBB Group Member
3901 Carmichael Avenue
Jacksonville, FL 32207
(904) 396-5173 • (904) 396-5703

Report of Apparent Specific Gravity (ASTM D-5779)

CLIENT: US Army Corp of Engineers **JOB NO.:** 40564-1-4176-02

PROJECT: Miami Harbor Deepening **DATE:** April 27, 2001

Core No.	Elevation (ft-mlw)	Dry Weight	Weight in Water (g)	Specific Gravity
MH01-01	-49.6 / -50.4	2618.1	1391.8	2.135
MH01-13	-42.3 / -43.1	1598.1	903.6	2.301
MH01-18	-29.3 / -30.2	3524.3	2052.3	2.394
MH01-21A	-40.8 / -41.6	2716.1	1481.5	2.200