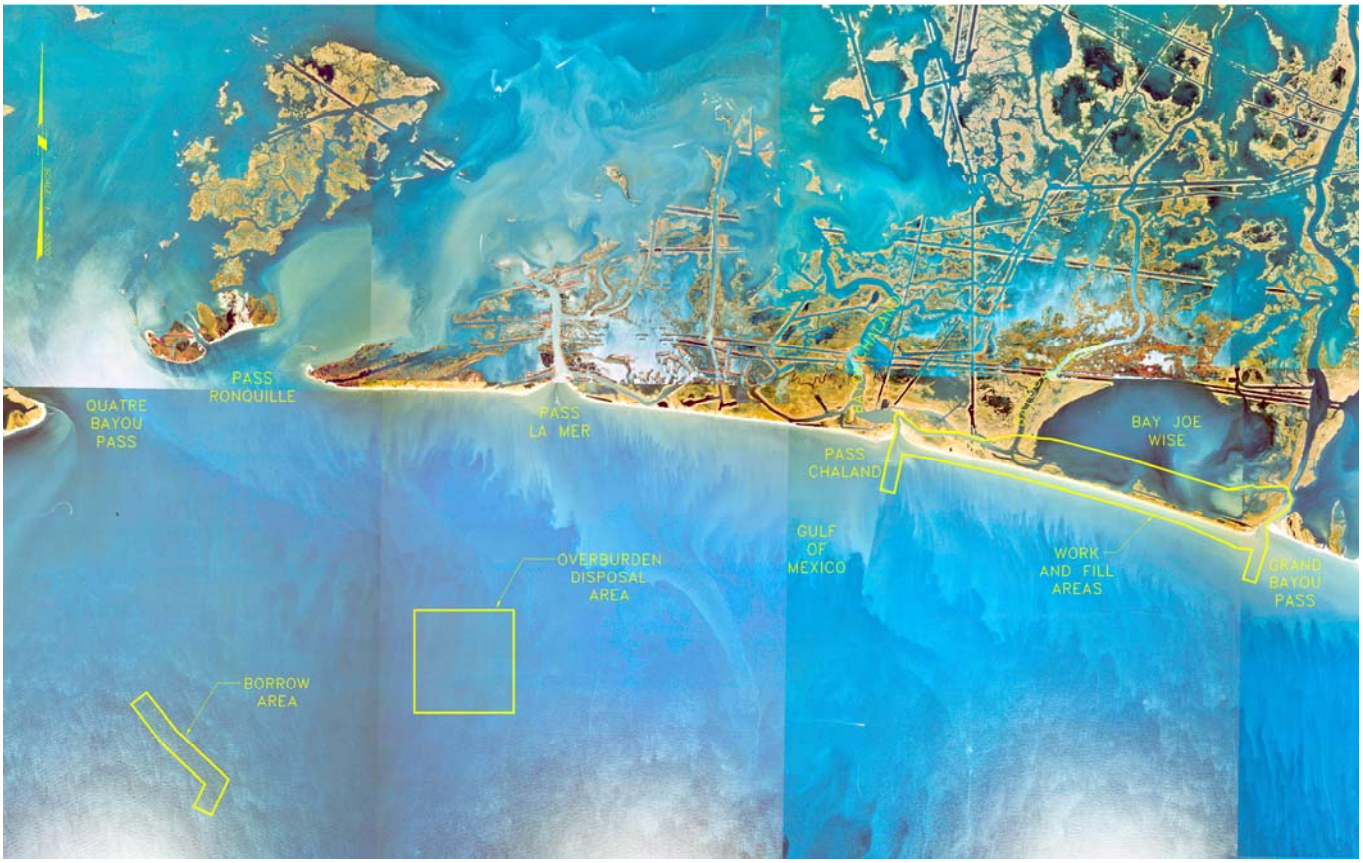
FINAL DESIGN REPORT

PASS CHALAND TO GRAND BAYOU PASS
Barrier Shoreline Restoration Project (BA-35)
Submitted: December 2005

Prepared For:

Louisiana Department of Natural Resources
Coastal Restoration and Management

NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce



Prepared By:

COASTAL
ENGINEERING
CONSULTANTS
INC.

SJB GROUP
INCORPORATED

EXECUTIVE SUMMARY

FINAL DESIGN REPORT

PASS CHALAND TO GRAND BAYOU PASS
BARRIER SHORELINE RESTORATION (BA-35)
LDNR CONTRACT NO. 2511-03-09
DECEMBER 21, 2005

This Final Design Report summarizes the supplemental field work, final design criteria, and design changes implemented following the 30% design review, and presents the recommended plan in support of the implementation of the Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration Project for the National Marine Fisheries Service and the Louisiana Department of Natural Resources.

The Scope of Services includes the following tasks:

- Prepare Final Design Report
- Prepare Final Opinion of Probable Construction Costs
- Prepare Final Design Drawings
- Prepare Final Specifications

The Project's design objectives include the following:

- Project life equal to twenty years (Year 20)
- Protect and preserve the structural integrity of the barrier shoreline along the Gulf of Mexico
- Create 226 acres of back-barrier marsh at Year 1 with unrestricted tidal exchange
- Marsh construction shall achieve an elevation such that by Year 3 the marsh elevation is within the tidal zone, defined from MHW to MLW, and remains within this zone through Year 20
- Address the severity of erosion along the gulf-front shoreline
- Close the multiple breachments that have occurred due to recent storm and hurricane damage and prevent breaching during the design life
- Vegetate newly created marsh and dune areas
- Approximately 25% of the marsh platform would be 80% or greater vegetated after the first completed growing season after construction, and 100% of the marsh platform would be vegetated after three complete growing seasons
- Provide compatible sediments for marsh, beach and dune restoration
- Avoid impacts to adjacent shorelines from borrow area excavation
- Maintain water quality and circulation between Pass Chaland and Bay Joe Wise
- Construct approximately 10,000 linear feet of tidal creeks and six (6) one-acre tidal ponds to allow hydraulic exchange and circulation within the newly created marsh
- Protect or create approximately 161 acres of barrier island habitat at Year 20

The recommended plan includes a marsh platform to create back-barrier marsh habitats and aid in protecting and preserving the structural integrity of the barrier shoreline along the Gulf of

Mexico during the Project life. The marsh fill template consists of an approximate 8,000 foot long by 920 foot wide marsh platform, measured at MHW, with an approximate 3,000 foot long taper westward and an approximate 2,500 foot long expansion eastward, to tie into the existing marshes on each end. The surface area of the proposed marsh platform, measured at MHW, is approximately 270 acres. The construction berm elevation is +2.6 feet NAVD and the corresponding fill volume is approximately 1.67 million cubic yards. The required marsh fill volume is 2.67 million cubic yards, including the cut to fill ratio. The marsh template includes excavation of approximately 6,000 feet of primary tidal creeks.

The recommended plan also includes a beach and dune fill to address the severity of erosion along the gulf-front shoreline and multiple breachments that have occurred due to recent storm and hurricane damage. The landward beach and dune fill template is designed to provide an approximate 7,500 foot long beach and dune fill with 2,000 foot taper eastward to tie into the beach and dune on the eastern end, and an approximate 3,000 foot long expansion westward at Bayou Huertes completed by an approximate 1,500 foot long taper to tie into the beach and dune on the western end. The tapers are provided to blend the sediments into the existing grades and maintain a buffer from the inlets on both ends of the Bay Joe Wise Headland. The dune component includes a 50 foot wide crest width at +7 feet NAVD, widening to 190 feet at Bayou Huertes, with 1:30 side slopes. The beach fill template includes a construction berm at +4.5 feet NAVD, with an average width of over 350 feet widening to over 600 feet at Bayou Huertes, and 1:30 side slopes. The corresponding fill volume is approximately 1.03 million cubic yards and the required beach/dune fill volume including the overfill and cut to fill ratios is 1.55 million cubic yards.

The proposed 150-acre beach and dune platform is constructed in full section between the existing beach and the proposed marsh. This will maximize the placement of coarser material within the seaward portion of the overall fill template, optimizing project performance as the coarser material will be more resistive to erosion.

Lastly, a water exchange channel is recommended to maintain the current flow-way and circulation patterns between Pass Chaland and Bay Joe Wise. The water exchange channel template is designed with maximum dimensions of the bottom depth at -5.5 feet NAVD, bottom width at 70 feet, and side slopes of 1:8, with a cross sectional area of 890 square feet measured from Mean High Water. The water exchange channel length is approximately 4,200 feet and the proposed dredge volume is approximately 70,000 cubic yards.

The borrow area is located offshore in Quatre Bayou Pass, has sufficient quantities of compatible sediments for marsh, beach and dune restoration, and has been designed to avoid impacts to the adjacent shorelines. An overburden disposal area is included in the Project design to be utilized for disposal of the overburden material in the borrow area.

The Final Opinion of Probable Construction Cost is approximately $19.6 million dollars.

PRELIMINARY DESIGN REPORT

PASS CHALAND TO GRAND BAYOU PASS BARRIER SHORELINE RESTORATION (BA-35)

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FINAL DESIGN REPORT

PASS CHALAND TO GRAND BAYOU PASS
BARRIER SHORELINE RESTORATION (BA-35)
LDNR CONTRACT NO. 2511-03-09
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1.0 INTRODUCTION

This Final Design Report summarizes the supplemental field work, concluding analyses, detailed design work, recommended plan, and cost estimating completed in support of the implementation of the Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration Project (BA-35, CWPPRA Priority Project List 11) for the National Marine Fisheries Service (NMFS) and the Coastal Restoration Division of the Louisiana Department of Natural Resources (LDNR). This Project is funded and authorized in accordance with the provisions of the Coastal Wetlands Planning, Protection, and Restoration Act (16 U.S.C.A., Sections 3951-3956) and has been approved by the PL 101-646 Task Force.

The objective of this Project is to protect and preserve the structural integrity of the barrier shoreline along the Gulf of Mexico. The Project, as planned, would include design of a marsh platform approximately 1,000 feet wide contiguous with the northern side of the Gulf shoreline of Bay Joe Wise. It is estimated that approximately 2.67 million cubic yards of dredged material consisting of clays, silts and sands will be required to construct the marsh platform. Further, LDNR desires to include a beach and dune component to address the severity of erosion along the gulf-front shoreline and multiple breachments that have occurred due to recent storm and hurricane damage. It is estimated that approximately 1.55 million cubic yards of dredged material consisting primarily of sand will be required to construct the beach and dune component. Lastly, a water exchange channel is recommended to maintain the current flow-way and circulation patterns between Pass Chaland and Bay Joe Wise. It is estimated that an approximate 4,200-foot long channel will have to be dredged with a corresponding volume of approximately 70,000 cubic yards.

Phase I is a non-construction phase and includes engineering and design, landrights, monitoring plan development, baseline monitoring, and Project administration. During this phase a preliminary investigation was performed and presented as part of a 30% interagency design review. The preliminary investigation included initial field work, development of preliminary design criteria and alternatives, and analysis of the alternatives resulting in a recommended plan. This analysis was approved based on technical and economic feasibility and summarized in the Preliminary Design Report. Subsequently, the project was authorized to move forward to 95% design in which detailed plans and specifications and other documentation required for Phase II construction were developed.

SJB Group, Inc. (SJB) in association with Coastal Engineering Consultants, Inc. (CEC) is pleased to present the Final Design Report for this Project.

2.0 SCOPE OF SERVICES

The scope of services for this Project includes a Preliminary Design Phase and a Final Design Phase. The Preliminary Design Phase contracted scope of services includes the following tasks.

- On the basis of the Study and Report Phase Documents accepted by LDNR, prepare the Preliminary Design Phase Documents consisting of final design criteria, preliminary drawings, outline specifications, and written descriptions, all of which are to be subject to approval and acceptance by LDNR.

- Advise LDNR if additional reports, data, information or services of the types are necessary for the Final Design Phase and assist LDNR in obtaining such reports, data, information or services.

- Based on the information contained in the Preliminary Design Phase documents, submit a revised opinion of probable Construction Costs as well as any adjustments necessary to further refine Total Project Costs.

- Prepare Preliminary Design Drawings in sufficient detail to obtain information necessary for permitting actions consisting of the following:
  - Develop preliminary plan views of alternate marsh fill
  - Develop preliminary cross sections and fill templates
  - Develop preliminary fill volume estimates
  - Refine alternate borrow area plans and sections and preliminary wave refraction analysis
  - Refine available volume estimates and determine overfill ratios
  - Delineate preliminary dredge material containment systems
  - Lay out preliminary environmental access and protection corridors
  - Lay out preliminary construction access and pipeline corridor plans

- Prepare the preliminary specifications including a description of the work, special requirements, and technical specifications.

- Develop and propose alternate design strategies for dredged material placement and containment for consideration by LDNR. Use the environmental and cultural resource assessments prepared by NMFS and USACE respectively in developing these strategies. This analysis shall include the following:
  - Mitigation of erosion
  - Environmental impacts analysis
  - Environmental enhancements and benefits
  - Value engineering analysis
  - Preliminary opinion of project costs
  - Storm protection benefits
  - Maintenance requirements

The Final Design Phase contracted scope of services includes the following tasks.

♦ Based on the Preliminary Design Phase alternatives analysis and recommendations, conduct the following:
  - Shoreline and Resource Impact Study
  - Borrow Area Evaluation and Design
  - Marsh Fill Design
  - Project Access and Restoration Design

♦ Prepare the Final Plans for use in bidding and constructing the project incorporating all agency comments. The Plans shall include the following:
  - Marsh and Beach Fill Area Plans and Sections
  - Borrow Area Plans and Sections
  - Dredge Material Containment and Environmental Protection
  - Project Access and Pipeline Corridors
  - Survey Cross Sections with Final Design Layout Delineated for Construction.
  - Site Layout Map and Vicinity Map, and other information necessary for project completion.

♦ Prepare the Final Specifications for use in bidding and constructing the project incorporating all agency comments. The Specifications shall include General and Special Provisions, Technical Specifications, and all appropriate bidding and construction forms.

♦ Provide a finalized Opinion of Probable Cost and a Schedule of Items to be bid upon by proposing Contractors based on the Final Design. Consider construction access, construction workload, material availability, mobilization, transport costs, and fuel costs in developing the Opinion of Cost.

♦ Prepare a Final Feasibility Study Report summarizing all aspects of Preliminary and Final Design.

3.0 PROJECT AREA AND SETTING

3.1 BAY JOE WISE HEADLAND

3.1.1 Physical Characteristics

The Bay Joe Wise Headland is located approximately 50 miles southeast of New Orleans, Louisiana, in the Plaquemine's Parish, Coast 2050 Region 2, Barataria Basin. The Project reach proposed for restoration extends from Chaland Pass in the west to Grand Bayou Pass in the east. The barrier island fronts the Gulf of Mexico and protects the shallow interior bay, Bay Joe Wise, and adjacent wetlands and marsh (Figure 3-1).

Figure 3-1: Aerial Photograph of the Bay Joe Wise Headland, November 2002

Based upon historical profile characteristics and site observations made by SJB and CEC field personnel, the beach and dune along the Headland are low-lying with average berm elevation of +3 to +4 feet NAVD (North American Vertical Datum of 1988) and berm slope ranging from approximately 1:20 to 1:30. The dry beach width varies from 0 to approximately 50 feet. The offshore slope varies from approximately 1:80 to 1:130. Both Chaland Pass and Grand Bayou Pass are shallow inlets with fairly sizable ebb shoals and relatively small flood shoals. Bay Joe Wise is a shallow interior bay with average water depths of 3 to 4 feet.

The Headland has experienced significant erosion, such that, it has receded to critical width and has breached during recent storm and hurricane activity, e.g. Hurricanes Lili and Isidore in 2002. During the aerial reconnaissance flight and site visit in March 2003, it was confirmed the breach was still open and water was flowing full. During the July 2003 surveys (SJB et al., 2003), CEC photographed the breach and observed water flowing full during periods of high tide (Figure 3-2). Based on visual observations and comparisons to the prior conditions, it appeared the breach was closing slowly over time. During the supplemental field work conducted in May 2004 (Appendix A), the breach was observed to be open and flowing full at all tide stages, indicating the breach most likely did not close, and in fact, opened further.

The marsh, wetlands, beach and dune habitats within the Project reach have undergone significant loss due to natural processes including wind and wave induced erosion, storm overtopping and breaching, sea level rise, and subsidence, as well as man-influenced activities including oil and gas exploration and related canal dredging.

The Project area is one of, if not the, most rapidly disappearing areas in Louisiana, experiencing a loss rate of over 73 acres per year since 1988 (Coastal Research Laboratory (CRL), 2000). A photographic analysis was conducted to determine the acreage of land versus water, land acreage change, and breakdown of land mass into distinct habitats. In 2000, the land versus water acreage was estimated to be approximately 1,039 acres and 3,503 acres respectively. The habitat inventory estimated 769 acres of marsh, 41 acres of uplands, 200 acres of shrubs, 7 acres of inter-tidal, and 22 acres of beach. By applying the loss rate of 73 acres per year, the short–term year of disappearance was predicted to be 2014 (CRL, 2000).

Figure 3-2: View looking south from Bay Joe Wise into the Gulf through the breach

3.1.2 Pipelines

There are several pipeline canals crossing Bay Joe Wise including one directly through the Project reach. Further, there are numerous offshore pipelines that make landfall through and adjacent to the Project reach. SJB made contact with the following pipeline companies to inform them of the survey work conducted as part of this scope:

- Tennessee Gas
- Promix (Mustang Engineering, Inc.)
- Enterprise Products, Co.

This work included a magnetometer survey to locate existing facilities, utilities and improvements in the Project area (SJB et al., 2003), which may be affected by construction of the proposed Project.

3.1.3 Oyster Leases

In personal communication with VJ Verrata, the landrights representative for LDNR, SJB obtained a list of the owners and oyster leases in the Project area. An example of a staked lease area is shown in Figure 3-3. SJB made contact with the following owners to inform them of the survey work conducted as part of this scope:

- Ms. Charlotte O'Reilly Eustis
- Mr. Thomas Meyers
- Mr. Ridgely T.Finley, III
- Ms. Carol Finley
- Mr. John D. O'Reilly, III
- Mr. Gerald Meyers
- Ms. Frederica O'Reilly
- Ms. Elinor Finley King
- Ms. Ann Meyers Lapeyre
- Mr. Michael O'Reilly
- Ms. Elinor O'Reilly
- Mr. William G. Christian, Jr., J.D., C.F.P.
- Ms. Loretto O'Reilly

Figure 3-3: White poles depict Oyster Lease boundary

LDNR shall conduct an oyster lease survey to enable assessment of impacts to oyster farming from the proposed Project.

3.2 QUATRE BAYOU PASS

The geological development of the Louisiana coastline is the result of the formation and subsequent abandonment of a series of deltas of the Mississippi River over the last several thousand years. A new delta forms when the slope across the active delta becomes so flat that an alternative shorter and faster flow to the sea is formed. At that time, the former delta front begins to retreat, as the land surface subsides due to the compaction of the sediments.

The remnants of the LaFourche delta and a portion of the St. Bernard delta, as defined by Frazier (1967), formed the coastal bulge on the west side of the embayment between 500 and 3000 years before present, while the present Mississippi River delta has formed in the last 500 years. Each of the deltaic lobes has an associated layer or layers of sand, along with various natural levees along distributary channels. Other potential sand bodies derived from these former deltas include barrier island complexes, such as Grand Isle, located to the west of the current project.

The offshore surficial sediments away from the present and formed deltas are predominantly very fine loose silts and clays, being derived from the Mississippi River. The ongoing compaction of the underlying older deltaic sediments, in combination with the world-wide sea level increase, has led to a rapid relative sea rise throughout the southern Louisiana deltaic shoreline, and that relative sea level rise is the cause of the rapid shoreline transgression in the work area, as documented by Williams (1991).

The Project area is located between the former LaFourche delta and the present Mississippi River delta (Figure 3-4), and therefore was not an area of pronounced sand deposition, leaving little in the way of significant sand sources within the offshore sediments. The shore face through the work area is characterized by a series of very thin, low barrier islands that are being rapidly eroded, indicative of an area where there is little offshore sand to provide a source for the natural migration of sand to the beach.

A regional sand search for the Barataria Basin was completed by Kindinger et al. (2001) and LDNR (2000). Other relevant data for the Project area were prepared by Kulp and Penland (2001) and Suter et al. (1991). This work identified potentially acceptable beach and marsh fill quality sediment in Quatre Bayou Pass. Review of the data suggested that the eastern third of Quatre Bayou Pass is an area where the existing overburden is thinning. In the same area, isopach maps indicated the presence of ten to fifteen feet of sand below the overburden. Three potential distributary channels were identified and recommended for further investigation. Existing data also suggested the presence of a distributary channel system to the east of the Quatre Bayou survey area, which was also recommended for further investigation. The results of the sand source search are presented in Section 6.0.

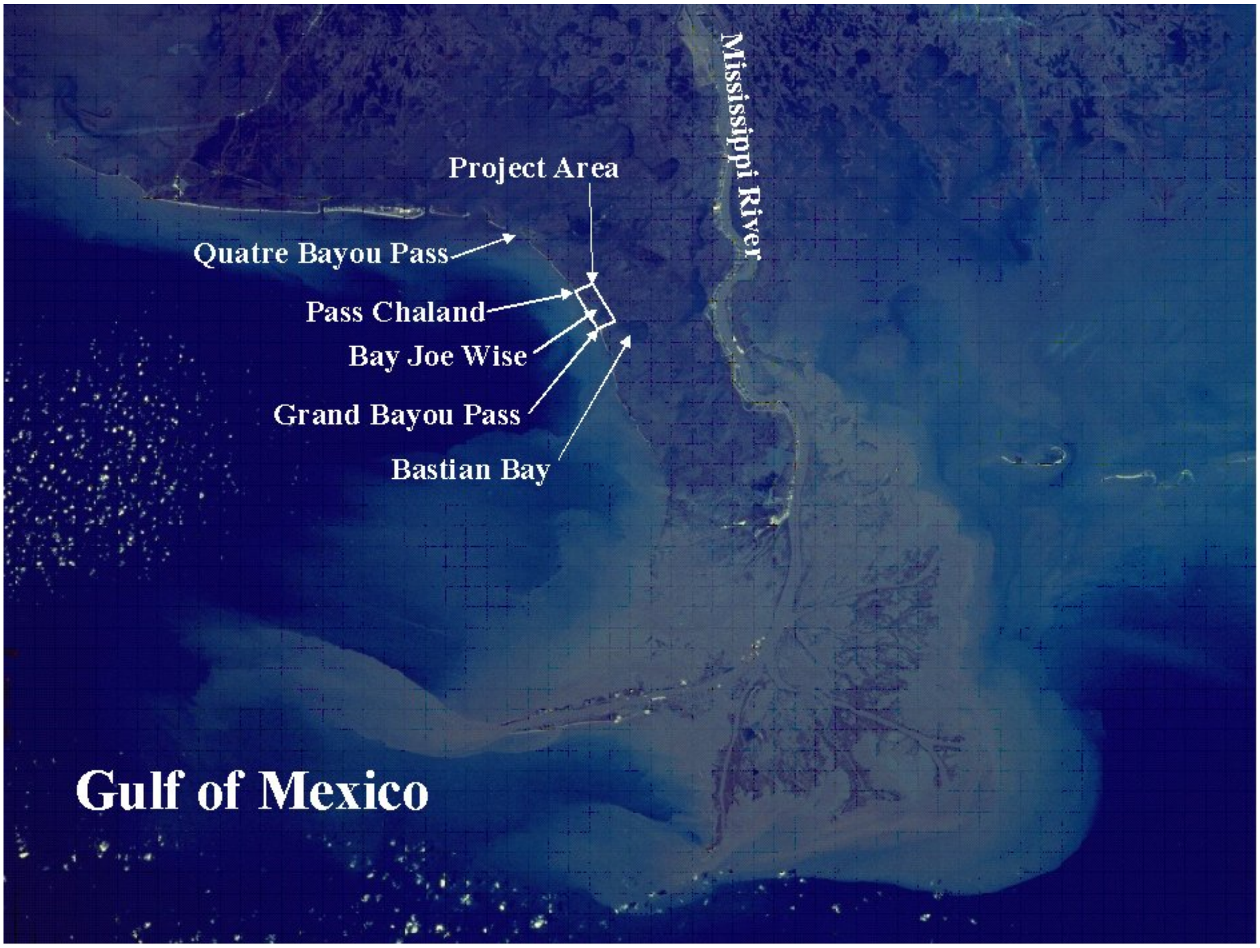


Figure 3-4: Project Location Aerial Exhibit

4.0 FINAL DESIGN CRITERIA

4.1 SURVEYS

4.1.1 Average Marsh Elevation

Five (5) areas located within healthy, stable marshes were surveyed to determine the natural ground elevations. The elevations of the active marsh surface ranged from 1.08 feet NAVD to 1.65 feet NAVD, with an overall average of approximately 1.5 feet NAVD. The reported Mean High Water (MHW) elevation (Section 4.2) is 1.53 feet NAVD, nearly identical to the average marsh elevation.

4.1.2 Tidal Creek Geometry

One of the most important design questions in tidal wetland restoration and in estuarine maintenance dredging projects is the prediction of the size and shape of equilibrium or self maintaining tidal creeks.

Tidal creeks are necessary to allow hydraulic exchange and circulation within the marsh. If the hydrological conditions are established, the chemical and biologic conditions will respond. The purpose of the tidal creeks is to enable tidal exchange within the interior of the newly created marsh and allow for sedimentation on the marsh platform by deposition of the suspended sediment carried in by the tides and currents.

A predictive tool based on empirical hydraulic geometry relationships derived from field measurements of local natural creeks was applied to define tidal creek design criteria and used to size the proposed tidal creeks. Selected existing, naturally-occurring tidal creeks in the vicinity were surveyed as a model to guide design of tidal creeks within the limits of the marsh barrier project. Survey data from the two creeks selected have been used to develop average cross-sections of both large, Type 1, and small, Type 2, tidal creeks. The creek parameters upon which these averages are based include area, width, depth, and side slope. These values along with the range of widest and narrowest creek widths have been included in Table 4-1. The tidal creek naturally takes a meandering sinuous course winding back and forth. The sinuosity of the creek can be measured as a ratio of the amplitude of the curve against the length of the curve for one channel bend. Using the aerial photograph of the area surveyed, the respective sinuosity of the large and small creeks have been determined and included in Table 4-1.

The measured tidal creek cross sections have been graphically represented for both the Type 1 and Type 2 creeks as shown in Figure 1. The defined average channel geometry has been plotted on top of the natural sections taken from the various stations surveyed.

The objective is to restore structure, function, and ecological processes in an area alternately inundated and drained by tidal action. Tidal interaction is a function of flooding depth, duration, and frequency, and is necessary for optimal fish utilization and development of the marsh vegetative communities. Tidal flushing shall be provided to maintain circulation and water quality.

TABLE 4-1
TIDAL CREEK DESIGN CRITERIA

Type	Average					Range		Sinuosity Ratio
	Width		Depth	Side Slope	Area	Widest	Narrowest	
	Top (ft)	Bottom (ft)	(ft)		(sq. ft)	(ft)	(ft)	
Large	78	40	4.8	1(V):4(H)	280	110	50	0.6
Small	47	10	1.8	1(V):10(H)	50	60	20	0.2

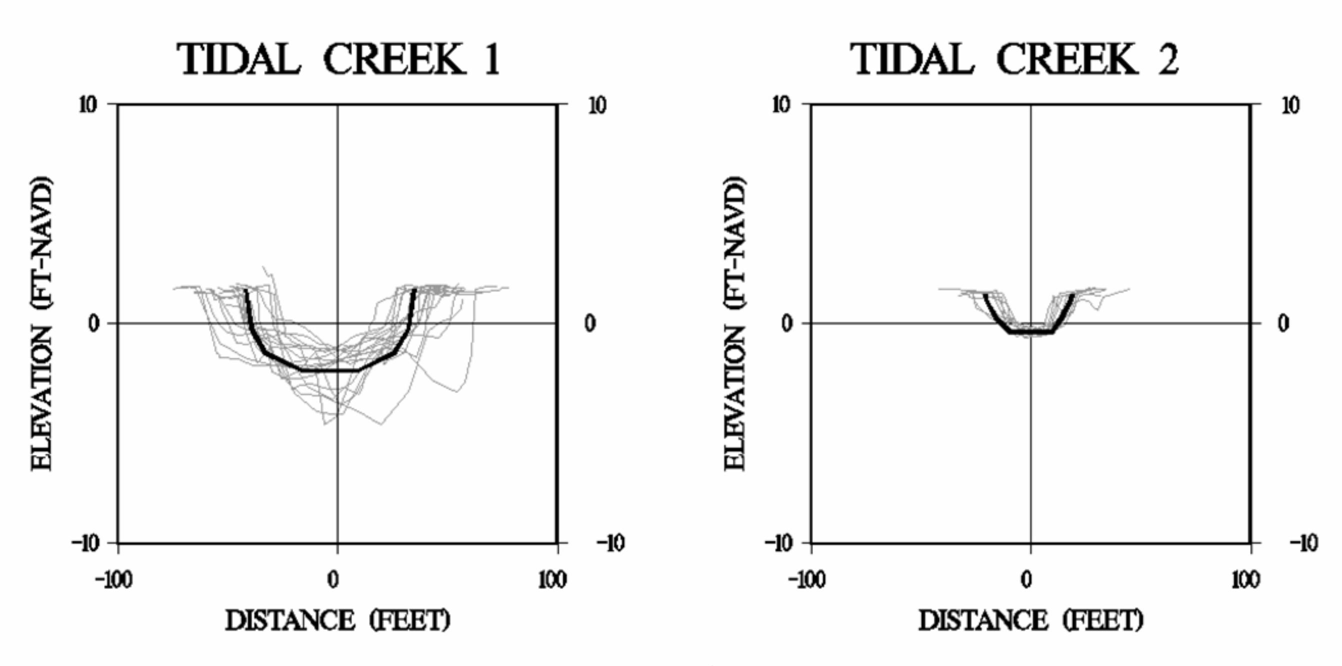


Figure 4-1: Comparisons of Tidal Creek Surveys

4.2 COASTAL PROCESSES DESIGN CRITERIA

4.2.1 Shoreline Erosion Rate

As presented in the Coastal Processes Report (SJB and CEC, 2004), the design gulf-front shoreline erosion rates on the Bay Joe Wise Headland ranged from –3.6 to –9.2 feet per year, with an average of –6.4 feet per year. The average shoreline orientation from west to east is 105 degrees.

4.2.2 Volumetric Erosion Rate

The conservative estimates of the volumetric erosion rates for the 15,000 foot reach along the Bay Joe Wise Headland ranged from –1.3 to –5.0 cubic yards per year per foot along the gulf-front shoreline with an average of approximately –2.4 cubic yards per year per foot along the gulf-front shoreline; and the conservative estimate of the total volumetric loss for the beach and dune was approximately –36,760 cubic yards per year (SJB and CEC, 2004).

4.2.3 Wind Statistics

Wind data statistics were generated using the U.S. Army Corps of Engineers (2000) Mississippi Delta Wave Hindcast Study from 1976 to 1995 at WIS Node B7, located in 11 meter water depth at 29D12’N, 89D42’W offshore of the Bay Joe Wise Headland, and are presented in Table 4-2.

TABLE 4-2
DIRECTIONAL WIND STATISTICS

ANGLE BAND	AVG. WIND SPEED (MPH)	% OCCURRENCE
0 - 22.5	14.9	7.4
22.5 - 45	14.0	7.5
45 - 67.5	12.4	8.3
67.5 – 90	11.9	6.0
90 – 112.5	11.3	8.4
112.5 – 135	11.5	8.8
135 – 157.5	12.2	10.7
157.5 – 180	11.8	6.1
180 – 202.5	10.3	5.6
202.5 – 225	9.7	4.4
225 – 247.5	9.6	4.6
247.5 – 270	9.5	2.7
270 – 292.5	10.5	4.7
292.5 – 315	11.4	3.7
315 – 337.5	13.1	5.5
337.5 - 360	14.6	5.8

Storm wind statistics were compiled by Coastal Planning and Engineering (CP&E) (2003) on behalf of LDNR for the Chaland Headland and Pelican Island Projects at the Grand Isle tide station from 1984 to 2001, and are presented in Table 4-3.

4.2.4 Wave Statistics

Wave data statistics were generated using the U.S Army Corps of Engineers (2000) Mississippi Delta Wave Hindcast Study from 1976 to 1995 at WIS Node B7, located in 11 meter water depth at 29D12’N, 89D42’W offshore of the Bay Joe Wise Headland. The average wave height, period and direction for all the waves were 1.9 feet, 4.2 seconds, and 158.8 degrees respectively. The average shoreline orientation from west to east is 105 degrees, thus the angle band of onshore waves is 105 to 285 degrees. The average wave height, period and direction for the onshore waves were 2.3 feet, 4.7 seconds, and 176.8 degrees. Directional and seasonal wave statistics are presented in Table 4-4 and Table 4-5 respectively. CP&E (2003) compiled extremal wave statistics, which are presented in Table 4-6.

TABLE 4-3
STORM WIND STATISTICS

FREQUENCY	STAGE (NAVD, FT)	SPEED (MPH)	DIRECTION (DEG)
QUARTERLY	1.6	41	2
SEMI-ANNUAL	1.6	45	22
ANNUAL	1.6	47	24
2-YEAR	1.6	50	19
3-YEAR	2.7	51	350
4-YEAR	3.4	52	321
5-YEAR	4.0	53	301

In personal communication on October 22, 2003 with Harley Winer, U.S. Army Corps of Engineers, New Orleans District, he stated that even with the improved WIS data produced in the 2000 report, there still remains a slight bias from the southeast resulting in gross transport in the opposite direction to that observed and measured in the field in the vicinity of Grand Isle. These wave data are recommended as design criteria for use in the Project design, noting that shoreline modeling tasks should address the southeast bias through calibration and sensitivity testing.

TABLE 4-4
DIRECTIONAL WAVE STATISTICS

ANGLE BAND (DEG)	AVG. WAVE HEIGHT (FT)	% OCCURRENCE	AVG. PERIOD (SEC)
0 – 22.5	1.5	6.2	3.5
22.5 – 45	1.5	6.5	3.4
45 – 67.5	1.3	7.2	3.5
67.5 – 90	1.5	5.2	3.5
90 – 112.5	1.5	7.2	3.5
112.5 – 135	1.6	6.1	3.7
135 – 157.5	2.1	8.1	4.1
157.5 – 180	2.6	18.2	5.5
180 – 202.5	3.1	10.2	5.8
202.5 – 225	1.9	4.2	4.3
225 – 247.5	1.5	3.7	3.8
247.5 – 270	1.6	2.3	3.7
270 – 292.5	1.4	3.5	3.6
292.5 – 315	1.5	2.8	3.7
315 – 337.5	1.6	4.4	3.7
337.5-360	1.4	4.3	3.6

TABLE 4-5
OFFSHORE WAVE STATISTICS

	ALL WAVES				ONSHORE WAVES (105-285 DEG)			
MONTH	WAVE HEIGHT (FT)		PERIOD	DIRECTION	WAVE HEIGHT (FT)		PERIOD	DIRECTION
	AVG.	MAX	(SEC)	(DEG)	AVG.	MAX	(SEC)	(DEG)
Jan.	2.3	11.0	4.2	158.6	2.7	11.0	5.1	173.0
Feb.	2.4	9.5	4.4	159.6	2.8	9.5	5.2	177.5
March	2.6	11.2	4.9	167.1	3.0	11.2	5.5	171.7
April	2.4	8.9	4.7	164.8	2.7	8.9	5.1	171.2
May	1.9	6.8	4.5	156.8	2.1	6.8	4.7	168.6
June	1.5	6.7	4.2	170.4	1.7	6.7	4.3	182.1
July	1.3	9.6	3.8	200.4	1.4	9.6	3.8	202.1
Aug.	1.2	22.7	3.9	182.7	1.5	22.7	4.1	198.2
Sept.	1.2	13.5	3.9	131.7	1.7	13.5	4.5	172.1
Oct.	1.6	20.6	3.8	125.5	2.2	20.6	4.6	164.5
Nov.	2.2	9.3	4.2	138.8	2.7	9.3	5.1	168.5
Dec.	2.3	8.8	4.1	149.0	2.8	8.8	4.9	172.3
Annual	1.9	22.7	4.2	158.8	2.3	22.7	4.7	176.8

TABLE 4-6
OFFSHORE GULF WAVES VS. RETURN PERIOD

RETURN PERIOD	WAVE HEIGHT		WAVE PERIOD	
(YEARS)	(FT)	+/- STD.	(SEC)	+/- STD.
1	12.4	0.8	10.0	0.2
5	18.0	1.9	11.7	0.6
10	20.5	2.5	12.4	0.8
20	22.9	3.7	13.2	1.2
50	26.3	6.2	14.2	2.0

4.2.5 Tide Statistics

The tidal datum at Grand Isle is listed in Table 4-7 (CP&E, 2003) with references to MHW and Mean Low Water in NAVD 1988. The measured maximum tidal amplitude for the Gulf of Mexico and Bay Joe Wise were 2.0 feet and 1.8 feet respectively. The measured average phase lag from gulf to bay was one hour and twenty minutes.

4.2.6 Currents

At Grand Bayou Pass, the measured peak ebb and flood currents were 3.6 and 2.4 feet per second respectively. At Pass Chaland, the measured peak ebb and flood currents were 3.0 and 2.9 feet per second respectively. Further, currents were measured at the critical throat cross sections in the primary channels leading into Bay Joe Wise for the interior channel leading from Grand Bayou Pass to the bay, the measured peak ebb and flood currents were 2.0 and 1.8 feet per second respectively. For the interior channel leading from Pass Chaland to the bay, the measured peak ebb and flood currents were 1.5 and 1.8 feet per second respectively.

TABLE 4-7
GRAND ISLE TIDAL DATUM

DESCRIPTION	MLLW (FT)	NAVD (FT)
Highest Observed Water Level (10/27/85)	4.48	4.93
Mean Higher High Water (MHHW)	1.11	1.56
Mean High Water (MHW)	1.08	1.53
Mean Sea Level	0.56	1.01
Mean Tide Level	0.55	1.00
Mean Low Water	0.02	0.48
Mean Lower Low Water (MLLW)	0.00	0.45
North American Vertical Datum, 1988 (NAVD)	-0.45	0.00
Lowest Observed Water Level (2/3/51)	-2.76	-2.31

4.2.7 Storm Surge

CP&E (2003) compiled storm surge and wave set-up statistics on behalf of LDNR for the Chaland Headland and Pelican Island Projects, which are recommended as design criteria and presented in Table 4-8.

TABLE 4-8
STORM SURGE VS. RETURN PERIOD

RETURN PERIOD (YEARS)	STORM STAGE (FT, NAVD)	WAVE SETUP (FT)	STAGE & WAVE SETUP (FT, NAVD)
5	4.0	3.6	7.6
10	5.9	4.2	10.0
20	7.7	4.6	12.3
50	9.5	5.4	14.9
100	10.3	5.9	16.3

4.2.8 Design Storm Statistics

CP&E (2003) compiled storm statistics on behalf of LDNR for the Chaland Headland and Pelican Island Projects, which are recommended as design criteria and presented in Table 4-9.

TABLE 4-9
DESIGN HURRICANE STATISTICS

STORM	RETURN PERIOD (YEAR)	WAVE HEIGHT (FT)	PERIOD (SEC)	STORM SURGE* (FT, NAVD)	STORM SURGE ** (FT, NAVD)	WINDS (MPH)
ISIDORE	17	21	13	+3.7	+5.0	38
LILI	40	40	14	+4.7	+4.8	39
ANDREW	20	23	13	+7.7	+7.7	***

* Measured at Chaland Pass ** Measured at Grand Isle *** Not Reported

4.2.9 Depth of Closure

The depth of closure, defined as the seaward limit of active sand transport, was determined by profile comparisons, comparisons to empirical solutions and values reported in the literature, and diver observations made in the field. Based on the analysis, the depth of closure is computed to be approximately -11 feet NAVD.

4.2.10 Sea Level Rise and Subsidence

Sea level rise and subsidence statistics were compiled by both CP&E (2003) and Weston Solutions (2003) on behalf of LDNR for the Chaland Headland and Pelican Island Projects and East/West Grand Terre Island Project respectively. The predicted design rate, including the contributions from both sea level rise and subsidence, were reported as 0.04 feet per year (Weston, 2003) and 0.05 feet per year (CP&E, 2003). The more conservative rate of 0.05 feet per year, equal to 1 foot over the 20-year design life is recommended for design criteria.

4.3 MARSH, BEACH, AND DUNE SEDIMENTOLOGY DESIGN CRITERIA

4.3.1 Native Sediments

As a basis for comparison and evaluation of Project performance, eighteen (18) samples were collected from six (6) shore-perpendicular transects along the native beach. Samples were located in order to provide a representation of the entire active beach profile including samples from -5 feet NAVD along the offshore bar, from the active beach face, and from the dune or overwash area. These samples were tested for grain size analysis. The laboratory results were then assimilated to develop a native beach composite sample. The composite mean grain size of the native beach material was computed to be approximately 0.2 mm. Shallow native marsh samples were also collected for analysis. The textural statistical characteristics are presented in Table 10 for the composite native dune, beach face, and -5 NAVD samples.

TABLE 4-10
NATIVE SHORELINE SAMPLE SEDIMENT CHARACTERISTICS

	Dune Composite		**Beach Composite**		**Nearshore Composite**	
% of Sample Finer By Weight	**(phi)**	**(mm)**	**(phi)**	**(mm)**	**(phi)**	**(mm)**
95	1.786	0.290	1.786	0.290	0.089	0.940
84	1.943	0.260	1.837	0.280	1.943	0.260
50	2.322	0.200	2.322	0.200	2.474	0.180
16	2.737	0.150	2.837	0.140	3.252	0.105
5	3.224	0.107	3.626	0.081	3.540	0.086
Std. Dev.	-0.438	0.058	-0.557	0.070	-0.902	0.181
Mean	2.334	0.203	2.332	0.207	2.556	0.182
Sorting	-0.397	0.055	-0.500	0.070	-0.654	0.078

4.3.2 Cut to Fill Ratios

Losses due to the dredge and fill process, that is, excavation of the borrow area sediments, transport to the fill area, and dewatering of the fill sections, are a function of the percent silts, construction techniques, and erosional losses of the fill template due to storm activity prior to survey and acceptance. Based on the percent silts in the proposed borrow area (Section 6.0) and experience with similar projects built using the anticipated construction techniques to be employed on this Project, the predicted cut to fill ratios for the marsh fill and the beach and dune fill are 1.6 and 1.3 respectively.

4.4 FILL TEMPLATES AND VOLUMES

4.4.1 Introduction

The Project goal is to construct an average 1000-foot wide marsh platform contiguous with the northern side of the gulf shoreline along the Bay Joe Wise Headland, from the east side at Grand Bayou Pass extending west past Bay Joe Wise. As part of the Project Initiation Meeting, a site visit was held at which time multiple breachments were observed along the gulf-front shoreline of the Bay Joe Wise Headland. In order to achieve the Project's goals, it was determined that the beach and dune would also have to be restored to address the severity of erosion. Figure 4-2 is a close-up view of the Project site and Figure 4-3 is a conceptual rendering of the proposed marsh, beach, and dune fill developed during final design created on the 2002 aerial photograph.

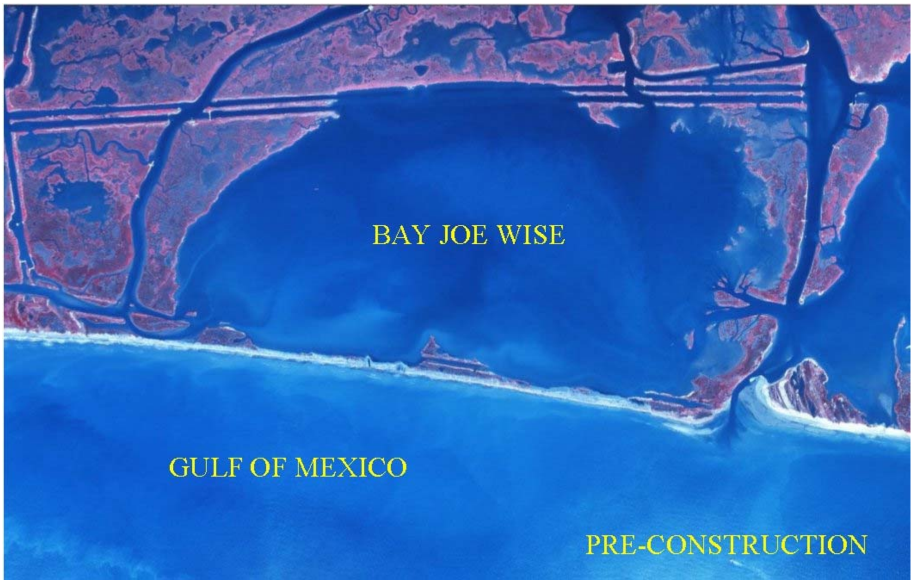


Figure 4-2: Close-up View of the Project Site (2002 Aerial Photograph)

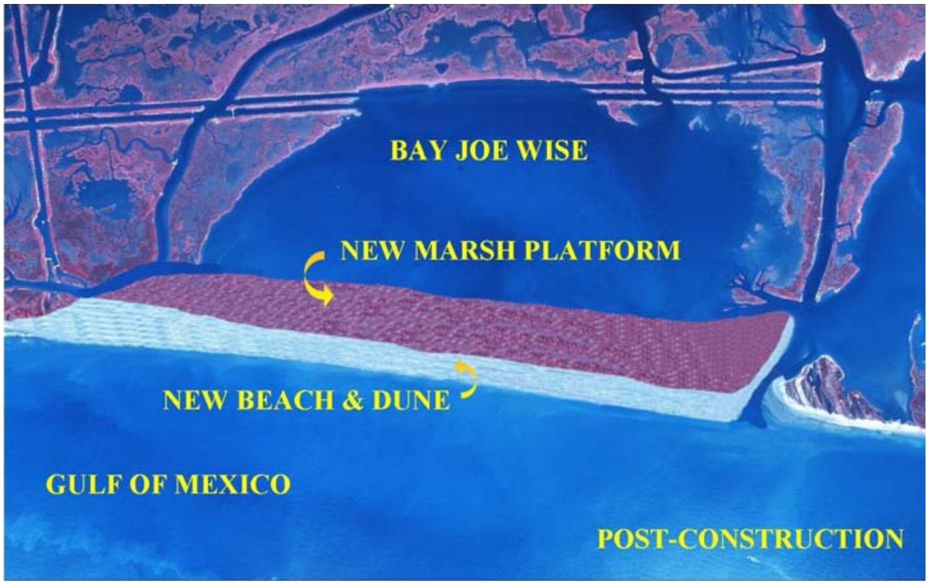


Figure 4-3: Conceptual Rendering of the Proposed Marsh, Beach, and Dune Fill

4.4.2 Marsh Fill Design Criteria

The average natural marsh elevation is approximately 1.5 feet NAVD. Adding in the combined design criteria for sea level rise, subsidence, and settlement for the 20-year Project life (Section 8.0), the proposed marsh construction berm elevation is 2.6 feet NAVD. The design marsh platform width is 1000 feet. Applying these design criteria to the 500-foot marsh profiles measured as part of the Data Collection Task under the Topography, Bathymetric and Magnetometer Survey Report (SJB et al., 2003), the design marsh fill volume is approximately 1.67 million cubic yards. Including the cut to fill ratio design criteria of 1.6 (Section 4.3), the predicted volume to construct the design marsh template is approximately 2.67 million cubic yards.

4.4.3 Beach and Dune Fill Design Criteria

The design volumetric erosion rate is approximately 37,000 cubic yards per year (Section 4.2). Multiplying by the 20-year Project life, the design beach and dune fill volume is 740,000 cubic yards. Applying the design overfill ratio (Section 6.0), the design fill volume is approximately 860,000 cubic yards. Including the cut to fill ratio design criteria (Section 4.3), the predicted volume to construct the beach and dune template is approximately 1.12 million cubic yards. Actual construction volumes have been increased to 1.03 million cubic yards of fill (1.55 million cubic yards including the overfill and cut to fill ratios) to accommodate eastern and western end re-designs and a fill template optimization discussed in Section 9.6.

5.0 DESCRIPTION OF ALTERNATIVES

5.1 DESIGN OBJECTIVES

Five (5) alternatives were developed to achieve the following Project design objectives.

- Project life equal to twenty years (Year 20)
- Protect and preserve the structural integrity of the barrier shoreline along the Gulf of Mexico
- Create 226 acres of back-barrier marsh at Year 1 with unrestricted tidal exchange
- Marsh construction shall achieve an elevation such that by Year 3 the marsh elevation is within the tidal zone, defined from MHW to MLW, and remains within this zone through Year 20
- Address the severity of erosion along the gulf-front shoreline
- Close the multiple breachments that have occurred due to recent storm and hurricane damage and prevent breaching during the design life
- Vegetate newly created marsh and dune areas
- Approximately 25% of the marsh platform would be 80% or greater vegetated after the first completed growing season after construction, and 100% of the marsh platform would be vegetated after three complete growing seasons
- Provide compatible sediments for marsh, beach and dune restoration
- Avoid impacts to adjacent shorelines from borrow area excavation
- Maintain water quality and circulation between Pass Chaland and Bay Joe Wise
- Construct approximately 10,000 linear feet of tidal creeks and six (6) one-acre tidal ponds to allow hydraulic exchange and circulation within the newly created marsh
- Protect or create approximately 161 acres of barrier island habitat at Year 20

The alternatives include some or all of the components described below.

5.1.1 Marsh Fill

The Project includes design of a 1,000-foot wide marsh platform contiguous with the northern side of the gulf-front shoreline along the Bay Joe Wise Headland from Grand Bayou Pass to west of Bayou Huertes to restore and maintain the barrier shoreline. The design elevation of the marsh to achieve the tidal zone design objective is 2.6 feet NAVD. It is estimated that approximately 2.67 million cubic yards of dredged material will be required to construct the marsh platform. The marsh platform shall be planted with appropriate vegetation. Templates transitioning into the existing marshes at both ends of the bay were evaluated during the modeling tasks to minimize impacts to circulation patterns and provide for water levels, channel geometry, and flow of sufficient magnitude within the bay to support the newly created marsh.

5.1.2 Beach and Dune Fill

The Project includes design of a beach and dune fill to address gulf-front erosion and close the breachments. It is estimated that approximately 1.12 million cubic yards of dredged material will be required to construct the beach and dune fill to address the design erosion rate over the Project life. Actual construction volumes have been increased as discussed in Section 9.6. The dune platform shall be planted with appropriate vegetation. Various fill templates were evaluated during the modeling tasks to balance technical, fiscal, and environmental factors that best optimized Project performance. The dune width and slope were designed to match existing healthy dunes in the Project area.

5.1.3 Borrow Area

The native marsh primarily consists of clays, silts and sands and the native beach and dune primarily consist of fine sand. The Project includes design and siting of a suitable borrow area that contains sufficient volumes of sediments compatible with the native marsh, beach and dune.

5.1.4 Water Exchange Channel

In order to maintain the current flow-way and circulation patterns between Pass Chaland and Bay Joe Wise, the Project includes design of a water exchange channel. It is estimated that an approximate 4,200-foot long channel will have to be dredged with a corresponding volume of approximately 70,000 cubic yards.

5.1.5 Tidal Creeks

To enable tidal exchange within the interior of the newly created marsh and allow for sedimentation on the marsh platform by deposition of the suspended sediment carried in by the tides and currents, the Project includes design of approximately 6,000 feet of primary tidal creeks.

5.2 ALTERNATIVE 1: NO ACTION

This alternative is to allow for conditions to remain in their present state and no construction is included in this alternative. The Project area is experiencing a loss rate of over 73 acres per year since 1988 (CRL, 2000). In 2000, the land versus water acreage was estimated to be approximately 1,039 acres and 3,503 acres respectively. The habitat inventory estimated 769 acres of marsh, 41 acres of uplands, 200 acres of shrubs, 7 acres of inter-tidal, and 22 acres of beach. By applying the loss rate of 73 acres per year, the short–term year of disappearance was predicted to be 2014 (CRL, 2000). This alternative does not achieve any of the design objectives, thus it was not considered to be a practical alternative.

5.3 ALTERNATIVE 2: MARSH ONLY

This alternative is designed to provide an approximate 8,200 foot long by 1,000 foot wide marsh platform in Bay Joe Wise with an approximate 5,800 foot long taper of varying width seaward of Bayou Huertes. The taper to the west is proposed to maintain the current flow patterns in the primary channel from Pass Chaland to Bay Joe Wise. The surface area of the proposed marsh platform is approximately 250 acres. The construction berm elevation is +2.6 feet NAVD accounting for the preliminary design criteria on average existing marsh elevation, sea level rise, subsidence and consolidation. The corresponding fill volume is approximately 1.46 million cubic yards. The required fill volume including the preliminary design criteria for the cut to fill ratio is 2.33 million cubic yards. A plan view and typical cross sections for Alternative 2 are shown in Figures 5-1 and 5-2 respectively.

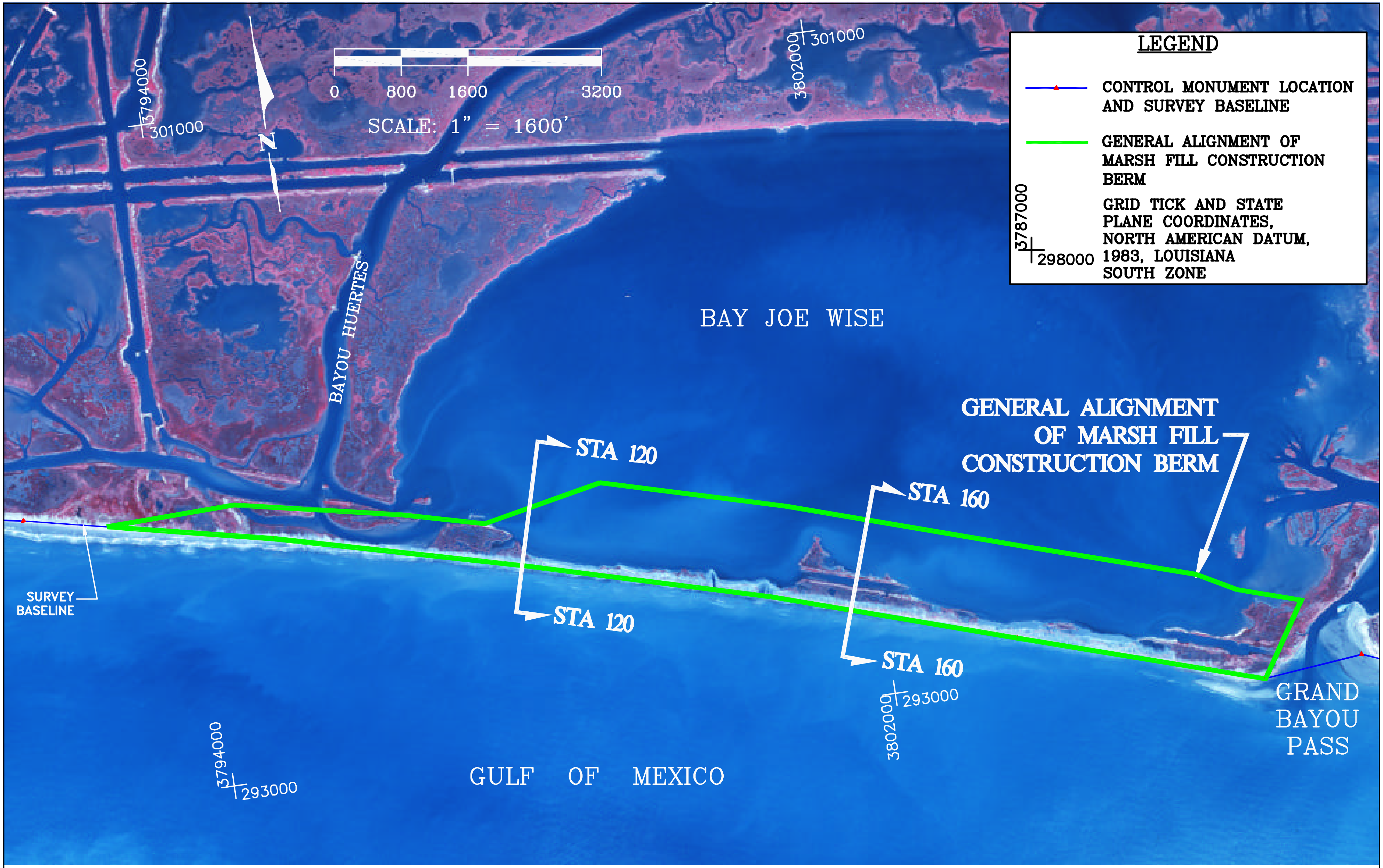


FIGURE 5-1: ALTERNATIVE NO. 2 PLAN VIEW

Coastal Engineering Consultants, Inc.   02132FIG5-1.DWG   SEP 19, 2005   SJB GROUP INCORPORATED

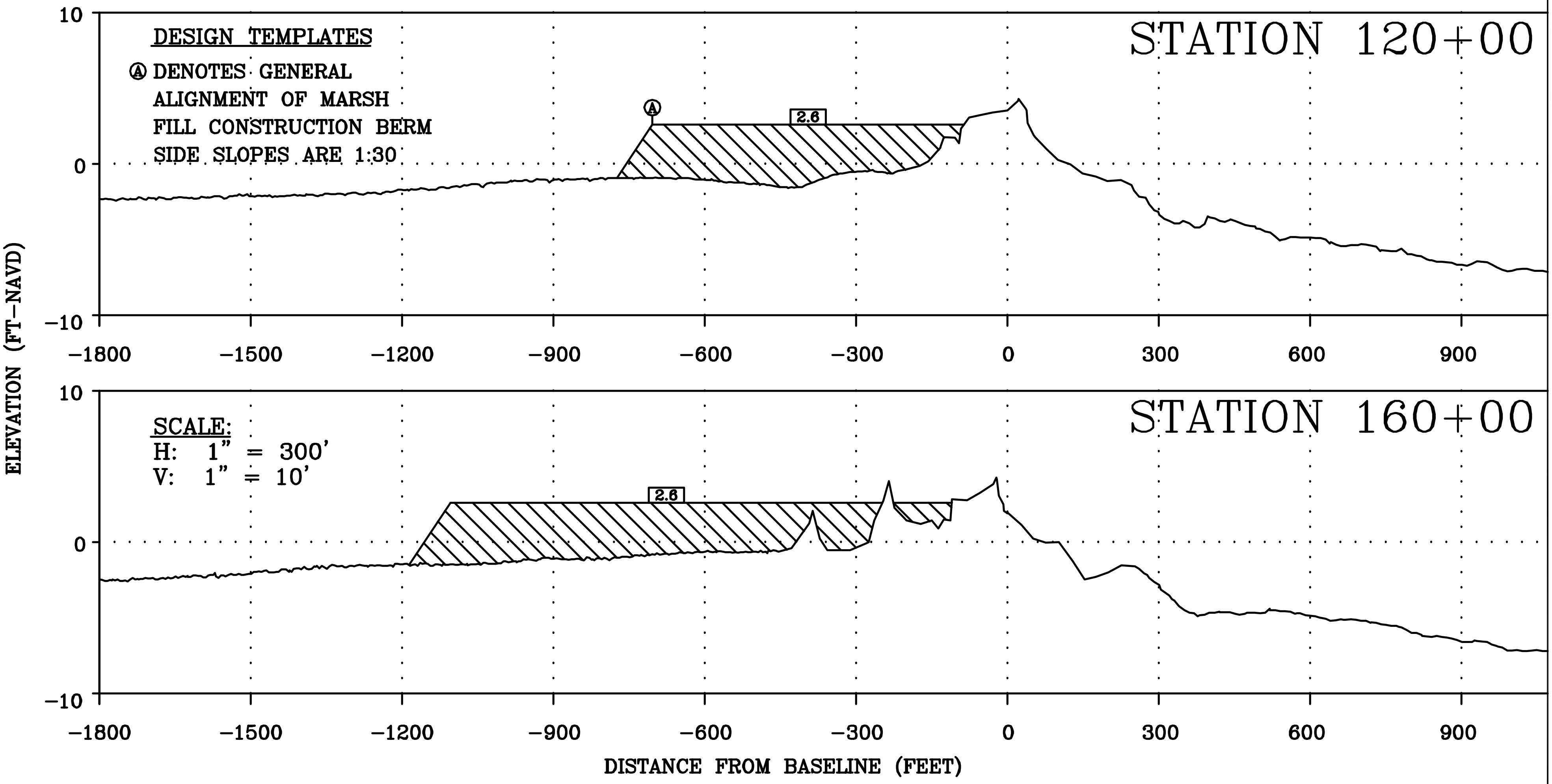


FIGURE 5-2: ALTERNATIVE NO. 2 TYPICAL CROSS SECTIONS

Coastal Engineering Consultants, Inc.   02132FIG5-2.DWG   SEP 19, 2005   SJB GROUP INCORPORATED

5.4 ALTERNATIVE 3: MARSH, BEACH AND DUNE

This alternative is designed to provide an approximate 8,200 foot long by 1,000 foot wide marsh platform in Bay Joe Wise with an approximate 5,800 foot long taper of varying width seaward of Bayou Huertes. The taper to the west is proposed to maintain the current flow patterns in the primary channel from Pass Chaland to Bay Joe Wise. The surface area of the proposed marsh platform is approximately 250 acres. The construction berm elevation is +2.6 feet NAVD accounting for the preliminary design criteria on average existing marsh elevation, sea level rise, subsidence and consolidation. The corresponding fill volume is approximately 1.46 million cubic yards. The required fill volume including the preliminary design criteria for the cut to fill ratio is 2.33 million cubic yards.

This alternative is also designed to provide an approximate 11,000 foot long beach and dune fill with 1,000 foot tapers on each end to close the breach areas and restore and protect the erosive beach. The tapers are provided to blend the sediments into the existing grades and maintain a buffer from the inlets on both ends of the Bay Joe Wise Headland. The dune component includes a 50 foot wide crest width at +7 feet NAVD with 1:30 side slopes. The beach fill template includes a 70 foot wide construction berm at +5 feet NAVD with 1:30 side slopes. The elevations were chosen to correspond to storm surge levels between the 5- and 10- year storm events to minimize overtopping into the marsh. The average beach fill width measured at MHW is approximately 230 feet excluding the tapers. The surface area of the proposed beach and dune platform is approximately 65 acres measured at MHW. The corresponding fill volume is approximately 1.2 million cubic yards including the preliminary design criteria for the overfill ratio. The required fill volume including the preliminary design criteria for the cut to fill ratio is 1.56 million cubic yards. A plan view and typical cross sections for Alternative 3 are shown in Figures 5-3 and 5-4 respectively.

5.5 ALTERNATIVE 4: MARSH AND BEACH

This alternative includes the same preliminary design fill for the marsh platform in Bay Joe Wise and taper to the west of Bayou Huertes. The surface area is approximately 250 acres. The construction berm elevation is +2.6 feet NAVD accounting for the preliminary design criteria on average existing marsh elevation, sea level rise, subsidence and consolidation. The corresponding fill volume is approximately 1.46 million cubic yards. The required fill volume including the preliminary design criteria for the cut to fill ratio is 2.33 million cubic yards.

This alternative examines a different beach fill template than Alternative 1 to close the breach areas and restore the erosive beach. It is designed to provide an approximate 11,000 foot long beach fill with 1,000 foot tapers. The tapers are provided to blend the sediments into the existing grades and maintain a buffer from the inlets on both ends of the Bay Joe Wise Headland. The fill template includes a 360 foot wide construction berm at +4 feet NAVD with 1:30 side slopes excluding the tapers. The elevation was chosen to match existing dune elevations and not control overtopping into the marsh. The average beach fill width measured at MHW is approximately 290 feet excluding the tapers. The surface area of the proposed beach and dune platform is approximately 80 acres measured at MHW. The corresponding fill volume is approximately 1.2 million cubic yards including the preliminary design criteria for the overfill ratio. The required

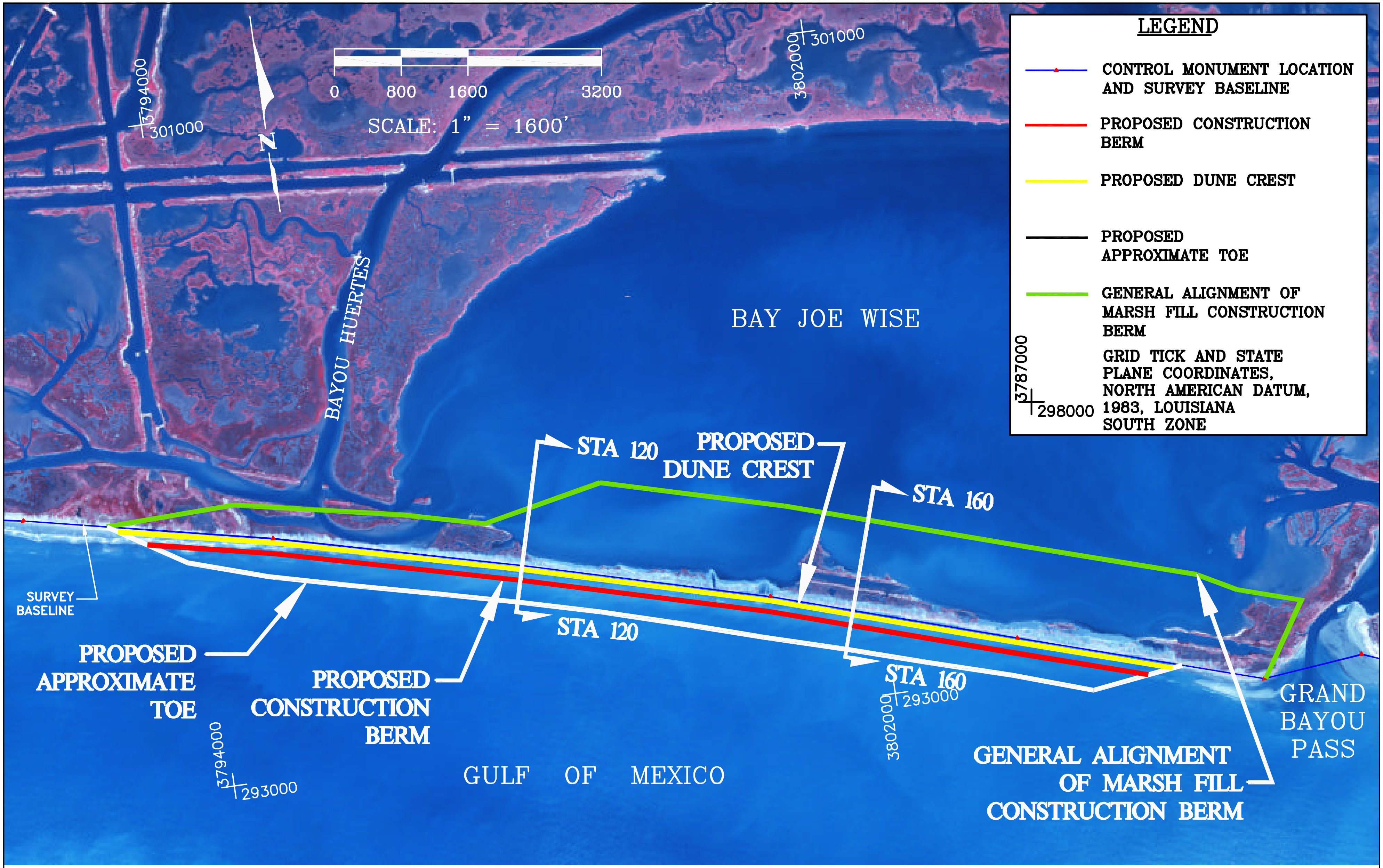


FIGURE 5-3: ALTERNATIVE NO. 3 PLAN VIEW

Coastal Engineering Consultants, Inc. 02132FIG5-3.DWG SEP 19, 2005 SJB GROUP INCORPORATED

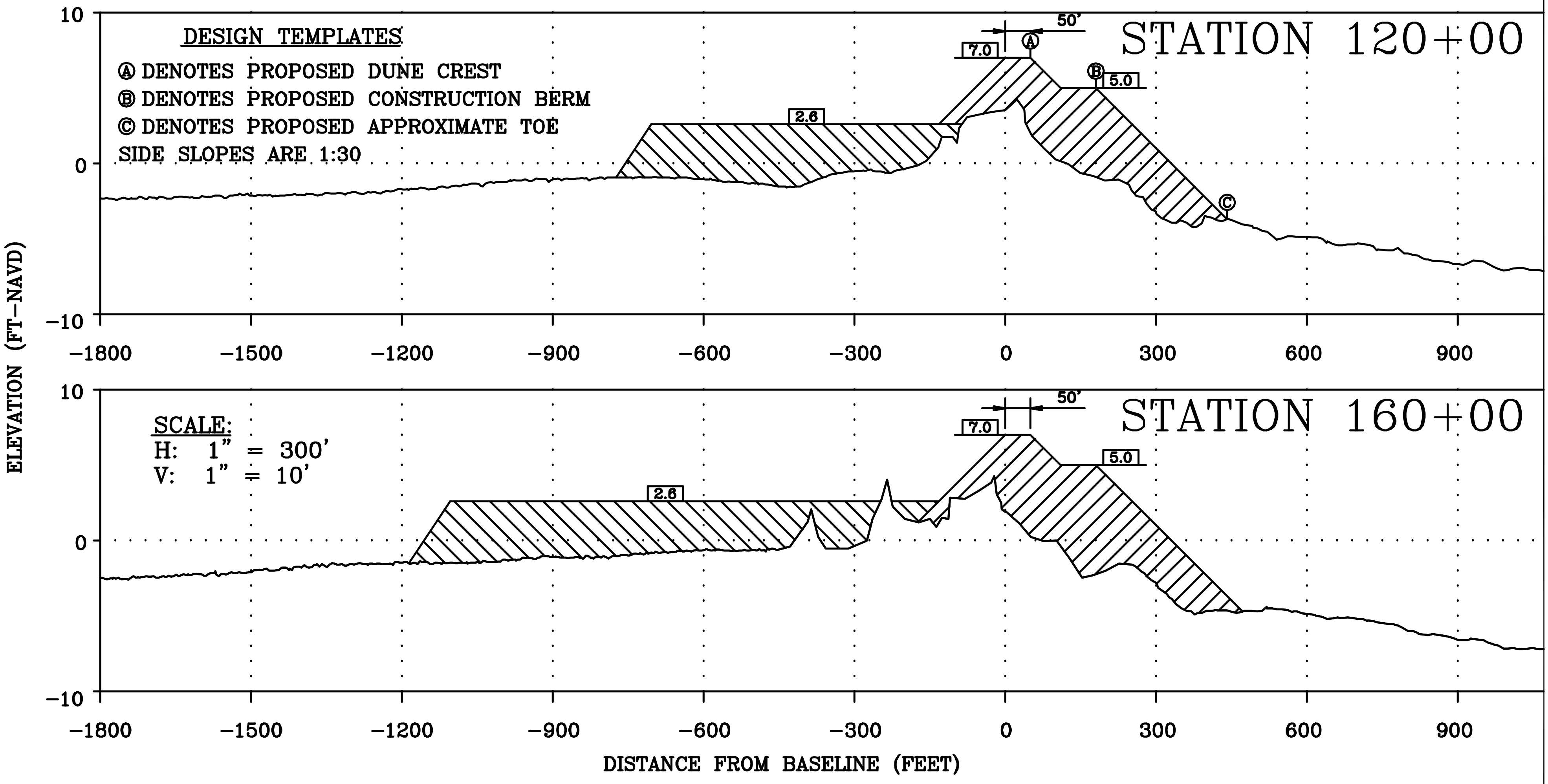


FIGURE 5−4: ALTERNATIVE NO. 3 TYPICAL CROSS SECTIONS

Coastal Engineering Consultants, Inc. 02132FIG5−4.DWG SEP 19, 2005 SJB GROUP INCORPORATED fill volume including the preliminary design criteria for the cut to fill ratio is 1.56 million cubic yards. A plan view and typical cross sections for Alternative 4 are shown in Figures 5-5 and 5-6 respectively.

5.6 ALTERNATIVE 5: MARSH, LANDWARD BEACH AND DUNE

This alternative examines a different approach to optimizing fill performance by taking advantage of the existing sedimentology of the gulf-front shoreline. That is, the native sediments are coarser than the borrow sediments such that they will withstand erosion more than the borrow sediments. Another way to state this is that the beach fill comprised of the finer grain borrow sediments will erode faster than the native sediments. Thus, the marsh, beach and dune fills are translated landward, behind the existing beach and dune, compared to Alternatives 3 and 4. In order to restore and protect the headland at Bayou Huertes, the primary channel from Pass Chaland to Bay Joe Wise is proposed to be filled. In order to maintain flow and exchange from the gulf to the bay through Pass Chaland, a water exchange channel is proposed to be created through the existing marsh along an existing small tributary channel.

The marsh fill template is designed to provide an approximate 9,500 foot long by 1,330 foot wide marsh platform in Bay Joe Wise, with an approximate 2,500 foot long taper of varying width westward of Bayou Huertes and an approximate 1,500 foot long taper eastward, to tie into the existing marshes on each end. The surface area of the proposed marsh platform is approximately 335 acres. The construction berm elevation is +2.6 feet NAVD accounting for the preliminary design criteria on average existing marsh elevation, sea level rise, subsidence and consolidation. For this alternative, the construction berm is the term used to denote the sand fill for the beach constructed between the new marsh and the existing beach/dune, which will act as the seaward containment dike. The corresponding fill volume is approximately 1.5 million cubic yards. The required fill volume including the preliminary design criteria for the cut to fill ratio is 2.40 million cubic yards, including the preliminary design criteria for the cut to fill ratio.

The landward beach and dune fill template is designed to provide an approximate 10,500 foot long beach and dune fill with 1,000 foot tapers on each end to close the breach areas and restore and protect the erosive beach. The tapers are provided to blend the sediments into the existing grades and maintain a buffer from the inlets on both ends of the Bay Joe Wise Headland. The dune component includes a 50 foot wide crest width at +7 feet NAVD corresponding to the 10-year storm event to minimize overtopping into the marsh with 1:30 side slopes. The beach fill template includes a 100 foot wide construction berm at +4 feet NAVD corresponding to the existing dune and beach elevations with 1:30 side slopes. The proposed 50-acre beach and dune platform is constructed in full section between the existing beach and the proposed marsh. This will maximize the placement of coarser material within the seaward portion of the overall fill template, optimizing project performance as the coarser material will be more resistive to erosion. The corresponding fill volume is approximately 860,000 cubic yards including the preliminary design criteria for the overfill ratio. The required fill volume including the preliminary design criteria for the cut to fill ratio is 1.12 million cubic yards.

The water exchange channel template is designed to approximate the primary channel geometry and provide access for construction equipment. The maximum dimensions include a bottom

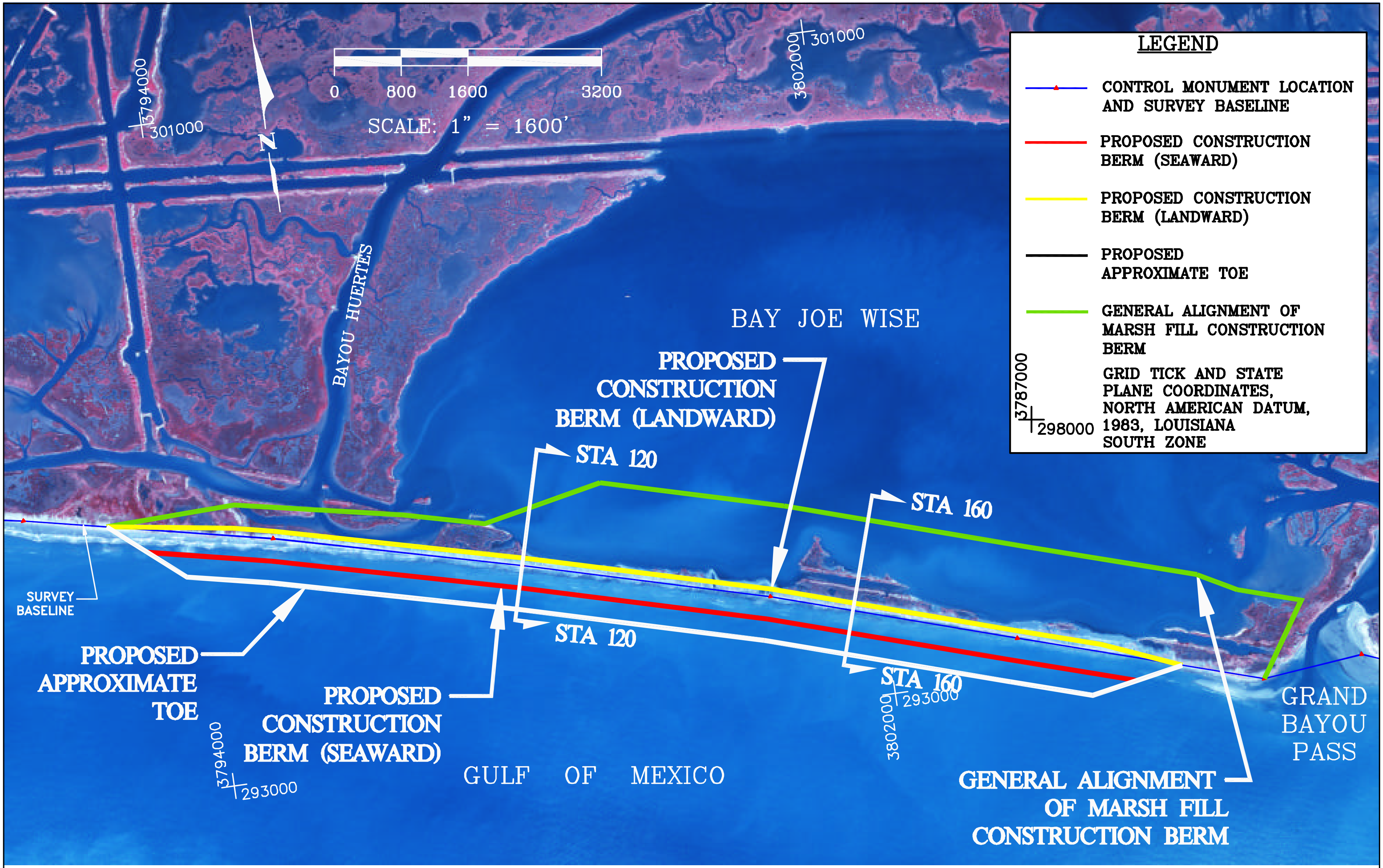


FIGURE 5–5: ALTERNATIVE NO. 4 PLAN VIEW

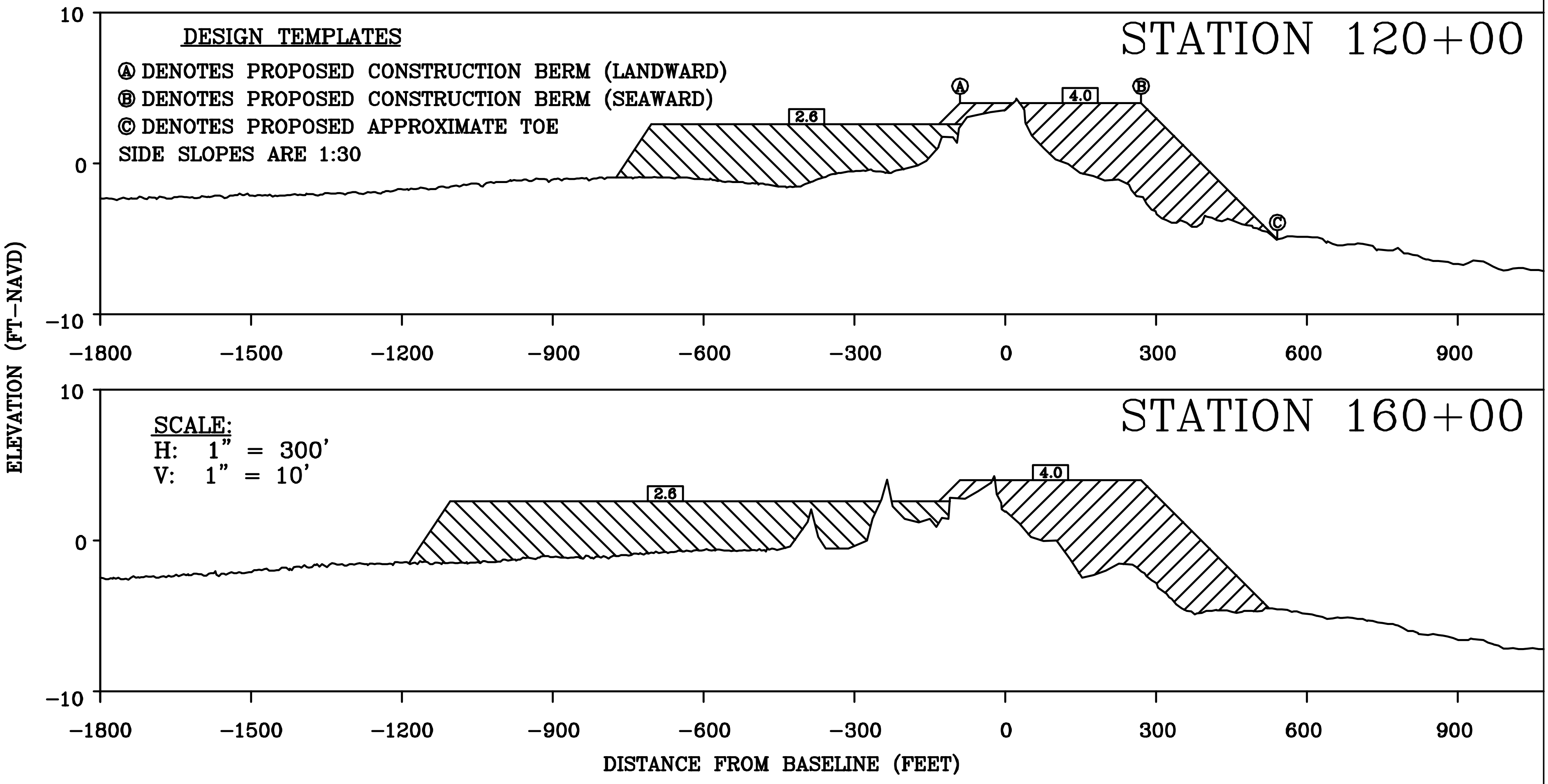


FIGURE 5−6: ALTERNATIVE NO. 4 TYPICAL CROSS SECTIONS

Coastal Engineering Consultants, Inc. 02132FIG5−6.DWG SEP 19, 2005 SJB GROUP INCORPORATED depth of -5.5 feet NAVD, bottom width of 70 feet, side slope of 1:8, and cross sectional area of 890 square feet measured from Mean High Water. The water exchange channel length is approximately 4,200 feet and the proposed dredge volume is approximately 70,000 cubic yards. A structural dike is proposed along the south channel line to contain the marsh fill. This material is proposed to be placed within the proposed marsh fill template thus reducing the quantity required from the borrow area. A plan view and typical cross sections for Alternative 5 are shown in Figures 5-7 and 5-8 respectively. Figure 5-8 includes a representative cross-section of the proposed water exchange channel.

The alternative of not dredging an alternative channel has been investigated. The measured and observed flow-ways and circulation patterns indicate the tidal connection between Bay Joe Wise and Grand Bayou Pass is minimal and not efficient compared to the connection from the Gulf to Bay Joe Wise via Bastian Bay (to the east). This connection is the primary flow-way from the east, and there is insufficient evidence to suggest that Grand Bayou Pass would grow in size to accommodate closing the western connection through to Pass Chaland. The alternative channel is necessary to provide essential circulation and water exchange between the Gulf and Bay Joe Wise through Pass Chaland for the health of the existing and newly created marsh.

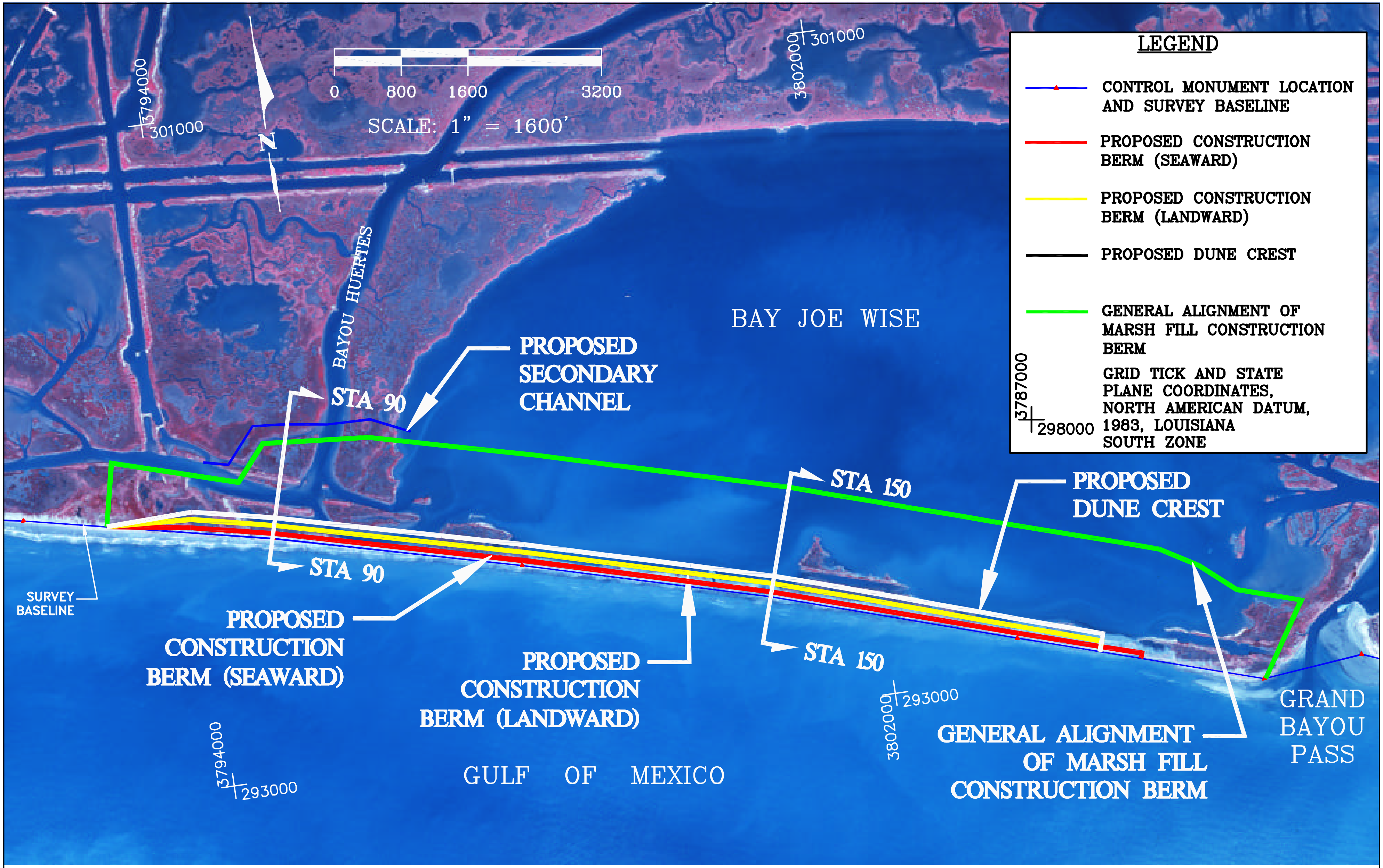


FIGURE 5-7: ALTERNATIVE NO. 5 PLAN VIEW

Coastal Engineering Consultants, Inc. 02132FIG5-7.DWG SEP 19, 2005 SJB GROUP INCORPORATED

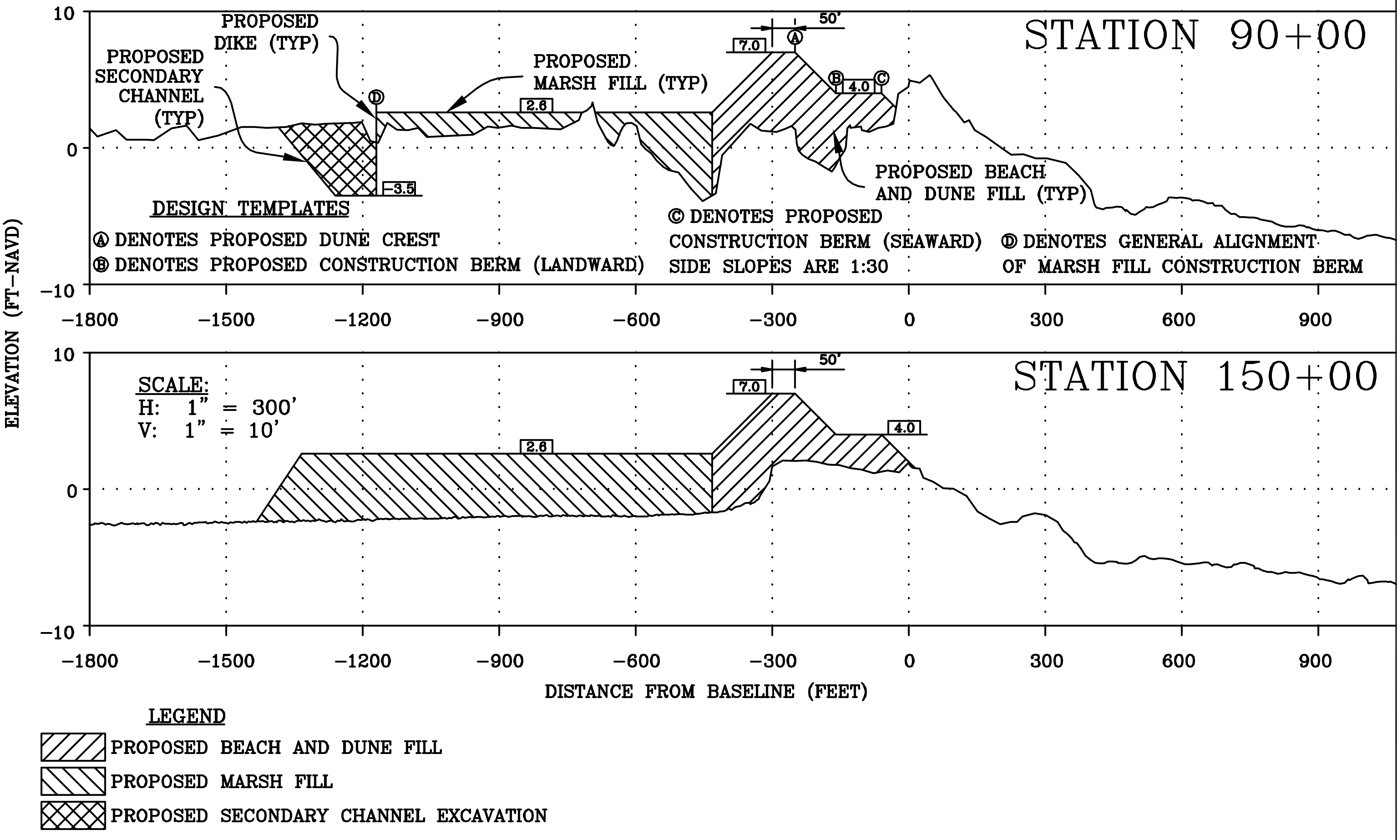


FIGURE 5-8: ALTERNATIVE NO. 5 TYPICAL CROSS SECTIONS

Coastal Engineering Consultants, Inc.   02132FIG5-8.DWG   SEP 19, 2005   SJB GROUP INCORPORATED

6.0 OFFSHORE BORROW AREA

6.1 BACKGROUND

The identification and evaluation of a borrow area to obtain necessary materials to construct a project is a major component of the design effort. The borrow area determination followed an extensive amount of prior survey and geologic analysis, as presented in the Geophysical Technical Memorandum (SJB and CEC, 2003), that identified the Quatre Bayou Deep Sand Body (Kindinger and Flocks, 2001) as a logical area for extended survey.

SJB, CEC, STE, and ALPINE conducted upland, Bay Joe Wise area and offshore geotechnical and geophysical surveys to evaluate potential sediment sources; locate potential sources of borrow material; determine the suitability of the sediments in these potential areas; recommend borrow areas, sediment thickness, characteristics, and available quantities; and prepare sand source inventory plans. Magnetometer surveys were conducted to identify existing facilities, pipelines, wells, and other obstructions that may affect usage of the recommended borrow areas. The initial results of this analysis and a proposed borrow area were presented in the Field Data Summary Report (SJB et al., 2004). The preliminary design effort aimed to refine those results and develop borrow area plans and sections, refine available volume estimates, and recompute overfill ratios.

Marsh surface samples from representative locations in the vicinity of the proposed marsh fill were obtained and native beach, dune, and nearshore samples were also collected for grain size analysis. A typical beach and marsh sample analysis is presented in Figure 6-1.

The project team also conducted a combined offshore geotechnical and geophysical survey consisting of magnetometer surveys, side scan sonar, bathymetric, and seismic subbottom surveys. Survey plan maps, magnetometer data and maps, geophysical cross sections, core logs, penetration graphics, vibracore photos, and grain size analysis were presented in the Final Report, Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration (BA-35), Offshore Geophysical and Geotechnical Survey for LDNR Contract No. 2511-03-09 (ALPINE et al., 2004). Geophysical and geotechnical survey areas depicting the seismic survey track lines and offshore vibracore locations are shown in Figure 6-2.

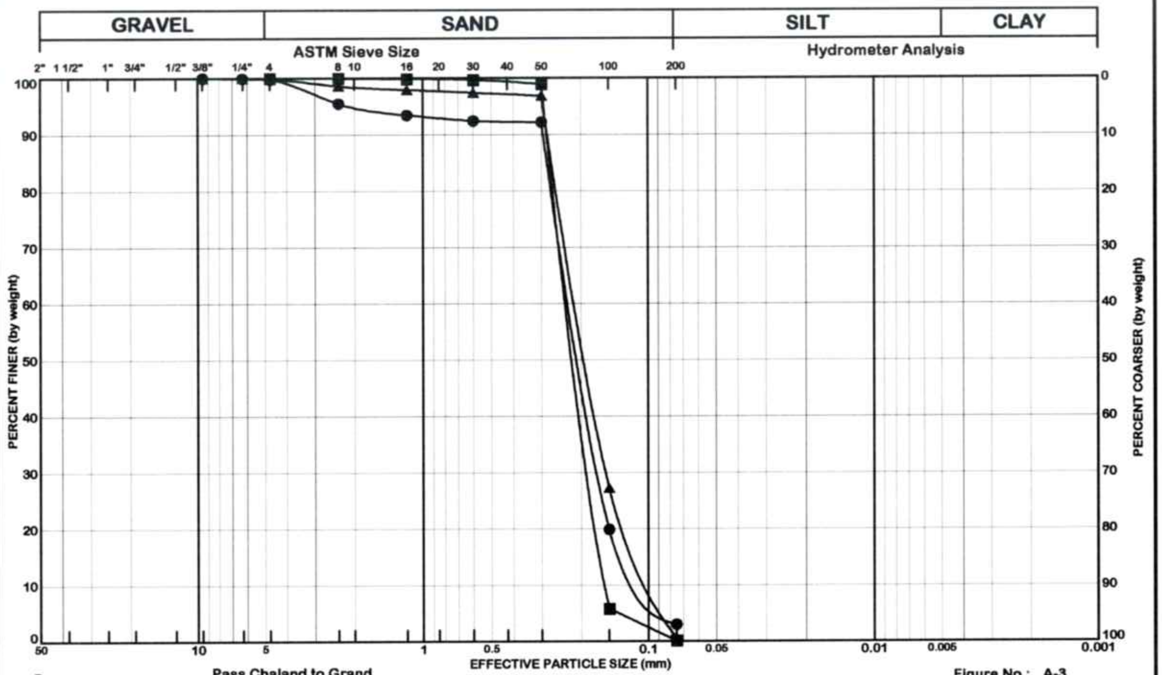
6.2 GEOPHYSICAL AND GEOTECHNICAL ANALYSIS

One significant subbottom feature, a buried channel located along the southwest side of the survey area south of Quatre Bayou Pass, was identified Using the seismic subbottom data the channel depth was determined to be over 30 feet below the sea floor, equal to approximately -50 feet NAVD, assuming a speed of sound in sediments of 5,400 feet per second. This area was delineated as a proposed borrow area (SJB and CEC, 2004) and is shown in Figure 6-2.

Two excerpts (ALPINE et al., 2004) of seismic profiles through the channel, Profile A’-A and Profile E’-E are presented in Figure 6-3. Features such as the approximate channel shape or

LELAP Certificate No. 02052

Sample No.	Identification	Gravel (%)	Sand (%)
● N-3	Beach	0.3	96.8
■ N-3	Dune Sand	0.0	99.9
▲ N-3	Near Shore	0.2	99.3



ASTM D422

STE
Soil Testing Engineers, Inc.

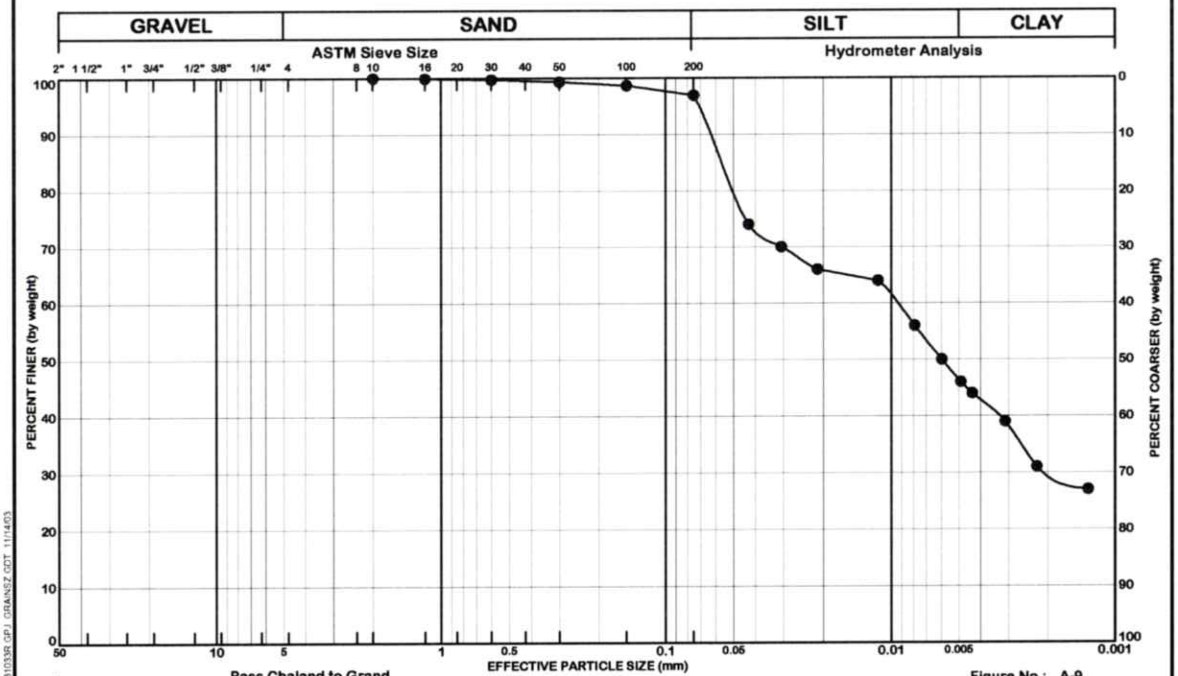
Pass Chaland to Grand
Bayou Pass
Barrier Shoreline
Restoration

GRAIN SIZE ANALYSIS

Figure No.: A-3
File No.: 03-1033
Date: 10/09/2003

LELAP Certificate No. 02052

Sample No.	Identification	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
● Marsh	Marsh	0.0	3.1	50.5	46.4



ASTM D422

STE
Soil Testing Engineers, Inc.

Pass Chaland to Grand
Bayou Pass
Barrier Shoreline
Restoration

GRAIN SIZE ANALYSIS

Figure No.: A-9
File No.: 03-1033
Date: 08/05/2003

FIGURE 6-1: TYPICAL BEACH AND MARSH SAMPLE ANALYSIS

APR 19, 2004

02132FIG6-1.DWG

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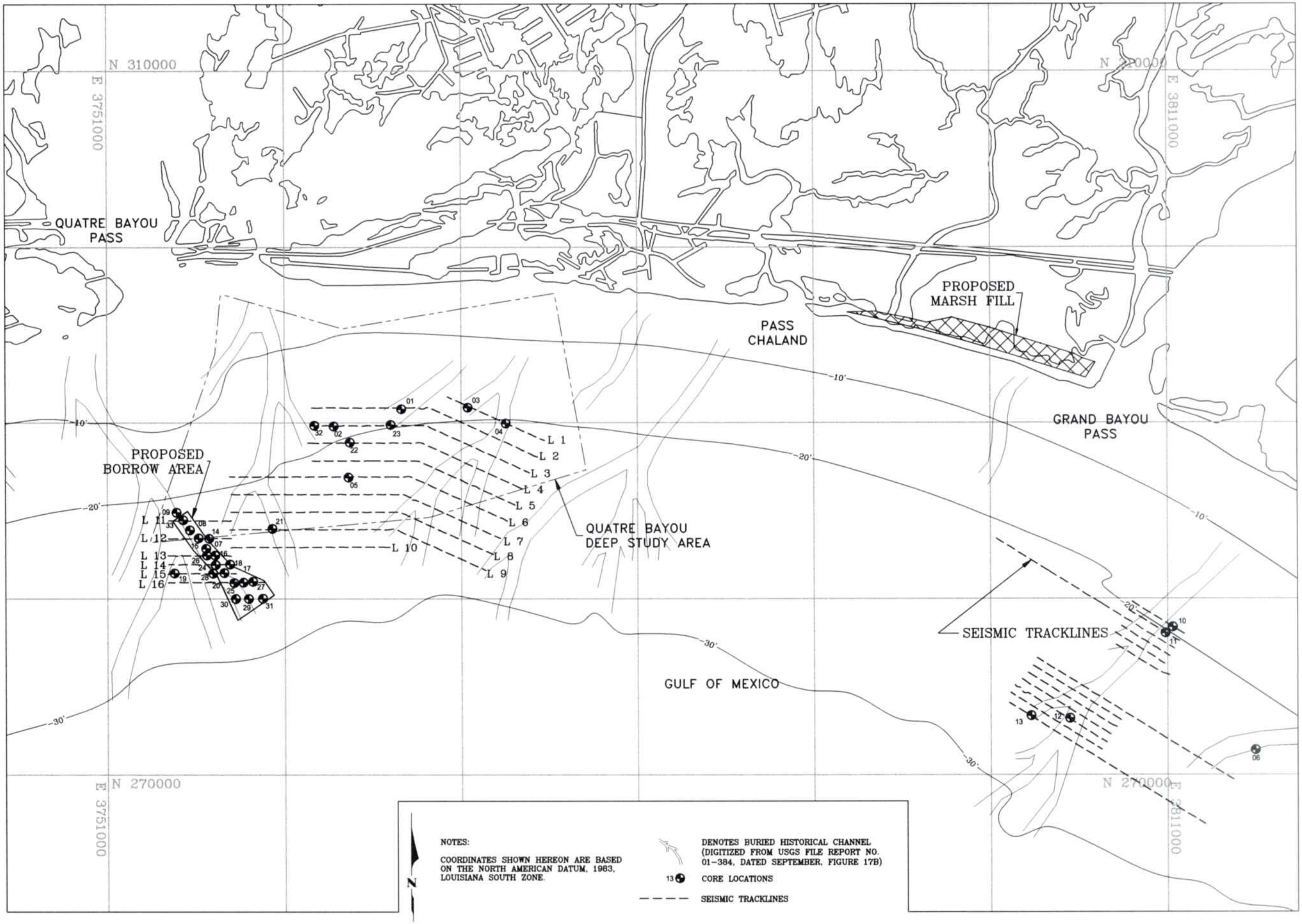
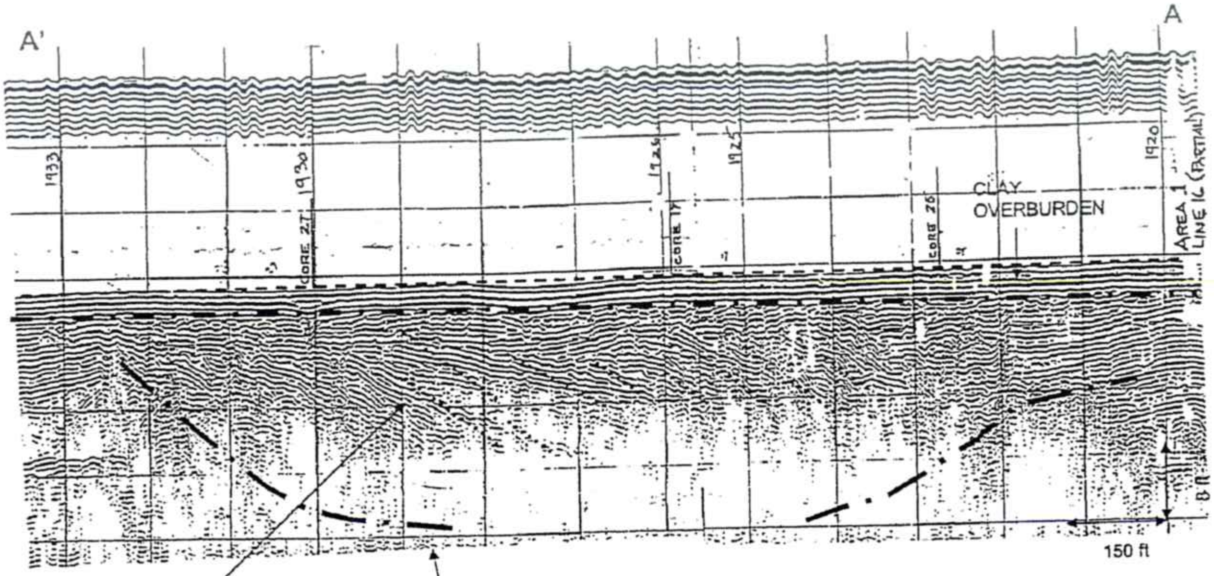


FIGURE 6-2: GEOPHYSICAL AND GEOTECHNICAL SURVEY AREAS, 2003

Coastal Engineering Consultants, Inc. 02132FIG6-2.DWG JULY 12, 2004 SJB GROUP INCORPORATED

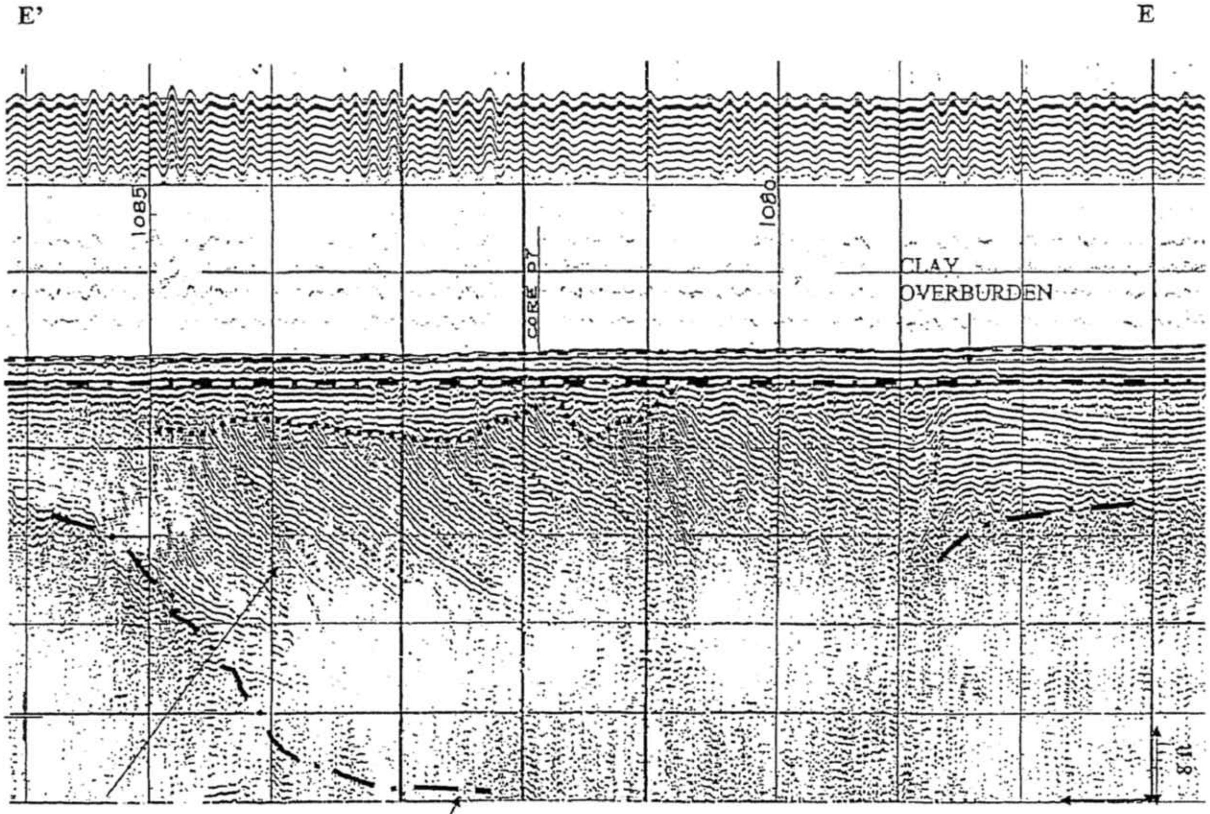


STEEPLY DIPPING CROSSBEDS

BROAD CHANNEL FEATURE

Seismic Profile, Area 1, Line 16
Buried Distributary Channel

RECTANGLE SCALE
8 ft high by 150 ft wide



STEEPLY DIPPING SANDY CROSSBEDS

BROAD CHANNEL FEATURE

Seismic Profile, Area 1, Line 10
Buried Distributary Channel

RECTANGLE SCALE
8 ft high by 150 ft wide

FIGURE 6-3: TYPICAL SEISMIC PROFILES

02132FIG6-1.DWG

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outline, dipping sedimentary strata, and clay overburden are clearly discernable and drawn as an overlay on the seismic data. Excerpts from eight (8) profiles through the channel are included in Appendix B.

The most prominent features observed in the seismic data collected through the channel are the series of relatively steeply dipping reflectors. Such features are generally indicative of sediment deposition in a more active current regime, while flat-lying layers such as the overburden are indicative of sediments deposited in a quiet environment. The scale for Profile A’-A is shown in the lower right-hand corner. Each horizontal fix line indicates 8 feet of depth and each vertical fix line indicates 150 feet of horizontal distance along the track line. The width of the channel in is on the order of 1,500 feet.

Vibracore sampling conducted within the outline of the buried channel confirmed the presence of sand within the sediments. Core boring logs and the correlative core penetration graphs for Cores 17, 25, and 27 are shown in Figures 6-4 through 6-6. The location of these cores are identified on Profile A’-A in Figure 6-3. Additional core logs and penetration graphs are presented in Appendix B.

Core 17 is located near the center of the long axis of the broad channel feature identified in Profile A’-A. The sediment characteristics in the channel are well illustrated when the core drilling log and the penetration graph in Figure 6-4 are compared to the seismic data. The core documents a dark clay from the surface to 6 feet below the surface. This is labeled clay overburden on Profile A’-A. It is very flat lying sediment deposited in the low energy environment offshore. The penetration graph showed that the core literally slipped through the upper six (6) feet with little or no resistance in a very short amount of time. This is typical for loose soft fine-grain clay or silt materials. The penetration graph shows a series of spikes at depths of 10 feet, 13 feet, and 15 feet. These spikes correlate to the resistance encountered by the vibracore as it penetrated more dense sandy materials. The indentations at 11 feet and 17 feet are representative of a reduction in resistance as the core moved more quickly through clay or silt layers.

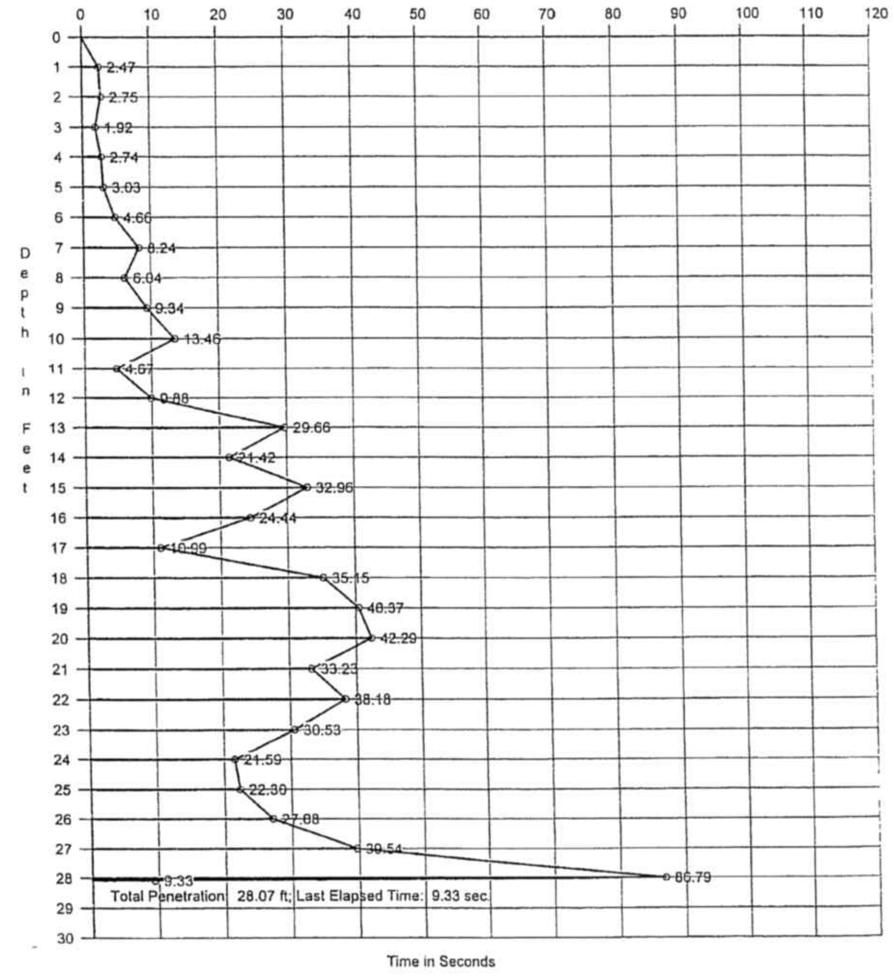
The percent sand and the grain size of the sample material tested is presented on the core log. This core log and penetration graph, showing a fairly resistant sandy material in the lower 15 feet of the core, is very instructive when interpreting the seismic data. Referring again to Profile A’-A, it can be seen that the interbedded clay and silty fine sands from 6 feet to 13 feet are representative of the irregular and then more steeply dipping cross-bedded sediment in that part of the channel. Below 13 feet to 14 feet, the signature on Profile A’-A becomes very bright or appears “washed out” and is indicative of sandy material.

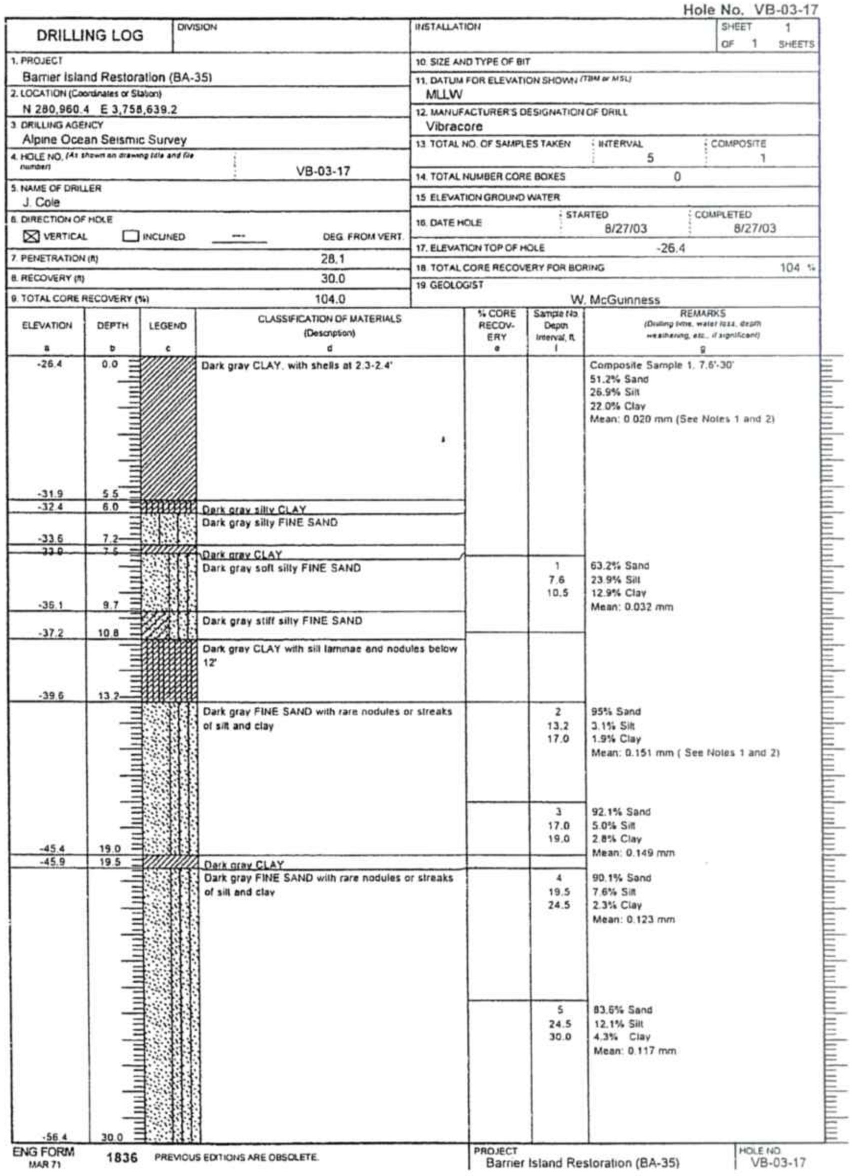
In contrast, comparison of Figures 6-5 and 6-6 for Cores 25 and 27, respectively, present the characteristics of the flanks or sides of the channel. In both Cores 25 and 27, the penetration record shows fairly rapid penetration down to approximately 15 feet to 20 feet and then very slow penetration from 20 feet to the bottom of the core. The core logs document either silty fine sand or interbedded fine sand and clay on the lateral portions of the broad channel feature shown on Section A’-A.

Penetration Graph for Core No. 17, Run 1

Date: 8/27/03	Penetration: 28.07 ft	Easting: 3758639.24	Lat: 2915.8385
Start Time: 3:33:25 PM	Recovery: 30.0	Northing: 280960.35	Long: 08950.0907
End Time: 3:43:40 PM	W. D. Corrected: 26.4 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 27.6 ft		

Comment:





Hole No. VB-03-17

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT Barrier Island Restoration (BA-35)		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) N 280,960.4 E 3,758,639.2		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY Alpine Ocean Seismic Survey		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore	
4. HOLE NO. (As shown on drawing title and file number)	VB-03-17	13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 5 COMPOSITE 1
5. NAME OF DRILLER J. Cole		14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	--- DEG. FROM VERT.	15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED 8/27/03 COMPLETED 8/27/03
		17. ELEVATION TOP OF HOLE	-26.4
7. PENETRATION (ft)	28.1	18. TOTAL CORE RECOVERY FOR BORING	104 %
8. RECOVERY (ft)	30.0	19. GEOLOGIST	
9. TOTAL CORE RECOVERY (%)	104.0		W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No. Depth Interval, ft f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-26.4 -31.9	0.0 5.5		Dark gray CLAY, with shells at 2.3-2.4'			Composite Sample 1, 7.6'-30' 51.2% Sand 26.9% Silt 22.0% Clay Mean: 0.020 mm (See Notes 1 and 2)
-32.4	6.0		Dark gray silty CLAY			
-33.6	7.2		Dark gray silty FINE SAND			
-33.9	7.5		Dark gray CLAY			
-36.1	9.7		Dark gray soft silty FINE SAND		1 7.6 10.5	63.2% Sand 23.9% Silt 12.9% Clay Mean: 0.032 mm
-37.2	10.8		Dark gray stiff silty FINE SAND			
-39.6	13.2		Dark gray CLAY with silt laminae and nodules below 12'			
-45.4	19.0		Dark gray FINE SAND with rare nodules or streaks of silt and clay		2 13.2 17.0	95% Sand 3.1% Silt 1.9% Clay Mean: 0.151 mm (See Notes 1 and 2)
					3 17.0 19.0	92.1% Sand 5.0% Silt 2.8% Clay Mean: 0.149 mm
-45.9	19.5		Dark gray CLAY			
-56.4	30.0		Dark gray FINE SAND with rare nodules or streaks of silt and clay		4 19.5 24.5	90.1% Sand 7.6% Silt 2.3% Clay Mean: 0.123 mm
					5 24.5 30.0	83.6% Sand 12.1% Silt 4.3% Clay Mean: 0.117 mm

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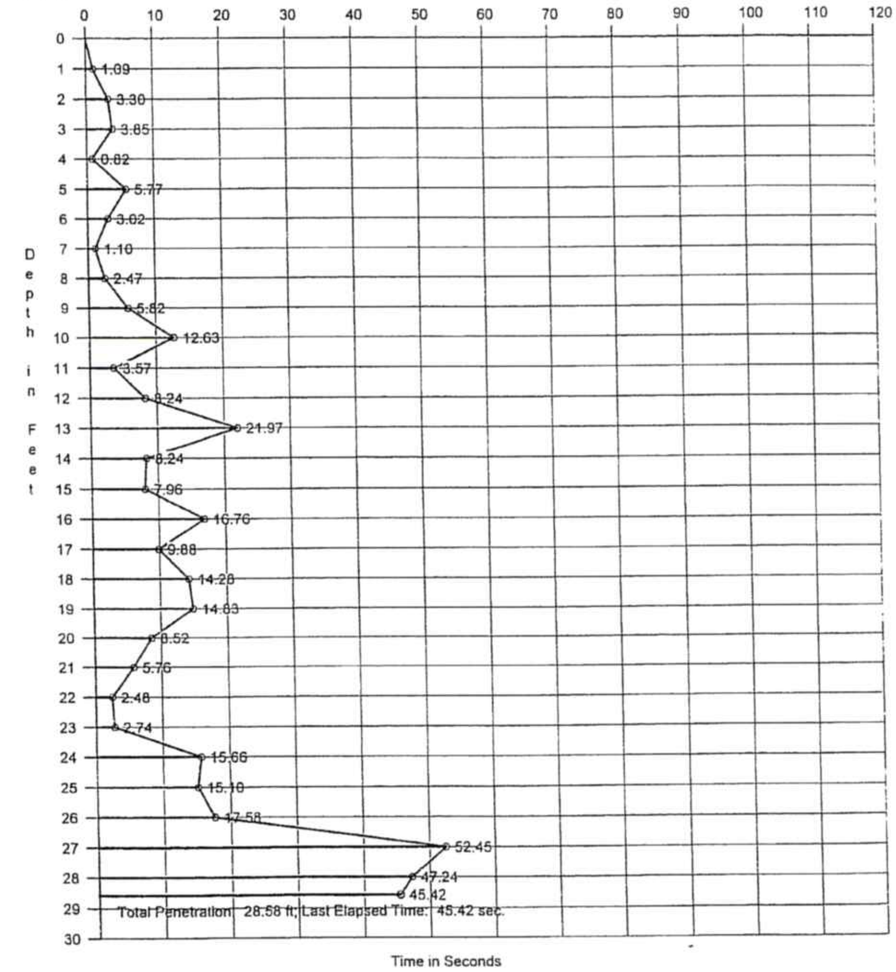
PROJECT Barrier Island Restoration (BA-35) | HOLE NO. VB-03-17

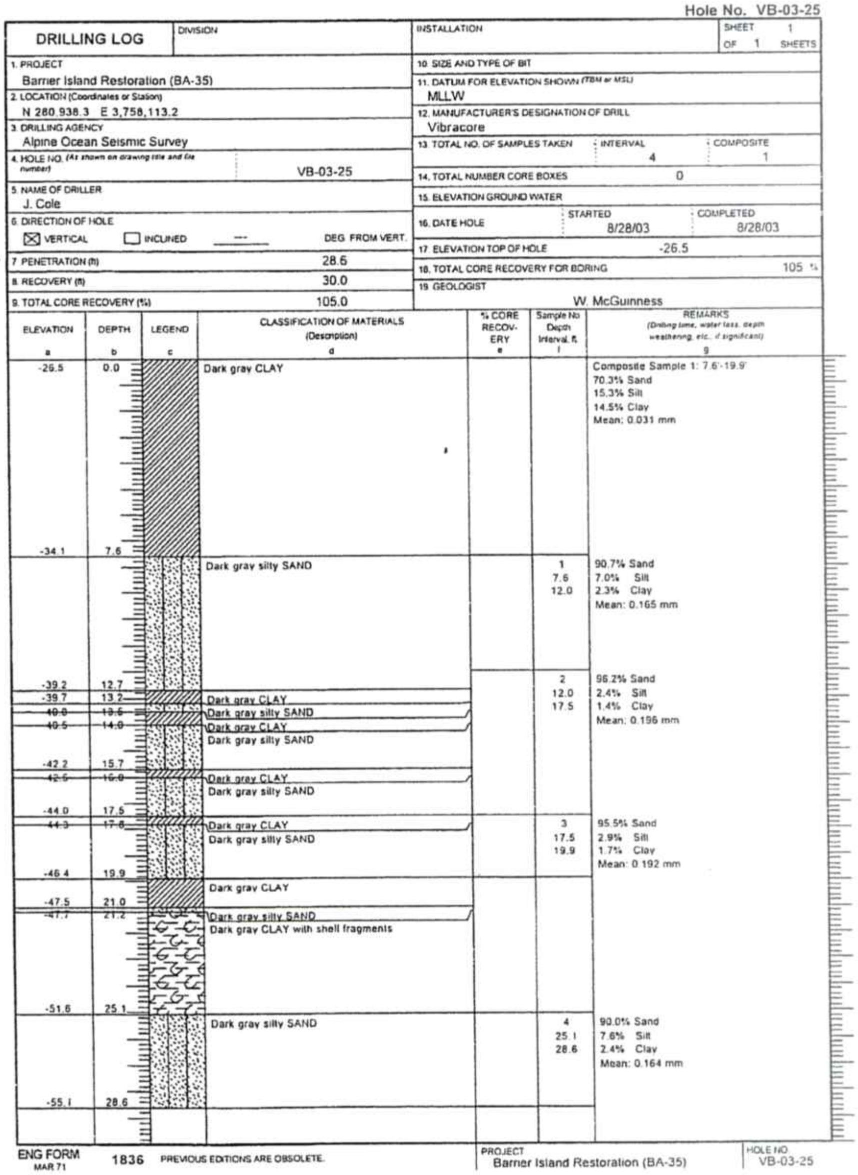
FIGURE 6-4: CORE 17

Penetration Graph for Core No. 25, Run 1

Date: 8/28/03	Penetration: 28.58 ft	Easting: 3758113.19	Lat: 2915.8360
Start Time: 2:57:38 PM	Recovery: 30.0	Northing: 280938.26	Long: 08950.1897
End Time: 3:03:37 PM	W. D. Corrected: 26.5 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 27.6 ft		

Comment:





Hole No. VB-03-25

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Barrier Island Restoration (BA-35)
2. LOCATION (Coordinates or Station): N 280,938.3 E 3,758,113.2
3. DRILLING AGENCY: Alpine Ocean Seismic Survey
4. HOLE NO. (As shown on drawing title and file number): VB-03-25
5. NAME OF DRILLER: J. Cole
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. PENETRATION (ft): 28.6
8. RECOVERY (ft): 30.0
9. TOTAL CORE RECOVERY (%): 105.0
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL: Vibracore
13. TOTAL NO. OF SAMPLES TAKEN: INTERVAL 4 COMPOSITE 1
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER
16. DATE HOLE: STARTED 8/28/03 COMPLETED 8/28/03
17. ELEVATION TOP OF HOLE: -26.5
18. TOTAL CORE RECOVERY FOR BORING: 105 %
19. GEOLOGIST: W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	Sample No Depth Interval, ft f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-26.5	0.0		Dark gray CLAY			Composite Sample 1: 7.6'-19.9' 70.3% Sand 15.3% Silt 14.5% Clay Mean: 0.031 mm
-34.1	7.6		Dark gray silty SAND		1 7.6 12.0	90.7% Sand 7.0% Silt 2.3% Clay Mean: 0.165 mm
					2 12.0 17.5	96.2% Sand 2.4% Silt 1.4% Clay Mean: 0.196 mm
-39.2	12.7		Dark gray CLAY			
-39.7	13.2		Dark gray silty SAND			
-40.0	13.6		Dark gray CLAY			
-40.5	14.0		Dark gray silty SAND			
-42.2	15.7		Dark gray CLAY			
-42.5	16.0		Dark gray silty SAND			
-44.0	17.5		Dark gray CLAY		3 17.5 19.9	95.5% Sand 2.9% Silt 1.7% Clay Mean: 0.192 mm
-44.3	17.8		Dark gray silty SAND			
-46.4	19.9		Dark gray CLAY			
-47.5	21.0		Dark gray silty SAND			
-47.7	21.2		Dark gray CLAY with shell fragments			
-51.6	25.1		Dark gray silty SAND		4 25.1 28.6	90.0% Sand 7.6% Silt 2.4% Clay Mean: 0.164 mm
-55.1	28.6					

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PROJECT: Barrier Island Restoration (BA-35)

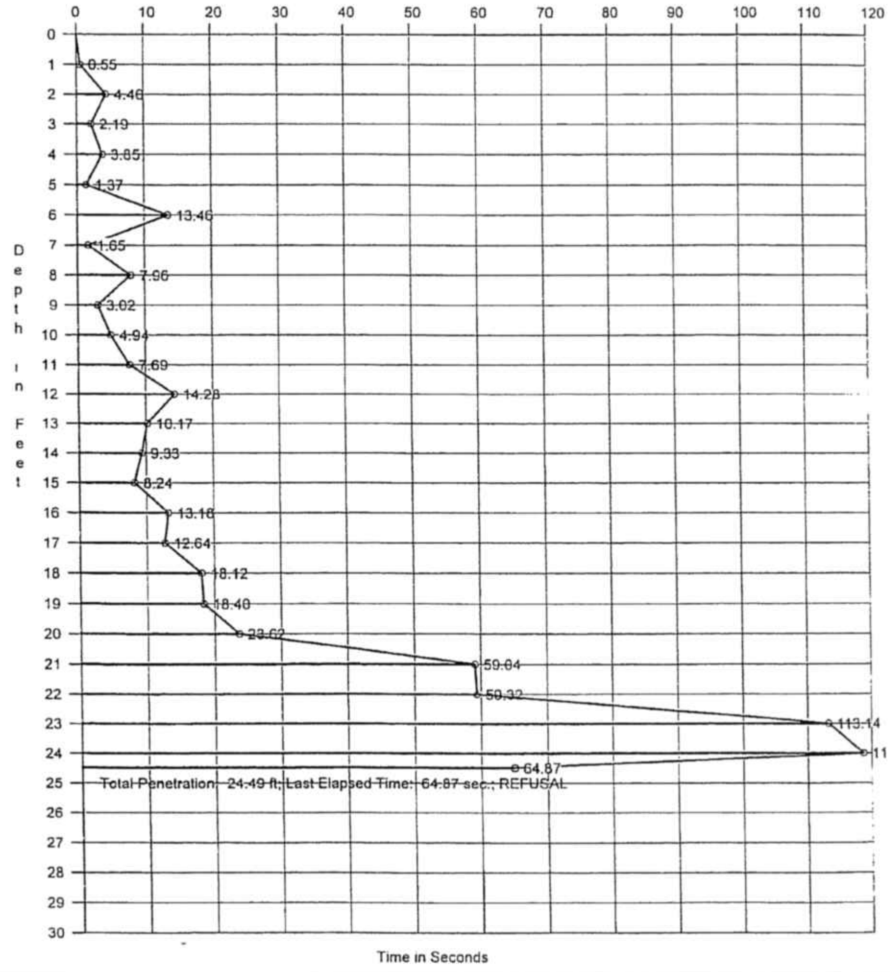
HOLE NO. VB-03-25

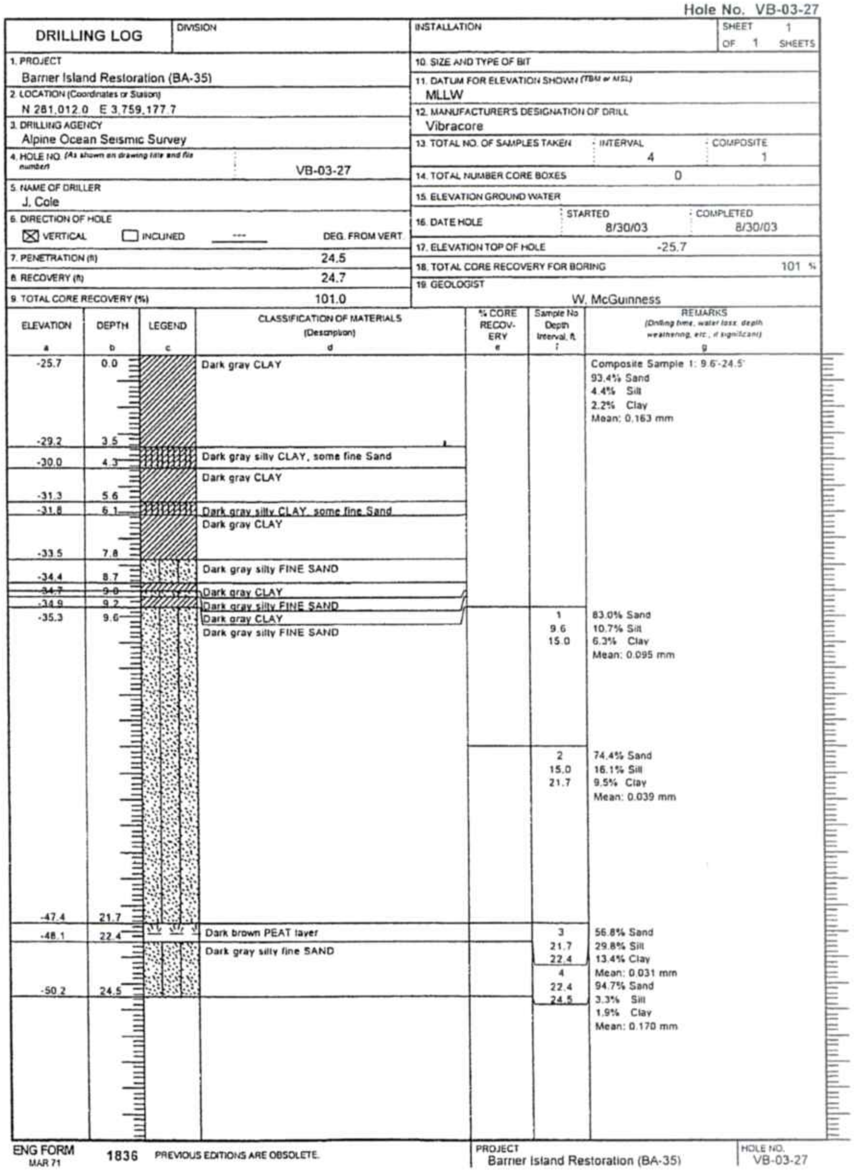
FIGURE 6-5: CORE 25

Penetration Graph for Core No. 27, Run 1

Date: 8/29/03	Penetration: 24.49 ft	Easting: 3759177.66	Lat: 2915.8459
Start Time: 9:29:30 AM	Recovery: 24.7	Northing: 281012.01	Long: 08949.9893
End Time: 9:39:24 AM	W. D. Corrected: 27.5 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 28.9 ft		

Comment:





Hole No. VB-03-27

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT Barrier Island Restoration (BA-35)		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) N 281,012.0 E 3,759,177.7		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY Alpine Ocean Seismic Survey		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore	
4. HOLE NO. (As shown on drawing title and file number)	VB-03-27	13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 4 COMPOSITE 1
5. NAME OF DRILLER J. Cole		14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. PENETRATION (ft)	24.5	16. DATE HOLE	STARTED 8/30/03 COMPLETED 8/30/03
8. RECOVERY (ft)	24.7	17. ELEVATION TOP OF HOLE	-25.7
9. TOTAL CORE RECOVERY (%)	101.0	18. TOTAL CORE RECOVERY FOR BORING	101 %
		19. GEOLOGIST	W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No Depth Interval, ft f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-25.7	0.0					Composite Sample 1: 9.6'-24.5' 93.4% Sand 4.4% Silt 2.2% Clay Mean: 0.163 mm
-29.2	3.5	▨	Dark gray CLAY			
-30.0	4.3	▦	Dark gray silty CLAY, some fine Sand			
-31.3	5.6	▨	Dark gray CLAY			
-31.8	6.1	▦	Dark gray silty CLAY, some fine Sand			
-33.5	7.8	▨	Dark gray CLAY			
-34.4	8.7	░	Dark gray silty FINE SAND			
-34.7	9.0	▨	Dark gray CLAY			
-34.9	9.2	░	Dark gray silty FINE SAND			
-35.3	9.6	▨	Dark gray CLAY			
-47.4	21.7	░	Dark gray silty FINE SAND		1 9.6 15.0 2 15.0 21.7	83.0% Sand 10.7% Silt 6.3% Clay Mean: 0.095 mm 74.4% Sand 16.1% Silt 9.5% Clay Mean: 0.039 mm
-48.1	22.4	▥	Dark brown PEAT layer		3 21.7 22.4	56.8% Sand 29.8% Silt 13.4% Clay Mean: 0.031 mm
-50.2	24.5	░	Dark gray silty fine SAND		4 22.4 24.5	94.7% Sand 3.3% Silt 1.9% Clay Mean: 0.170 mm

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PROJECT Barrier Island Restoration (BA-35)

HOLE NO. VB-03-27

FIGURE 6-6: CORE 27

The seismic data for Profile E'-E along with the penetration graph and core log for Core 7, shown in Figure 6-7, offer a good typical description of the channel feature. The penetration graph correlates well with the drilling log showing very rapid 1 to 3 seconds per foot penetration down to 10 feet below the surface of the bottom. The material in the core was a dark gray clay. Below 10 feet, the resistance shown on the penetration graph gradually increased to 35 to 40 seconds per foot down to the bottom of the core which ended in a high percentage, 80% to 90%, of sand with a grain size ranging from 0.12 to 0.17 mm. The upper 10 feet penetrates clay overburden or relatively flat lying clay materials and then transitions into 6 feet of cross-beds that are comprised of interbedded sand and clay. The bright white sandy signature is found in the lower portion of the broad channel feature below 17 feet corresponds to increased resistance in the penetrometer record. The scale for Section E'-E is shown in the lower right-hand corner. Each horizontal fix line indicates 8 feet of depth and each vertical fix line indicates 150 feet of horizontal distance along the track line. This channel is on the order of 900 to 1000 feet in width.

The composite sample data collected from channel samples from all cores in the channel, excluding the overburden, had an average mean grain size of 0.054 mm which is silt, according to ASTM D2487-92. While this soil description is classified silt, based on the average grain size, the cores include a range of sand and clay materials within the soil sample. Initial review of the geophysical and geotechnical data in the vicinity of the subsurface channel enabled an initial conclusion that the sediments in that area would be suitable for marsh construction.

6.3 PRELIMINARY BORROW AREA PLAN

The general location of proposed borrow area, south of Quatre Bayou Pass, is less than ten (10) miles from the Project area. The area is shown in Figure 6-2. It should allow for hydraulic cutter-head dredges to excavate and transport the sediment via pipeline to the Project area. The bathymetry of the borrow area indicates that the ocean floor has a very low relief with minor topographic changes in water depths of -20 feet NAVD to -28 feet NAVD. The side scan sonar surveys in this area revealed a flat, featureless surface providing reasonable assurance that there are no areas of environmental concern or any pipeline or other man-made obstructions that might be adversely impacted by the dredging activities from the area indicated. Water depth is consistent with reasonable cutter-head operation (ALPINE et al., 2004).

Based on the geophysical, geotechnical, and laboratory data analysis, CEC delineated the location, depth, breadth, and length of a preliminary borrow area (SJB et al., 2004) comprised of approximately 7.9 million cubic yards of sand, silt and clay suitable to build the marsh fill. This area was deemed a suitable prospect for a source of material to construct the Project.

6.4 REFINED BORROW AREA PLAN

Seismic surveys as presented in Figure 6-3 and Appendix B were utilized to evaluate subsurface geometry. By examining the seismic data in concert with core logs, penetrometer data and individual grain size analysis, a revised shape, length, width, and depth of a structural basin offshore was developed and used to refine the preliminary borrow area plan.

Penetration Graph for Core No. 07, Run 1

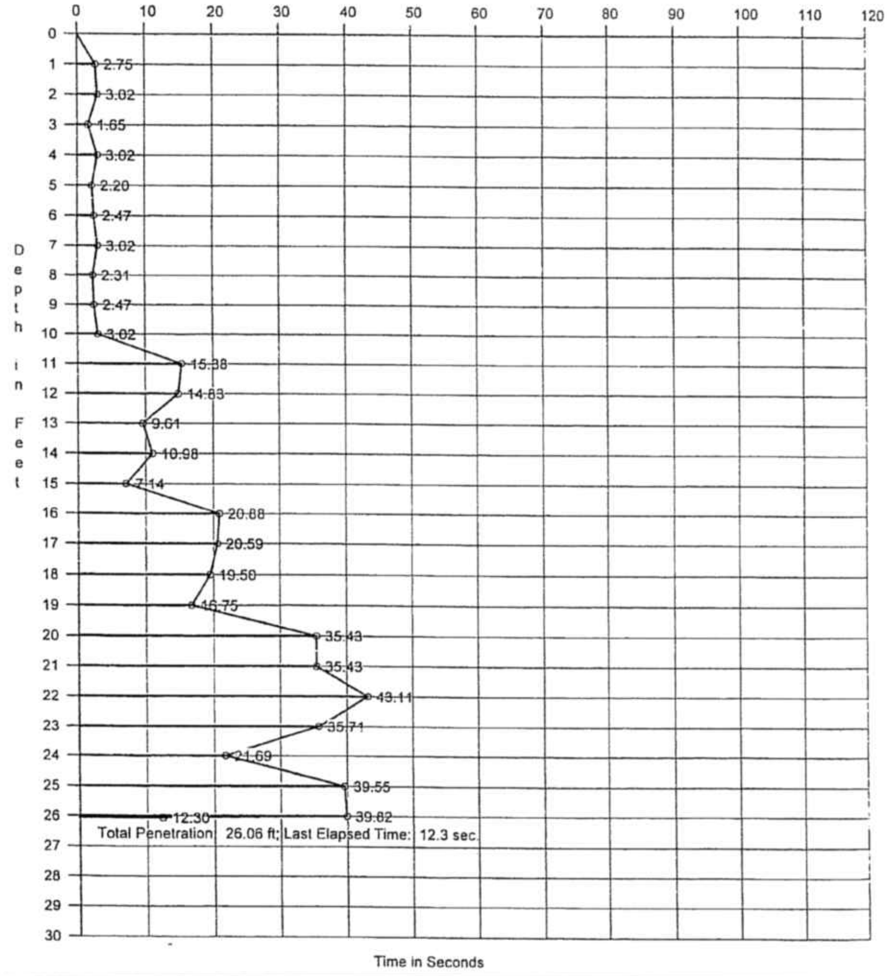
Date: 8/25/03
Start Time: 3:38:16 PM
End Time: 3:45:22 PM

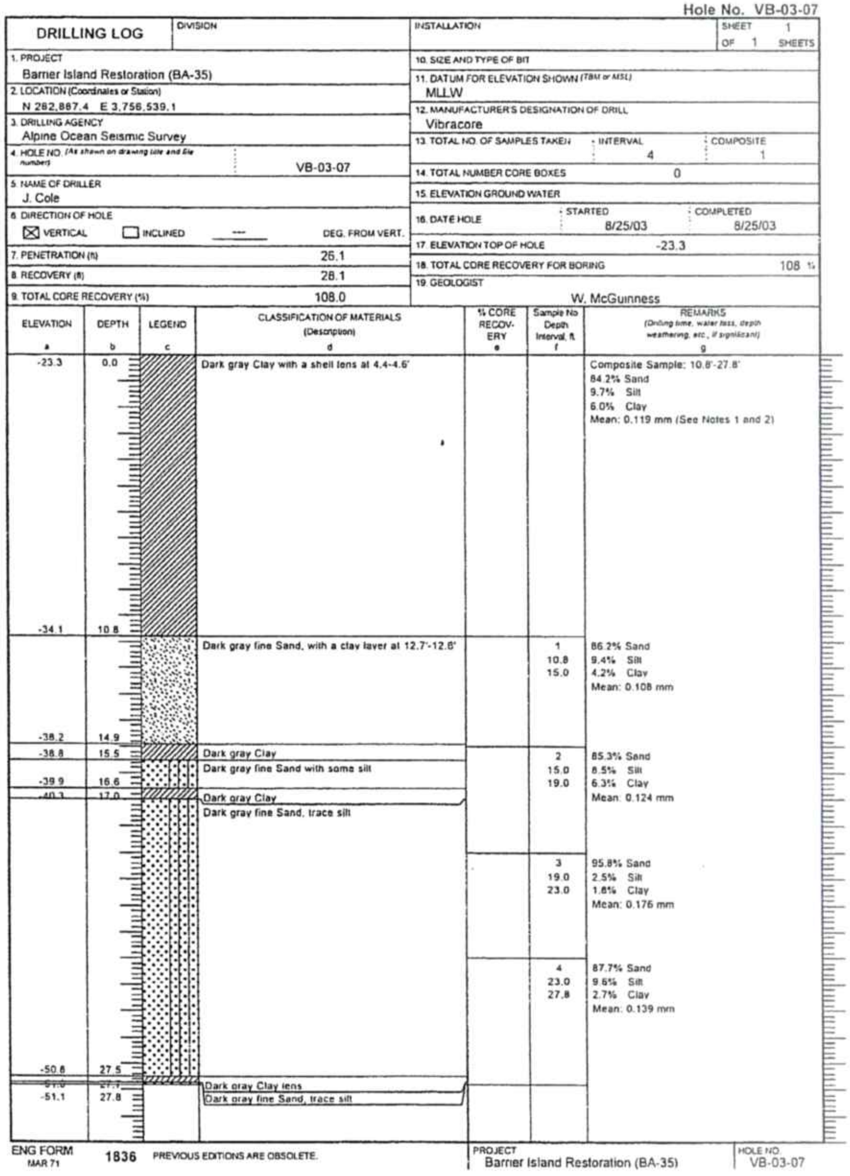
Penetration: 26.06 ft
Recovery: 28.1
W. D. Corrected: 23.3 ft
W. D. Raw: 24.2

Easting: 3756539.1
Northing: 282887.37
Coord. System: la south

Lat: 2916.1609
Long: 8950.4811
Datum: WGS-84

Comment:





Hole No. VB-03-07

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT Barrier Island Restoration (BA-35)		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) N 282,887.4 E 3,756,539.1		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY Alpine Ocean Seismic Survey		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore	
4. HOLE NO. (As shown on drawing title and file number)	VB-03-07	13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 4 COMPOSITE 1
5. NAME OF DRILLER J. Cole		14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED 8/25/03 COMPLETED 8/25/03
7. PENETRATION (ft)	26.1	17. ELEVATION TOP OF HOLE	-23.3
8. RECOVERY (ft)	28.1	18. TOTAL CORE RECOVERY FOR BORING	108 %
9. TOTAL CORE RECOVERY (%)	108.0	19. GEOLOGIST	W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	Sample No Depth Interval, ft f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-23.3	0.0		Dark gray Clay with a shell lens at 4.4-4.6'			Composite Sample: 10.8'-27.8' 84.2% Sand 9.7% Silt 6.0% Clay Mean: 0.119 mm (See Notes 1 and 2)
-34.1	10.8		Dark gray fine Sand, with a clay layer at 12.7'-12.8'		1 10.8 15.0	86.2% Sand 9.4% Silt 4.2% Clay Mean: 0.108 mm
-38.2	14.9		Dark gray Clay			
-38.8	15.5		Dark gray fine Sand with some silt		2 15.0 19.0	85.3% Sand 8.5% Silt 6.3% Clay Mean: 0.124 mm
-39.9	16.6		Dark gray Clay			
-40.3	17.0		Dark gray fine Sand, trace silt		3 19.0 23.0	95.8% Sand 2.5% Silt 1.8% Clay Mean: 0.176 mm
					4 23.0 27.8	87.7% Sand 9.6% Silt 2.7% Clay Mean: 0.139 mm
-50.8	27.5		Dark gray Clay lens			
-51.0	27.7		Dark gray fine Sand, trace silt			
-51.1	27.8					

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PROJECT Barrier Island Restoration (BA-35)
HOLE NO. VB-03-07

FIGURE 6-7: CORE 7

A plan view of the borrow area including core locations with seismic track lines is shown in Figure 6-8. The preliminary borrow area plan presented the Field Data Summary Report (SJB et al., 2004) is shown as a dashed line in this figure. The eight (8) seismic Profiles, A'-A to H'-H, are labeled for reference. The refined borrow area plan is shown as a solid line in this figure.

The analysis and comparison of borrow area geotechnical and geophysical data reveals three primary sedimentologic units throughout the borrow area. The upper unit is a flat lying loose fine clay overburden. The middle unit is a group of interbedded irregular clay, silt, and sand layers that are exemplified by dipping beds in the seismic records. The lower unit is typically fine sand with some silt or clay layers documented in the core and penetrometer records.

This geologic sequence has suggested a selective dredging process, wherein the upper two units are considered for use to construct the marsh fill and the lower unit is considered for use to construct the beach or dune fill component. The borrow area, therefore, has been segregated into at least two layers for selective dredging, an upper "marsh cut" and a lower "beach/dune cut."

The upper cut is comprised of 6 to 8 feet of flat lying overburden clay material and a 10 to 12 foot thick interbedded irregular sequence of clay, silt, and sand. Steeply dipping strata were noted on the seismic data in this layer. The lower cut is an average of 12 feet thick and is primarily fine sand with occasional silt or clay units. Example borrow area cuts are shown in Figure 6-9. Additional borrow area cuts are presented in Appendix B.

It is expected that the overburden will be excavated and disposed of in one of the following environmentally acceptable manners; open-water disposal adjacent to the proposed borrow area, disposal in an adjacent borrow pit created by another project, or entrained in the excavated borrow slurry pumped to the fill area and lost in the transport and disposal process. This material was therefore excluded from the compatibility analysis and the Rj analysis. The cut-to-fill ratio of 1.6 for the marsh fill developed in Section 4 of this report included this overburden volume and assumed it would all be lost through the dredging and dewatering processes.

The refined borrow area plan view has been divided into three sections: Cut 1 with a cut depth to -50 feet NAVD, Cut 2 to -53 feet NAVD, and a southern Cut 3 to -55 feet NAVD. The geometry and character of these sections are based upon interpretation of seismic data and the vibracores.

6.5 FILL MATERIAL ANALYSIS

The composite channel samples for the entire borrow area excluding overburden were determined to be silt per ASTM D2487-92. The composite of the noncohesive samples from the borrow area cores was determined to be fine sand. The mean grain size was computed by methods presented in Hobson (1977) where the estimate of the mean (M_ϕ) is obtained by

$$M_\phi = \frac{\phi 84 + \phi 16}{2}.$$

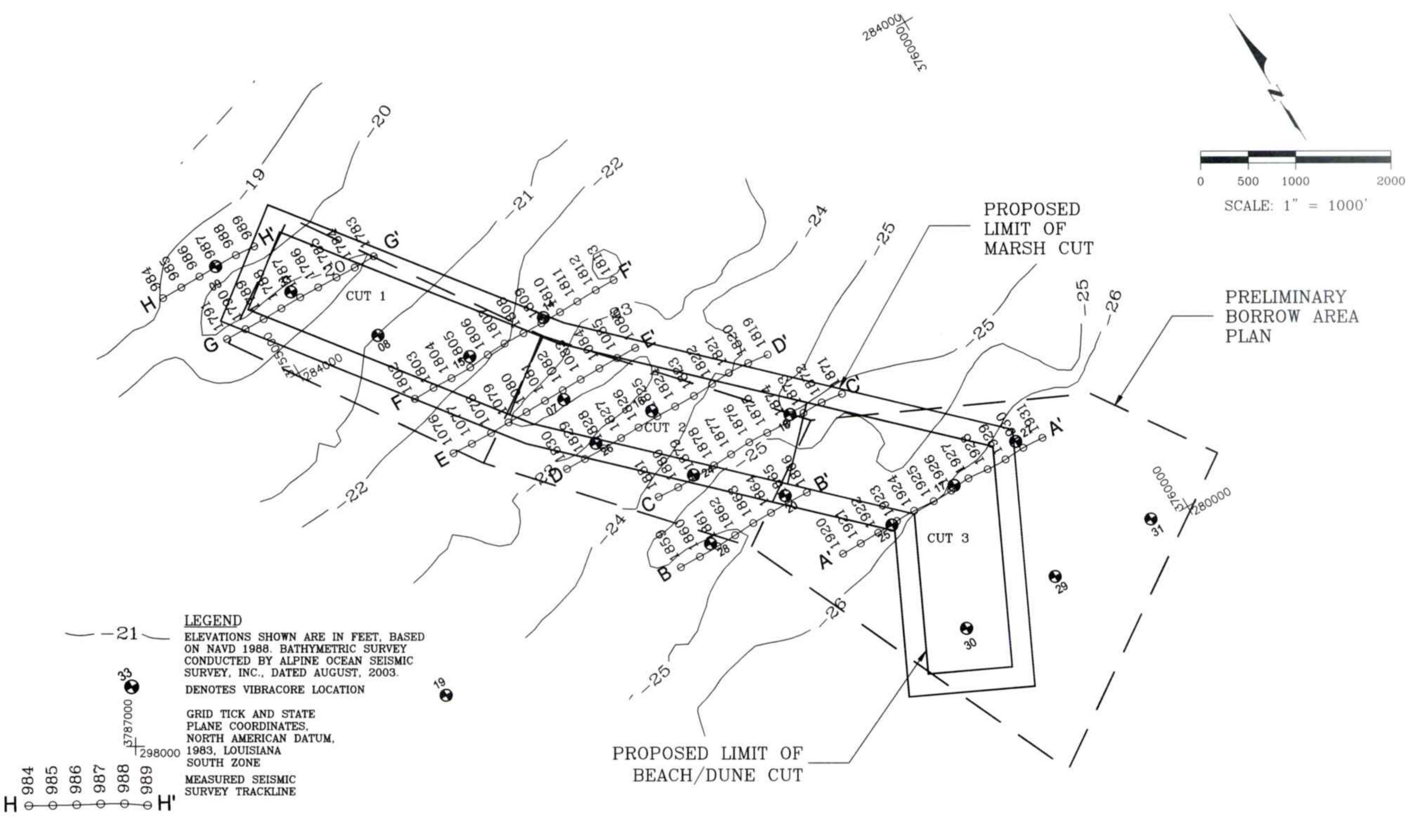

FIGURE 6-8: BORROW AREA MAP

Coastal Engineering Consultants, Inc.

02132FIG6-8.DWG

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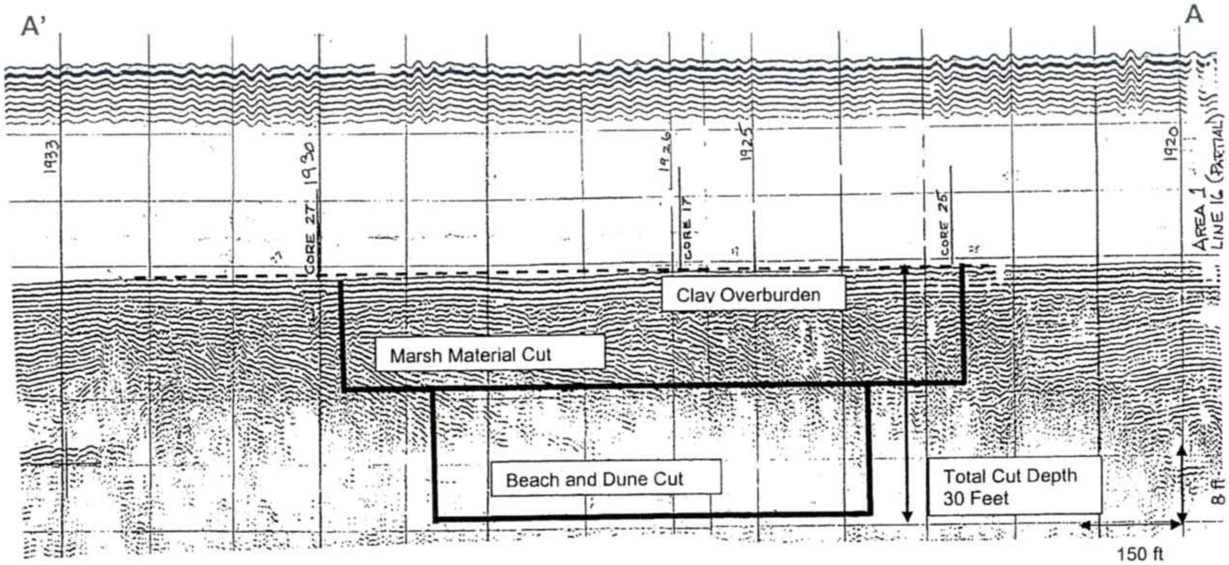
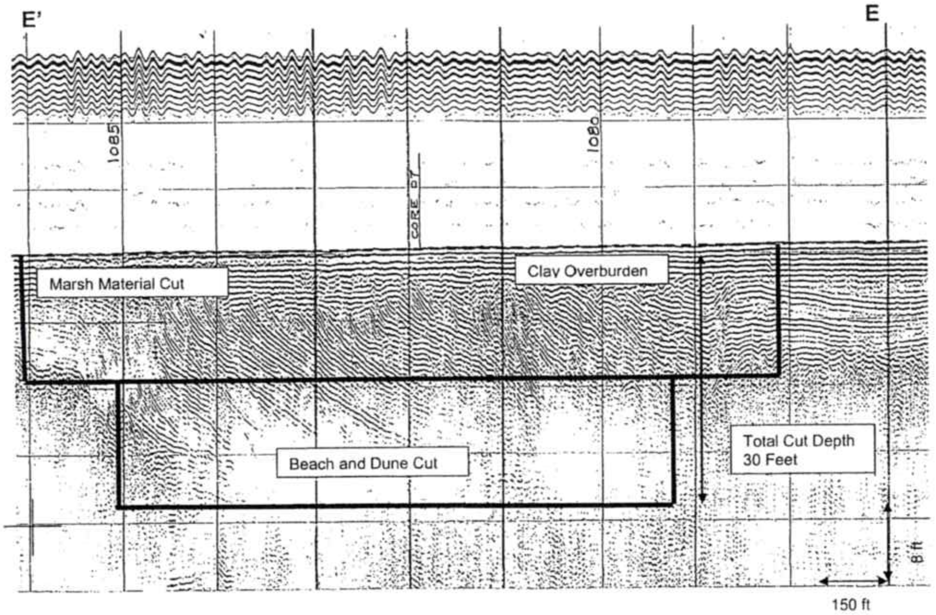


RECTANGLE SCALE
8 ft high by 150 ft wide



RECTANGLE SCALE
8 ft high by 150 ft wide

FIGURE 6-9: PROPOSED BORROW AREA CUTS

02132FIG6-9.DWG

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6.5.1 Marsh Cut - Grain Size Evaluation

The goal of obtaining sediments for marsh restoration purposes is to provide stable sediment that imitates the natural soil. In addition to optimal elevation of the marsh surface for rapid vegetation colonization, the marsh supports a diverse range of aquatic species that live in and breed or feed in the marsh sediment. It is important to have initial soil stability to support plant installation and growth along with a soil to support the organisms. Native marsh samples were collected and analyzed for grain size distribution to allow numerical characterization of the natural marsh sediment, providing a basis for comparison and evaluation of potential borrow materials for use in marsh creation. Table 6-1 presents a revised grain size evaluation for the marsh cut. A selective dredging analysis was conducted by producing a marsh fill composite based on samples collected from the marsh cut horizon. The borrow area sediments are coarser overall than the native marsh sediments. The weighted average mean grain size was 0.076 mm. The resulting range of borrow material distribution in the marsh cut provides a functional match to native marsh sediment distribution. Thus, the borrow area is recommended for use to provide suitable stable material to construct the marsh fill.

6.5.2 Beach and Dune Cut - Grain Size Analysis

The analysis of the beach and dune cut is applied to noncohesive sediments and uses the overfill ratio method proposed by Dean (1986). An overfill ratio is a means of predicting the quantity of borrow material needed for one unit of stable beach material for use in dune and beach restoration. An overfill ratio of 1.05 means that 1.05 cubic yards of sand has to be dredged from a borrow area and placed on the beach for each cubic yard of beach fill that is desired to remain in place on a nourished beach. This technique does not include losses due to the dredging process nor background erosion rates.

As a basis for comparison, native beach samples (STE, 2004) were used to develop a beach composite sample for comparison to the proposed borrow material composite. Table 6-2 shows the cumulative grain-size distribution of the composite native beach material and a composite of individual noncohesive samples tested from the lower third of the borrow area within the beach and dune cut. The grain size analysis and overfill computations are for a select group of cores that fall along the center of the refined borrow area plan. These cores have 10 feet to 15 feet of noncohesive fine sand material in the lower half of the cores. The mean grain size for the individual sample composites ranged from 0.082 to 0.202 mm and the borrow area composite mean grain size was 0.136 mm. The overfill ratios for the individual sample composites ranged from 1.022 to 1.559, and the borrow area composite overfill ratio was 1.164. The grain size frequency curves for the beach and dune cut are compared to the native beach in Figure 6-10. The curves have a high degree of similarity, with the borrow material being finer than the native beach material.

TABLE 6-1
BORROW AREA MARSH CUT WEIGHTED AVERAGES

Core	Core Sample	Mean Grain Size (mm)	Sample Length	Weighted Core Average Grain Size
VB-33	VB-33c 050-150	0.027	6.9	0.078
	VB-33 142-207	0.191	3.1	
VB-08	VB-08c 087-210	0.090	7.8	0.071
	VB-08e 280-302	0.003	2.2	
VB-15	VBb-15-050-100	0.023	4.5	0.078
	VB-15 100-150	0.122	5.0	
	VB-15 150-200	0.135	0.5	
VB-07	VB-07e 310-341	0.003	3.1	0.080
	VB-07 108-150	0.108	4.2	
	VB-07 150-190	0.124	2.7	
VB-26	VB-26e 310-339	0.003	2.9	0.111
	VB-26 098-130	0.164	3.2	
	VB-26 130-140	0.003	1.0	
	VB-26 140-190	0.199	2.9	
VB-16	VB-16 050-100	0.031	3.1	0.040
	VB-16 100-150	0.018	5.0	
	VB-16 150-200	0.111	1.9	
VB-24	VB-24e 310-324	0.003	1.4	0.101
	VB-24 074-100	0.177	2.6	
	VB-24e 350-377	0.003	2.7	
	VB-24 127-178	0.164	3.3	
VB-18	VB-18e 310-314	0.003	0.4	0.038
	VB-18 060-100	0.045	4.0	
	VB-18 100-150	0.033	5.0	
	VB-18 150-200	0.056	0.6	
VB-20	VB-20 036-080	0.149	2.7	0.118
	VB-20 080-120	0.027	4.0	
	VB-20 120-176	0.171	5.3	
VB-25	VB-25e 310-341	0.003	3.1	0.135
	VB-25 076-120	0.165	4.4	
	VB-25 120-175	0.196	4.5	
VB-17	VB-17 310-339	0.030	2.9	0.060
	VB-17 076-105	0.032	3.1	
	VB-17e 370-396	0.010	2.6	
	VB-17 132-170	0.151	3.4	
VB-30	VB-30e 310-430	0.003	12.0	0.003

Hobson mean grain size = $(\varphi_{16}+\varphi_{84})/2$

Marsh Cut Average = 0.076

Source: Alpine et al., 2004

02132-marshtable.xls

APR 19, 2004

TABLE 6-2
BORROW AREA BEACH AND DUNE CUT COMPOSITE GRAIN SIZE ANALYSIS

		% Weight Retained on Sieve								
US Standard Sieve Sizes	**Native Beach Composite**	VB33C 142-292	VB8C 195-306	VB15C 150-304	VB7C 150-278	VB16C 150-302	VB18C 150-308	VB17C 132-304	VB30C 134-282	**Borrow Area Composite**
2"	**0.0**	0	0	0	0	0	0	0	0	**0**
1"	**0.0**	0	0	0	0	0	0	0	0	**0**
0.5"	**0.2**	0	0	0	0	0	0	0	0	**0**
0.375"	**0.1**	0	0	0	0	0	0	0	0	**0**
0.25"	**0.1**	0	0	0	0	0	0	0	0	**0**
4	**0.2**	0	0	0	0	0	0	0	0	**0**
8	**1.7**	0	0	0	0	0	0	0	0	**0**
16	**1.2**	0	0	0	0	0	0	0	0	**0**
30	**0.9**	0	0	0	0	0	0	0	0	**0**
50	**0.8**	5	0	0	0	0	0	0	0	**0.6**
100	**76.6**	80	60	50	62	54	10	50	58	**53.0**
200	**17.6**	10	26	31	26	32	64	38	33	**32.5**
PAN	**0.6**	5	14	19	12	14	26	12	9	**13.9**
Mean Grain Size (mm)	**0.216**	0.202	0.127	0.139	0.145	0.137	0.082	0.134	0.153	**0.136**
Mean Grain Size (φ)	**2.342**	2.308	2.978	2.851	2.790	2.871	3.343	2.899	2.712	**2.882**
Beach Overfill	**N/A**	1.022	1.122	1.189	1.110	1.161	1.559	1.189	1.135	**1.164**

Hobson mean grain size = $(\varphi_{16}+\varphi_{84})/2$

Source: Alpine et al., 2004
02132-beachanddune.xls

APR 19, 2004

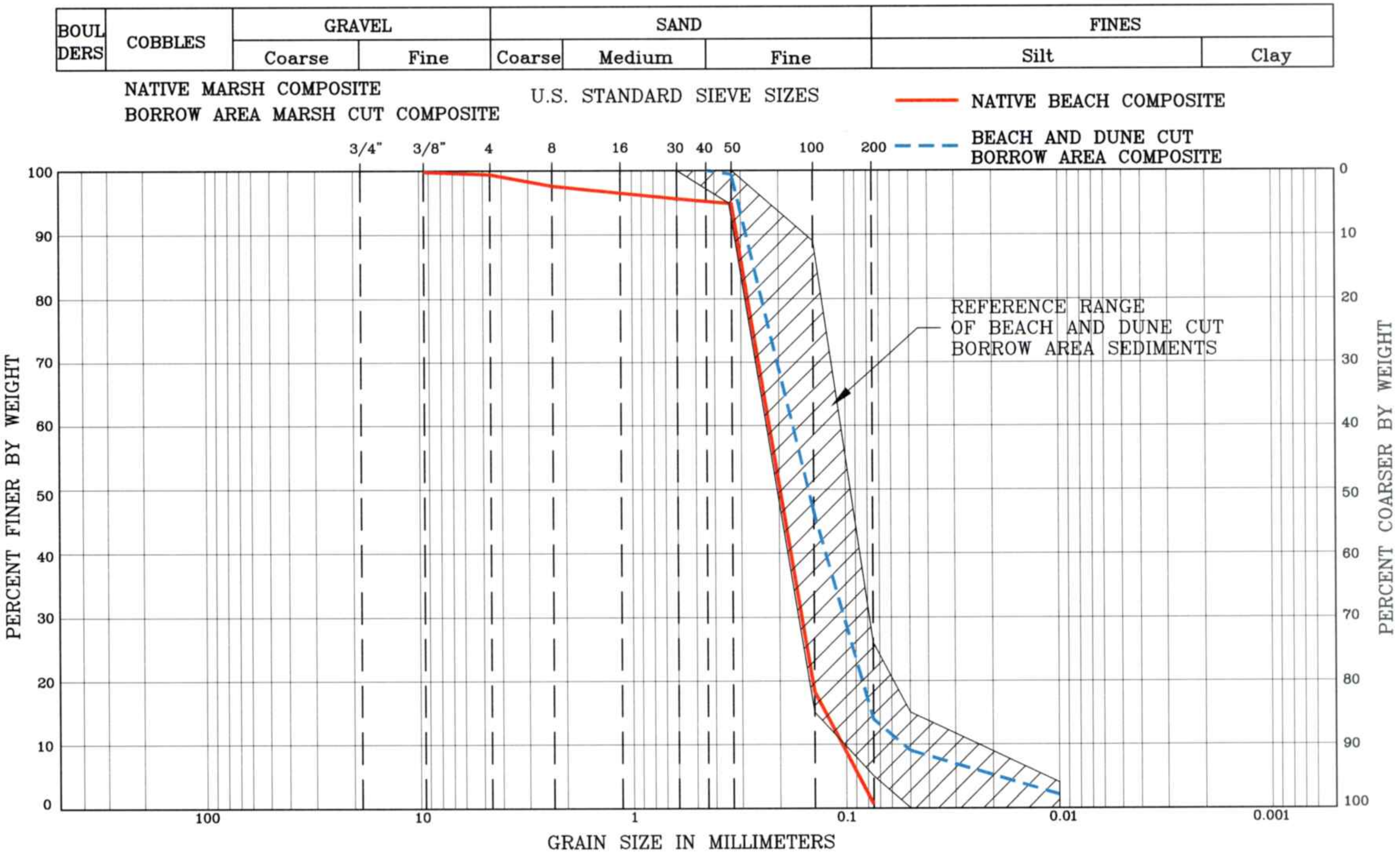

FIGURE 6–10: BEACH / DUNE CUT GRAIN SIZE DISTRIBUTION COMPARISON

An additional analysis useful for the evaluation of noncohesive granular beach fill material is the renourishment factor (Rj). This analysis provides an estimate of how often fill placement would be required to maintain a specific beach dimension. Rj (James, 1975) is a relative stability indicator. It attempts to predict long-term performance of different fill materials. Table 6-3 presents the Rj factor for the composite core samples that were analyzed by mechanical sieve according to ASTM D422 (ALPINE et al., 2004). An Rj of 1.0 infers that the borrow material would perform the same as the native material. The average Rj factor is 1.31, which suggests the beach and dune cut will provide suitable material for the beach and dune fill.

It is important to note that the Rj values ranged from a low of 0.83 to a high of 2.52. A value over 2.0 infers that the borrow material would erode twice as fast as the native material. The materials with an Rj on that order tend to have more silt and are a finer sand size than the native beach material. There is only one core, Core 18, at that level comprising a small percent of the material, so when blended should not pose a problem.

This selective dredging analysis results in a refined borrow area plan comprised of coarser compatible sediments for marsh, beach and dune construction.

6.6 BORROW AREA FINAL DESIGN

Based upon the 30% Design Review Meeting, consensus was reached that the refined borrow area plan is recommended for Phase 2 Project construction. The following issues were raised and addressed during the final design phase.

- Addition of Side Slopes to the Borrow Area Cuts
- Addition of Overdredge Tolerance of 5 Feet for the Beach / Dune Fill Cut
- Options for Overburden Disposal

The borrow area final design plan and typical cross sections are shown in Figures 6-11 through 6-13. Side slopes of 1 vertical: 10 horizontal have been added to the plans and sections. The seismic records show the “bright” signature defining the lower unit continues below the depth of the vibracores, suggesting that the fine sand continues deeper. The plans and sections have been modified to include the optional excavation 5 feet below the design cut depths to allow for deeper dredging of sands. The Technical Specifications (Section 10.0) include a provision that high quality sand is required and this optional excavation is at the contractor’s risk.

Table 6-4 presents the volumes for each cut and each layer. The total estimated volume in the borrow area is approximately 7.48 million cubic yards. The thickness of the overburden ranges from 4 to 7 feet, and the estimated volume is approximately 1.92 million cubic yards. The marsh cut is 6,800 feet long, 900 feet wide, and the thickness ranges from 10 to 12 feet. The estimated volume is approximately 2.78 million cubic yards. The beach and dune cut is 6,500 feet long, 600 feet wide, and the thickness is 12 feet. The estimated volume is approximately 2.12 million cubic yards. The estimated volume in the 5 foot allowable overdredge is approximately 660,000 cubic yards.

TABLE 6-3
RENOURISHMENT FACTOR CALCULATIONS (Rj)

Core Sample	Depth	δ	σ	Δ	R_j
VB-03-07	17.8-23.0	0.074	0.817	1.000	1.27
VB-03-15	20.2-21.2, 24-25	0.967	1.822	1.000	0.83
VB-03-08	17.0-30.0	0.157	0.804	1.000	1.40
VB-03-33	14.8-29.2	-0.095	0.635	1.000	1.23
VB-03-30	15.0-30.0	0.198	0.929	1.000	1.31
VB-03-24	23.1-28.1	0.109	0.951	1.000	1.17
VB-03-15	15.0-20.2	0.526	1.233	1.000	1.30
VB-03-15	20.2-21.5	0.851	1.677	1.000	0.95
VB-03-15	25.0-29.8	-0.067	0.659	1.000	1.24
VB-03-16	16.9-29.0	0.144	0.903	1.000	1.27
VB-03-17	15.0-30.1	0.536	1.306	1.000	1.20
VB-03-18	15.0-17.6	1.733	1.619	1.000	2.52
				AVERAGE	1.31

$\delta = (\mathbf{M}_{\varphi core}\text{-}\mathbf{M}_{\varphi native})/\sigma_{\varphi native}$

$\sigma = \sigma_{\varphi core}/\sigma_{\varphi native}$

$\Delta =$ WINNOWING FUNCTION

$\mathbf{R}_{j=}\ \mathbf{exp}[\Delta(\delta)-(\Delta^2/\mathbf{2})((\sigma_{\varphi core}{}^{2}/\sigma_{\varphi native}{}^{2})\mathbf{-1})]$

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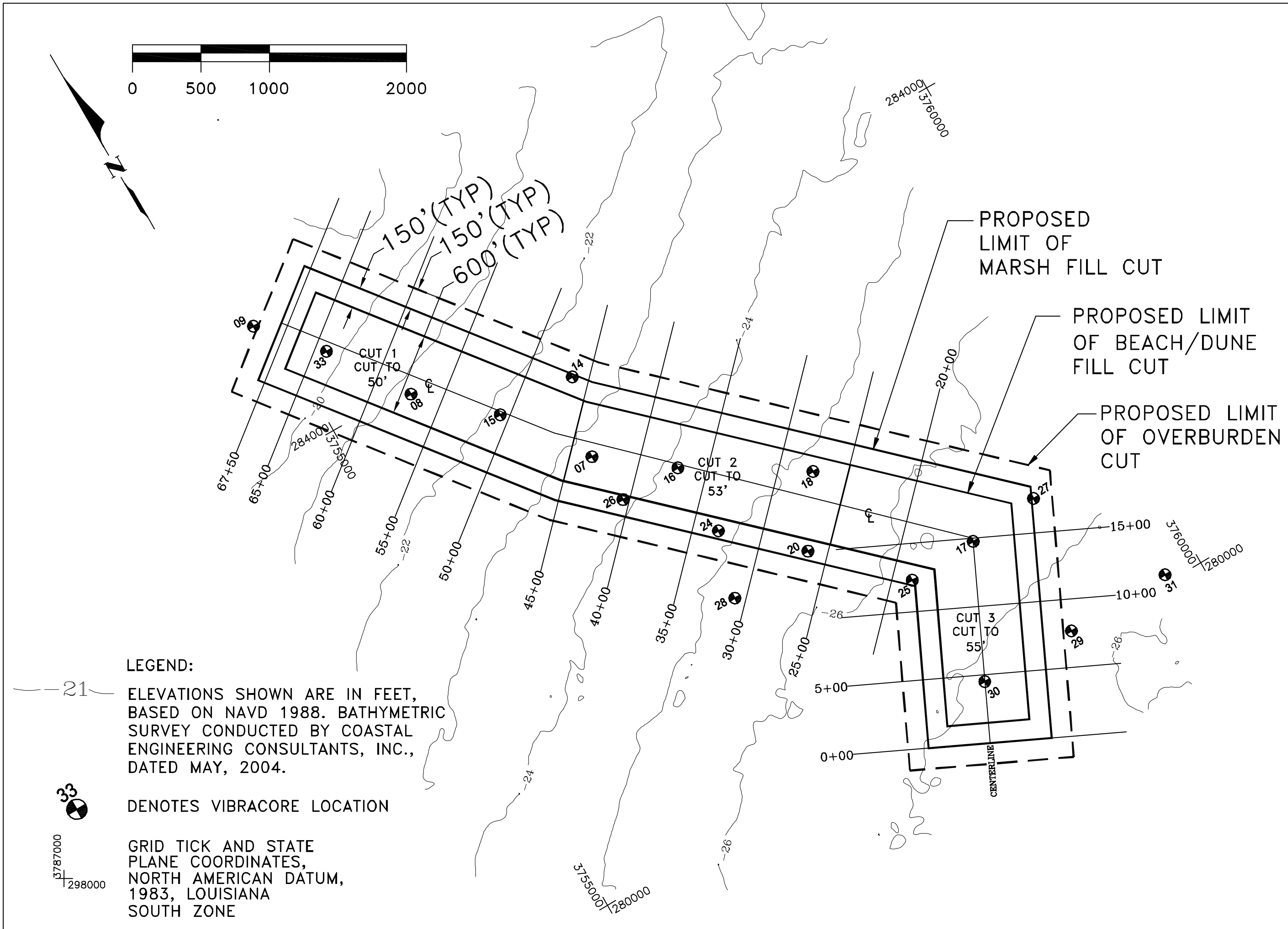
Source: STE, 2004
02132-renourishmentratio-pdr.xls



LEGEND:

ELEVATIONS SHOWN ARE IN FEET, BASED ON NAVD 1988. BATHYMETRIC SURVEY CONDUCTED BY COASTAL ENGINEERING CONSULTANTS, INC., DATED MAY, 2004.

DENOTES VIBRACORE LOCATION

GRID TICK AND STATE PLANE COORDINATES, NORTH AMERICAN DATUM, 1983, LOUISIANA SOUTH ZONE

FIGURE 6–11: BORROW AREA FINAL DESIGN PLAN

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02132FIG6–11.DWG

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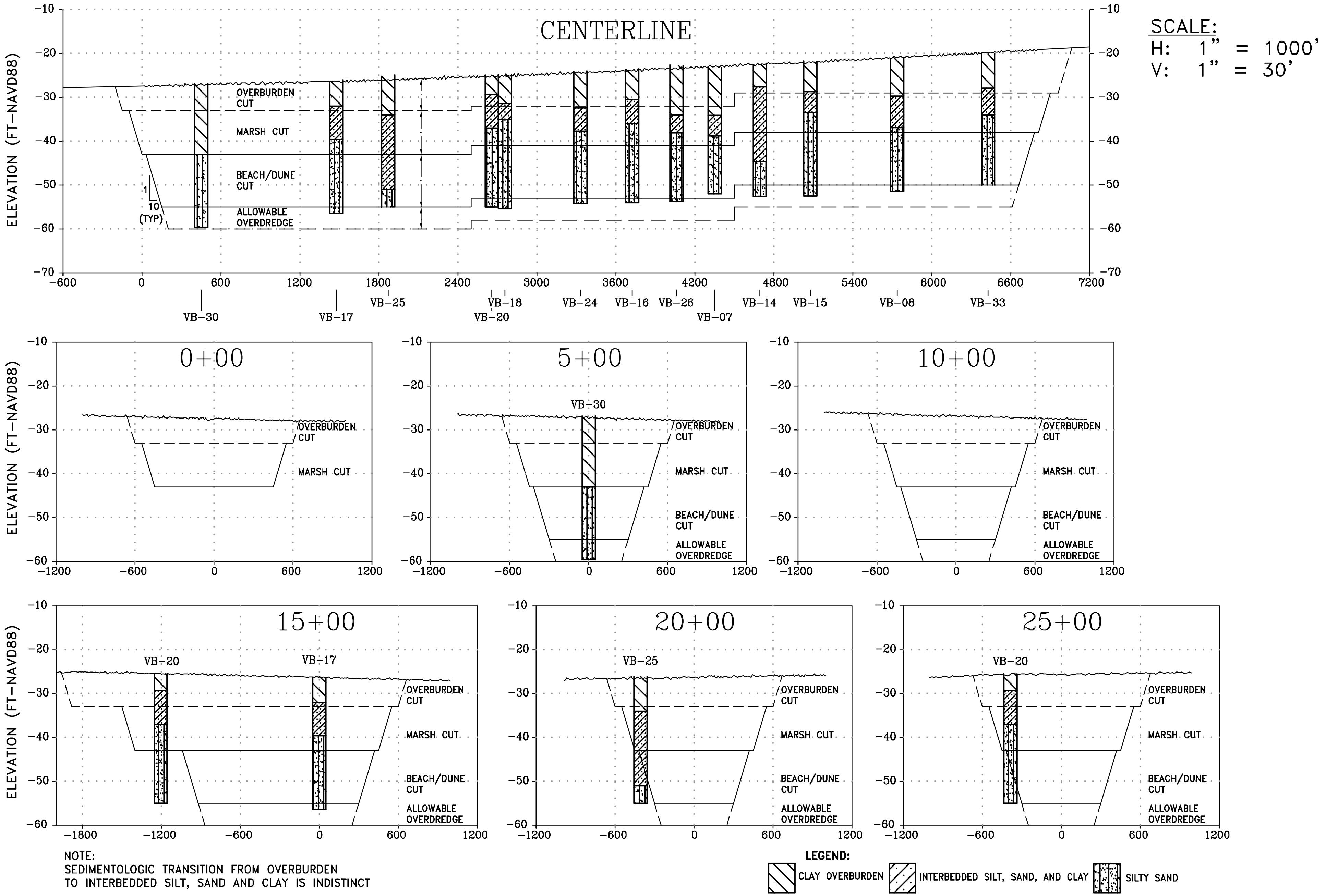

NOTE:
SEDIMENTOLOGIC TRANSITION FROM OVERBURDEN
TO INTERBEDDED SILT, SAND AND CLAY IS INDISTINCT

FIGURE 6-12: BORROW AREA FINAL DESIGN SECTIONS: 0+00 TO 25+00

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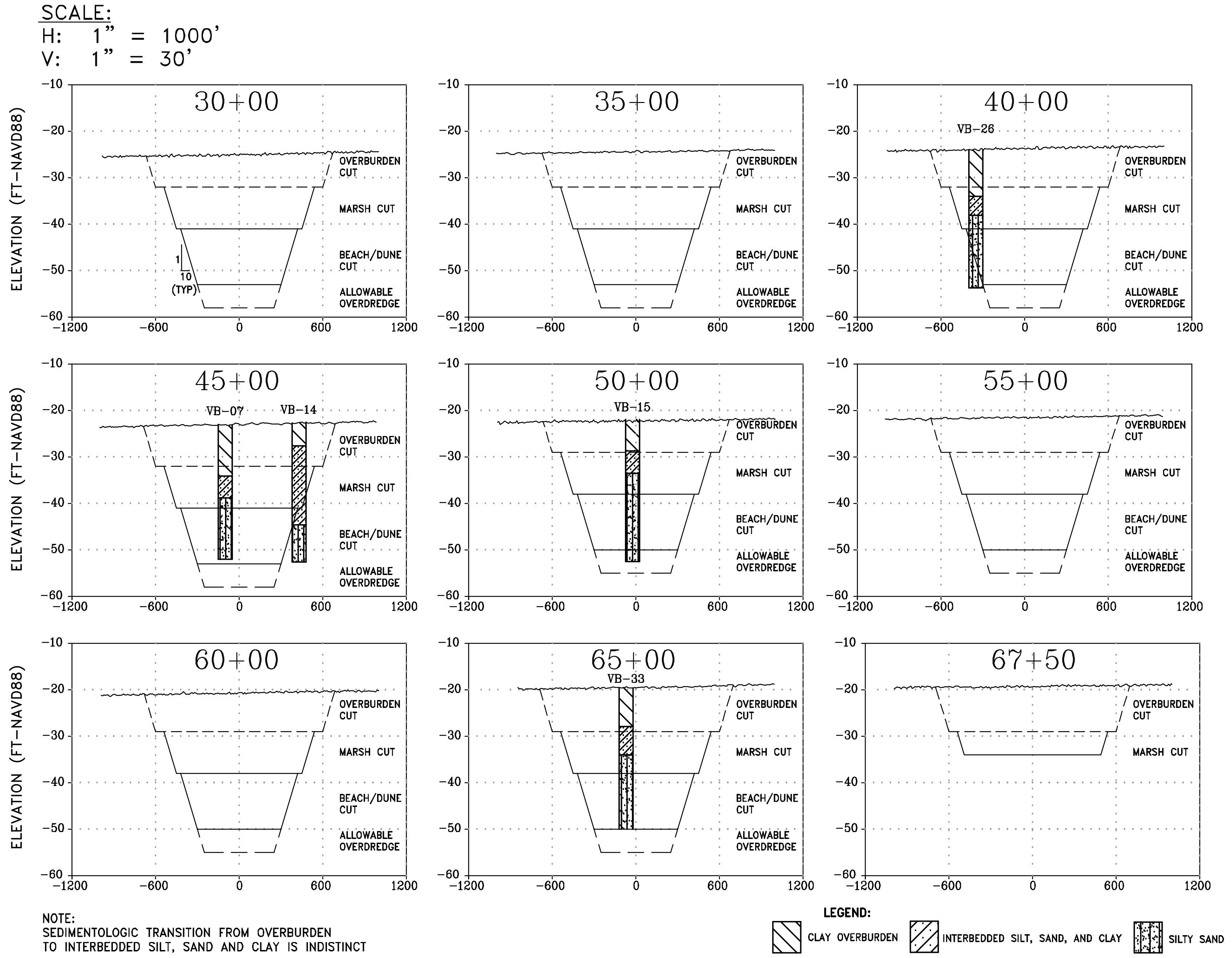

NOTE:
SEDIMENTOLOGIC TRANSITION FROM OVERBURDEN
TO INTERBEDDED SILT, SAND AND CLAY IS INDISTINCT

FIGURE 6-13: BORROW AREA FINAL DESIGN SECTIONS: 30+00 TO 67+50

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02132FIG6-11.DWG

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TABLE 6-4
BORROW AREA VOLUMES BY CUT

OVER BURDEN

CUT NO.	SURFACE AREA (SF)	CUT DEPTH (FT, NAVD)	AVERAGE THICKNESS (FT)	VOLUME (CY)
1	3,149,600	28	6.5	758,200
2	2,535,800	31	7	657,400
3	3,413,550	31	4	505,700
			TOTAL	1,921,300

MARSH FILL

CUT NO.	SURFACE AREA (SF)	CUT DEPTH (FT, NAVD)	THICKNESS (FT)	VOLUME (CY)
1	2,351,100	38	10	870,800
2	2,000,800	41	10	741,000
3	2,620,800	43	12	1,164,800
			TOTAL	2,776,600

BEACH / DUNE FILL

CUT NO.	SURFACE AREA (SF)	CUT DEPTH (FT, NAVD)	THICKNESS (FT)	VOLUME (CY)
1	1,592,000	50	12	707,600
2	1,440,700	53	12	640,300
3	1,742,000	55	12	774,200
			TOTAL	2,122,100

5 FT ALLOWABLE OVERDREDGE

CUT NO.	SURFACE AREA (SF)	CUT DEPTH (FT, NAVD)	THICKNESS (FT)	VOLUME (CY)
1	1,169,400	55	5	216,600
2	1,100,707	58	5	203,800
3	1,283,974	60	5	237,800
			TOTAL	658,200

TOTAL MARSH, BEACH AND DUNE FILL EXCLUDING OVERBURDEN **5,556,900**

The required marsh fill volume is 2.67 million cubic yards including losses determined by the cut-to-fill ratio of 1.6. The required beach and dune fill volume is 1.55 million cubic yards including the overfill ratio of 1.16 and the cut-to-fill ratio of 1.3. Thus, the proposed borrow area contains sufficient volumes of suitable sediments for marsh, beach, and dune restoration.

Calculation of the cut-to-fill ratio for the marsh fill assumes the overburden will be lost during the dredging and dewatering processes. The overburden is comprised of a very small percentage of silts and sands suitable for marsh construction. The large percentage of very fine material (ooze) would require considerable effort and time (containment and dewatering) to create additional marsh at costs higher than the estimates to dispose of it offshore. Therefore, the final design plans incorporate options for overburden disposal in the gulf including an offshore disposal area (ODA) or disposal in CWWPRA Project BA-38’s borrow area after it is utilized for construction. Review of the geophysical and geotechnical data from the offshore sediment search (ALPINE et al., 2004) of the ODA boundary indicates this area is devoid of magnetometer hits thus no impacts to pipelines or cultural resources are anticipated. Further, there is no indication from the seismic and vibracore data of any beach and marsh compatible sediments within the ODA boundary. The final design plans and typical cross sections for overburden disposal are shown in Figures 6-14 and 6-15 respectively.

The refined borrow area plan was evaluated for potential impacts to the adjacent shorelines from excavation of the proposed cuts through a wave refraction model study (Section 7.3). The model was rerun to incorporate the final design of the borrow area plan, including the added side slopes and optional deeper dredging, as well as the ODA (Appendix C). It is predicted that excavation of the borrow area and placement of material in the overburden disposal area will have negligible effects on wave refraction and resultant sediment transport patterns, and no adverse impacts to the adjacent shorelines.

7.0 ALTERNATIVES ANALYSIS

7.1 SEDIMENT TRANSPORT MODELING

7.1.1 Model Description

7.1.1.1 Software Description

One of the considerations in designing alternatives for rebuilding the barrier island and marsh separating Bay Joe Wise and the Gulf of Mexico is how the fill material will adjust and equilibrate under various storm scenarios. In order to evaluate this aspect of the alternative designs, a cross-shore sediment transport model was conducted for various normal and storm conditions on the proposed alternative fill templates.

In order to help predict the erosion rates for the native beach profile and proposed fill templates, the Storm-Induced Beach Change Model SBEACH was used (Rosati, et.al., 1993). The version of SBEACH chosen is part of a package developed by Veri-Tech, Inc., called the Coastal Engineering Design and Analysis System, or CEDAS. Version 2.01 of CEDAS was used throughout the SBEACH analysis.

SBEACH is a two-dimensional model that simulates cross-shore transport of sediment due primarily to breaking waves and changing water levels. Longshore wave and current sediment transport is not accounted for by SBEACH. Water level changes are calculated from input wind, storm surge, and tide data.

7.1.1.2 Grid Design

Each scenario was set up in SBEACH with the same grid cell layout. The bathymetric cross section was extracted from site data along a 3,700-foot transect at Station 140+00 on the survey baseline. This cross section, taken from the Topographic, Bathymetric and Magnetometer Survey Report (SJB, et. al., 2003), is representative of the beach profiles along the Bay Joe Wise Headland. The grid defined along this cross section, starting from the northern most end, consisted of 60 cells with widths of 5 feet, 120 cells with widths of 2.5 feet, 120 cells with widths of 5 feet, 560 cells with widths of 2.5 feet, 60 cells with widths of 5 feet, and 80 cells with widths of 10 feet. This provided the highest resolution that is, 2.5-foot cell widths, at the proposed back of the marsh where a relatively sharp change in the bathymetric elevation would exist, and at the proposed locations for the beach face and dune, where similarly rapid changes in elevation would be expected resulting in the highest transport volume.

7.1.1.3 Model Parameters and Calibration

No site specific data was available for calibration of the model, so pre- and post-storm conditions measured from the Chaland Headland Project, BA-38, (CP&E, 2003) were used to calibrate the SBEACH model. The calibration performed by CP&E was repeated as part of this investigation in order to verify the validity of the calibrated parameters with the different grid lay-out and time stepping set-up.

In the calibrated model, a transport rate coefficient (K) of 2.5×10^{-7} m^4/N was used. This coefficient can range from 2.5×10^{-7} to 2.5×10^{-6} m^4/N in SBEACH. As the name implies, this parameter controls the amount of cross-shore transport that will occur under given forces. Higher values cause a greater amount of sand transport to be modeled.

The coefficient for the slope-dependent term (ε) was set to 0.0001 m^2/s in the calibrated model. This coefficient can range from 0.0001 to 0.005 m^2/s, and accounts for changes in the transport rate that occur due to changes in the slope of the bathymetric surface. Larger values of ε will increase transport on sloped surfaces, which has the effect of subduing the development of sand bars in the simulation.

A transport rate decay coefficient multiplier (κ) of 0.3 was used in the calibrated model. This term can range from 0.1 to 0.5. Larger values for this parameter cause the transport rate to decay more quickly seaward of the breaker line.

The grain size used in the simulations varied depending on the alternative. Alternatives 1, 2, and 5 maintain the native beach on the seaward profile. The native beach material was found to have an average grain size of about 0.2 mm, so this grain size was used in those alternatives. Alternatives 3 and 4 propose beach fill from the proposed borrow area. The proposed fill material available for the beach and dune has an approximate average grain size of 0.15 mm, so this grain size was used for those alternatives (Section 6.0).

Each alternative was evaluated for erosion under three (3) different storm scenarios. The storm scenarios included the 5-year, 10-year, and 20-year storms. The 20-year storm scenario was modeled after the Hurricane Andrew design storm statistics reported by CP&E (2003). This storm was modeled for a 120 hour simulation period with peak waves of approximately 21 feet, peak storm stage of approximately 7.5 feet, and maximum wave period of approximately 13 seconds. Since data was unavailable for an entire 5- or 10-year storm, the distribution of wind speed, wave height, and water stage over time was scaled from the 20-year storm for these scenarios. The maximum wave height, wave period, storm stage, and wind speeds, presented in Section 4.2, for the 5- and 10-year storm scenarios were used to scale the maximum values down from the 20-year storm scenario, and the values ramping up to these peaks and winding back down from the peaks were scaled accordingly. For each storm scenario, a total of 7200 time steps were used with each time step simulating 1 minute, for a total simulation time of 120 hours.

7.1.2 Model Results

The calibrated model was run for the five (5) alternatives. The existing profile and proposed fill templates for the five (5) alternatives are displayed in Figure 7-1. A full description of each of the alternatives is provided in Section 5.0.

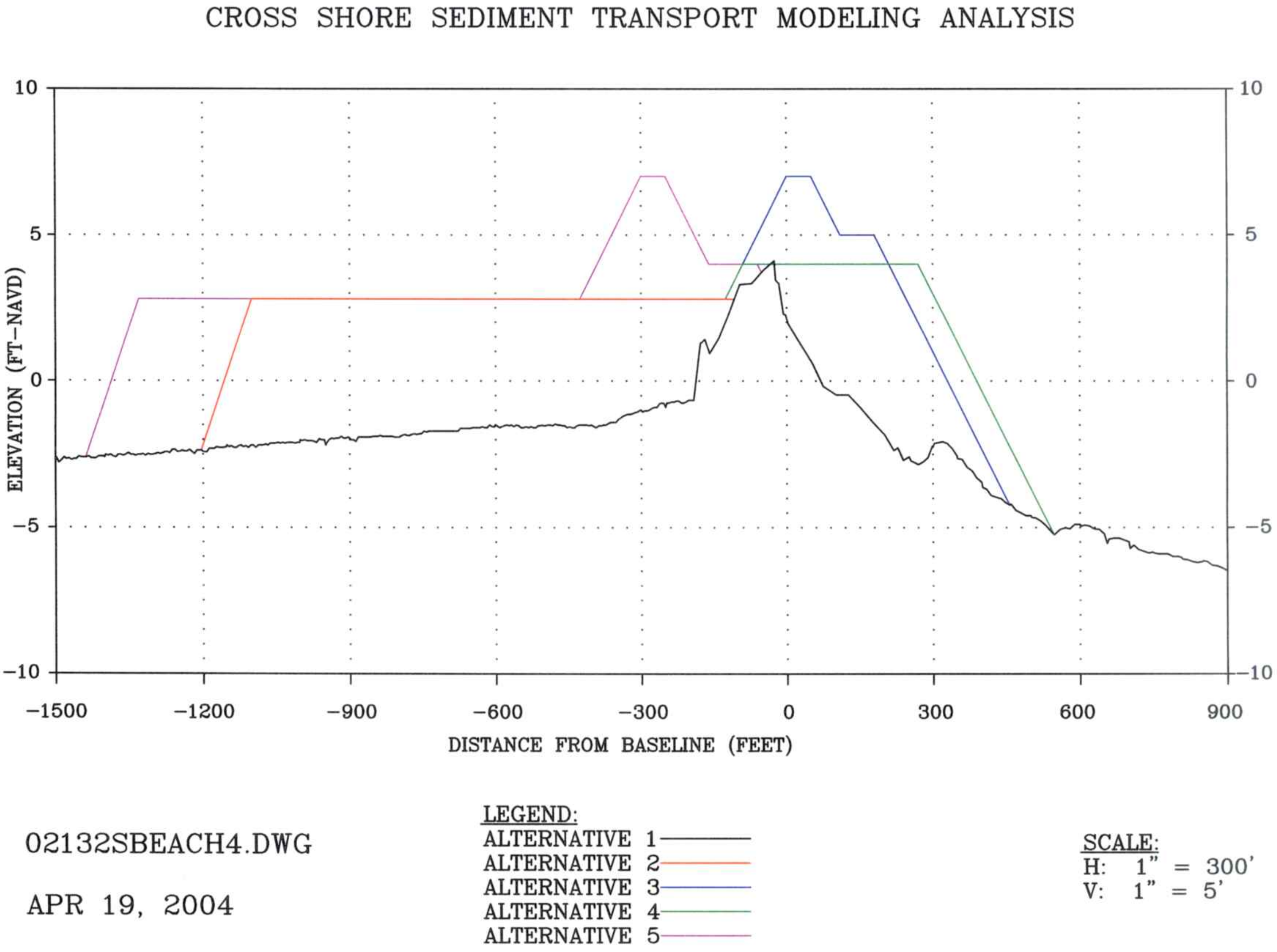

FIGURE 7−1: ALTERNATIVE FILL TEMPLATES

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In the first alternative, which is to maintain the existing conditions of the barrier island, the dune is flattened out at an elevation of roughly 2 to 2.5 feet NAVD in all three (3) storm scenarios, as shown in Figure 7-2. The 5-year storm caused the greatest amount of damage to the existing dune. This is most likely occurring because the existing headland's elevations are at or just below the 5-year predicted storm elevation. The significant storm events barely "feel" the headland as they move across and completely overtop it versus the 5-year storm which allows the waves to erode the dune for the longest period of time. Water elevations rise quickly enough to overtop the island in the 10- and 20-year storm scenarios to prevent them from causing any more damage to the dune. It is important to understand the model's application and limitations. The model's results are used in this analysis as a qualitatively comparison of alternatives to assess relative performance in terms of storm protection..

Results from the model of Alternative 2 are shown in Figure 7-3. In this alternative, the proposed marsh is built landward of the existing beach and dune. All storm scenarios do roughly the same amount of damage to the existing dune in this alternative.

Alternative 3 results are displayed in Figure 7-4. In this alternative, the beach and dune are restored in both elevation and width seaward of the existing beach. The elevation of the proposed dune is high enough to prevent very appreciable damage to the dune itself in the 5-year storm scenario. Both the 10- and 20-year storms flatten the dune out at an elevation of approximately 5 feet NAVD, causing a considerable amount of overwash into the marsh.

Figure 7-5 displays results for Alternative 4. The proposed beach fill built seaward of the existing beach is susceptible to erosion and overwash from the 5-year storm. Similar to Alternative 1, the 10- and 20-year storm surges raise water elevations rapidly resulting in less damage to the dune in comparison to the damage caused by the 5-year storm.

For Alternative 5, in which the proposed marsh, beach and dune are built landward of the existing beach and dune, the 5-year storm does not cause significant damage to the existing dune due to the relatively low water elevation, as seen in Figure 7-6. Both the 10- and 20-year storms generate water elevations high enough to erode the dune to an elevation of approximately 5 feet NAVD.

In addition to the effect of the storms on the dunes, the figures also show varying erosion caused by the storms on the beaches. The amount of maximum beach recession caused by each storm on each alternative is displayed in Table 7-1.

Alternatives 3 and 4 show a considerably larger amount of beach erosion than the other alternatives for all three (3) storm scenarios. These scenarios are the two (2) in which fill material from the proposed borrow area is added to restore and widen the native beach. The higher recession seen in these alternatives is most likely caused by the finer grained material available for the beach fill eroding more quickly, that is, the 0.15 mm fill, compared to the 0.2 mm native beach material, as well as the engineered slope adjusting to a more natural slope.

CROSS SHORE SEDIMENT TRANSPORT MODELING ANALYSIS

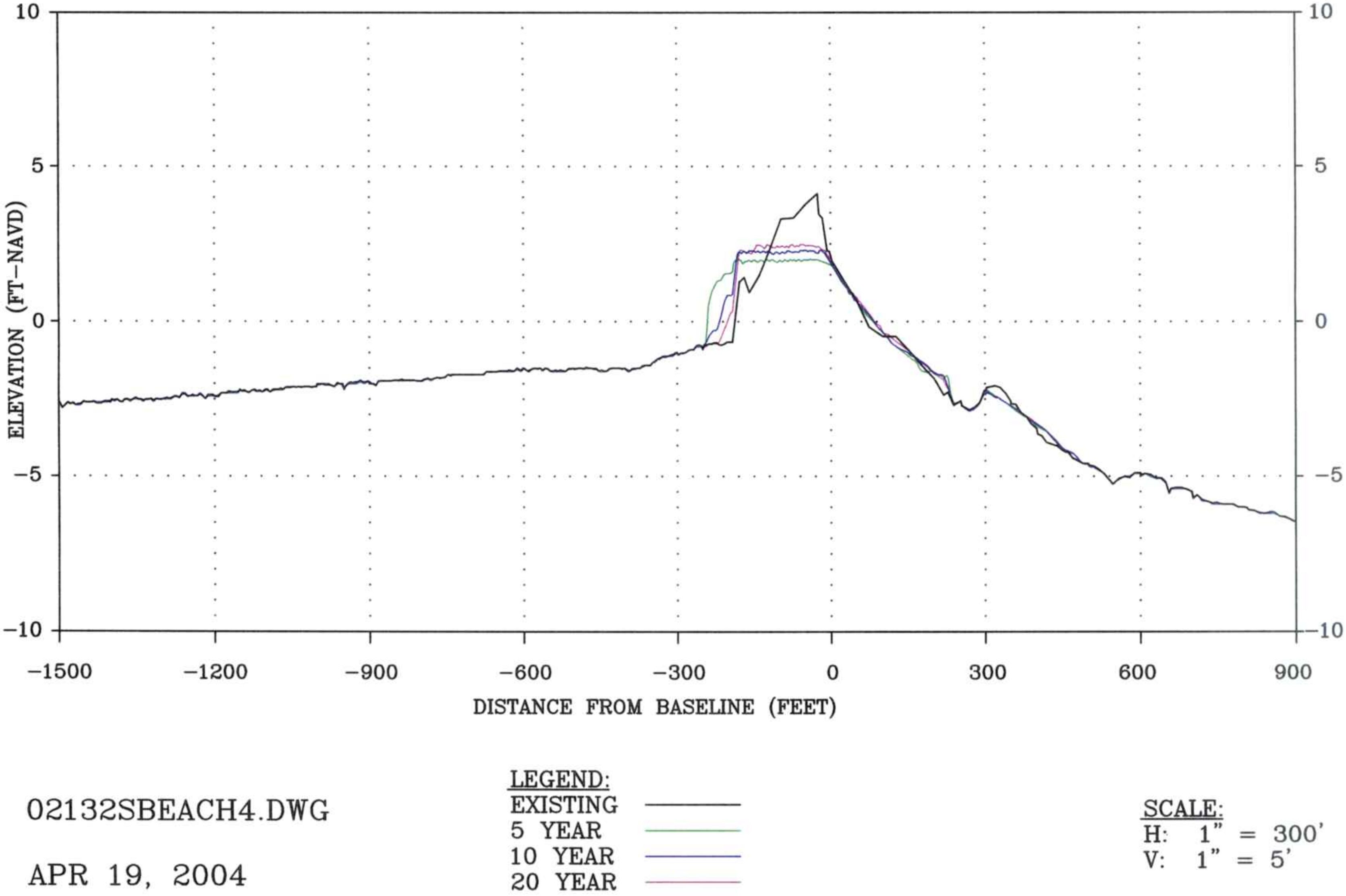

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FIGURE 7−2: SBEACH ALTERNATIVE 1 RESULTS

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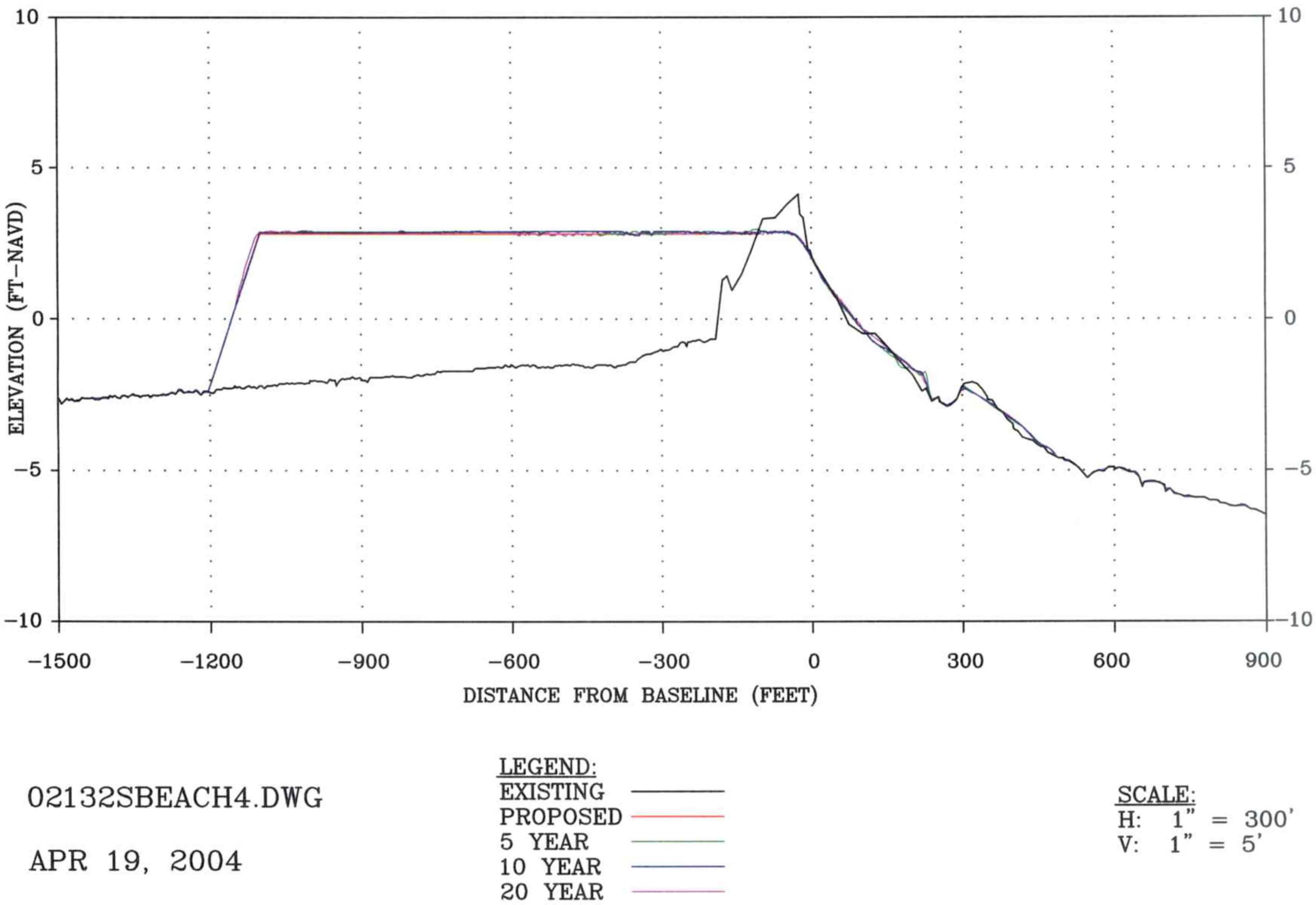
CROSS SHORE SEDIMENT TRANSPORT MODELING ANALYSIS



02132SBEACH4.DWG

APR 19, 2004

SCALE:
H: 1" = 300'
V: 1" = 5'

FIGURE 7−3: SBEACH ALTERNATIVE 2 RESULTS

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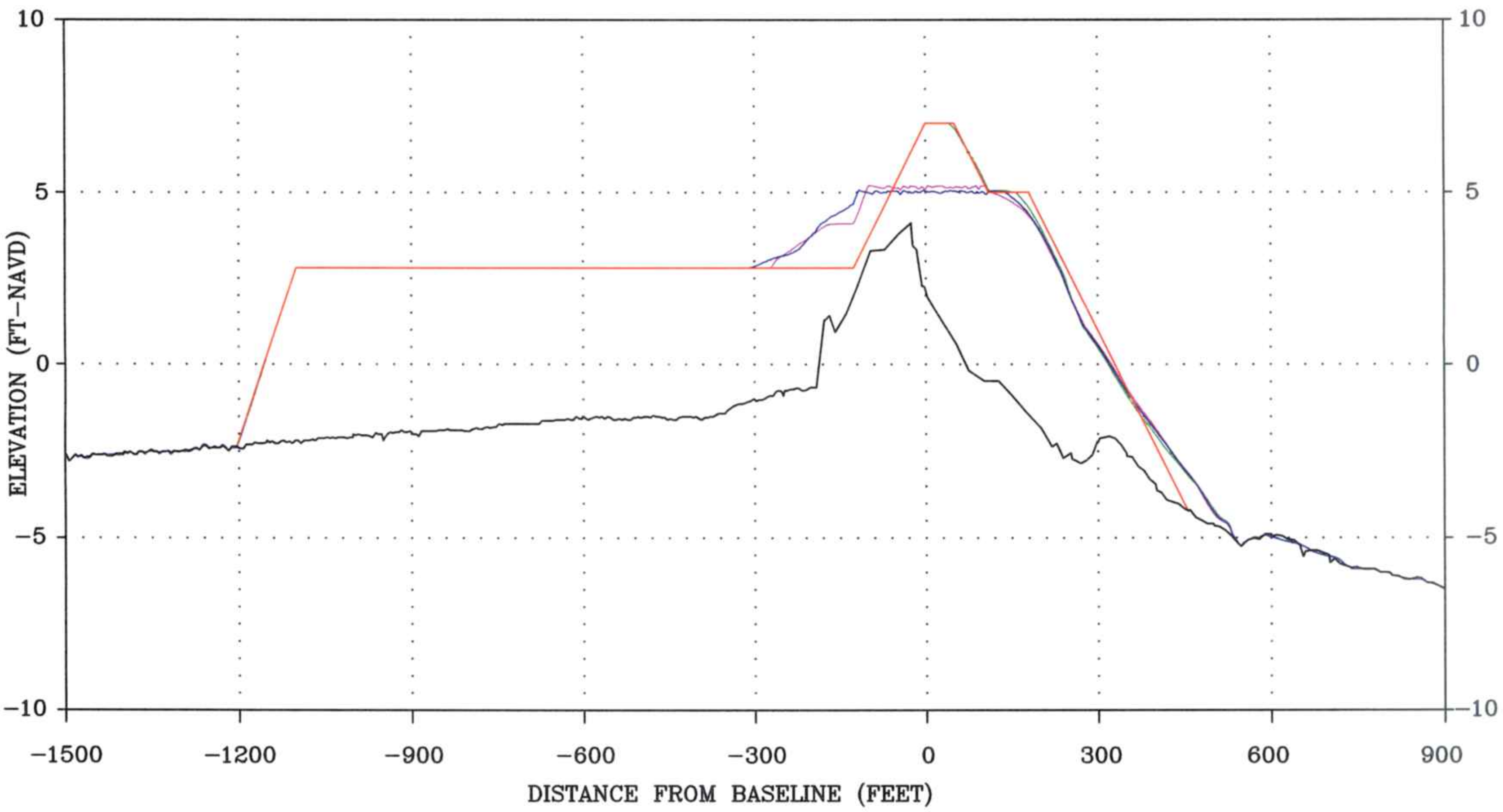
CROSS SHORE SEDIMENT TRANSPORT MODELING ANALYSIS



02132SBEACH4.DWG

APR 19, 2004

LEGEND:
EXISTING
PROPOSED
5 YEAR
10 YEAR
20 YEAR

SCALE:
H: 1" = 300'
V: 1" = 5'

FIGURE 7−4: SBEACH ALTERNATIVE 3 RESULTS

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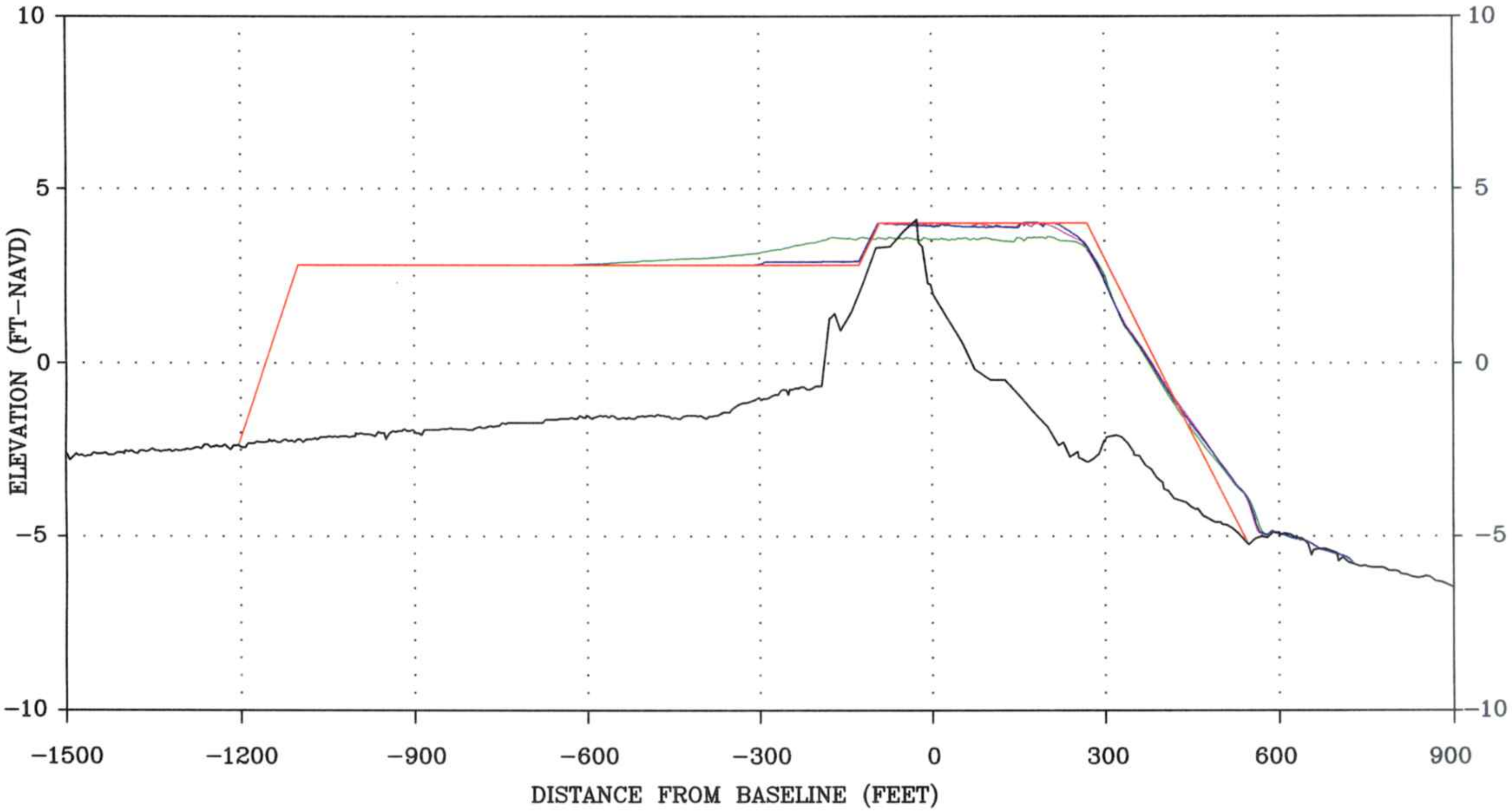
CROSS SHORE SEDIMENT TRANSPORT MODELING ANALYSIS



02132SBEACH4.DWG

APR 19, 2004

LEGEND:
EXISTING —
PROPOSED —
5 YEAR —
10 YEAR —
20 YEAR —

SCALE:
H: 1" = 300'
V: 1" = 5'

FIGURE 7−5: SBEACH ALTERNATIVE 4 RESULTS

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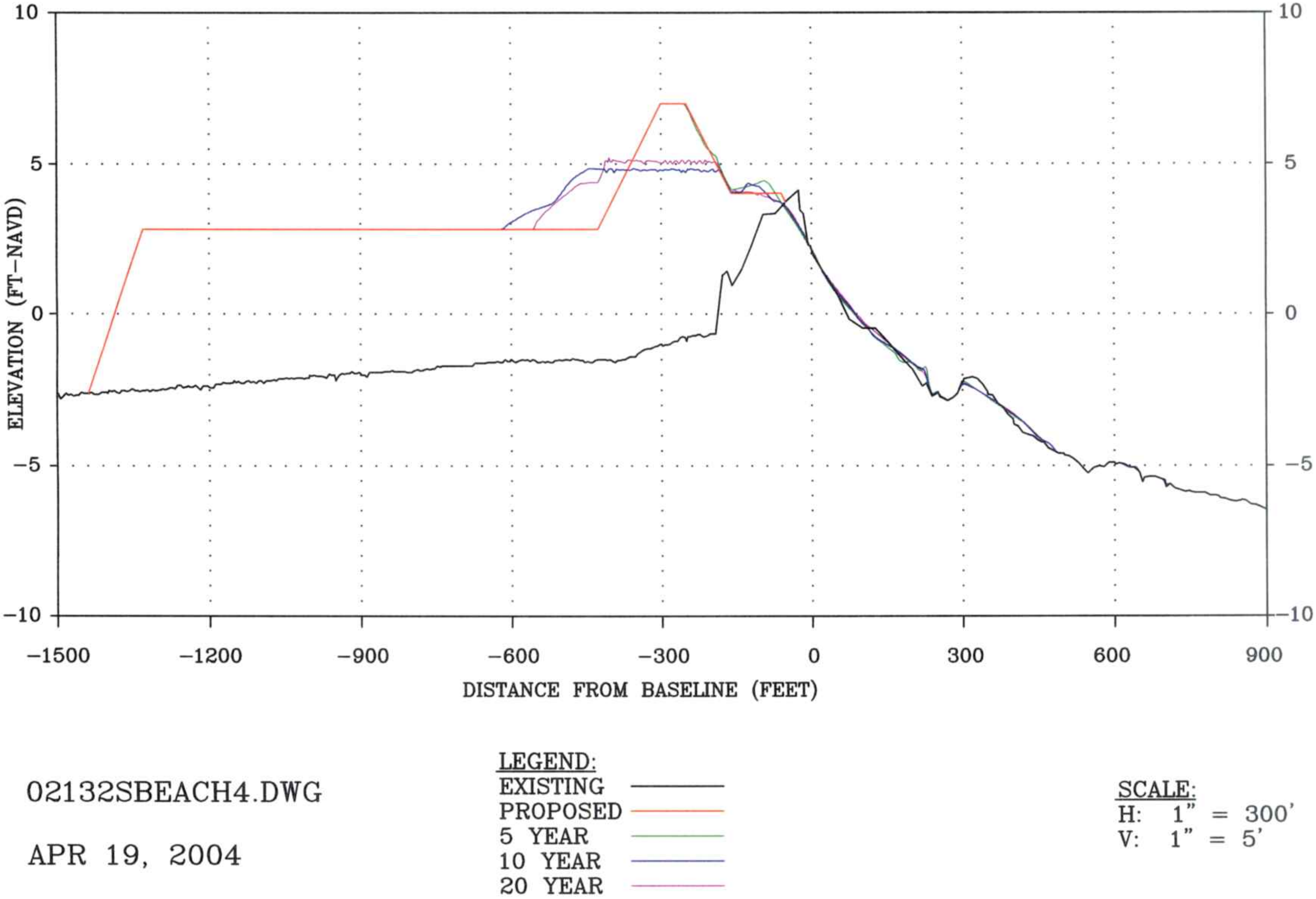
CROSS SHORE SEDIMENT TRANSPORT MODELING ANALYSIS



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SCALE:
H: 1" = 300'
V: 1" = 5'

FIGURE 7−6: SBEACH ALTERNATIVE 5 RESULTS

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Table 7-1: Beach Recession Values

	Beach Recession (feet)[1]		
	Storm Event (Return Time in Years)		
Alternative	5	10	20
1	4.66	2.01	4.82
2	4.66	1.75	4.69
3	22.82	20.33	17.84
4	23.47	21.81	19.54
5	4.67	1.66	1.49

1: The value for beach recession given is the maximum amount of recession that occurs at the mean water elevation (1 feet NAVD) at any point during the given storm. Subsequent erosion may reduce the magnitude of the recession in the final profile.

7.1.3 Sensitivity Analysis

Each storm scenario was run with the input wind direction at a constant 0 degrees (wind blowing directly on-shore), 45 degrees, and 135 degrees. Varying the wind angle did not have a noticeable effect on the model results.

Alternatives 4 and 5 were also run using K, ε, and κ over a wide range of values. The effects of the different values in the amount of beach recession is shown in Table 7-2. In general, relatively small changes to the value of K has a considerable effect on modeled erosion in the dunes. As the value of K approaches the maximum allowed by SBEACH, the dunes are almost completely washed away by the first set of waves to hit the shore. Large variations in ε cause minor changes in the modeled erosion near the mean water elevation of 1.0 feet NAVD, and changes in κ has virtually no effect on the modeled erosion near the mean water elevation.

7.1.4 Conclusions

From the results of the SBEACH modeling, it appears the alternatives that restore the dunes at higher initial elevations will provide the marsh with far better protection against more regular storms (i.e. the 5-year return interval storms). These alternatives with the higher dunes will face considerable damage in the larger 10- and 20-year storms. It appears, however, that the dunes should remain intact to provide the marsh with sufficient protection to prevent severe damage and breachment in these large storm scenarios. From this analysis, Alternatives 3 and 5 are the preferred alternatives.

The alternatives in which additional fill is placed seaward of the native beach show a much greater degree of erosion. One reason for this may be due to the engineered slope adjusting to a more natural distribution, suggesting the higher erosion rate may be temporary. Another reason for the greater erosion rate may be the finer grain size of the proposed fill material. Erosion of this finer material will most likely continue at a greater rate than the erosion of the native beach material even after the equilibrated profile and slope have been reached. This suggests Alternative 5 may be the preferred alternative, based on the results of the SBEACH modeling.

Table 7-2: Recession Sensitivity

Alternative 4			
20 Year Storm Scenario	Max Recession at 2 feet NAVD	Max Recession at 1 feet NAVD	Max Recession at 0 feet NAVD
Alt 4 K = 2.50E-7*	21.07	19.54	11.51
Alt 4 K = 5.00E-7	34.61	31.05	19.64
Alt 4 K = 1.25E-6	62.83	55.26	37
Alt 4 K = 2.50E-6	98.4	79.43	52.23
Alt 4 ε = 0.0001*	21.07	19.54	11.51
Alt 4 ε = 0.005	26.89	22.75	11.07
Alternative 5			
20 Year Storm Scenario	Max Recession at 2 feet NAVD	Max Recession at 1 feet NAVD	Max Recession at 0 feet NAVD
Alt 5 ε = 0.0001*	0.03 feet	1.49 feet	0.04 feet
Alt 5 ε = 0.0002	0.05 feet	1.93 feet	0.18 feet
Alt 5 ε = 0.0005	2.48 feet	3.05 feet	0.74 feet
Alt 5 ε = 0.001	8.18 feet	5.22 feet	1.32 feet
Alt 5 ε = 0.005	5.91 feet	5.97 feet	1.32 feet
Alt 5 K = 2.50E-7*	0.03 feet	1.49 feet	0.04 feet
Alt 5 K = 5.00E-7	1.45 feet	3.21 feet	0.01 feet
Alt 5 K = 1.25E-6	9.96 feet	3.92 feet	0.00 feet
Alt 5 K = 2.50E-6	45.60 feet	16.61 feet	0.00 feet
Alt 5 κ = 0.1	0.03 feet	1.56 feet	0.02 feet
Alt 5 κ = 0.2	0.03 feet	1.51 feet	0.03 feet
Alt 5 κ = 0.3*	0.03 feet	1.49 feet	0.04 feet
Alt 5 κ = 0.4	0.03 feet	1.47 feet	0.04 feet
Alt 5 κ = 0.5	0.03 feet	1.46 feet	0.02 feet

* = Calibrated value

Note 1: "Max Recession" refers to the maximum recession that occurs at any point during the storm, and may not be indicative of the final profile's recession at the given elevation.

Note 2: Mean water elevation is approximately 1.0 feet NAVD.

7.2 CIRCULATION MODELING

7.2.1 Model Description

In order to predict the impact that various alternative marsh fills would have on water flow through Bay Joe Wise, an ADCIRC (ADvanced CIRCulation Model for Oceanic, Coastal and Estuarine Waters) model was developed (Luettich and Westerink, 2000). This section describes the model calibration process and the subsequent predictive scenarios that were run to provide design criteria for selection of the appropriate marsh fill alternative.

7.2.1.1 Software Description

Due to its robust capabilities, ADCIRC version 43.03 was selected as the primary modeling software for simulation of water surfaces and analysis of currents through Bay Joe Wise. Selected for this analysis, ADCIRC solves the equations describing the motion of a moving fluid on a rotating earth using a two-dimensional depth integrated (2DDI) model. ADCIRC formulates the equations of motion using traditional hydrostatic pressure and Bousinesq approximations. Finite element discretization is used for spatial distributions, while time is discretized using a finite difference method.

As a pre- and post-processor, the Surface-Water Modeling System (SMS), versions 8.0 and 8.1 (EMRL, 2004), were used. The mesh and parameter set-up, including gridding of the bathymetric data, were performed with SMS, and data was extracted from the ADCIRC output files using SMS.

7.2.1.2 Mesh Design

The complete lay-out of all the elements through the model is displayed in Figure 7-7. There are 119,221 elements in the model with 60,442 nodes located at the vertices of the triangular elements. The total area covered by the model is over 169 square miles.

Node spacing in the model ranges from about 9,000 feet in remote areas where refined information is not needed to about 50 feet or less in areas immediately surrounding Bay Joe Wise. Since the elements in the refined 50-foot node spacing area appear as solid white in Figure 7-7, close-up views of the mesh at the two primary inlets leading into the Bay, Pass Chaland and Grand Bayou Pass, are provided in Figure 7-8.

From the element distribution in Figure 7-8, it can be seen that the tighter node spacing is generally used where the water is very shallow, on land where wetting and drying may occur, and in narrow water channels where a detailed array of velocity calculations may be needed. The only significant section of the mesh where node spacing was reduced below 50 feet is in Grand Bayou Pass. Nodes in this channel are spaced as little as 25 feet apart in order to maintain good resolution for calculating flow velocities at low tide when this channel becomes very narrow. For all other narrow channels, a minimum of 2 nodes with bathymetric elevations below the lowest water mark were maintained to ensure a reasonable cross section was maintained for flow through the channel at all times. The nodes were set to ensure they always remained saturated, even at the lowest water level. This was done in order to avoid instabilities that can occur from water velocities becoming exceedingly high in channels that pinch down to a single saturated node, effectively forcing the entire channel's water flow to squeeze through a pin-hole sized cross section.

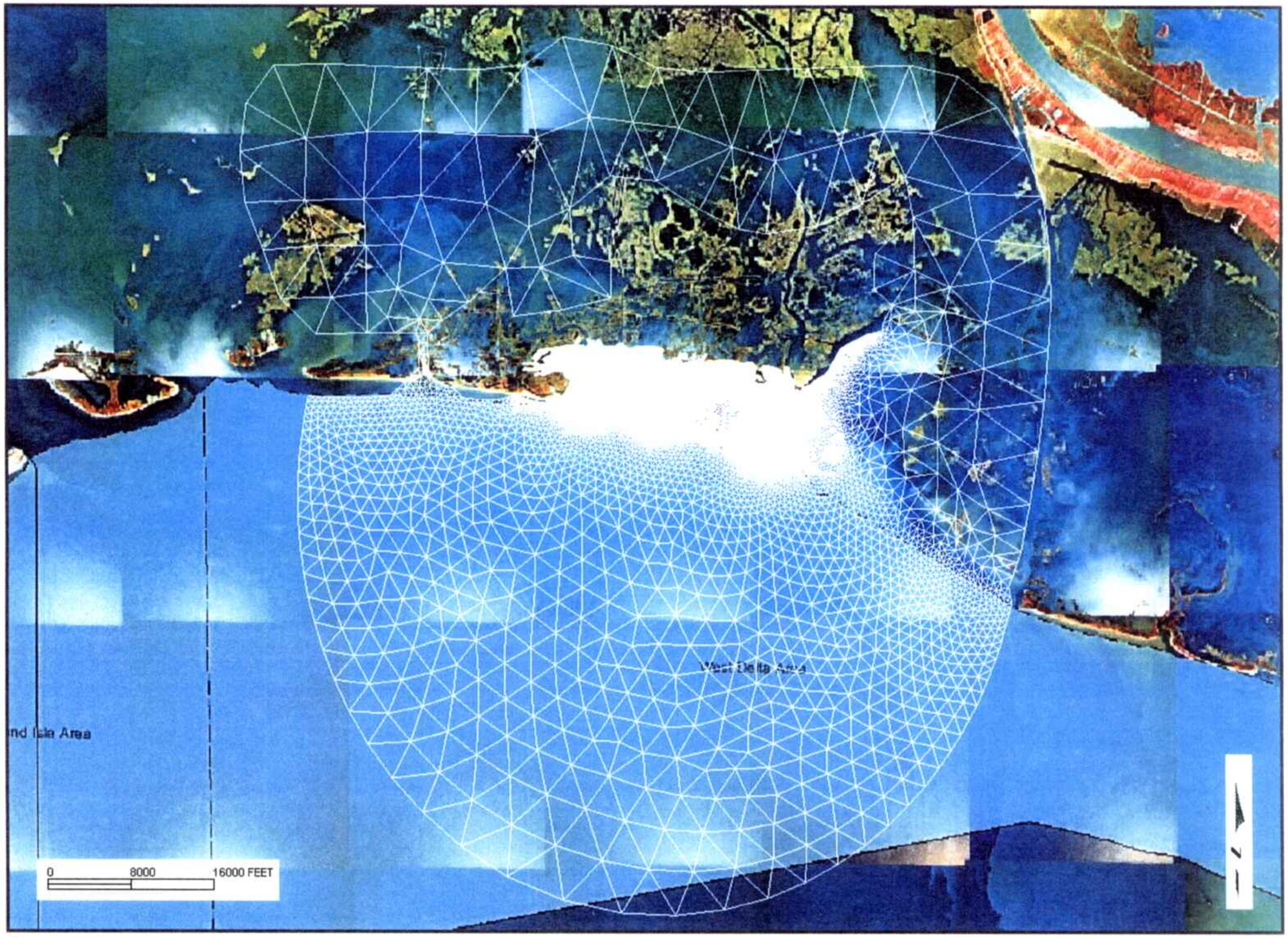
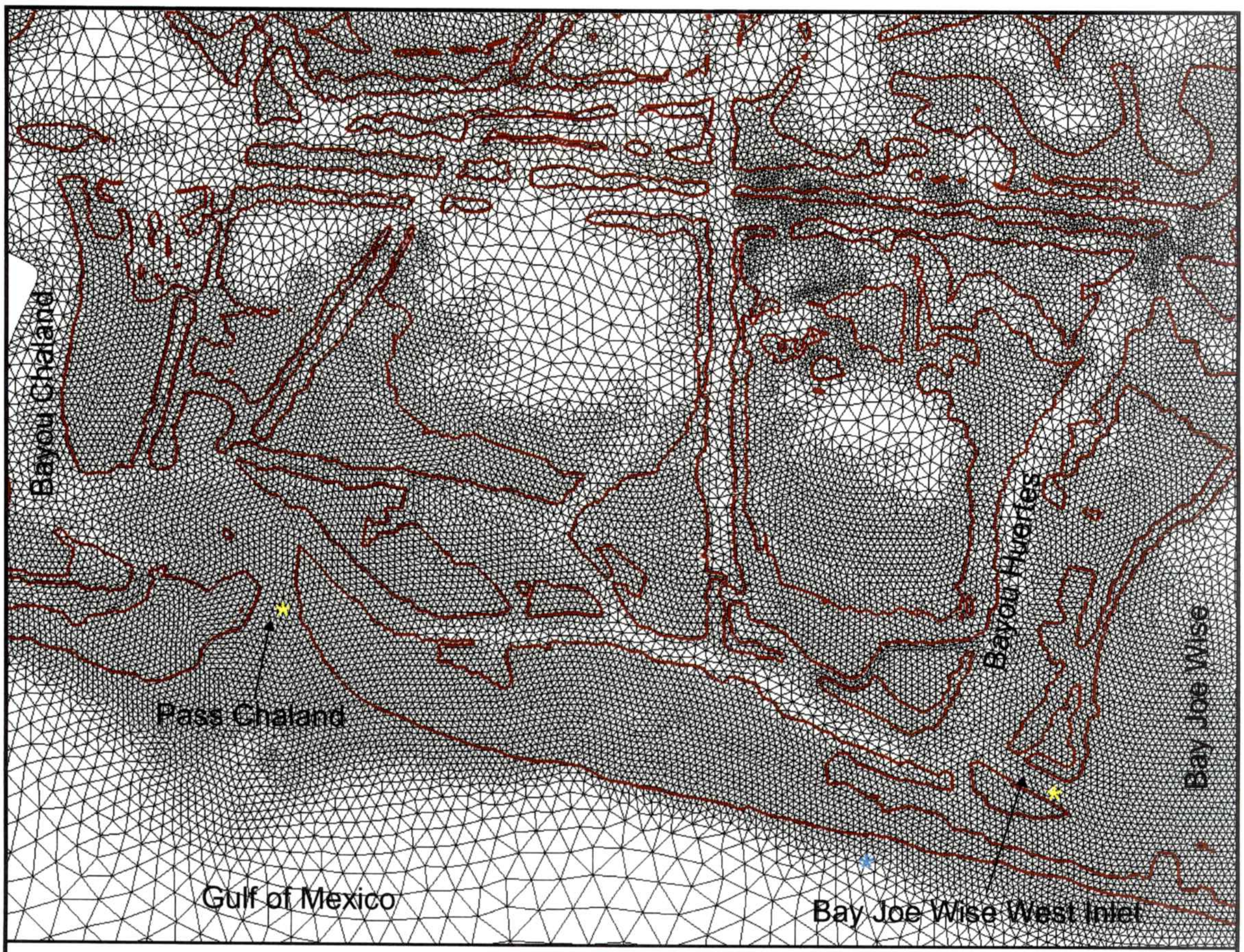
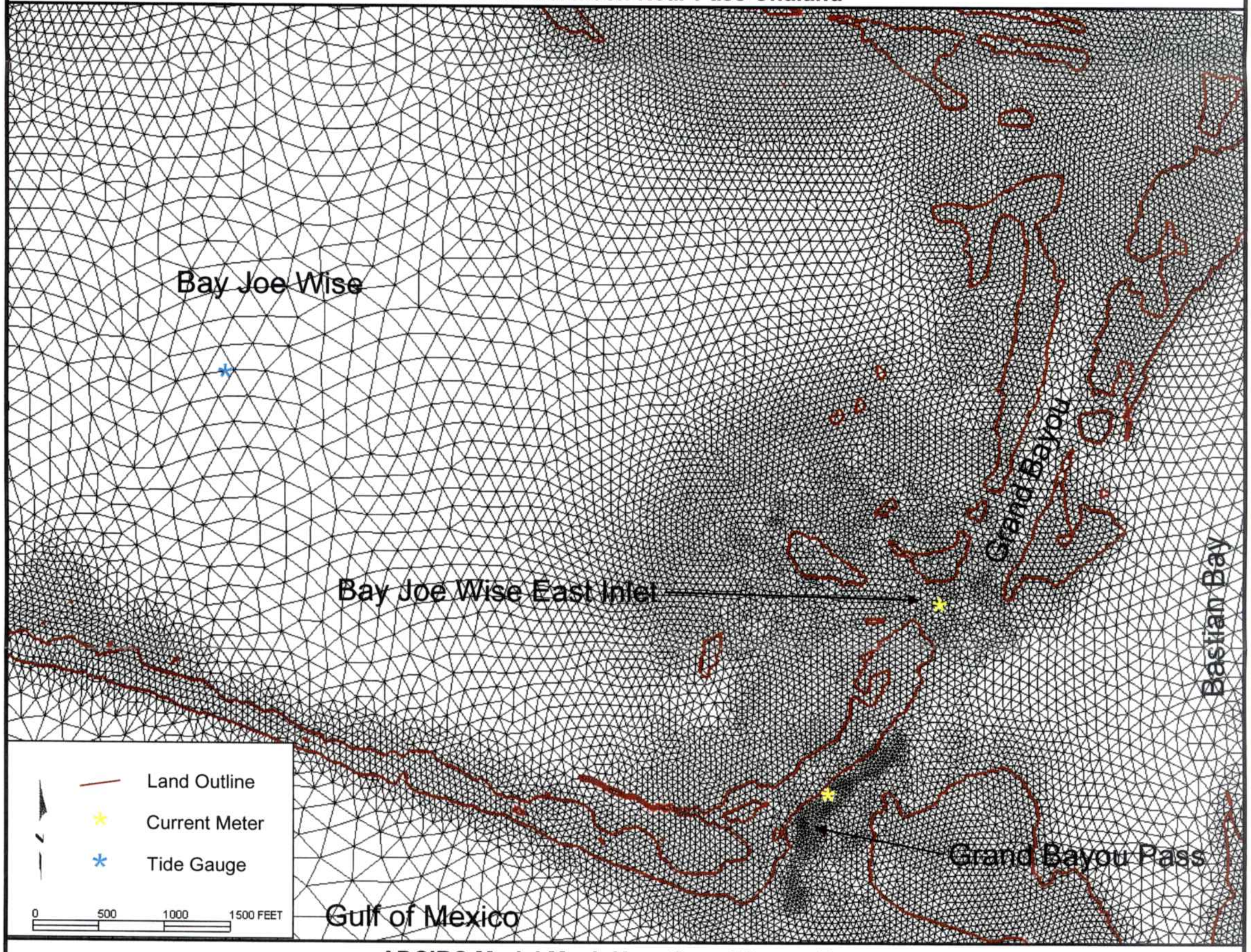


Figure 7-7.ppt
April 19, 2004

Figure 7-7: ADCIRC Mesh for Model Domain



ADCIRC Model Mesh Near Pass Chaland



ADCIRC Model Mesh Near Grand Bayou Pass

Figure 7-8: Close Up Views of ADCIRC Model Mesh

7.2.1.3 Model Parameters

Reducing the node spacing to less than 50 feet was used sparingly since the smaller node spacing can cause numeric instabilities to occur within the model if the time step size is not reduced to accommodate the small node spacing. A time step of 0.5 seconds was used in the calibrated model. Larger time steps caused the simulation to generate water elevations and distributions that were not physically possible. This time step size along with the size of the model and number of other parameters used, required roughly 24 hours to simulate a 24 hour period using a 3.0 GHz Pentium computer. With such long computation times, every effort was made to avoid modifications to the mesh that would require a further decrease in the time step size.

Currents were driven in the model by assigning the model boundary that extended from the westernmost barrier island out into the Gulf of Mexico and back up to the easternmost barrier island in the model domain (see Figure 7-7) as a specified elevation boundary with harmonic tidal constituents setting the changes in elevation along the boundary. The remainder of the model boundary was assigned as a zero normal flow boundary with tangential slip. The slip conditions for velocity were enabled since in some places, the model boundary did not necessarily represent a land boundary, although significant flow that might impact Bay Joe Wise itself was not anticipated through any part of that boundary. As such, water flowing parallel to the boundary should not be impeded as one might expect water flowing along a land boundary would be. In areas where the boundary did coincide with land, the bathymetric surface was set up to represent that feature, and therefore impeded the flow accordingly without imposing a no-slip condition on the boundary itself.

The tidal forcing parameters were obtained from the LeProvost database included with SMS. Tidal forces used in the calibrated simulation were: K1, O1, M2, N2, S2, K2, and Q1. A start time of 12:00 AM August 20, 2003, GMT, was used for the application of the tidal forces. At the beginning of the simulation, the model area had a uniform water surface elevation of 0 feet. In order to avoid causing the model to become unstable from an instantaneous application of a large tidal forcing along the Gulf boundary, a one day ramping period was used. With the one day ramping period, the tidal forcing was slowly increased until the forcing was applied at a full 100% at the end of the ramping period, allowing the model to slowly equilibrate to the applied tides.

ADCIRC uses the continuity equation and primitive momentum equations in a modified form called the Generalized Wave Continuity Equation (GWCE) to simulate the movement of fluid. The advective terms and time derivative terms in the GWCE can be turned off for simplified scenarios or for troubleshooting sources of instability in the model. Since the final simulation is far more accurate with both of these terms considered in the calculations, they were both used in the calculation of the currents in the calibrated model.

The region surrounding Bay Joe Wise is a very low-lying, flat marsh that normally becomes inundated at high tide and drains at low tide. Due to this characteristic of the region, wetting and drying calculations were activated in the calibrated model. The model was set up to allow nodes to become saturated when the water elevation in nearby nodes was at least 0.16 feet (0.05 meters) above the bathymetric surface of the dry node and also had a minimum water velocity of 0.16 feet per second (0.05 meters per second) moving through the neighboring saturated node. Once a node became dry, it had to remain dry for at least 90 time steps (45 seconds).

A hybrid bottom friction was used in the calibrated model. The hybrid friction equation sets a constant friction factor at depths below a user specified break point (H_{break}) and increases the friction factor with decreasing depth after the break point has been reached. The equation for the hybrid friction calculation follows:

Equation 7-1 $$C_f = C_{f\,\min}\left[1+\left(\frac{H_{break}}{H}\right)^{\theta}\right]^{\gamma/\theta}$$

where: C_f = Friction Coefficient
C_{fmin} = Minimum Friction Coefficient
H_{break} = Break Depth
H = Height of Water Column
θ = Asymptotic Approach Factor
γ = Friction Factor Increase

In the calibrated model, C_{fmin} was set to 0.003, H_{break} was 1 meter, θ was 10, and γ was 0.3333.

Wind and atmospheric pressure were not used in the model. Under normal conditions, they are not expected to significantly influence the movement and distribution of water in and around Bay Joe Wise.

The calibrated model was set up to simulate eight days, starting at 12:00 AM on August 20, 2003, GMT. The first day of the simulation was the ramping period, leaving seven days of fully forced tidal flows through the model. Output was generated for both water elevations and velocities every 30 minutes (3600 time steps) of simulation time for the entire model period.

7.2.2 Model Calibration

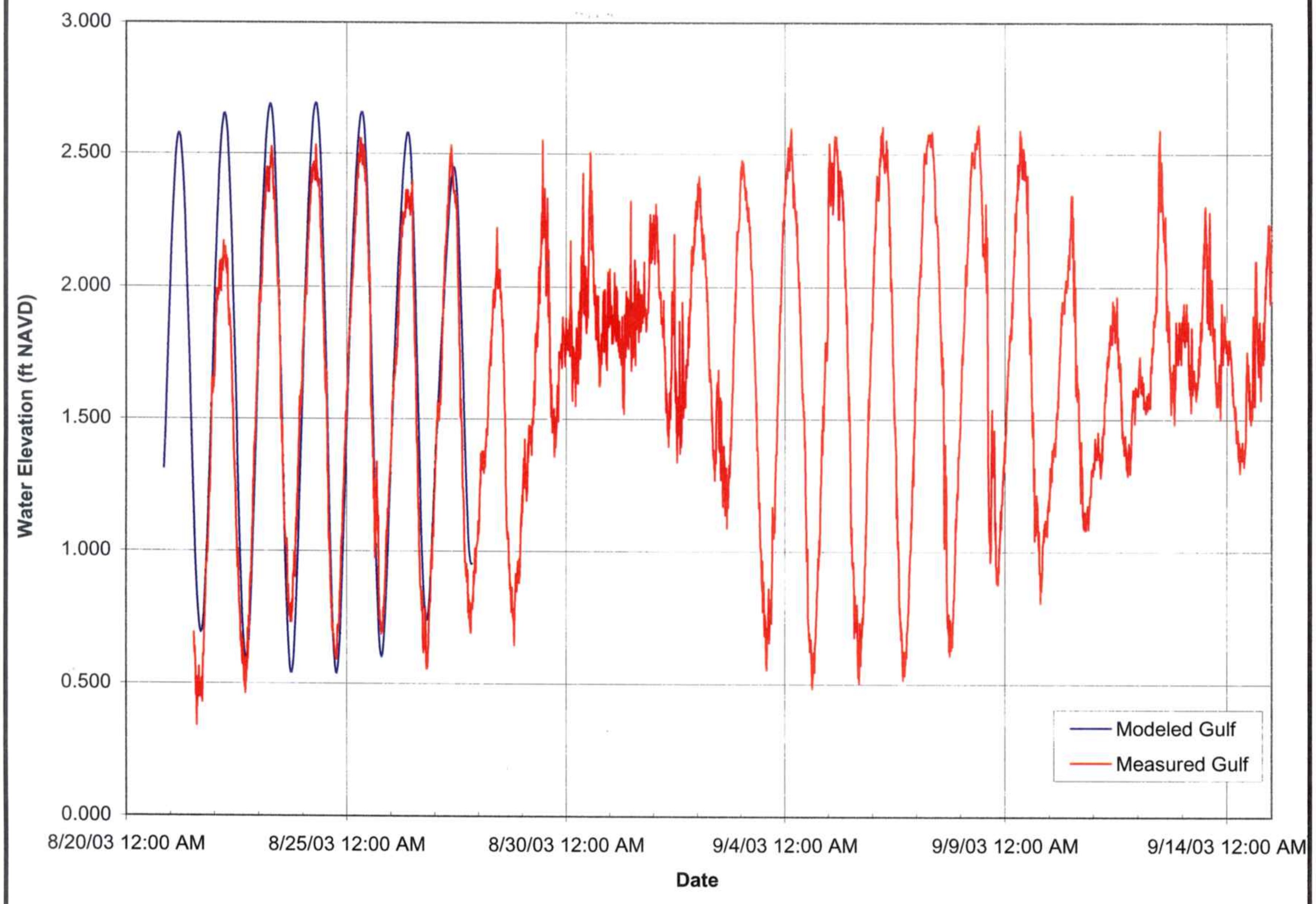
7.2.2.1 Water Elevations

The ADCIRC model was run with a large variety of different input parameters and mesh lay-outs in order to find a combination of parameters that provided the best possible match to the measured conditions while remaining physically realistic. Bathymetric data used in the model was obtained from survey activities on site as described in Section 4.1. For the deeper off-shore waters that were not surveyed as part of this project, data extracted from the National Geophysical Data Center's Geophysical Data System was used. Water elevation and flow velocity data for calibrating the model were obtained from two tide gauge and four current meter deployment locations, respectively. Details of this data are described in Section 4.2.

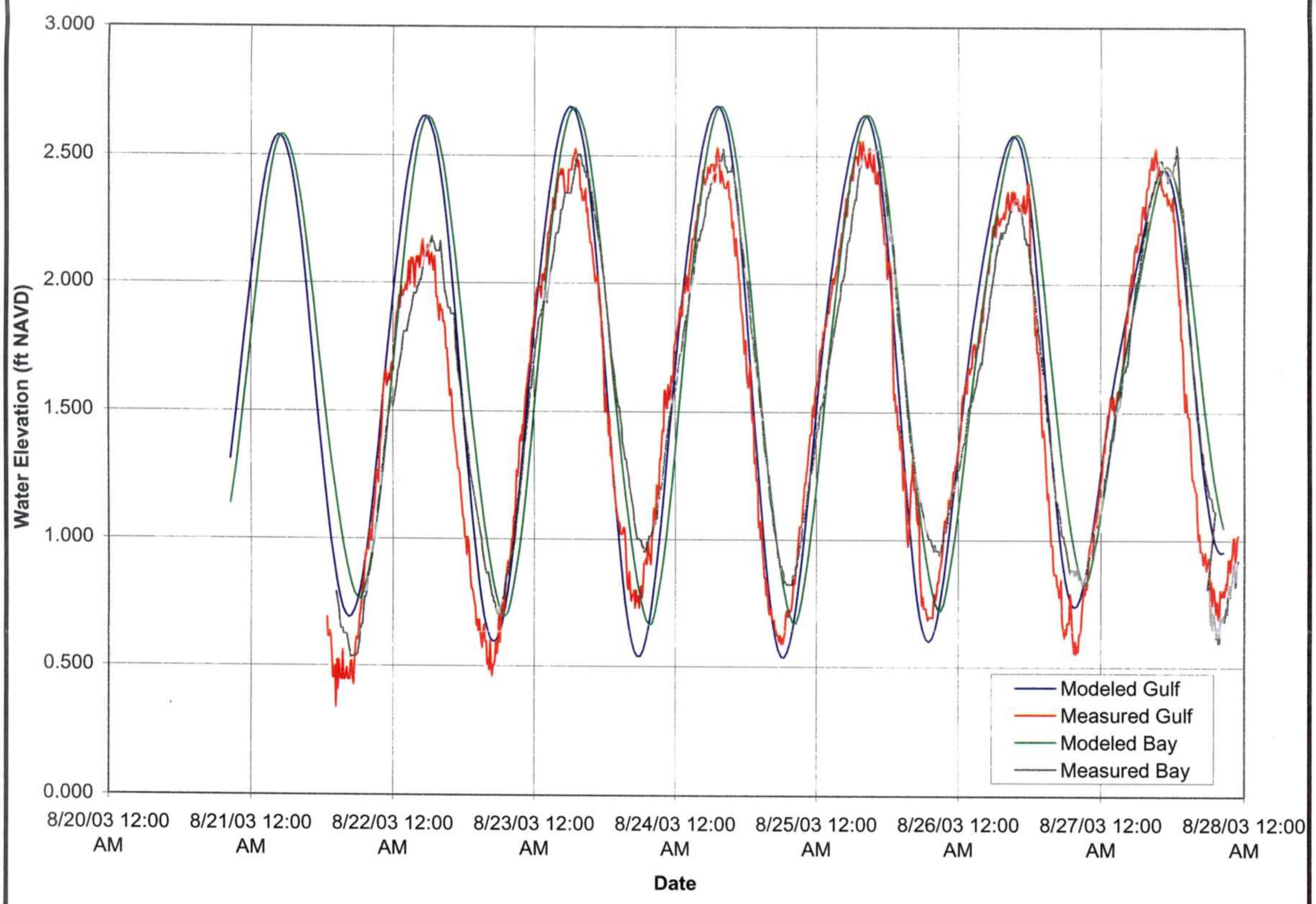
Figure 7-9 displays the modeled and measured water elevations at the two tide gauges. The top image in the figure displays the entire three and a half weeks of measurements from the tide gauge in the Gulf of Mexico with the seven days of simulated water elevations overlaid on the measured data. From this graph, it can be seen that ADCIRC is modeling the tide elevation as a consistent sinusoidal curve in the absence of wind and pressure forces. The ADCIRC curve steadily increases in magnitude until it reaches a peak near August 24th, then it steadily begins to decrease in magnitude. This trend matches very closely to the sinusoidal curve observed from the Gulf tides between September 2nd and September 10th displayed in the same graph, and trends in the Gulf tides in this region observed by NOAA. During the model period, however, the measured Gulf tides do not follow the steady increase and decrease in magnitude as closely as normally observed, although it does show the same general trend. This minor divergence from the normal trend is most likely due to windy conditions or a nearby pressure system. Despite the small perturbations in the Gulf tide during the week in which most of the measurements were made on site, the water elevations modeled by ADCIRC generally remained within 0.2 feet of the measured values.

The second graph displayed in Figure 7-9 displays modeled and measured water elevations for a one week period for both the Gulf tide gauge and the Bay Joe Wise tide gauge. As shown in the previous graph, observed water elevations diverge by as much as about 0.4 feet, but were generally within 0.2 feet, from the steady sinusoidal curve modeled by ADCIRC, but the same general trends are present, including the lag between high and low tides in the Gulf and the Bay, and the higher water elevations that remain in the Bay at low tide.

Comparisons of the modeled and measured data for both the Gulf and Bay tide gauges are shown in Figure 7-10. The "ideal match" line displayed on the graph shows what a perfect match between the modeled water elevations and measured water elevations would be. Points below the line showed modeled water elevations were too high. Likewise, points above the line were modeled too low. The graph shows that at higher modeled water elevations, the modeled elevations were approximately 0.2 feet high. This trend can be seen in Figure 7-9 where the measured high tides are somewhat stunted in comparison to the high tides in the early September measurements. The modeled low- and mid-tide water elevations generally match the measured values in the Gulf with some values slightly higher than measured and some slightly lower than measured. This scattering is also easy to see in Figure 7-9 as the low tide elevations tend to fluctuate from the normal sinusoidal curve more during this week than in subsequent weeks. Modeled low water elevations in the Bay were approximately 0.2 feet to 0.3 feet lower than measured.



Modeled Versus Measured – Gulf of Mexico – Long Term



Modeled Versus Measured – Gulf of Mexico and Bay Joe Wise

Figure 7-9: Modeled Versus Measured Water Elevations

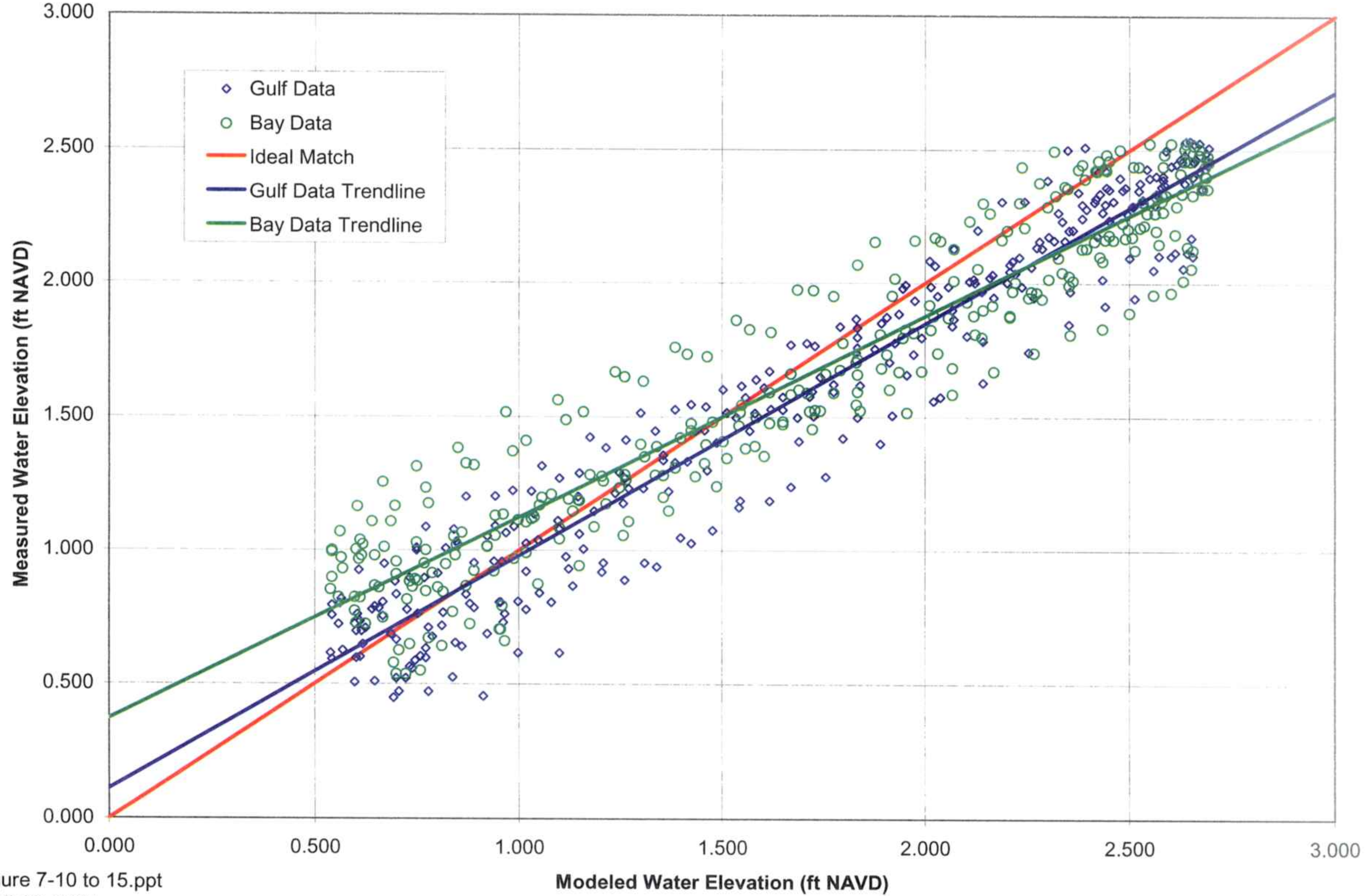


Figure 7-10 to 15.ppt
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Figure 7-10: Simulated Water Elevation
Comparison to Measured Elevations

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7.2.2.2 Current Velocities

Once it was determined a reasonable match between the modeled and measured Gulf and Bay water elevations had been achieved, the flow patterns within the channels running between the Gulf and the Bay were verified. Graphs of the modeled and measured current velocities at the four current meters were developed. These graphs are displayed in Figures 7-11 through 7-14. The locations are shown in Figure 7-8.

Modeled and measured water velocities are shown in Figure 7-11 for the Bay Joe Wise East Inlet. This is the primary entrance channel into Bay Joe Wise from Grand Bayou Pass on the east side of the Bay. The graph shows the velocities matched within approximately 0.1 foot per second on both flood tide and ebb tide. The modeled flood tide velocity may begin to decrease sooner than the measured velocity due to the inundation of water onto some of the islands in the inlet. Based on observations in the field, most of the islands in the channel become inundated with water during flood tide. Some of these islands may be getting flooded slightly earlier in the model than they should be, causing the water channel to expand, and the velocity to subsequently decrease earlier than expected. Overall, the pattern of the modeled flood and ebb velocities matched measured conditions very well at this inlet.

Figure 7-12 displays the comparison between the modeled and measured velocities in the Bay Joe Wise West Inlet. This is the primary entrance channel into Bay Joe Wise from Pass Chaland. As mentioned earlier in the discussion on the model development, a 50-foot node spacing was generally used in the areas of the model with shallow water and narrow water channels. Since at least two saturated nodes are required to maintain a stable water channel in ADCIRC, it is difficult to develop a channel with a width of 100 feet or less without refining the mesh further, which can then cause stability problems addressed earlier. The Bay Joe Wise West Inlet is generally only about 100 feet wide at mean water elevation, but due to the limitations of the 50-foot node spacing, it was represented in the model with a 150 feet width. This created a cross sectional area of 400 square feet in the model. The measured cross sectional area in the field was about 250 square feet. Using the relationship:

Equation 7-2 $Q = v*A$

where: Q = Flow Rate in cubic feet per second
v = Velocity in feet per second
A = Cross-Sectional Area in square feet

and assuming the flow rate remains constant as the cross sectional area changes, the velocity reported from the model should be about 60% higher to account for the smaller cross section. The green "modified modeled" line in Figure 7-12 represents the modeled data with this 60% adjustment. Similar to the Bay Joe Wise East inlet, the Bay Joe Wise West Inlet has an island on its southern border that becomes inundated with water during

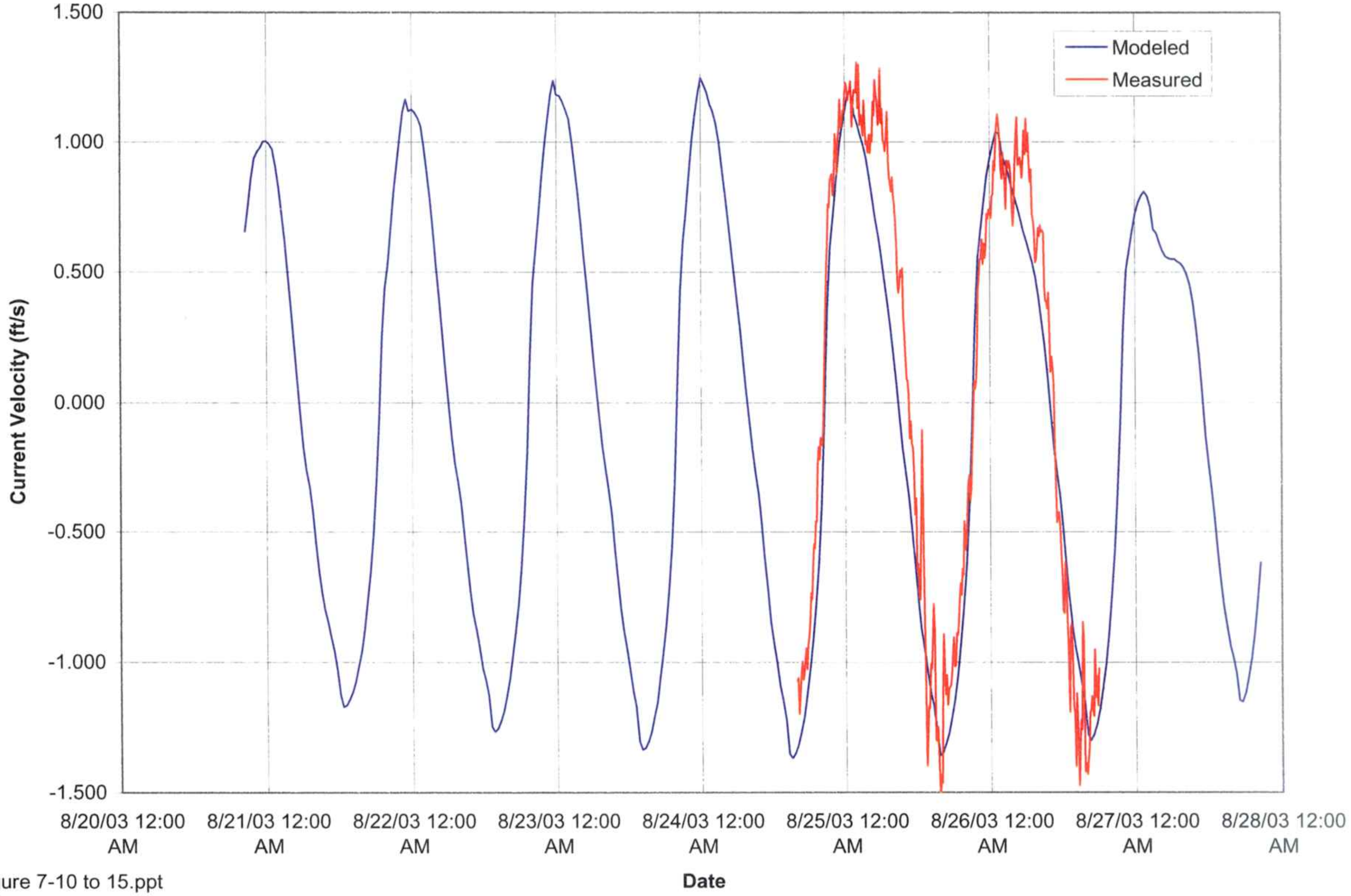

Figure 7-11: Modeled Versus Measured Current Velocities – Bay Joe Wise East Inlet

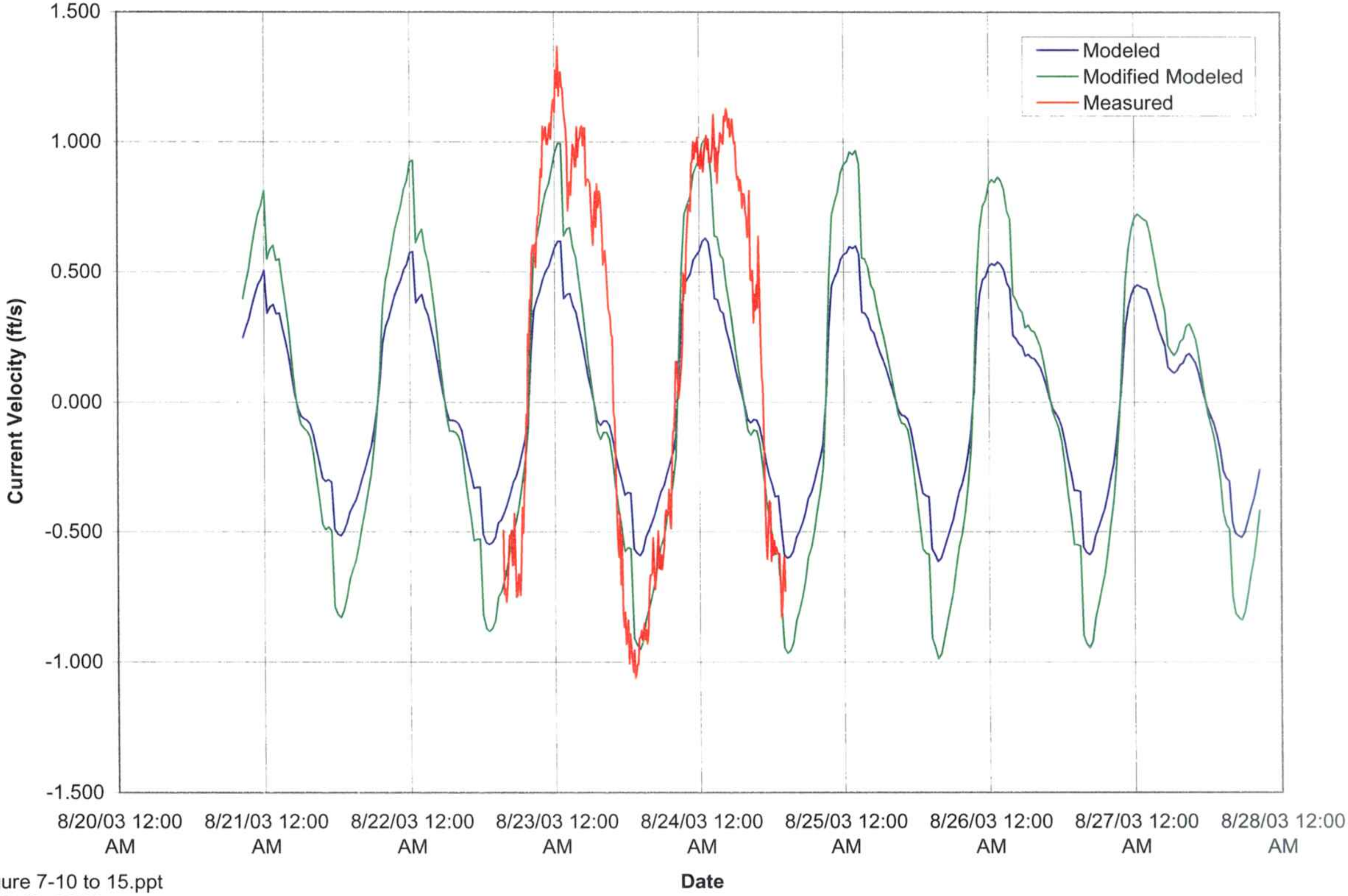

Figure 7-10 to 15.ppt
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Figure 7-12: Modeled Versus Measured Current Velocities – Bay Joe Wise West Inlet

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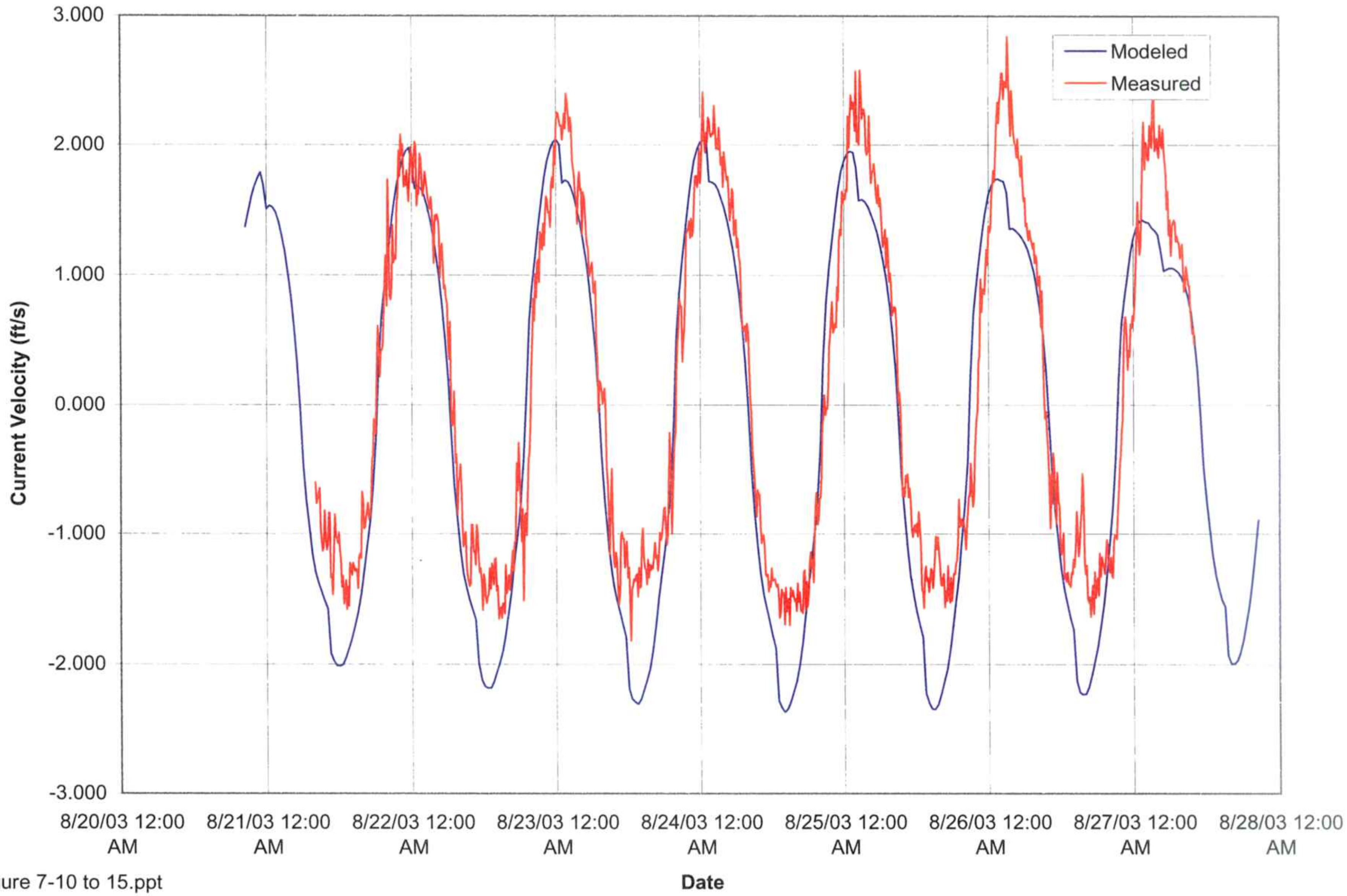

Figure 7-10 to 15.ppt
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Figure 7-13: Modeled Versus Measured Current Velocities – Grand Bayou Pass

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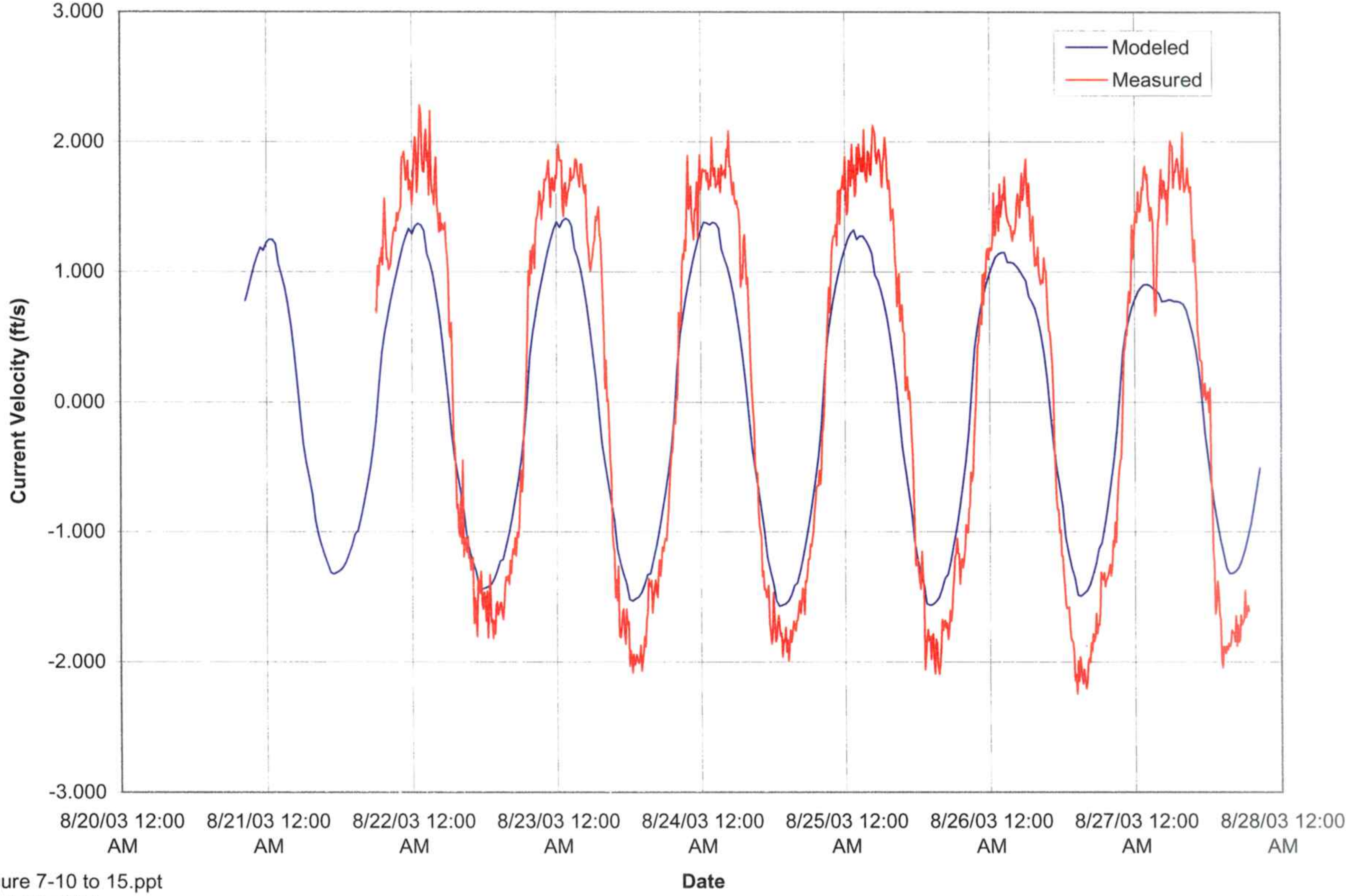

Figure 7-10 to 15.ppt
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Figure 7-14: Modeled Versus Measured Current Velocities – Pass Chaland

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flood tide. This inundation is what causes the velocity to drop suddenly instead of leveling off at the maximum velocity. Other than the sharp decrease in velocity caused by the early flooding of the island south of the inlet, the modeled velocities modified for the cross sectional area differences matched the measured values within 0.1 to 0.2 feet per second.

Comparisons of the modeled and measured currents in Grand Bayou Pass are presented in Figure 7-13. The flood tide velocity was matched within 0.2 feet per second during the first three (3) days of the simulation by the ADCIRC model, but the ebb velocity was modeled to be roughly 0.5 to 0.7 feet per second faster than what was observed on-site. This may be occurring for several different reasons. One of the more likely possibilities is the model is over-predicting the area of land that dries out on ebb tide. Since the peak velocity occurs fairly late in the ebb tide cycle, the water channel may be more constricted in the model than it should be. Another possibility is that some of the water flow needs to be redirected toward Bastian Bay during ebb tide. The primary focus on the development of the ADCIRC model is to simulate changes within Bay Joe Wise under the various proposed alternatives. Since the general flow patterns matched very well in Grand Bayou Pass, and the previous figures show matches to measured conditions in the inlets directly connected to the Bay itself, the predicted increase in velocity magnitude on ebb tide in Grand Bayou Pass was deemed an acceptable accuracy of the model for the predictive scenarios for which it was designed.

Figure 7-14 displays the graph of modeled and measured water velocities in Pass Chaland. The general distribution of modeled velocities matches the distribution of measured velocities, but the magnitudes at the peak flood tide and peak ebb tide velocities in the model are approximately 0.5 feet per second lower than measured. Bayou Chaland is the primary waterway that the water flowing through Pass Chaland flows into or out from. The Scope of Work for this Project did not extend into this area, and as such, the exact bathymetry of the northwest area of the model, which includes Bayou Chaland and the small Bays and channels that feed into it was developed using existing nautical charts and aerial photographs. One possibility of why the peak flows are too low is the modeled water depth in these areas may be too shallow. This may prevent the proper flow rate from coming in through Pass Chaland which in turn will cause at least part of the observed shortfall in the modeled velocity magnitude at Pass Chaland. Since the modeled water velocities matched the measured velocities at the Bay Joe Wise West Inlet, it appeared the component of flow coming in from Pass Chaland and flowing east toward Bay Joe Wise and Bayou Huertes was accurately represented by the model. As such, the 0.5 feet per second shortfall in peak velocity magnitude at the Pass was deemed an acceptable accuracy of the modeled flow patterns.

A direct comparison of the modeled and measured data is provided in Figure 7-15. The modeled velocity trends were within 0.1 to 0.2 feet per second (ebb and flood) for Bay Joe Wise East and 0.1 (ebb) to 0.4 (flood) feet per second at Bay Joe Wise West. Grand Bayou Pass matched very well at higher velocities, but diverged slightly from the ideal match at the ebb velocities. The modeled Pass Chaland velocities matched very well, between -1 and 1 foot per second, but become more skewed at the peak velocities.

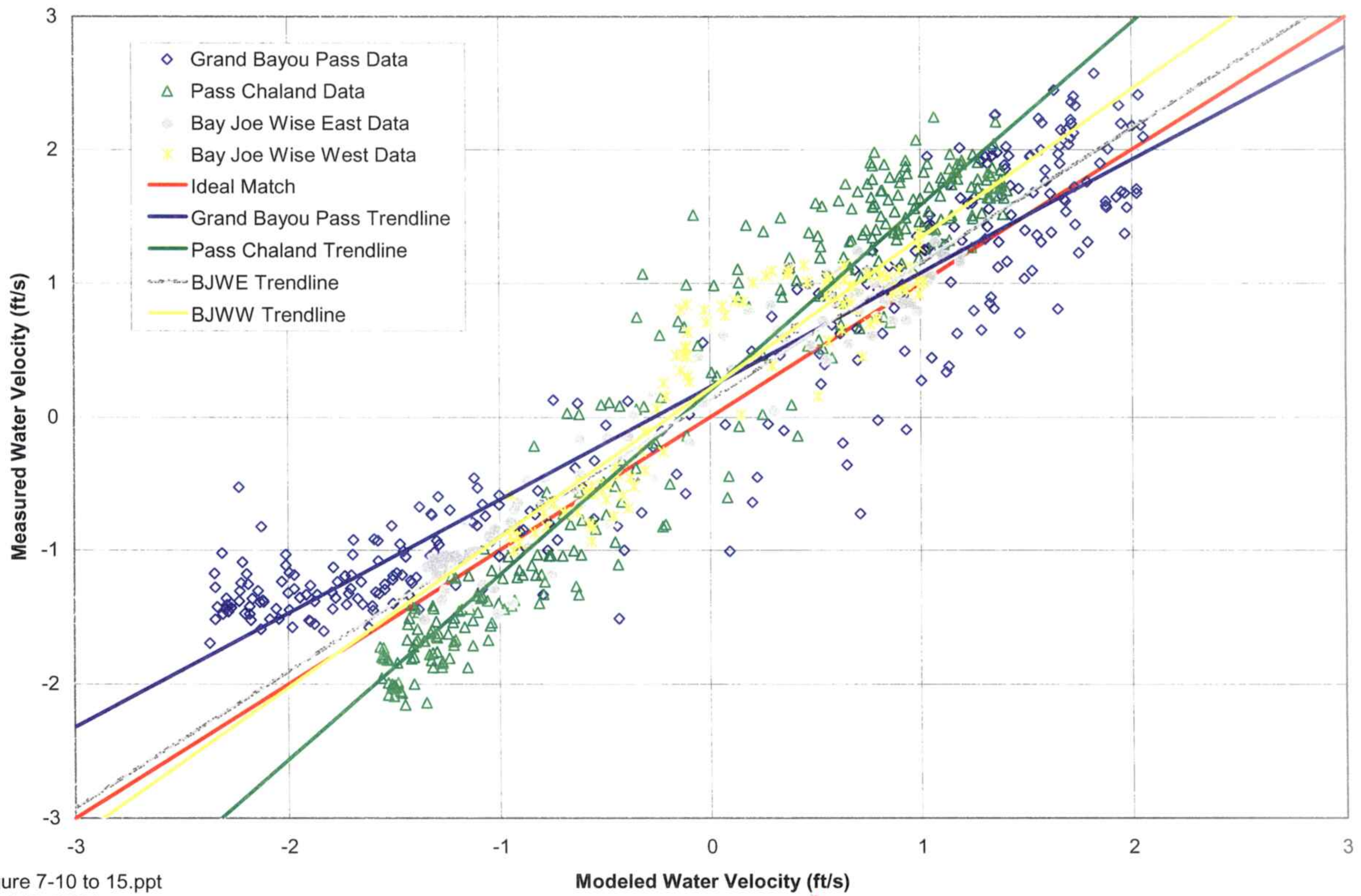


Figure 7-15: Simulated Water Velocity Comparison to Measured Velocities

7.2.3 Modeled Water and Flow Distributions

The graphs and comparisons in the previous section depicted quality matches between predicted and measured conditions at the monitored locations. Modeled water and velocity distributions must also match the conceptual distributions to help ensure accurate predictions can be obtained from the calibrated model.

Modeled water elevations through the Bays and channels surrounding Bay Joe Wise are shown in Figure 7-16. The water elevations were extracted late in the flood tide on 1:30 AM on August 24, 2003. In this figure, it can be seen a fairly large difference in water elevation exists at Pass Chaland and Grand Bayou Pass as the rising water works its way into the Bays and channels from the Gulf. Bastian Bay, which has a large opening directly to the Gulf, has water elevations that most closely match those simulated in the Gulf at that point in time as expected due to its direct connection to the Gulf. A fairly isolated Bay located immediately west of Bay Joe Wise has the lowest water elevations in this part of the model. Conceptually, this makes sense since this Bay is connected to the rest of the system by only two very narrow channels. Additionally, those two water channels themselves are reached only after the flooding water has flowed through almost every other part of these Bays and channels.

The current velocities for the same point in time represented in Figure 7-16 are shown in Figure 7-17. Vectors depict the direction of the modeled currents while the contours represent the magnitude of the current flow. The speed and direction of the flow are consistent with measurements and observations made during the Tidal Study.

As previously stated, the Bay Joe Wise region is a very low-lying, flat area and much of the land becomes inundated with water at high tide and drains at low tide. Figure 7-18 displays a representation of how this water inundation is accommodated within the ADCIRC model. The first (top) image in the figure shows the water elevations and dry land at low tide in the Gulf. As seen in this image, many of the water channels are very narrow and there is a fairly large amount of dry land present. The second (middle) image displays the water elevations and land distributions at mid tide. Some water channels have already become swollen at this point compared to the low tide water elevations, and some islands have already been completely submerged. The third image (bottom) displays the water elevations and land distribution at high tide in the Bay area. At full high tide, many islands are submerged, most of the channels are noticeably wider, and much of the “dry” land seen at low tide has been inundated.

7.2.4 Alternative Evaluations

The bathymetric surface in the calibrated model was adjusted to simulate the flow patterns that may exist in Bay Joe Wise under the alternative marsh fill templates. Figure 7-19 displays a contoured representation of the bathymetric surface in the calibrated model in the immediate vicinity of Bay Joe Wise. Figures 7-20 and 7-21 display the bathymetric surfaces with the incorporation of the proposed marsh fill for Alternatives 2 through 4 and Alternative 5, respectively.

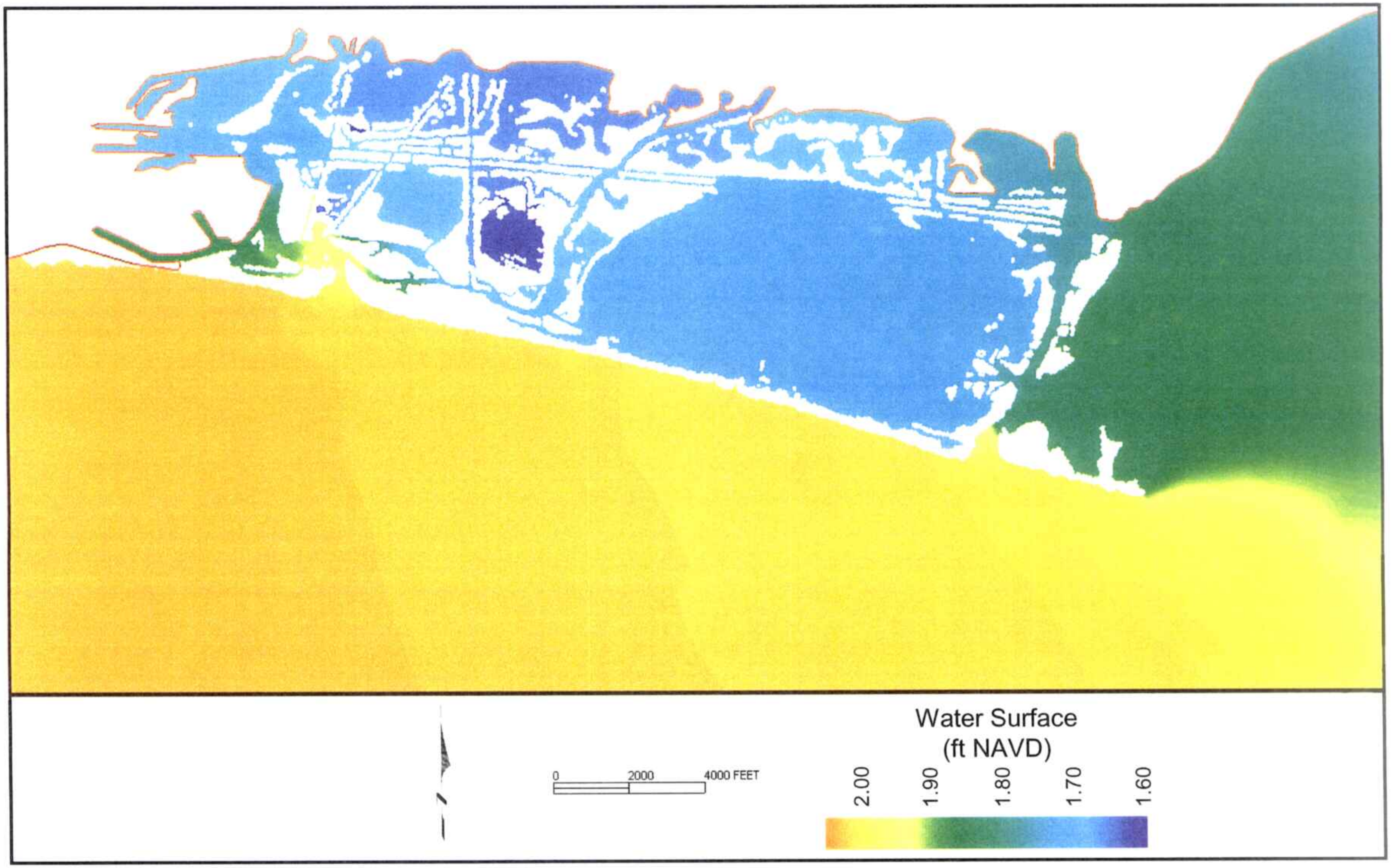
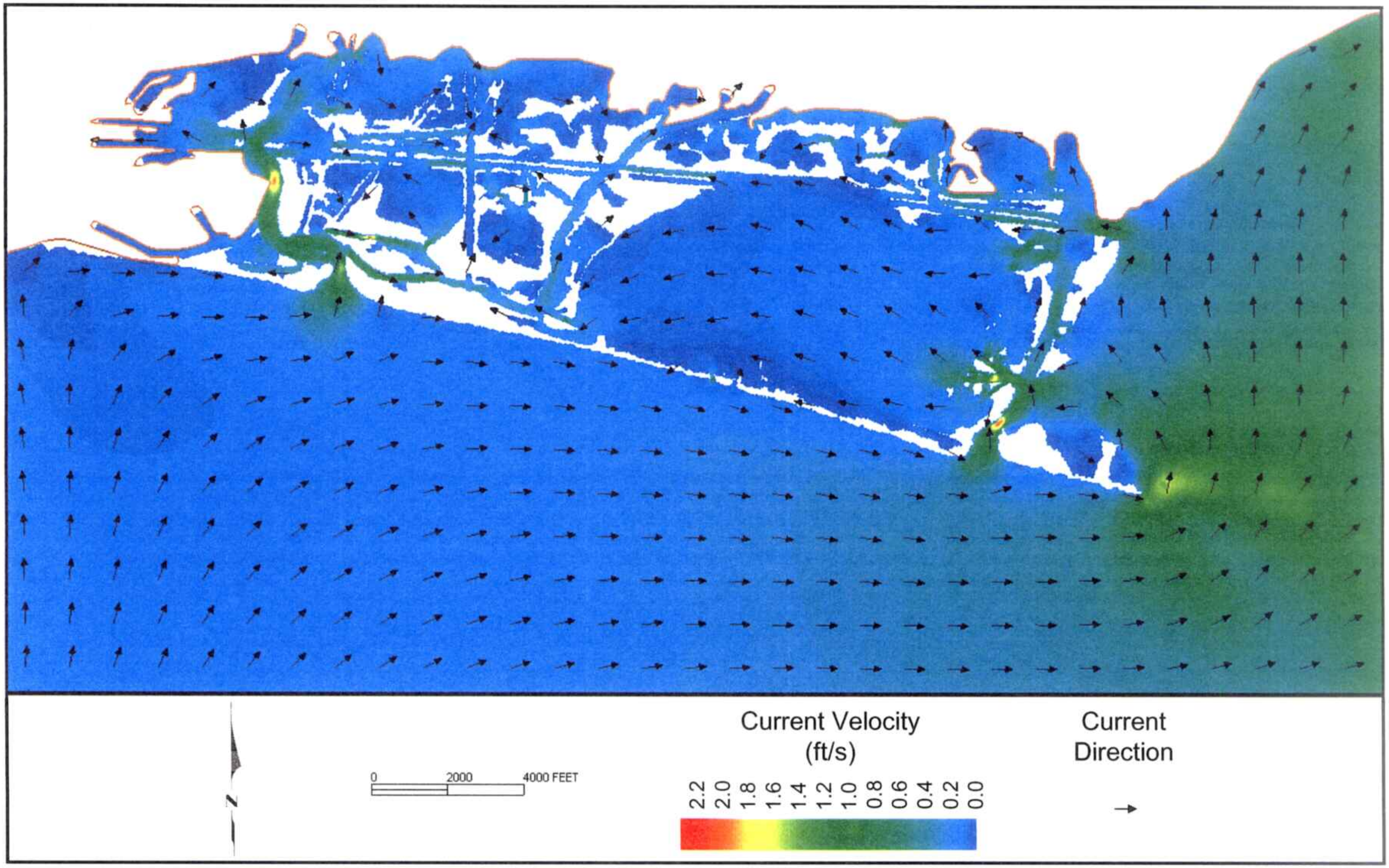


Figure 7-16: Flood Tide Water Elevation
(1:30 AM on 8/24/2003)



Figures 7-16 and 17.ppt
April 19, 2004

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Figure 7-17: Flood Tide Current Velocity
(1:30 AM on 8/24/2003)

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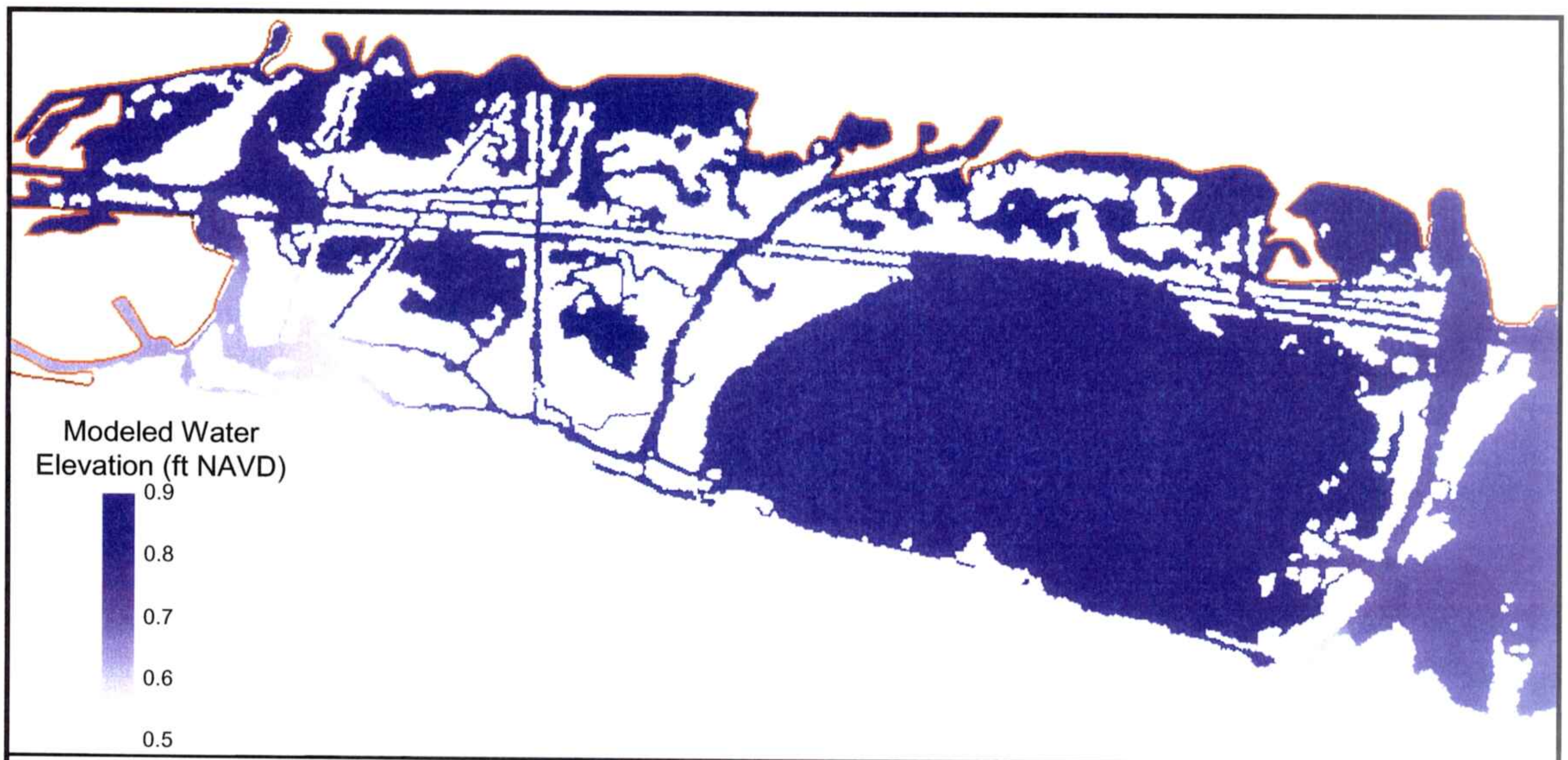
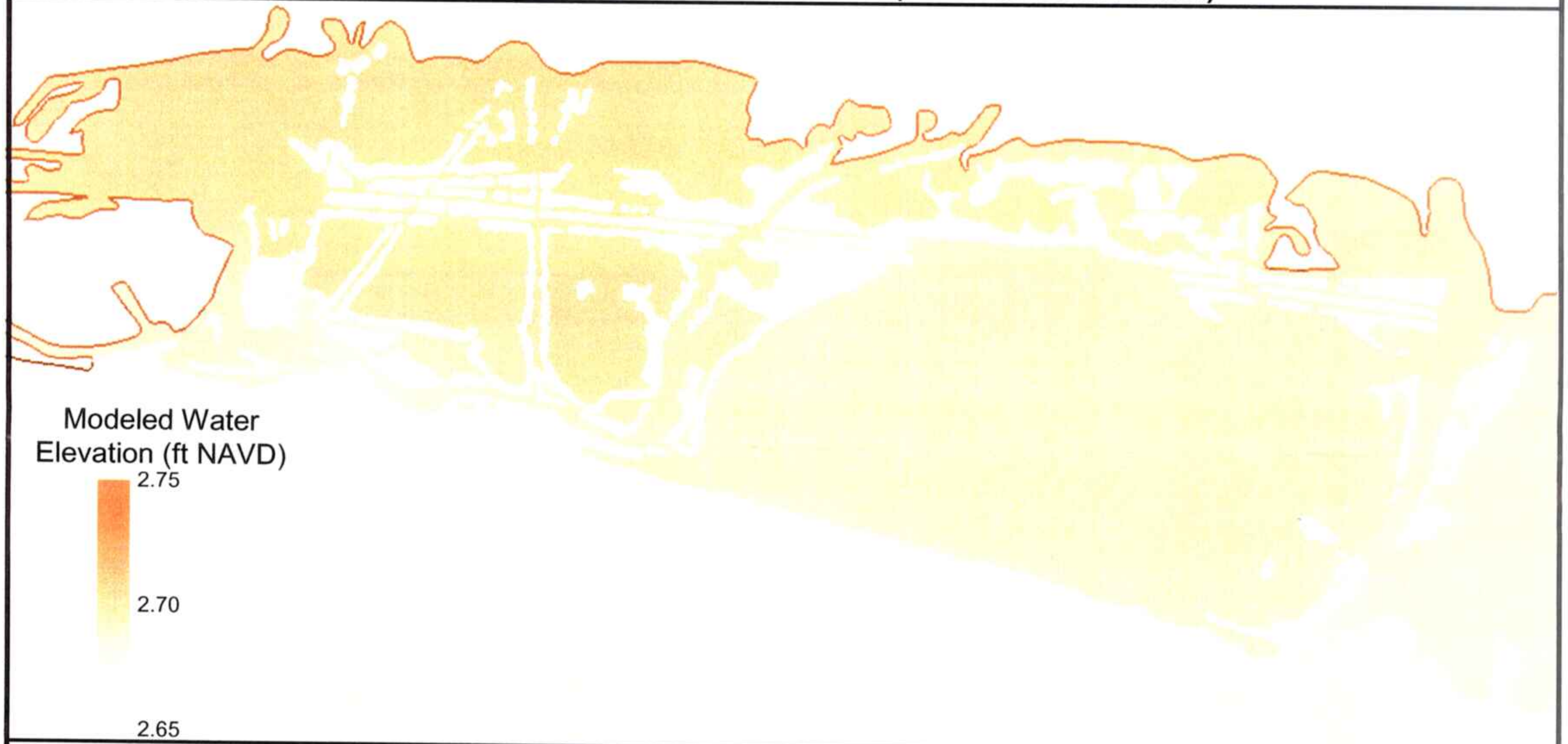


Modeled Water Distribution at Gulf Low Tide (6:00 PM on 8/23/2003)

Modeled Water Distribution at Mid Tide (12:30 AM on 8/24/2003)



Modeled Water Distribution at Bay High Tide (8:00 AM on 8/24/2003)

Figure 7-18.ppt
April 19, 2004

Figure 7-18: Modeled Water Distributions

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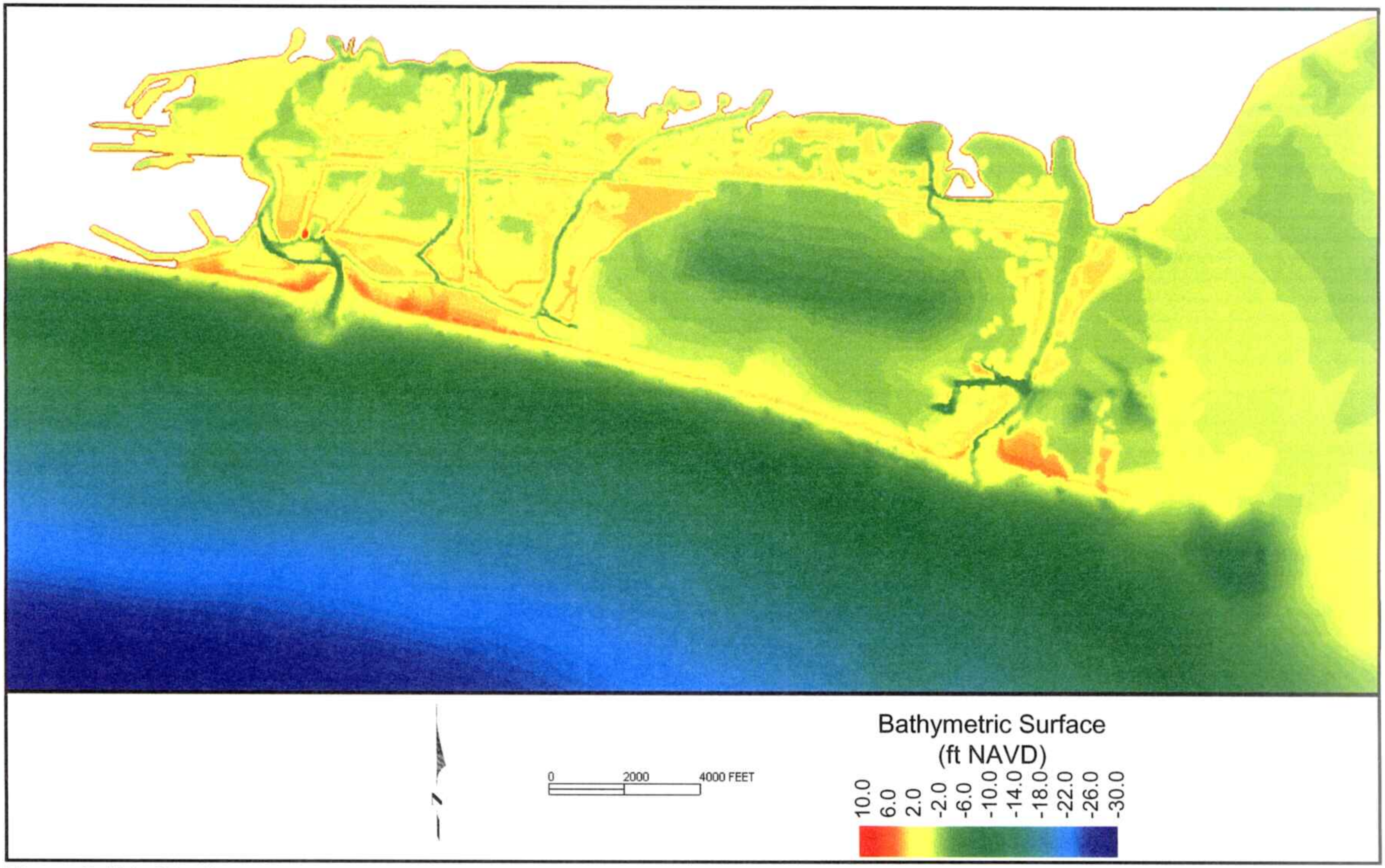
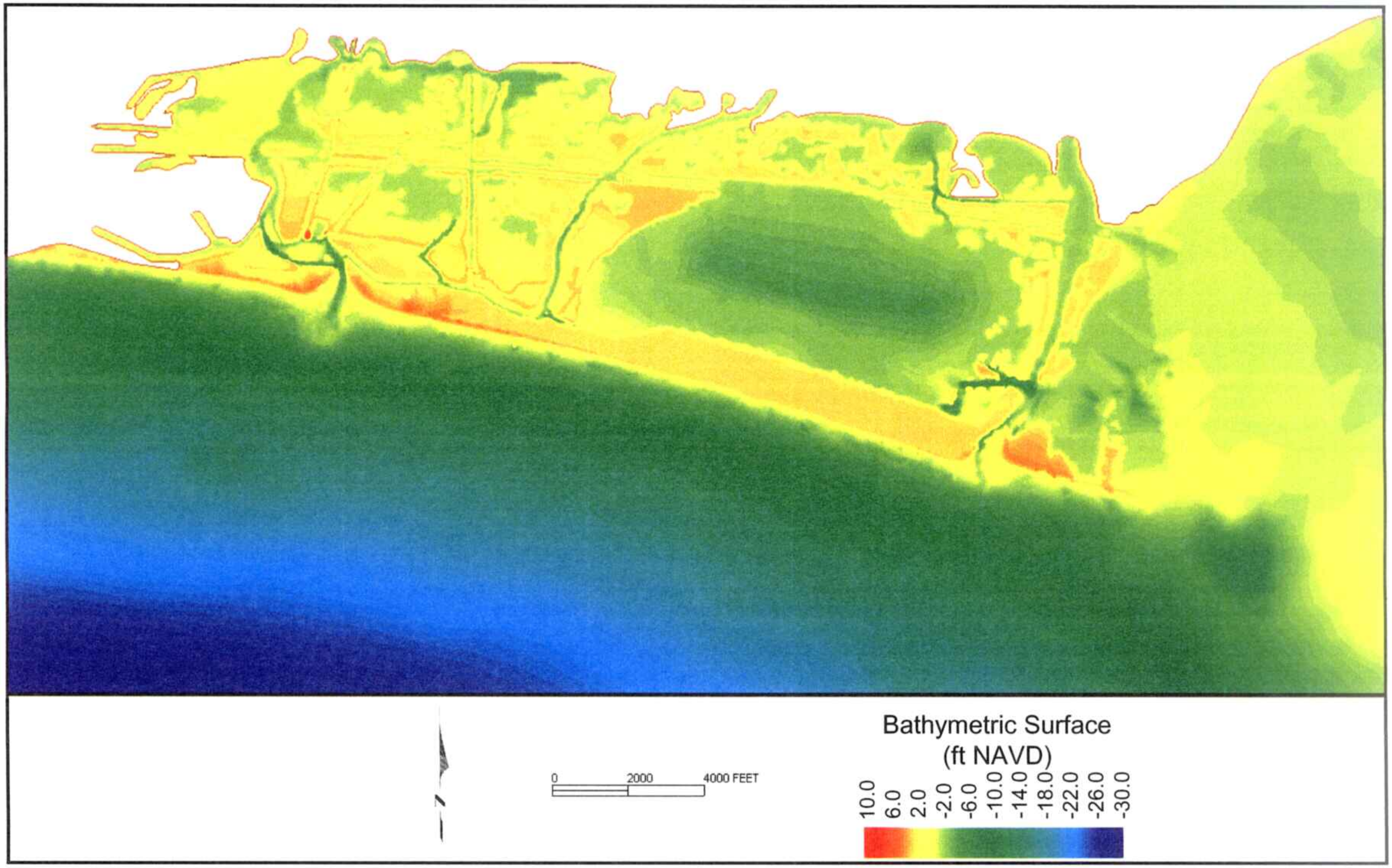


Figure 7-19: Existing Bathymetry



Figures 7-19 to 21.ppt
April 19, 2004

Figure 7-20: Proposed Bathymetry: Alternatives 2 through 4

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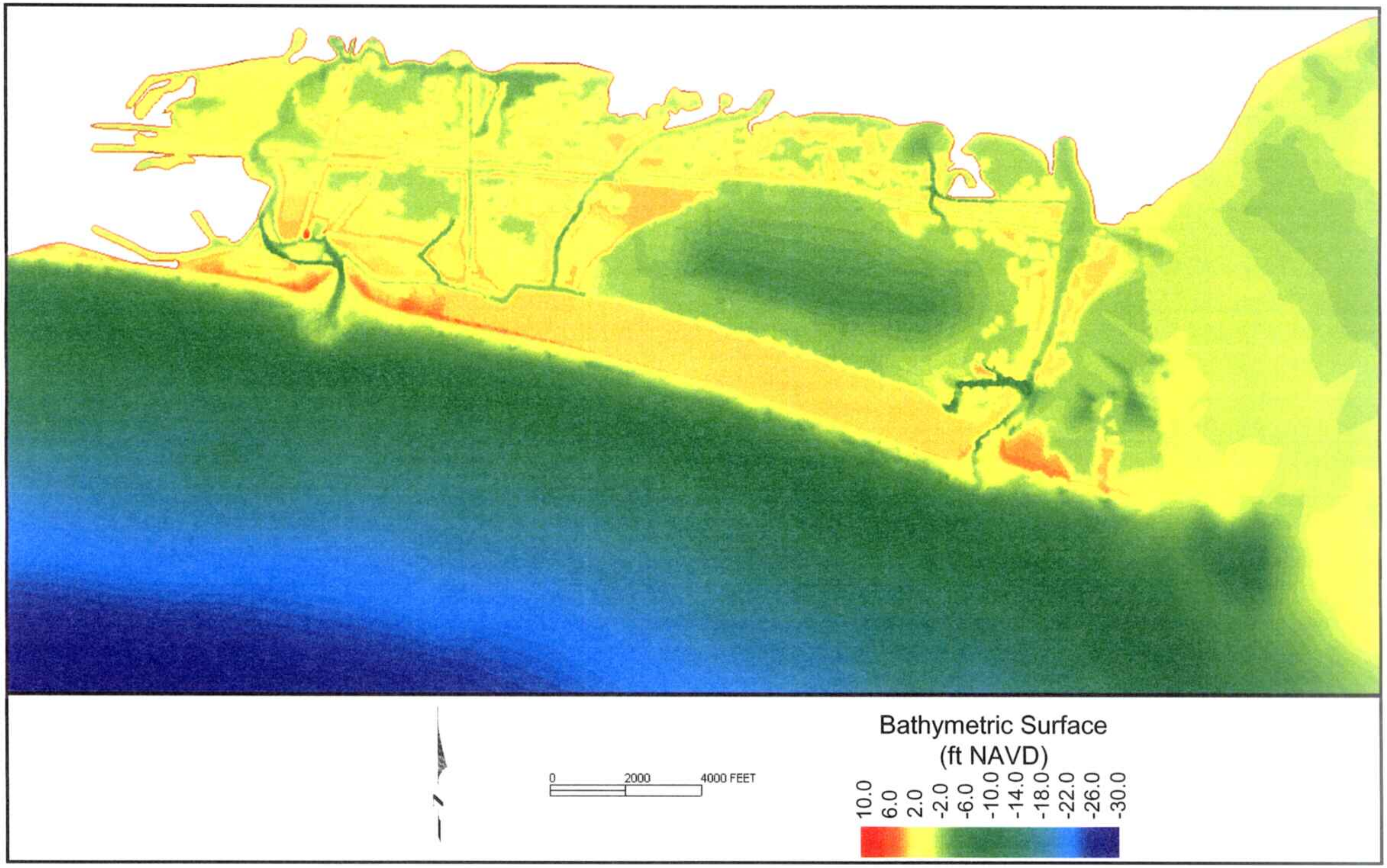

Figures 7-19 to 21.ppt
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Figure 7-21: Bathymetry: Alternative 5

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In order to model the desired area of marsh in Alternatives 2 through 4, the edge of the proposed marsh fill encroached on the Bay Joe Wise West Inlet. The depth reduction in the inlet can be seen in Figure 7-20.

The proposed marsh fill for Alternative 5 extends further landward into Bay Joe Wise. As a result, a secondary channel will be dredged to replace the Bay Joe Wise West Inlet as part of this alternative, and can be seen in the modeled bathymetric surface in Figure 7-21.

The effects of the alternatives on modeled water velocities moving through various points of the model were evaluated. The first point evaluated was in Grand Bayou Pass. Figure 7-22 displays the simulated velocities passing through this inlet under the three scenarios considered, which include no marsh (present conditions), the marsh fill template in Alternatives 2 through 4, and the marsh fill template for Alternative 5. From this graph, it can be seen there is a minimal impact on water flow velocities caused by changes to the proposed marsh template in the Bay.

Modeled water velocities in Pass Chaland are displayed in Figure 7-23. Like Grand Bayou Pass, the marsh fill templates have a negligible impact on water flow velocities at this pass.

The next point evaluated was in the Bay Joe Wise East Inlet. Comparisons of modeled water velocities in this inlet are shown in Figure 7-24. A greater difference in water velocities was observed. A slight decrease in water flow velocity magnitude occurred between the modeled Alternative 1 velocities and the modeled Alternatives 2 through 4 velocities (0.2 to 0.3 feet per second difference). The modeled Alternative 5 velocities are generally slightly smaller than the Alternative 2 through 4 velocities (less than approximately 0.1 feet per second). Conceptually, this decrease in maximum velocity seems reasonable since the volume of water (or the volume of the tidal prism) controlled by the Bay Joe Wise East Inlet has been reduced by the proposed marsh fill comparing Alternative 1 and Alternative 2 through 4, then it is reduced by a slight additional amount comparing Alternatives 2 through 4 to Alternative 5. This in turn can be expected to decrease the maximum velocity moving through the inlet.

Modeled Bay Joe Wise West Inlet velocities are displayed in Figure 7-25. As mentioned earlier, in order to achieve the desired marsh area, the Bay Joe Wise West Inlet had to be slightly reduced in cross sectional area for Alternatives 2 through 4. This reduction in cross sectional area resulted in simulated water velocity magnitudes slightly higher in magnitude than the modified modeled velocity magnitudes in the Alternative 1 scenario. The cross sectional area in the model for Alternatives 2 through 4 was held consistent with the proposed fill template, and therefore did not require similar modifications that were done for Alternative 1 as described in Section 7.2.2.2. The secondary channel in Alternative 5 was designed to match the existing cross-section in the Pass Chaland Channel, east of Bayou Huertes, which is deeper and almost twice as wide as the existing channel as modeled in Alternative 1 at the Bay Joe Wise West Inlet location. Due to the resulting difference in the cross-sectional area at the entrance to the Bay, the modeled water velocity in the secondary channel was nearly half the velocity modeled through the Bay Joe Wise West Inlet in Alternative 1.

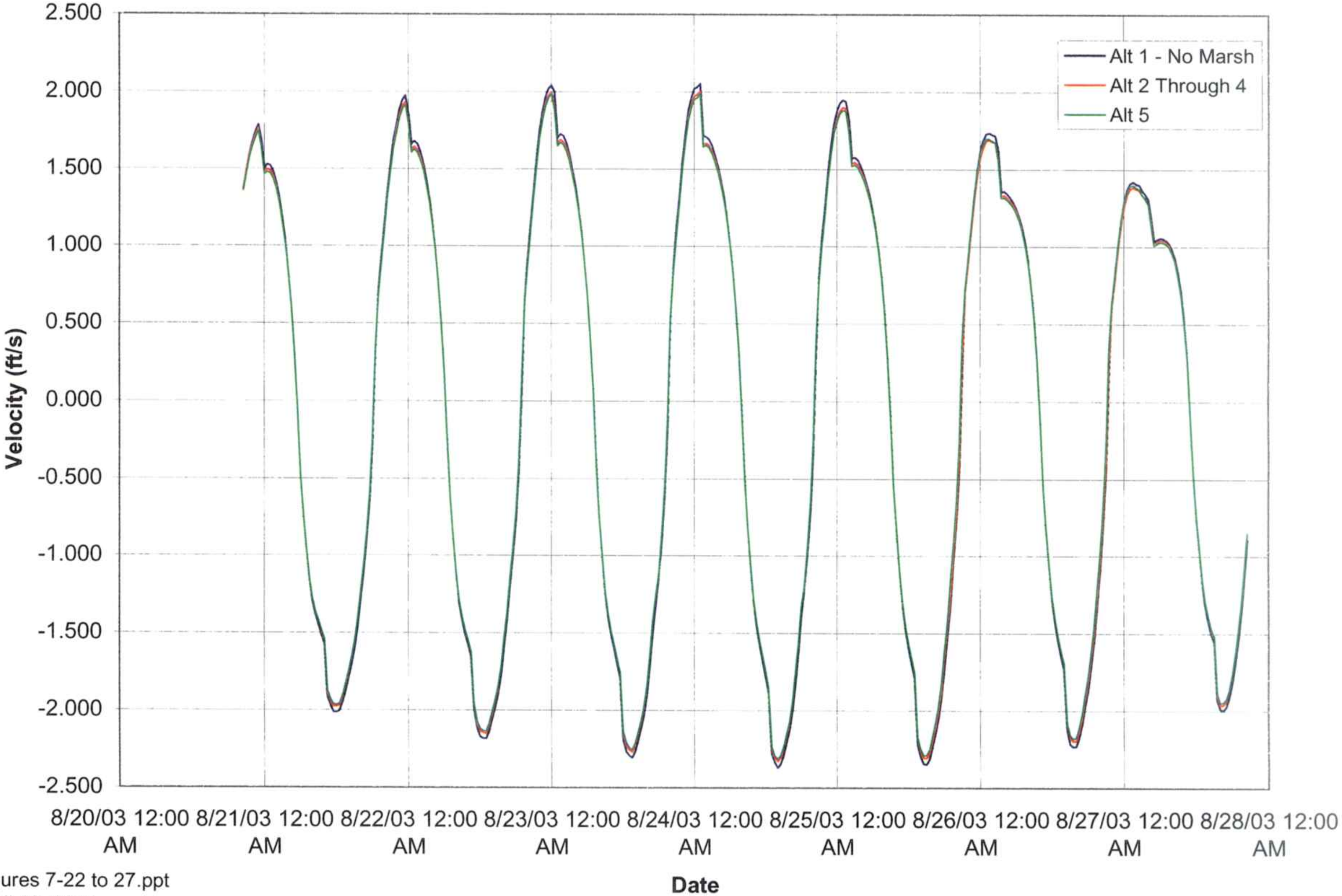


Figure 7-22: Modeled Velocities for the Alternative Marsh Fill Templates – Grand Bayou Pass

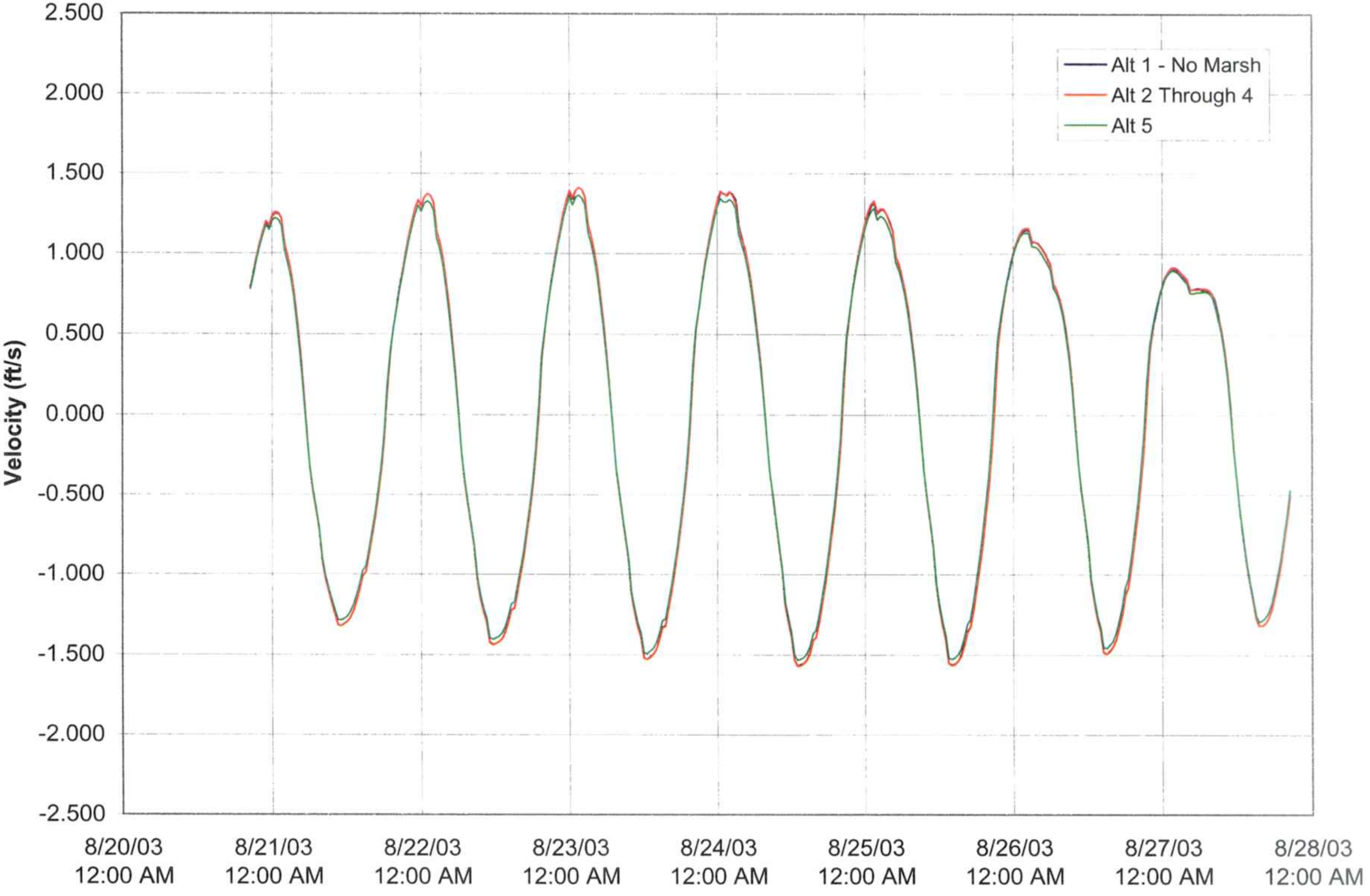
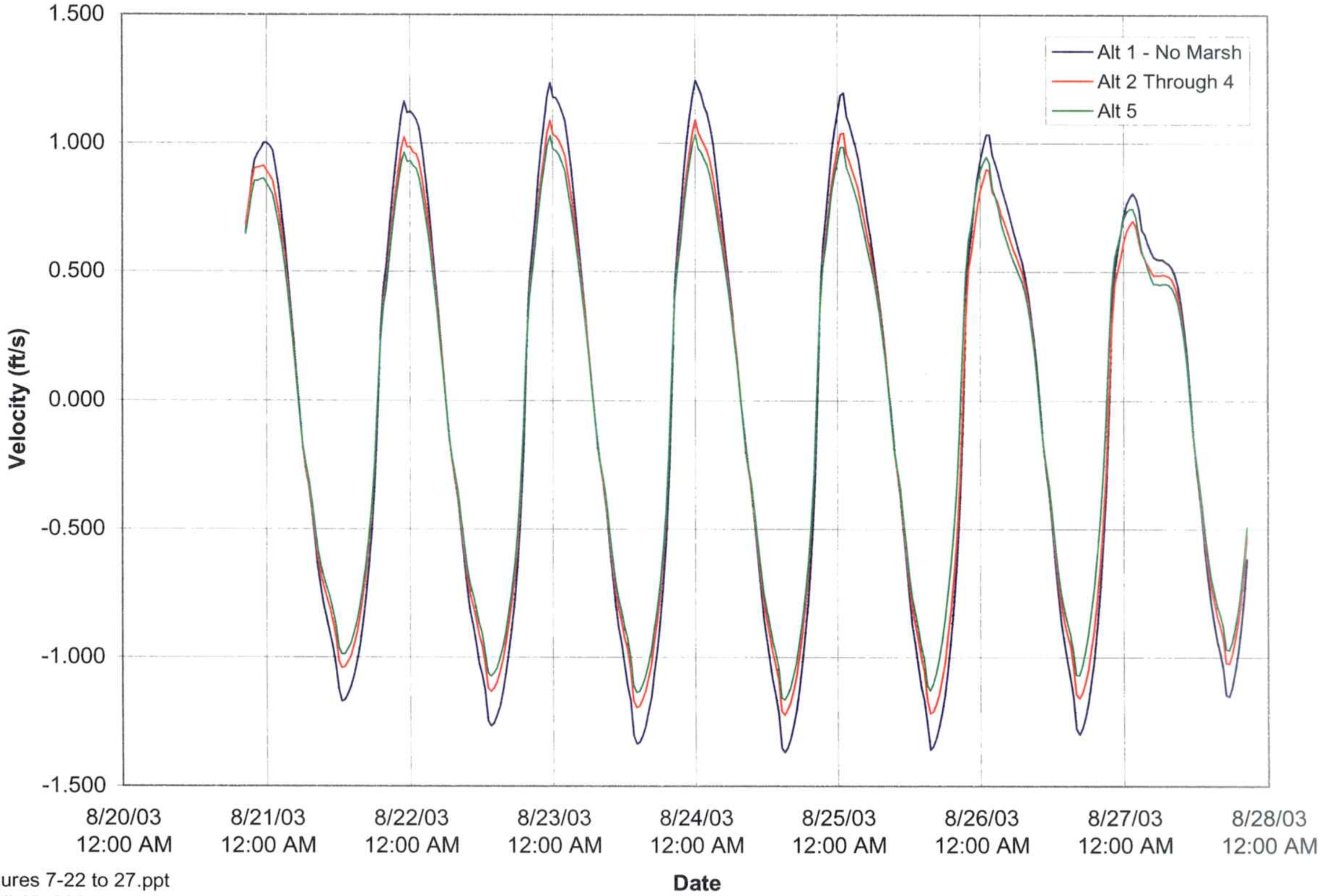


Figure 7-23: Modeled Velocities for the Alternative Marsh Fill Templates – Pass Chaland



Figures 7-22 to 27.ppt
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Figure 7-24: Modeled Velocities for the Alternative Marsh Fill Templates – Bay Joe Wise East Inlet

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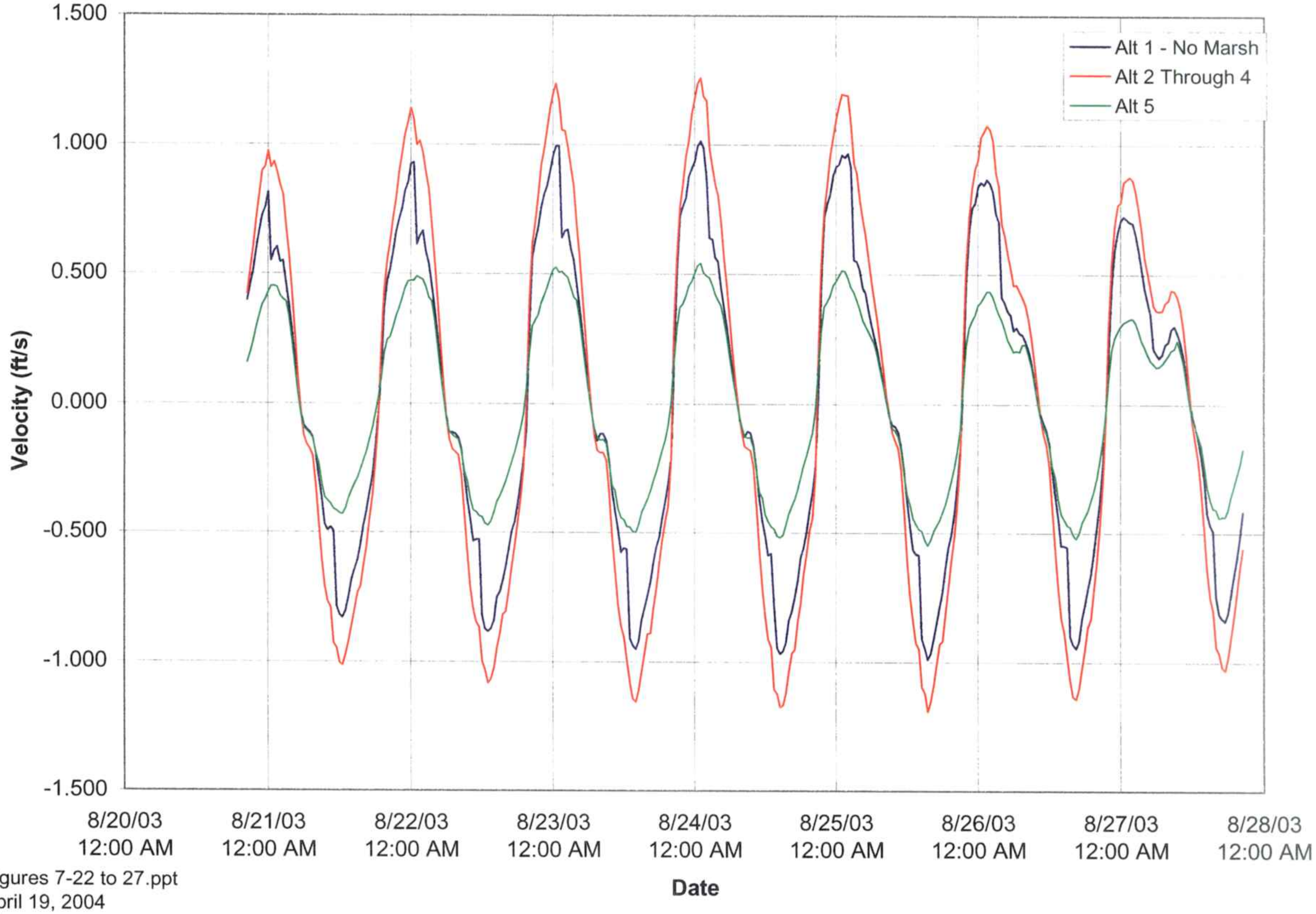

Figures 7-22 to 27.ppt
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Figure 7-25: Modeled Velocities for the Alternative Marsh Fill Templates – Bay Joe Wise West Inlet

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In addition to evaluating the flow velocity differences in the primary inlets, water velocity differences were also evaluated in Bayou Huertes and in the channel running between Pass Chaland and Bayou Huertes. The results for these two channels are presented in Figures 7-26 and 7-27, respectively. From these figures, it can be seen the velocities are within about 0.1 foot per second of each other for all three (3) scenarios. This supports the proposal for the secondary channel cross-section designed to match the Pass Chaland Channel and maintain existing flow patterns.

Plan view maps of the modeled velocity differences for the alternatives are presented in Figure 7-28 for the Pass Chaland area and Figure 7-29 for the Grand Bayou Pass area. In Figure 7-28, it can be seen that the majority of the velocity change caused by the marsh fill in Bay Joe Wise occurs in the Bay Joe Wise West Inlet only. In the Alternatives 2 through 4 scenario (middle image), the velocity is slightly higher at the east end of the inlet where the marsh fill has constricted the inlet most. On the western end of the inlet, modeled water velocities are slightly lower in these alternatives than they are in Alternative 1. The velocity increase seen in the Alternative 5 image (bottom) in the secondary channel west of Bayou Huertes is simply showing that water is now flowing through that channel, where it did not flow in the Alternative 1 model. The decrease in water velocity observed in the secondary channel at the entrance into the Bay for Alternative 5 is caused by the size of the proposed channel as described above.

The water velocities in the Bay Joe Wise East Inlet are fairly uniformly decreased in both the Alternatives 2 through 4 scenario and Alternative 5, as displayed in Figure 7-29. The magnitude and extent of the velocity decrease is slightly greater for Alternative 5 than in the Alternatives 2 through 4, however, the change is so small, it is not expected to adversely impact the inlet. If there is an impact on the inlet, it should be beneficial, as the primary decrease in water velocity has been modeled to occur near the islands in the inlet. A considerable amount of scour was observed in these areas around the islands, and the modeled decrease in water velocity in the vicinity of these islands may actually reduce the erosional stress.

7.2.5 Conclusions

The comparisons of modeled and measured data at the Bay Joe Wise Inlets (East and West) and observed and modeled flow patterns throughout the project area suggest the ADCIRC model was calibrated properly and simulated conditions in the Bay very well. Changes to the flow patterns are specifically of interest in the Bay, since that is where the marsh construction will alter the distribution of land. As such, predictive scenarios for the proposed alternative marsh fills should yield accurate results from the calibrated ADCIRC model.

Elsewhere in the modeled channel and Bay system, the slight discrepancy between measured and modeled peak current velocities in Pass Chaland do not seem to have a negative impact on the model’s simulated conditions in Bay Joe Wise. The scope of this project was to evaluate the potential effects of the marsh construction on the circulation

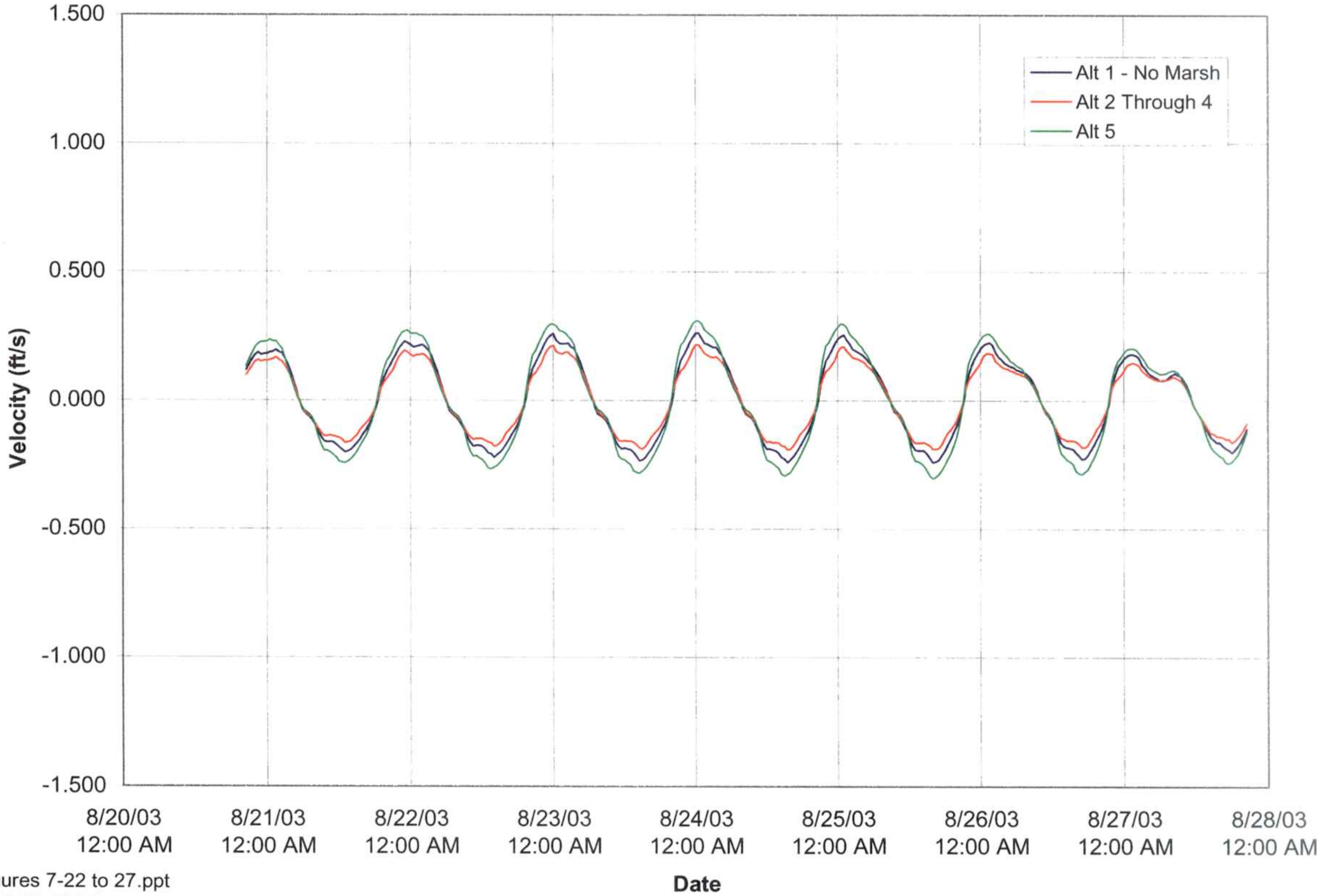


Figure 7-26: Modeled Velocities for the Alternative Marsh Fill Templates – Bayou Huertes

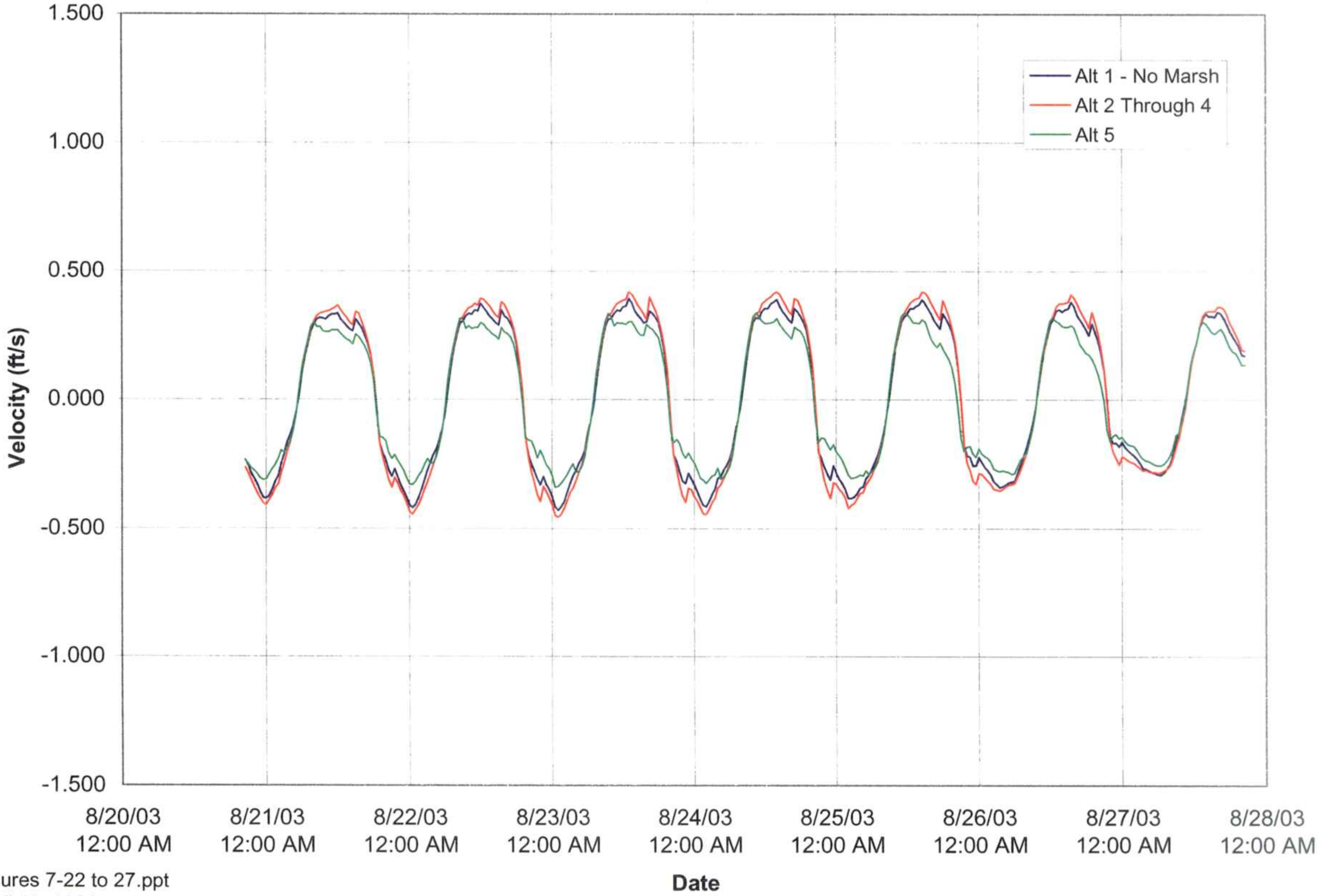
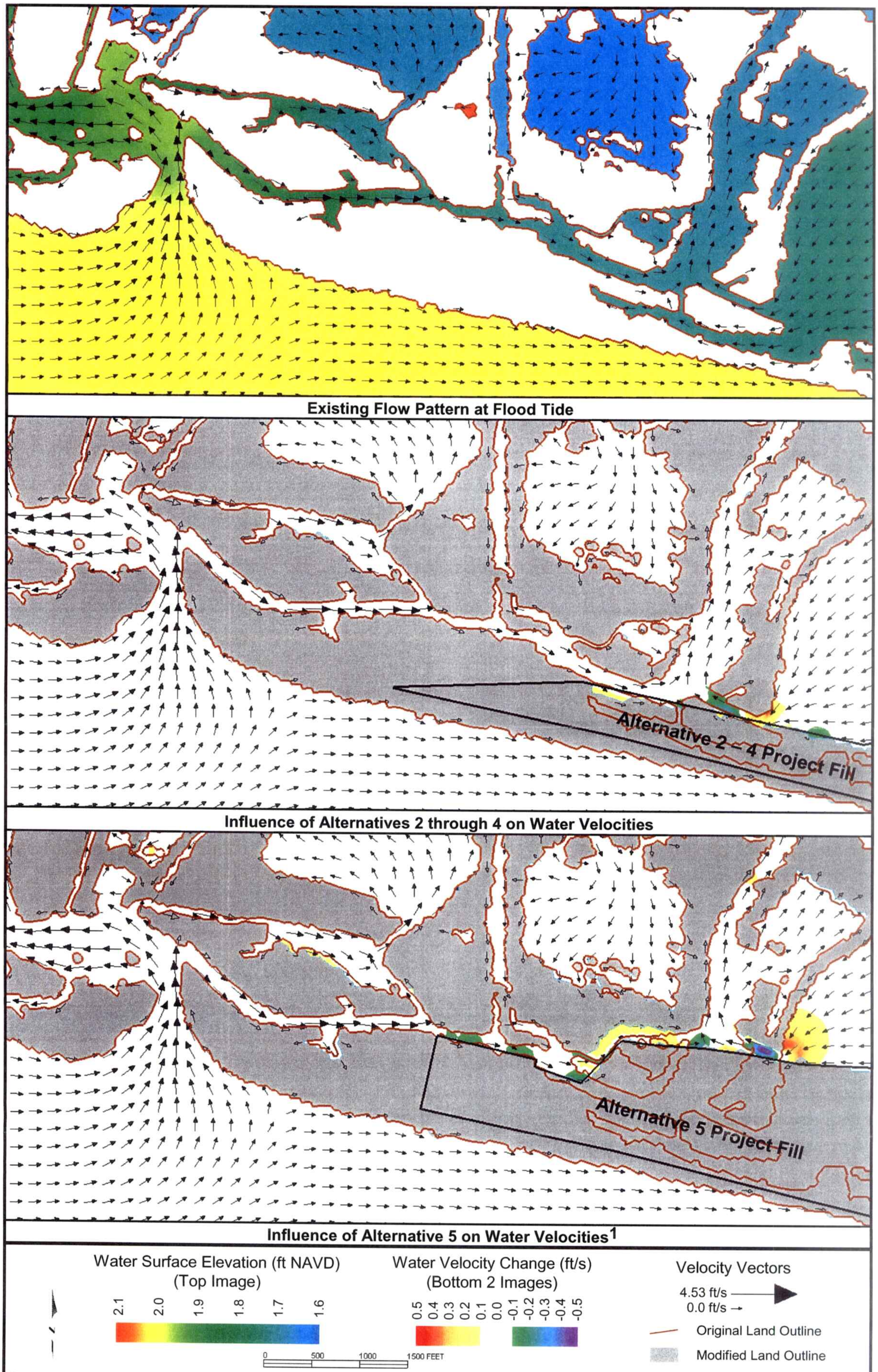


Figure 7-27: Modeled Velocities for the Alternative Marsh Fill Templates – Pass Chaland Channel



Note 1: The modified modeled water velocity through the original Bay Joe Wise West Inlet was compared to the modeled velocity in the new inlet in the velocity comparison for Alternative 5.

Figure 7-28: Pass Chaland Flow Patterns

Figure 7-28 and 29.ppt
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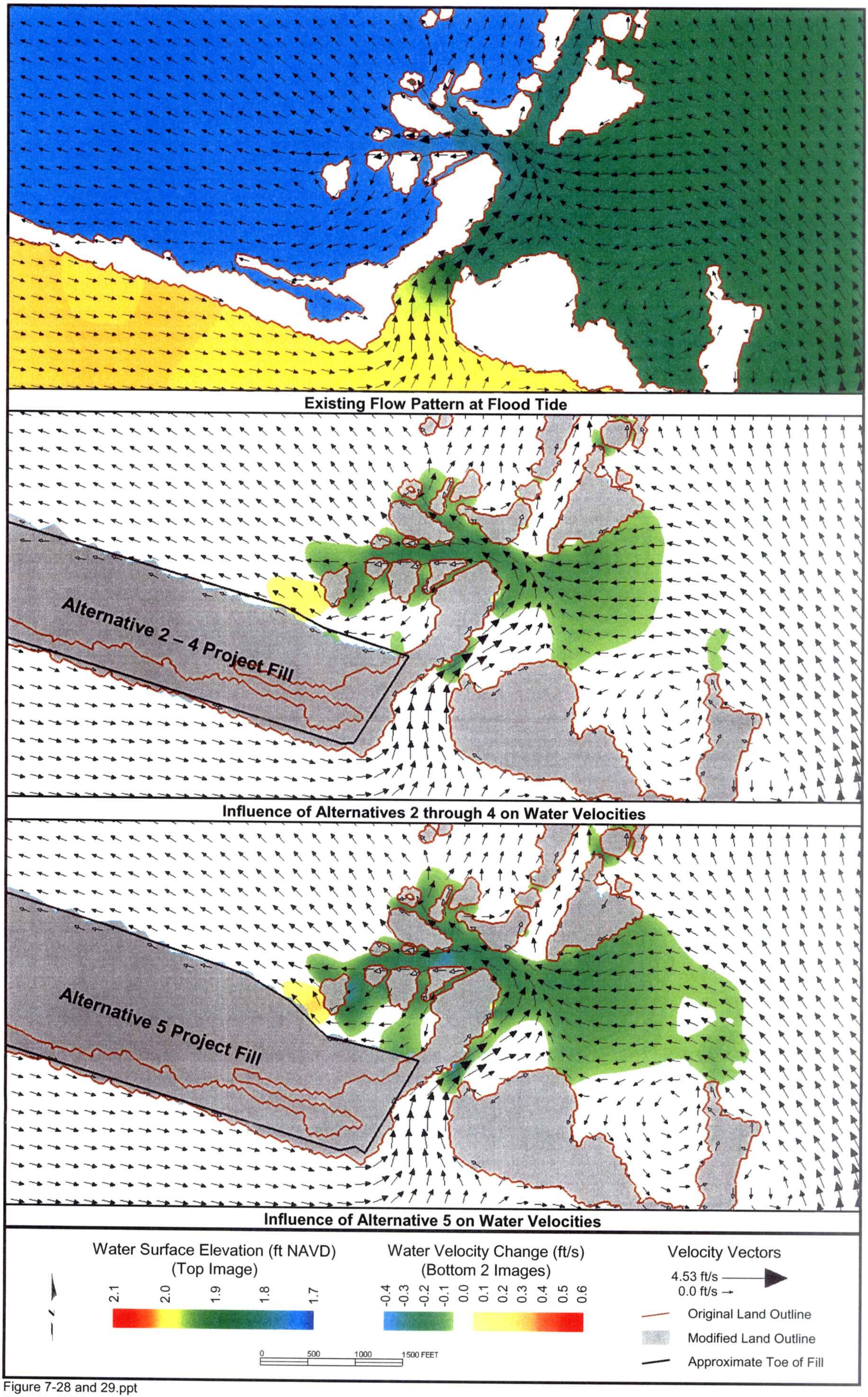

Figure 7-28 and 29.ppt
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Figure 7-29: Grand Bayou Pass Flow Patterns

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and flow patterns through Bay Joe Wise and its tributary channels. Consistent with the scope, fieldwork in the region focused on the Gulf, Bay Joe Wise, and the interior channels immediately on the landward side of the barrier island. No bathymetric surveys, current measurements, or water elevations were measured in the far northwestern portion of the channel system included in the ADCIRC model. Despite the lack of information for this area, it was incorporated into the model in order to provide a location to go for the portion of water that flows straight up Bayou Chaland, away from Bay Joe Wise, through Pass Chaland. Without that area incorporated, it would have been virtually impossible to regulate the amount of water that flows in through Pass Chaland and turns east toward Bayou Huertes and Bay Joe Wise. With the uncertainties in this area, many different scenarios could have been tested to increase the overall flow through Pass Chaland (i.e. deepening the bathymetric surface farther north in Bayou Chaland). Any of the scenarios may have helped provide a better match to the current velocities in the Pass, but would not necessarily have represented the true conditions any better than the present model, and therefore were not tested.

Alternatives 2 through 4 propose the same marsh fill template while Alternative 5 proposes a wider marsh fill template and secondary channel between the Pass Chaland Channel and the Bay across Bayou Huertes. The modeled comparisons as well as field observations emphasize the importance of maintaining this flow from Pass Chaland to the Bay. Alternatives 2 through 4 may pinch the existing channel at the Bay Joe Wise west location as the marsh adjusts and subsides, thus a proposed secondary channel should be included for any of these alternatives.

The ADCIRC model results of the proposed marsh templates for Alternatives 2 through 5 indicated minor changes are expected to occur with no adverse impacts in the water surfaces, current velocities and circulation patterns through the Bay and its tributary channels from construction of the marsh fill.

7.3 BORROW AREA WAVE REFRACTION MODELING

7.3.1 Model Description

7.3.1.1 Software Description

The Steady-State Spectral Wave Model (STWAVE) was used to evaluate changes to wave refraction and sediment transport patterns resulting from the proposed borrow area excavation.

STWAVE, as its name implies, is a steady-state finite difference model (Smith, Sherlock, and Resio, 2001). It simulates depth-induced wave refraction and shoaling, current-induced refraction and shoaling, depth and steepness induced wave breaking, diffraction, wind driven wave growth, and wave-wave interaction and whitecapping that redistribute and dissipate energy in a growing wave field. The version of STWAVE chosen is part of a package developed by Veri-Tech, Inc., called the Coastal Engineering Design and Analysis System, or CEDAS. Version 2.01 of CEDAS was used for this evaluation.

7.3.1.2 Grid Design

The model grid was made up of 401 columns (east-west direction) and 500 rows (north-south direction) of grid cells. Each grid cell was 200 feet long by 200 feet wide. This gave a total width of 80,000 feet (east-west) and a total length of 99,800 feet (north-south). The origin of the model grid, located at the southeast corner, was located at an Easting of 3,815,100 and a Northing of 205,100.

7.3.1.3 Model Parameters and Calibration

CP&E (2003) conducted an evaluation of the Chaland Headland Project (BA-38) borrow area also located in Quatre Bayou Pass. The bathymetry and STWAVE grid generated by CP&E are the same used herein to enable an evaluation of the post-dredge conditions from both borrow areas. The post-excavation bathymetric surface incorporated the proposed Project borrow area in the model scenarios.

A total of eleven (11) different incident wave cases were investigated. The wave parameters are displayed in Table 7-3. Initial wave heights, wave periods, angles, and water stages were obtained from CP&E (2003) for the first nine (9) scenarios to allow for comparison of the two model results. Cases 10 and 11 were added to simulate a 20-year storm from wave angles covering the rest of the spectrum. In all cases, the initial wave height was applied in a water depth of 27.5 meters, which was the approximate average depth of water at the southernmost section of the model where the waves generally originated. The initial wave height and period in the table are the input heights and periods for the waves. The local angle is the angle used by STWAVE. With the local angle, a value of zero degrees is straight toward shore, which is due north in this case. A value of 180 degrees is due north in the real world angle. Gamma is the spectral peakedness parameter and is used in STWAVE to control the width of the peak in the frequency spectrum. The parameter nn is the directional spreading coefficient which helps control how the wave energy is distributed in the frequency spectrum. The STWAVE user manual provides representative values of both gamma and nn for user defined wave period values.

For each storm scenario previously run by CP&E on the pre-excavation bathymetric surface, the same scenario and bathymetry were rerun to verify the model was functioning as it had in the previous investigation. In all nine (9) cases previously run, the output appeared to be identical when compared to the reported outputs. These comparisons served as the calibration of the model.

Table 7-3: Input Wave Parameters

Case Number	Initial Wave Height (ft)	Initial Wave Period (sec)	Local Angle (deg)	Real World Angle (deg)	Water Stage (ft NAVD)	Gamma	nn
1	2.5	5.0	57	123	1.0	3.3	4
2	2.6	4.6	49	131	1.0	3.3	4
3	2.5	5.0	23	157	1.0	3.3	4
4	2.6	4.6	15	165	1.0	3.3	4
5	2.5	5.0	-11	191	1.0	3.3	4
6	17.4	11.0	3	177	1.6	4.0	8
7	18.0	11.7	7	173	3.0	4.0	10
8	20.5	12.4	7	173	4.9	4.4	10
9	22.9	13.2	7	173	6.7	5.0	12
10	22.9	13.2	-11	191	6.7	5.0	12
11	22.9	13.2	-45	225	6.7	5.0	12

7.3.1.4 Borrow Area Incorporation

Both the proposed Bay Joe Wise borrow area and the proposed Chaland borrow area were incorporated into the wave calculation models. Figure 7-30 displays the locations and orientations of both borrow areas. The -7 feet NAVD and -15 feet NAVD bathymetric contours are also displayed on the figure. For the normal wave scenarios (Case Numbers 1 through 5 in Table 7-3), the point at which waves were found to be depth limited was -7 feet NAVD (CP&E, 2003). For the storm scenarios (Case Numbers 6 through 11 in Table 7-3), -15 feet NAVD was found to be the cutoff at which the waves became depth limited. The results are presented at these respective contours for consistency.

The modeled pre- and post-excavation bathymetry at the borrow areas is shown in Figure 7-31 and Figure 7-32 respectively. The difference between the pre-excavation bathymetry and the post-excavation bathymetry, or the depth of the borrow area excavation, is shown in Figure 7-33. From these figures, it is observed that the proposed Bay Joe Wise borrow area is in deeper water, and has a deeper proposed excavation than the proposed Chaland borrow area.

7.3.2 Model Results

STWAVE simulations were run for all eleven (11) cases listed in Table 7-3 for both the pre-excavation bathymetry and the post-excavation bathymetry for a total of 22 simulations. The changes in modeled wave heights were calculated for each case, and the plan view maps displaying those changes, starting from Case 1, are displayed in Figures 7-34 through 7-44. Under the normal wave conditions (Figures 7-34 through 7-38), the proposed Bay Joe Wise borrow area had minor impacts on modeled wave heights, primarily reducing wave heights.

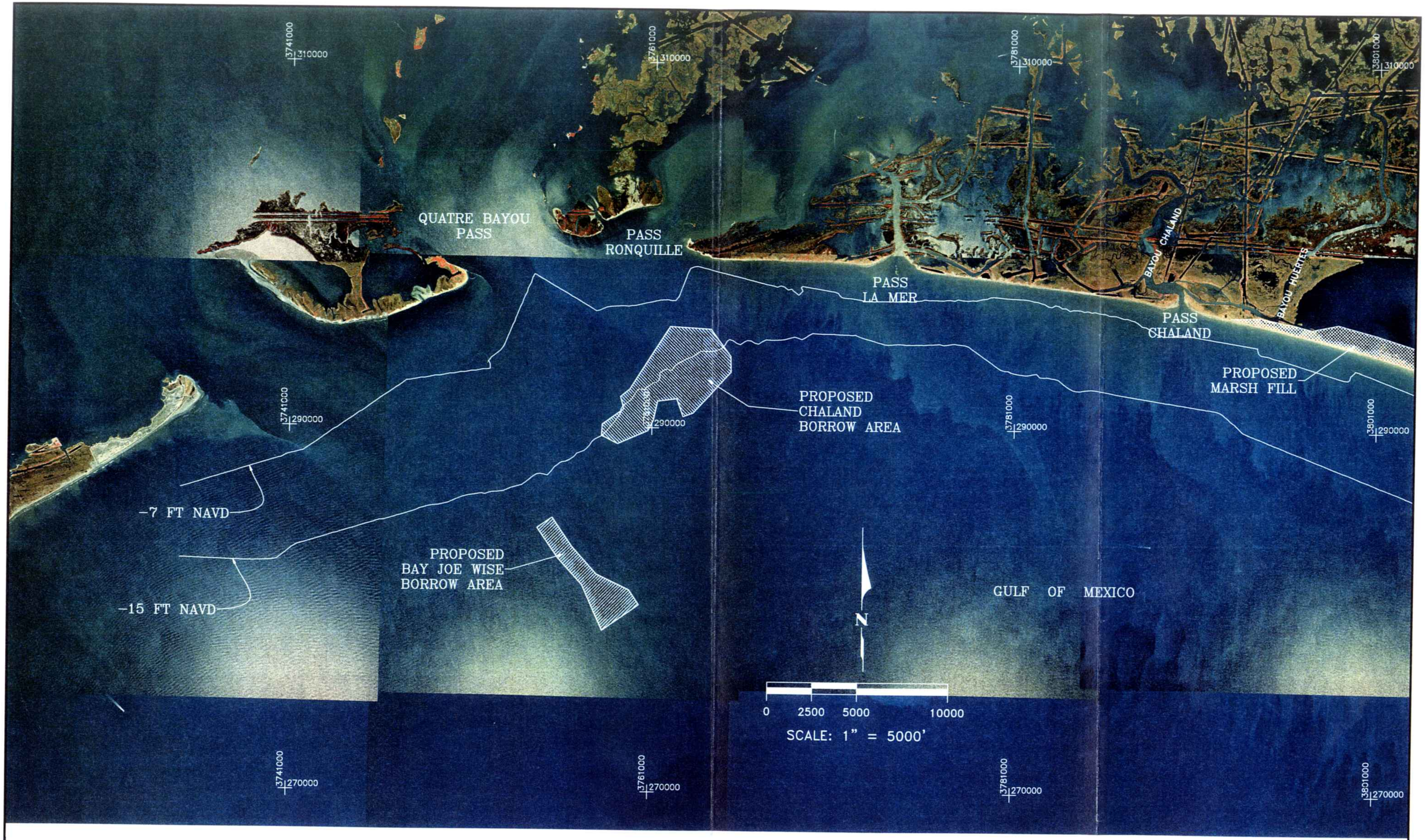

FIGURE 7-30: BORROW AREA LOCATION MAP

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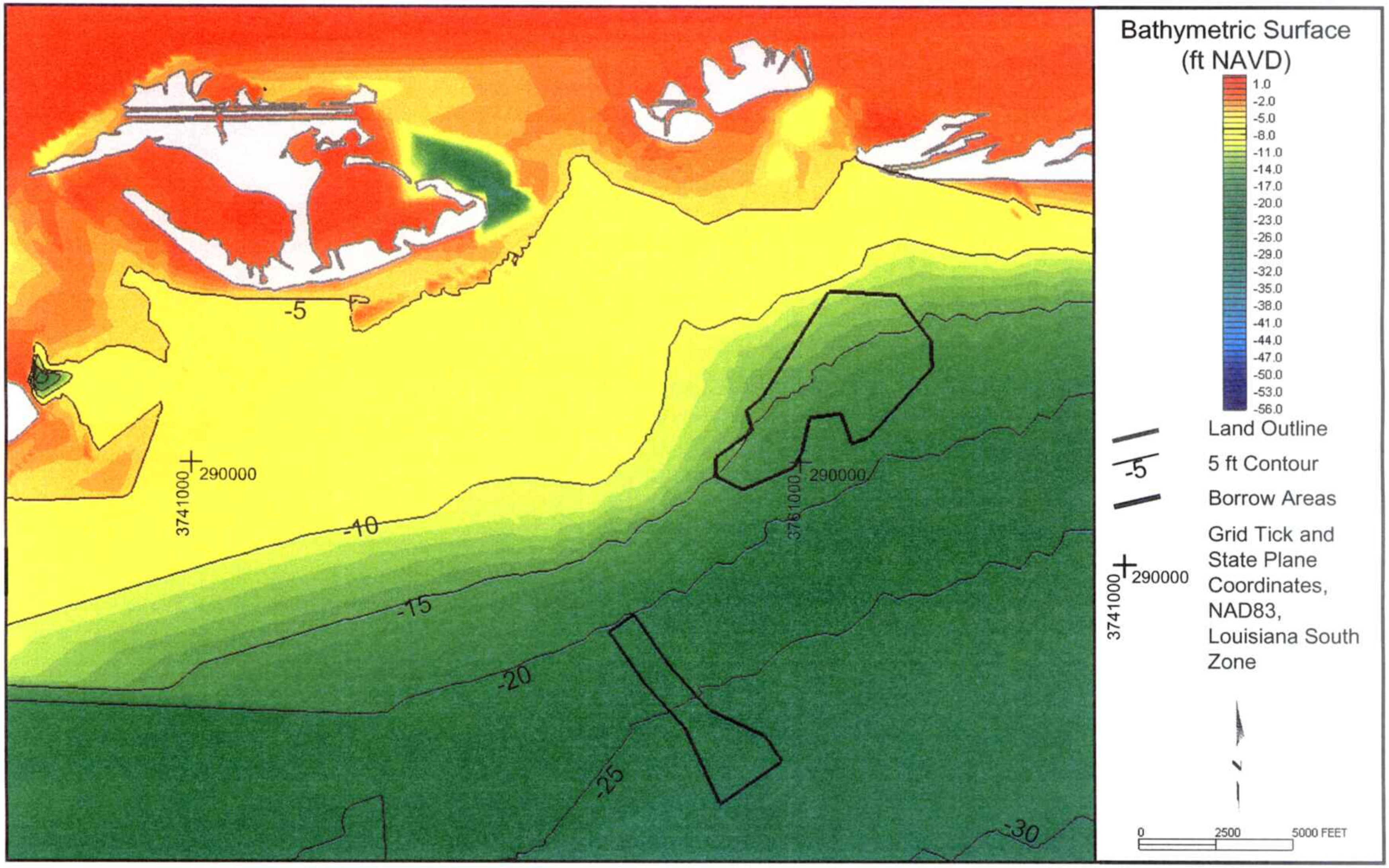

Figures 7-31 to 44.ppt
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Figure 7-31: Pre Excavation Bathymetry

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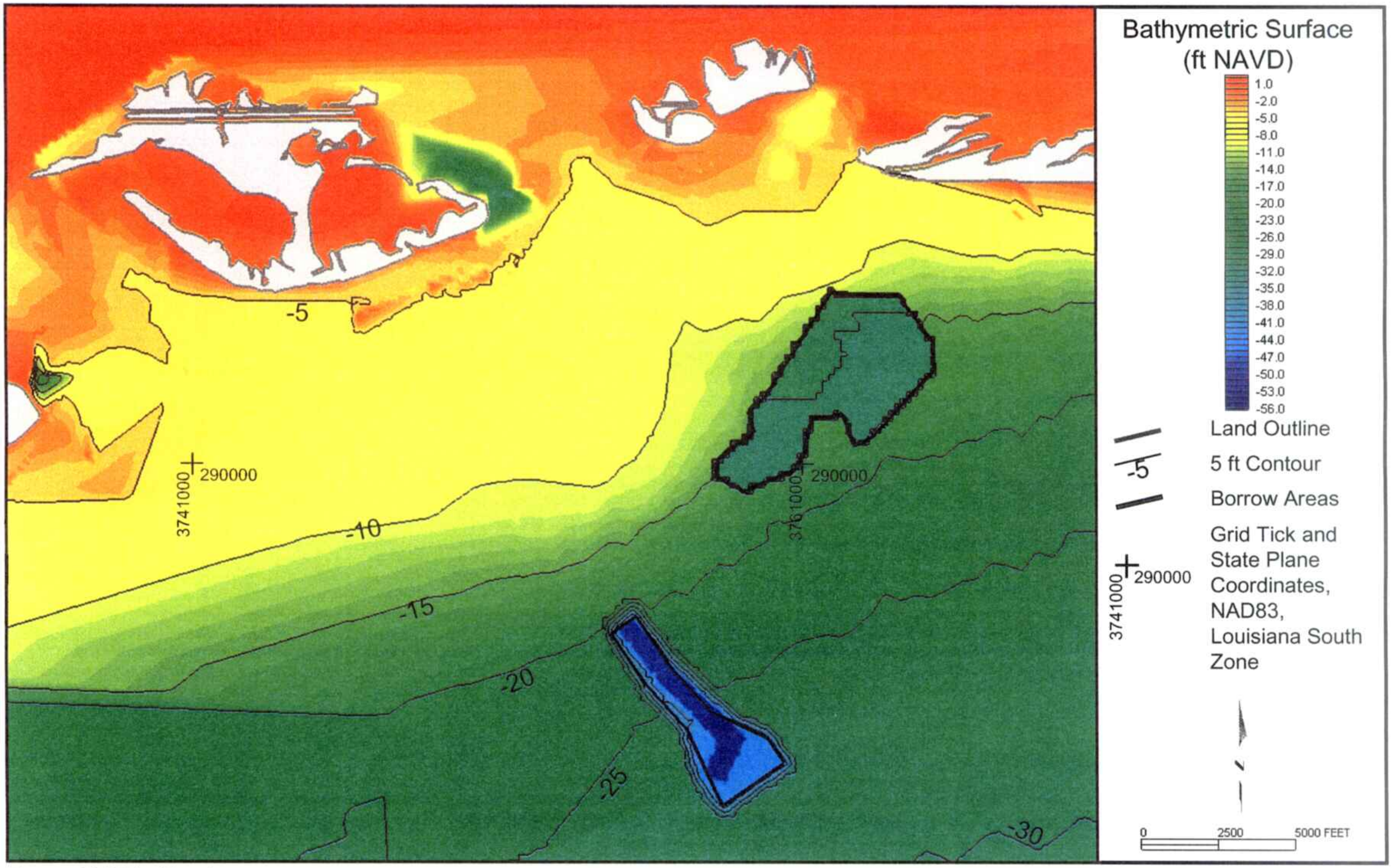

Figures 7-31 to 44.ppt
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Figure 7-32: Post Excavation Bathymetry

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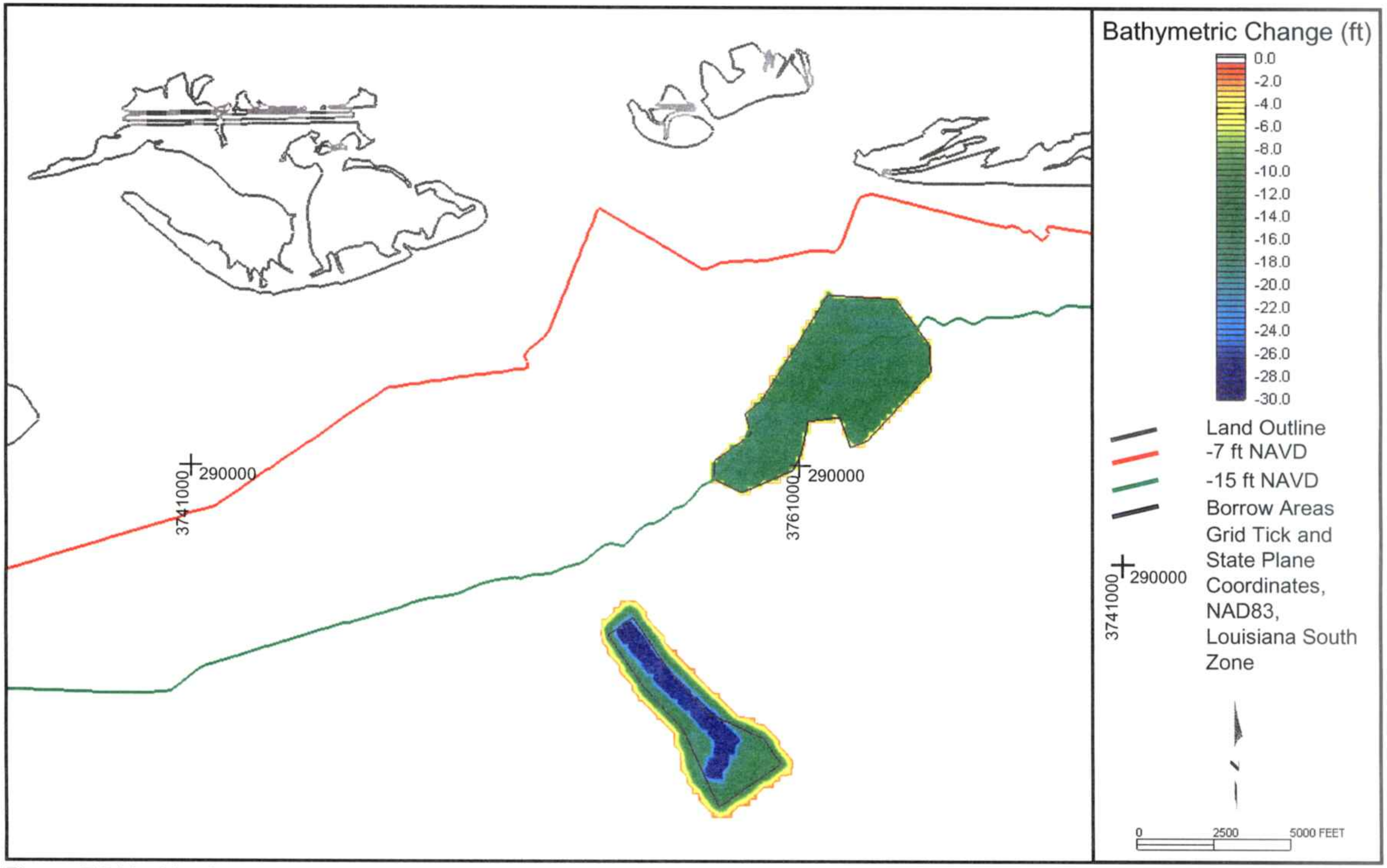

Figure 7-33: Post – Pre Bathymetric Change

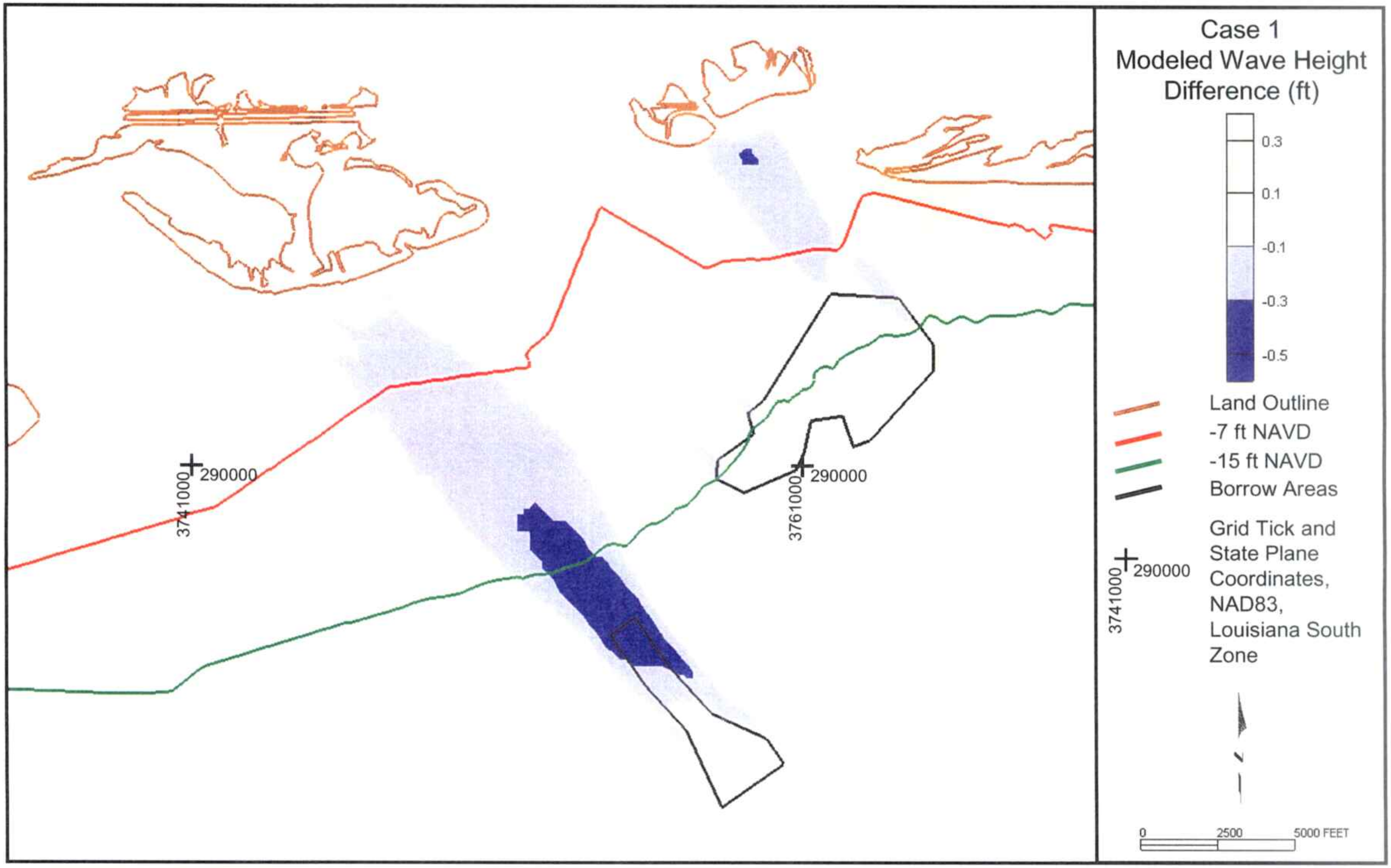

Figure 7-34: Wave Height Difference – Case 1

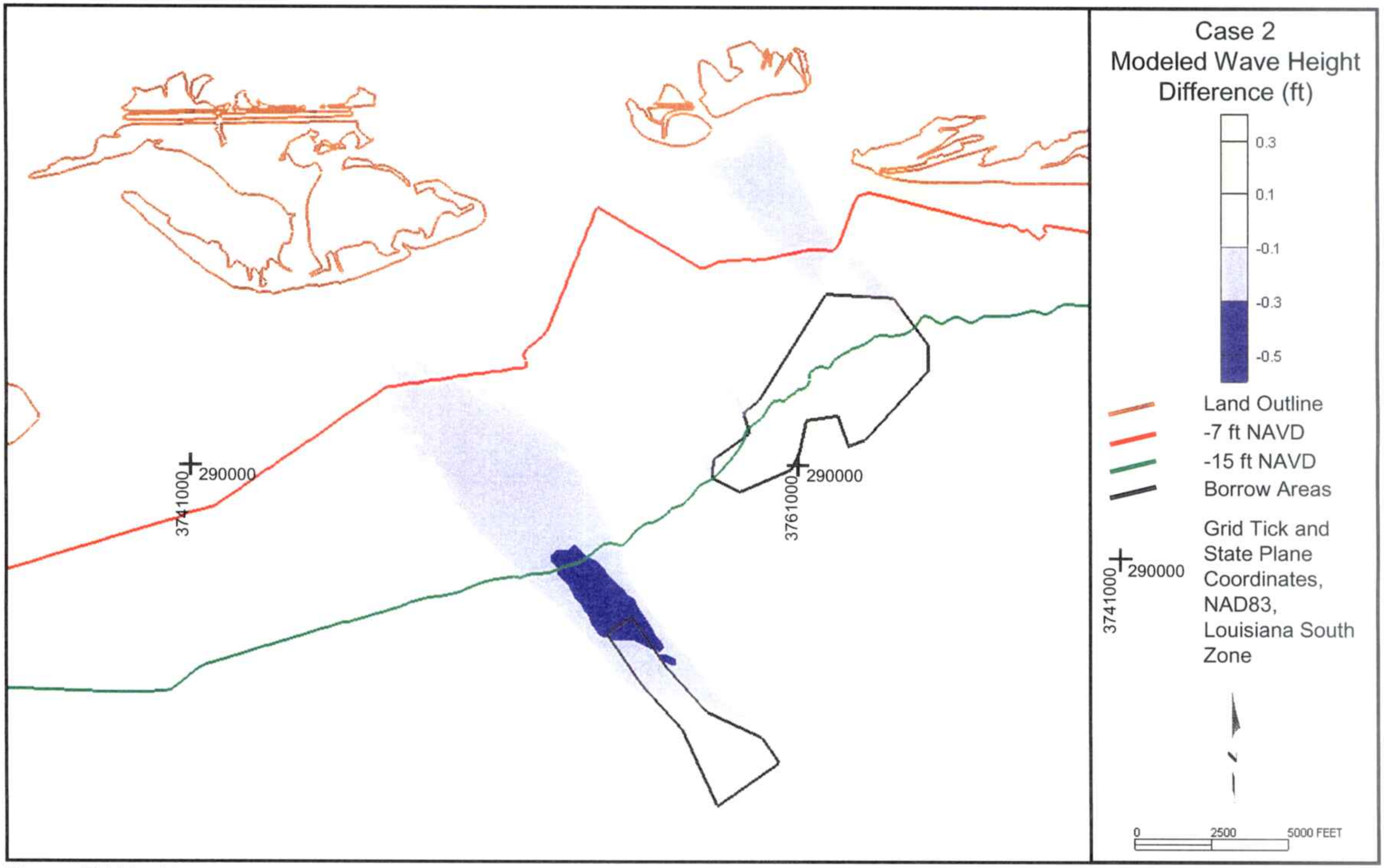

Figure 7-35: Wave Height Difference – Case 2

Figures 7-31 to 44.ppt
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Figure 7-36: Wave Height Difference – Case 3

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Figure 7-37: Wave Height Difference – Case 4

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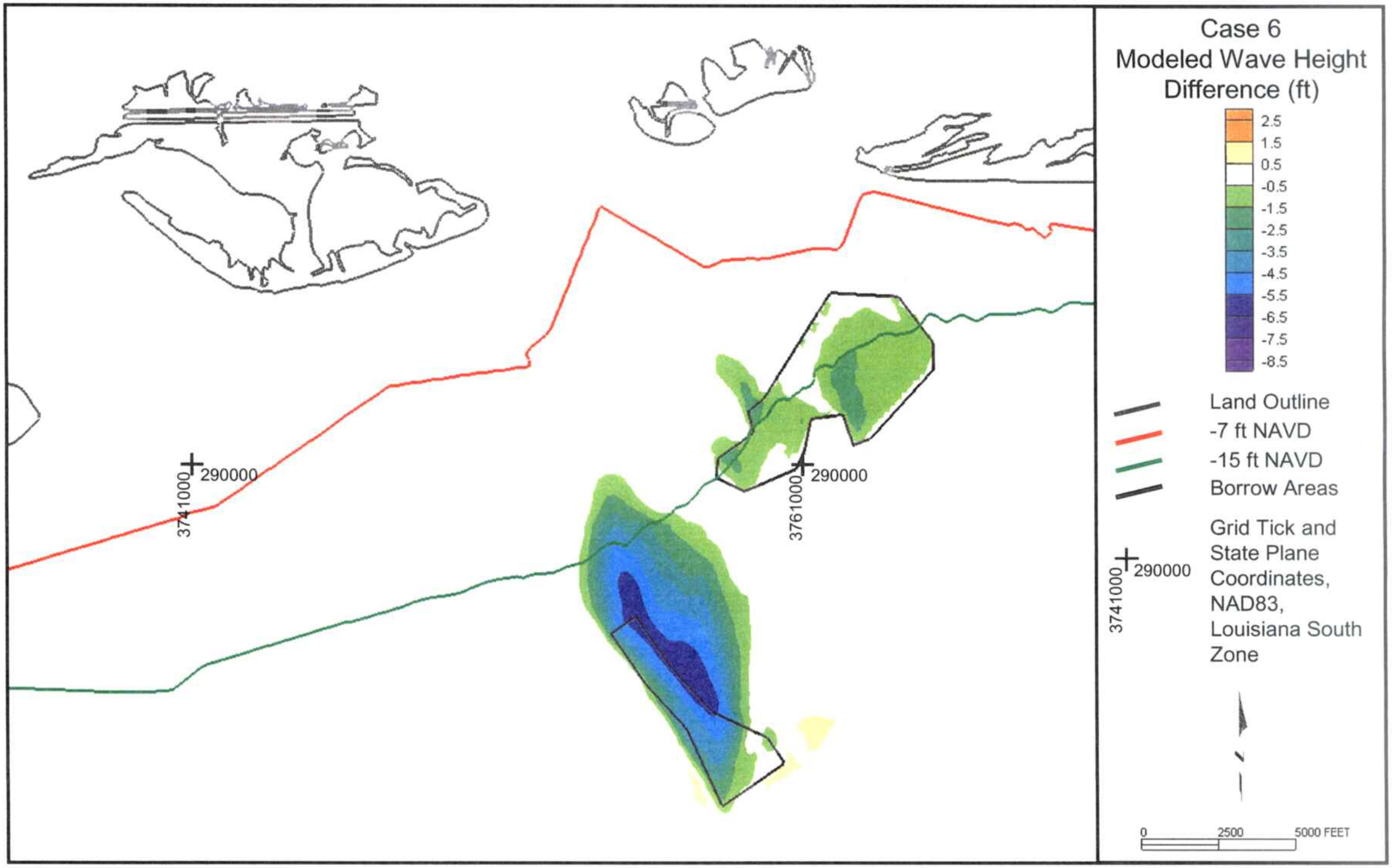
Figure 7-38: Wave Height Difference – Case 5



Figures 7-31 to 44.ppt
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Figure 7-39: Wave Height Difference – Case 6

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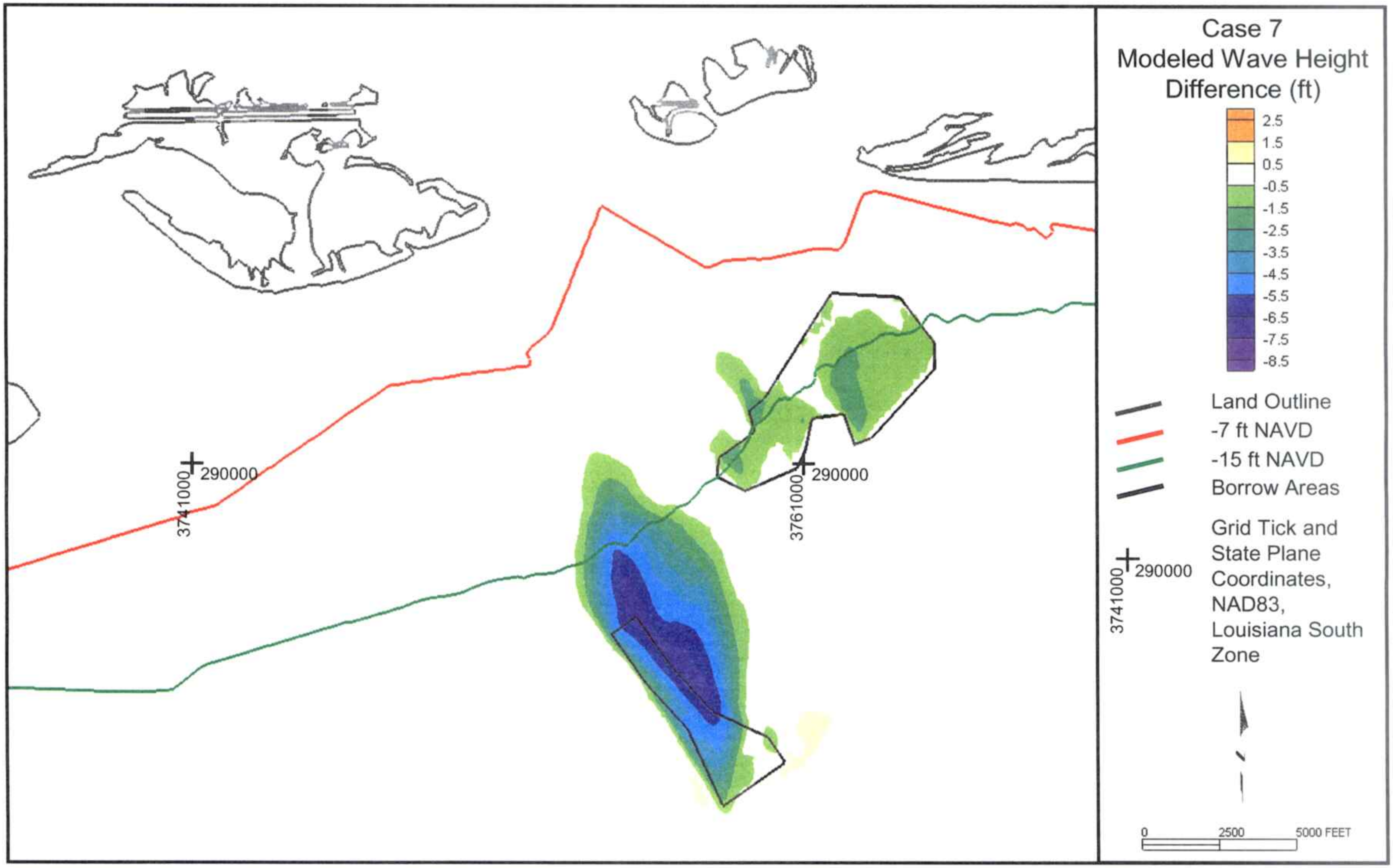


Figure 7-40: Wave Height Difference – Case 7

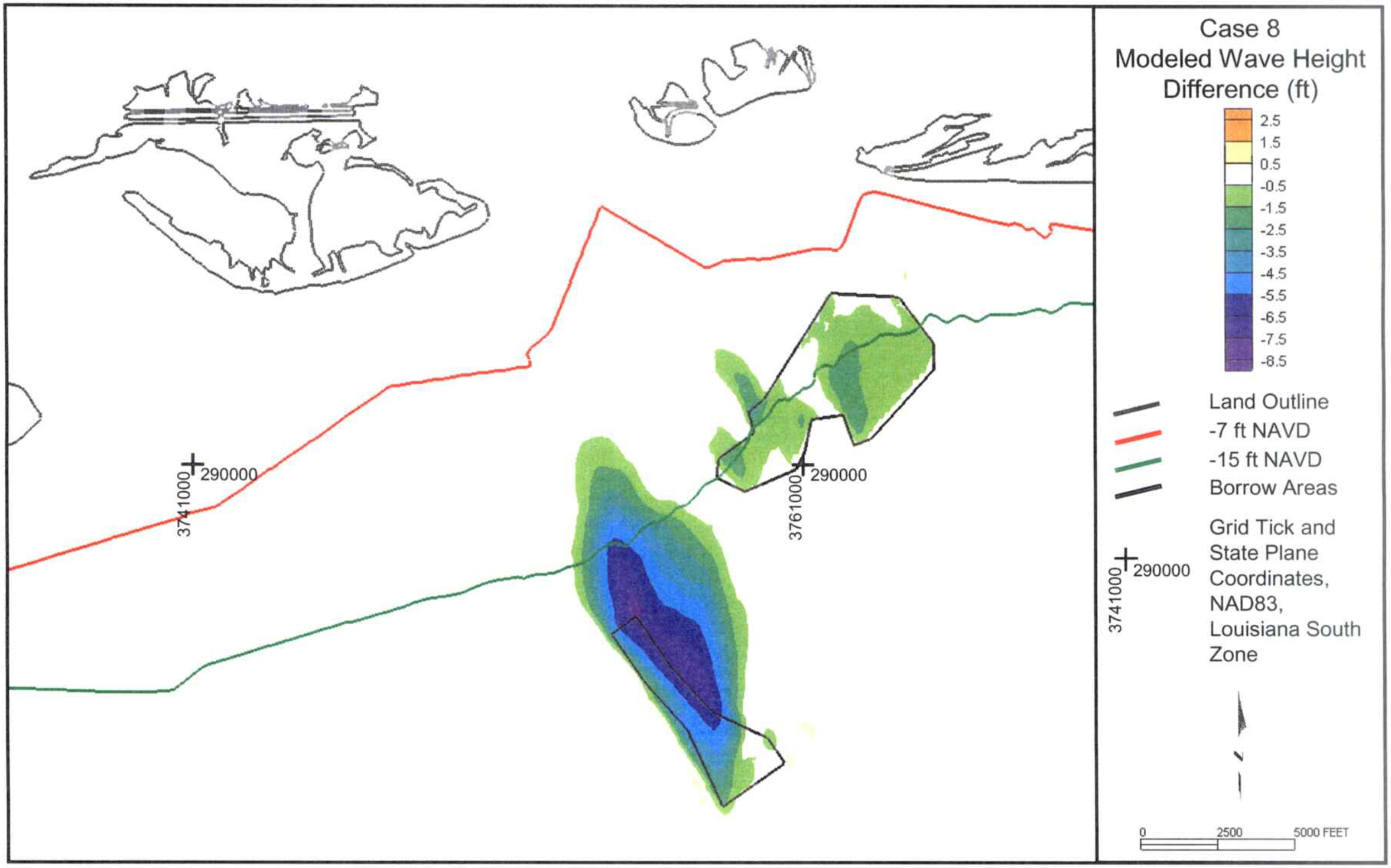


Figure 7-41: Wave Height Difference – Case 8

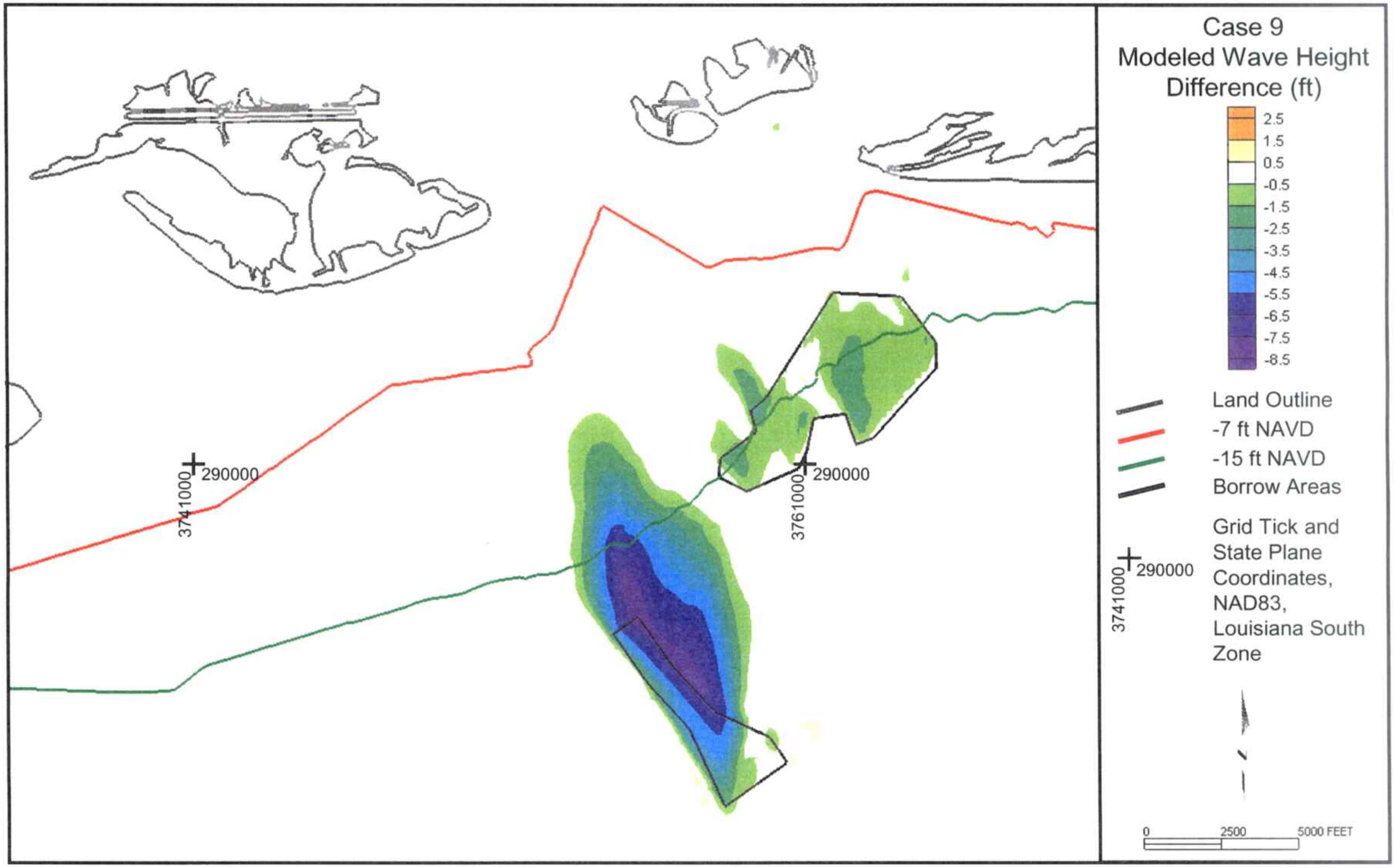


Figure 7-42: Wave Height Difference – Case 9

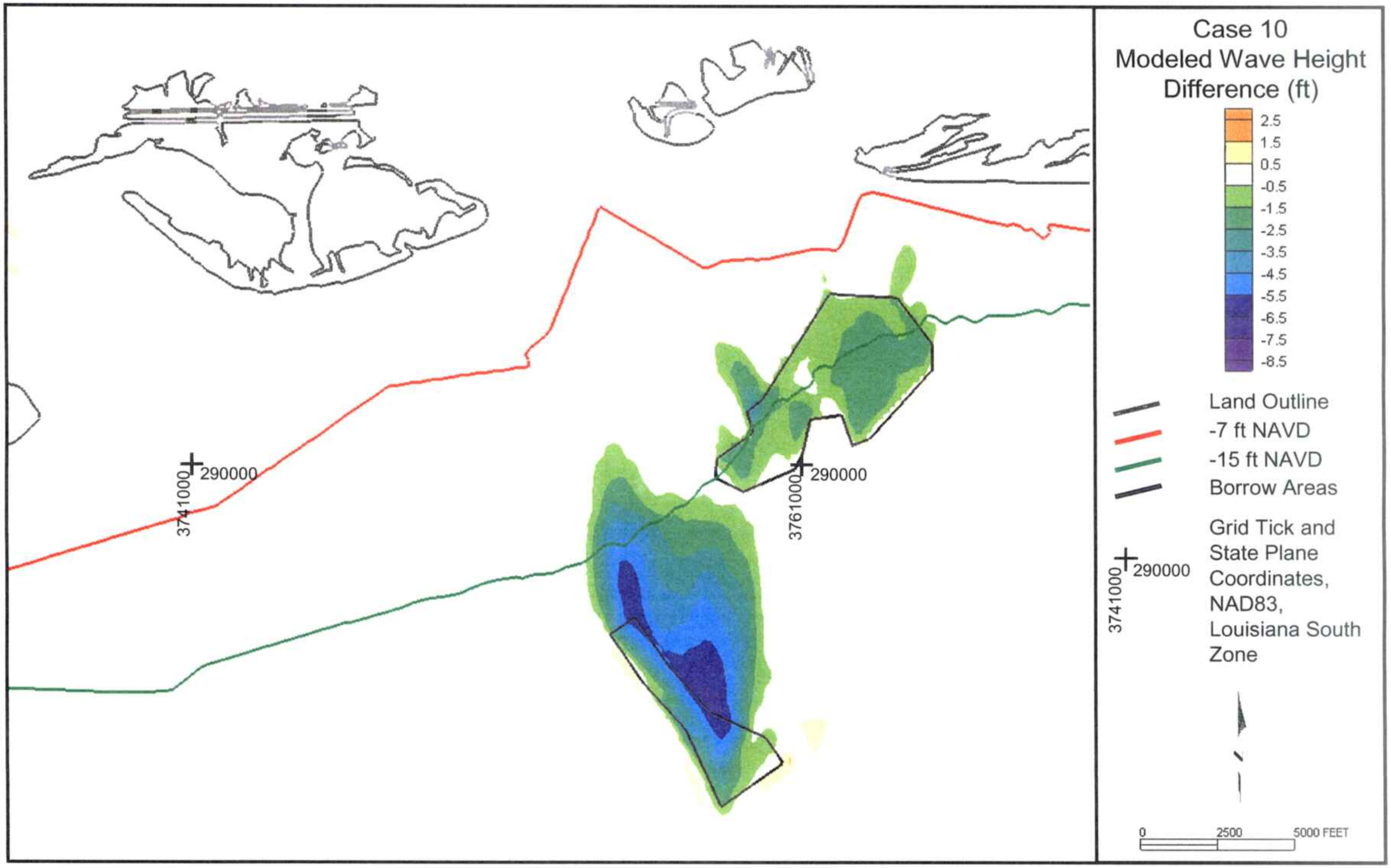


Figure 7-43: Wave Height Difference – Case 10

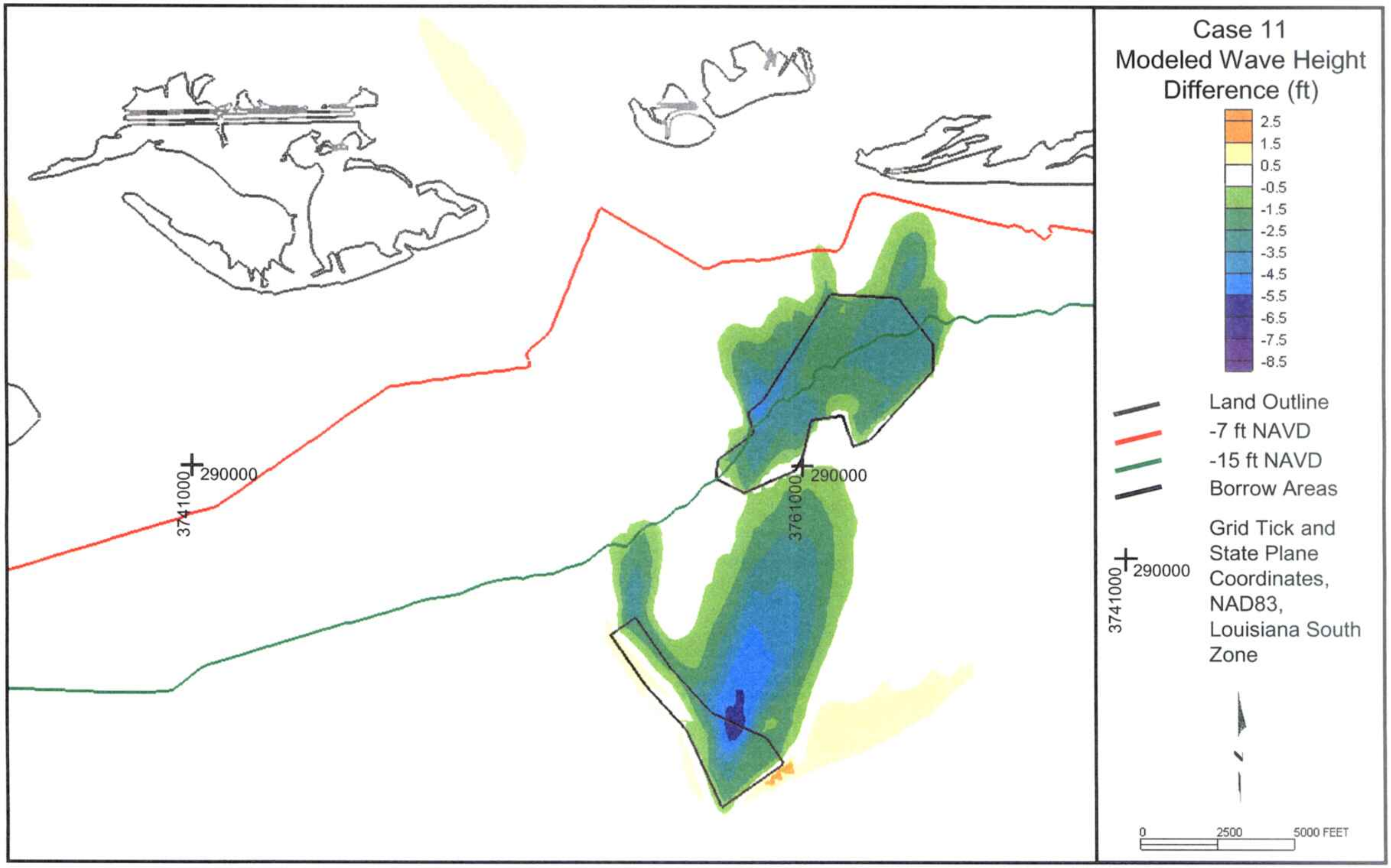


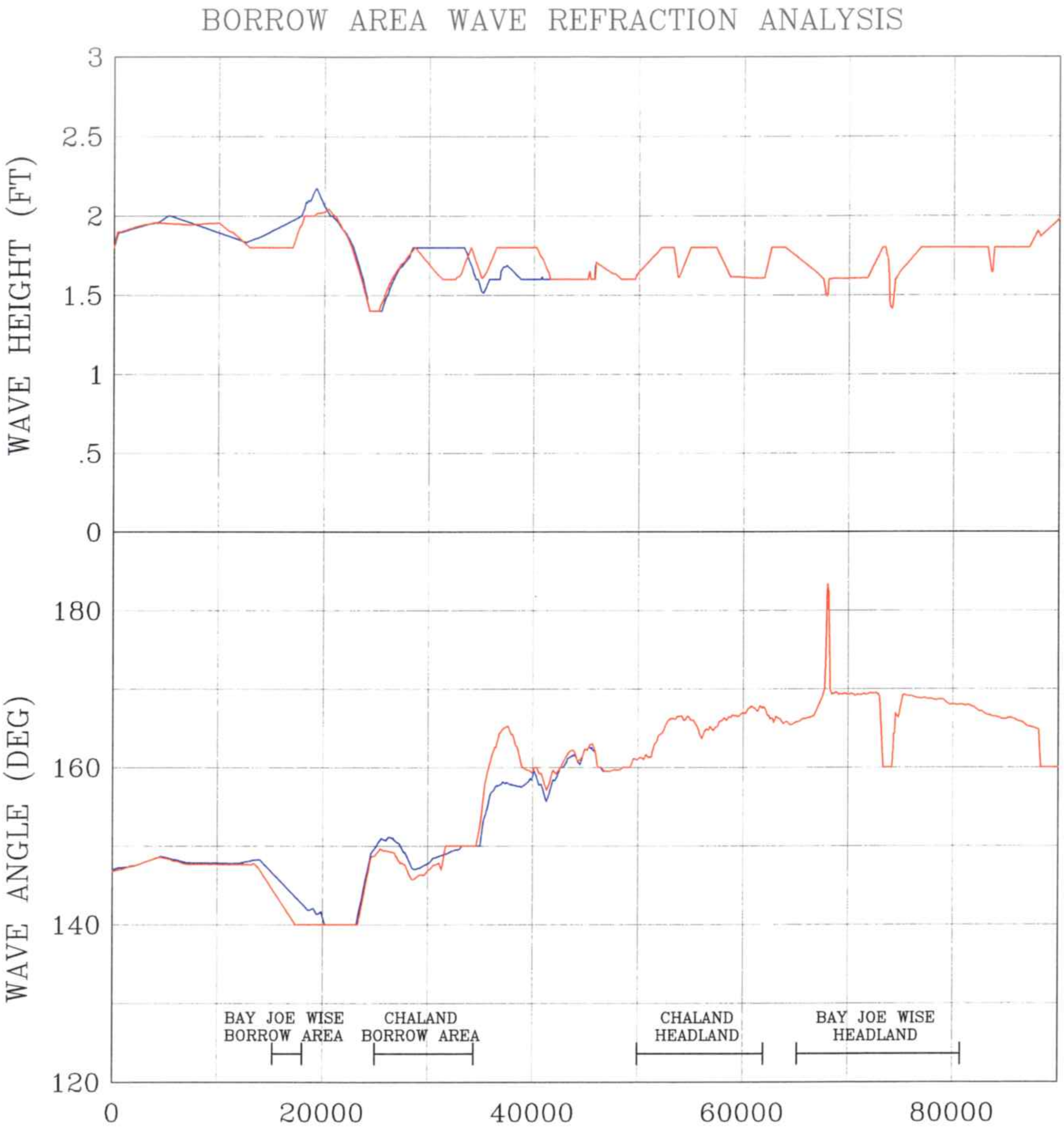
Figure 7-44: Wave Height Difference – Case 11

These changes in height did not extend all the way to dry land. The proposed Chaland borrow area showed minor changes in modeled wave heights at the land boundary on the order of about 0.1 feet. Under normal wave conditions, these negligible changes in wave height from excavation of the borrow areas will not adversely impact the adjacent shorelines. Figures 7-39 through 7-44 display the modeled wave height changes for the storm wave scenarios. In all wave conditions, the impacts on the magnitude of the wave heights at the land boundaries do not exceed 0.5 feet. In all cases, the modeled wave height changes within the breaking point are reductions in wave heights.

The Bay Joe Wise Borrow Area generally caused the waves to separate under all scenarios. In the normal wave cases, waves on the west side of the borrow area were modeled to refract slightly further to the west, while waves on the east side of the borrow area were simulated to refract slightly to the east. These changes were on the order of five (5) degrees for the normal wave scenarios. Similar separation of the waves in the storm scenario were also simulated in the model, but the waves on the western side of the borrow area generally refracted approximately twenty (20) to thirty (30) degrees to the west while waves on the east side of the borrow area refracted approximately five (5) to ten (10) degrees to the east. These deflections of the wave directions are the likely source of the reduction in wave height north of the borrow area. The deflections in the wave direction were isolated to within approximately 3500 feet of the borrow area in all scenarios.

Comparisons of the modeled wave heights and modeled wave angles between the pre-excavation bathymetry and post-excavation bathymetry for all eleven (11) cases are shown in Figures 7-45 through 7-55. For the normal wave scenarios (Figures 7-45 through 7-49), the data was extracted along the -7 feet NAVD bathymetric contour line and for the storm wave scenarios (Figures 7-50 through 7-55), the data was extracted along the -15 feet NAVD bathymetric contour line, corresponding to depth limited conditions as described in Section 7.3.1.

These figures show modeled wave heights decreasing slightly for most normal wave scenarios near the Bay Joe Wise borrow area, and slightly increasing in areas and decreasing in other areas near the Chaland borrow area. The magnitude of the wave height change along this bathymetric contour rarely exceeds 0.2 feet for the normal wave scenarios. The modeled wave heights decrease significantly under the storm wave scenarios at the proposed Bay Joe Wise borrow area. In general, at the -15 feet NAVD contour line, the wave heights are decreased by about 5 to 6 feet. The proposed Chaland borrow area generally decreases wave heights by about 2 feet in most of the storm scenarios. In both the storm and normal wave scenarios, the proposed Bay Joe Wise borrow area deflects waves more along a westerly path. The proposed Chaland borrow area deflects waves along a more northerly or easterly path. The potential zone of influence on wave refraction patterns from excavation of both borrow areas extends approximately 12,000 feet to the west and 20,000 feet to the east.



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INPUT PARAMETERS:
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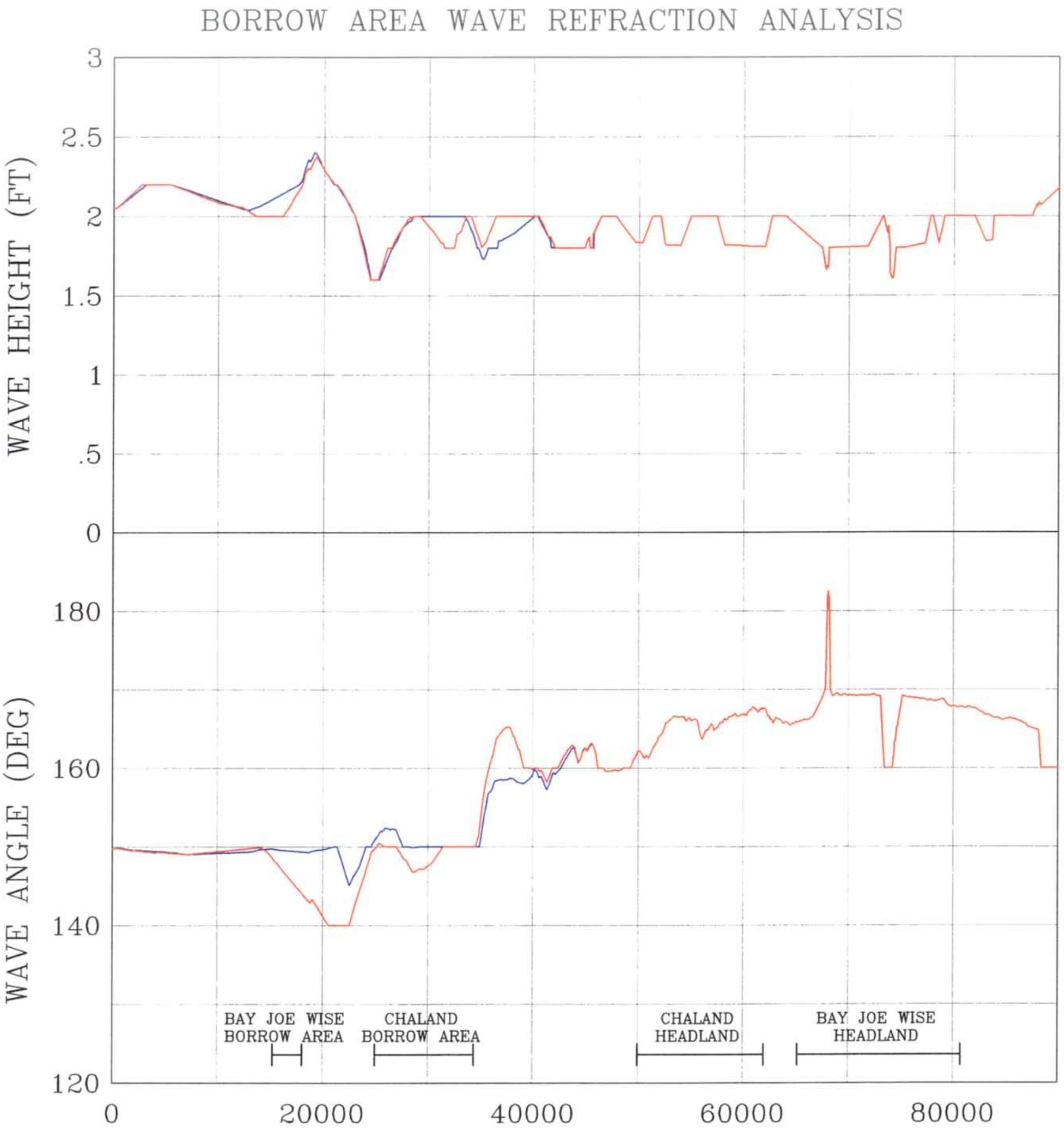
PERIOD = 5.0 SEC
ANGLE = 123 DEG

LEGEND:
— PRE
— POST

FIGURE 7-45: STWAVE CASE 1 RESULTS



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APR 19, 2004

INPUT PARAMETERS:
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PERIOD = 4.6 SEC
ANGLE = 131 DEG

LEGEND:
— PRE
— POST

FIGURE 7-46: STWAVE CASE 2 RESULTS

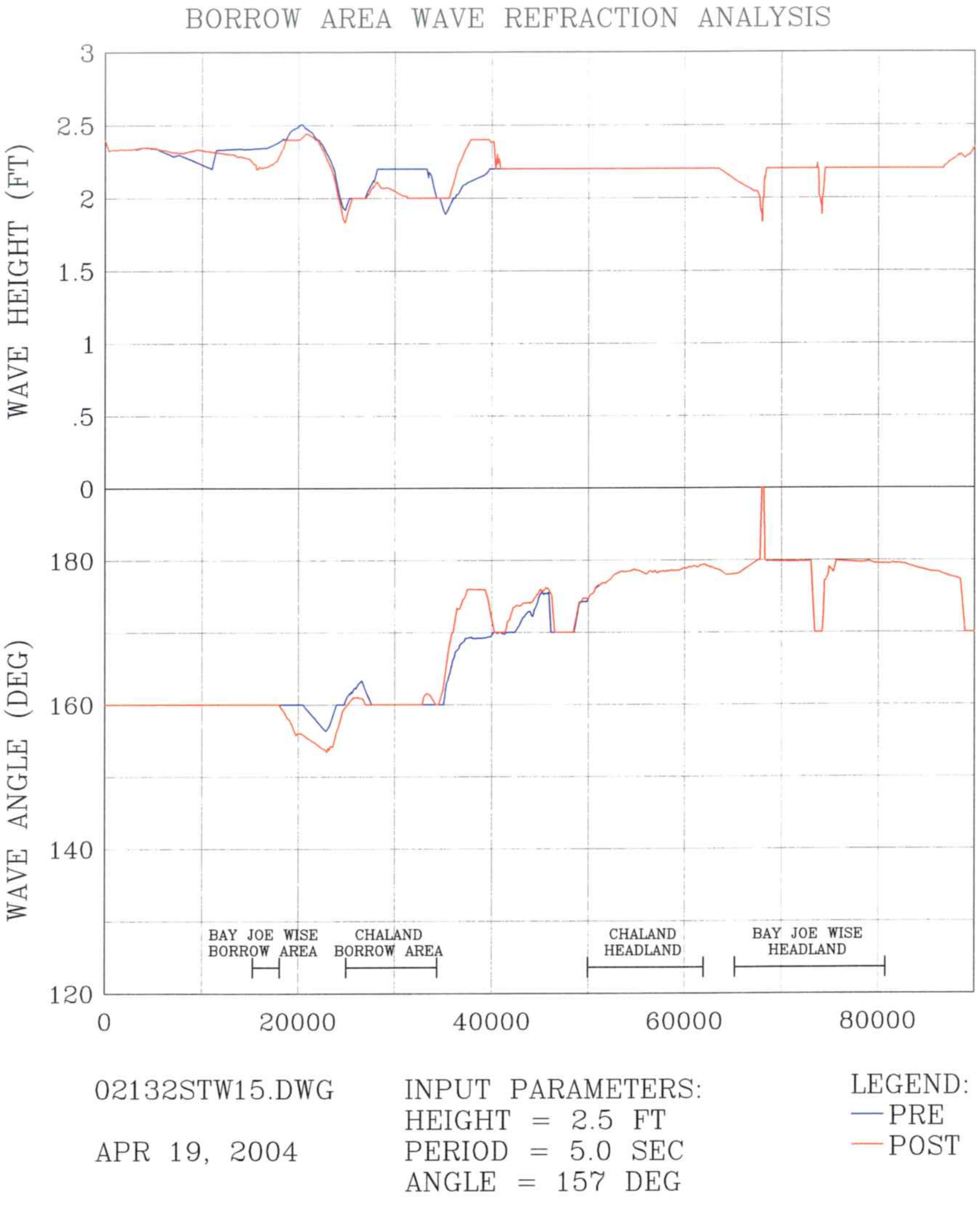
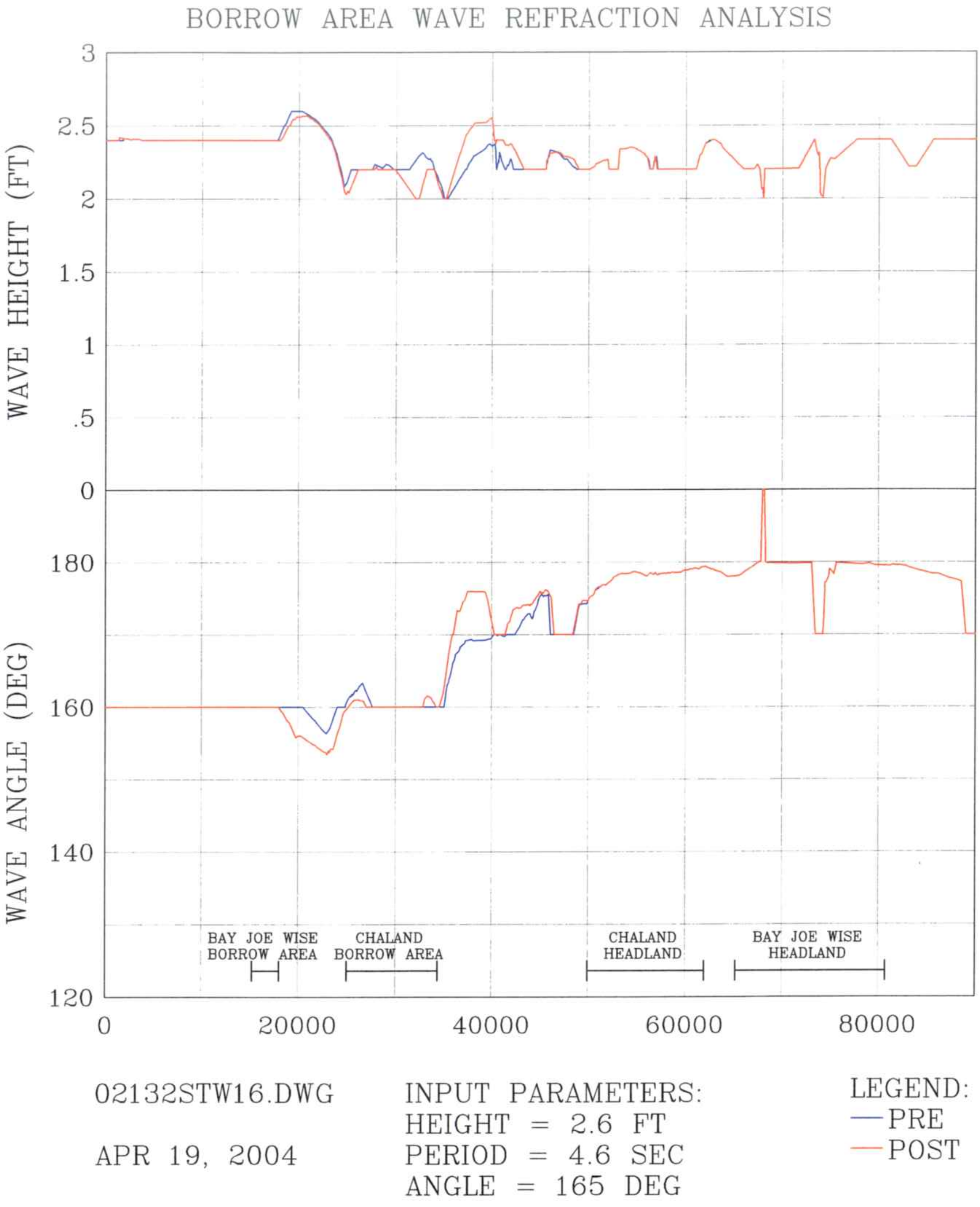


FIGURE 7-47: STWAVE CASE 3 RESULTS

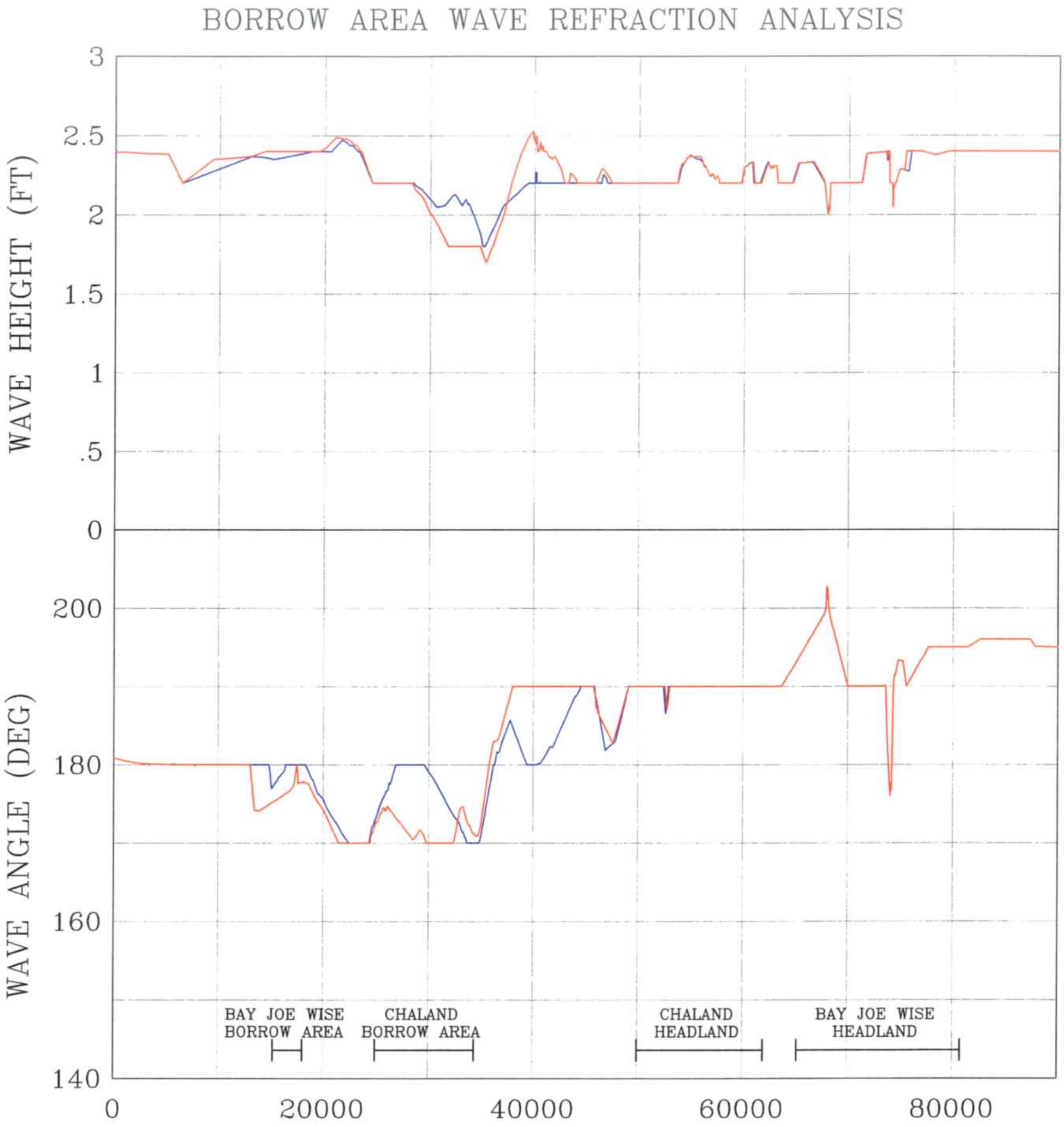


02132STW16.DWG

APR 19, 2004

INPUT PARAMETERS:
HEIGHT = 2.6 FT
PERIOD = 4.6 SEC
ANGLE = 165 DEG

FIGURE 7-48: STWAVE CASE 4 RESULTS



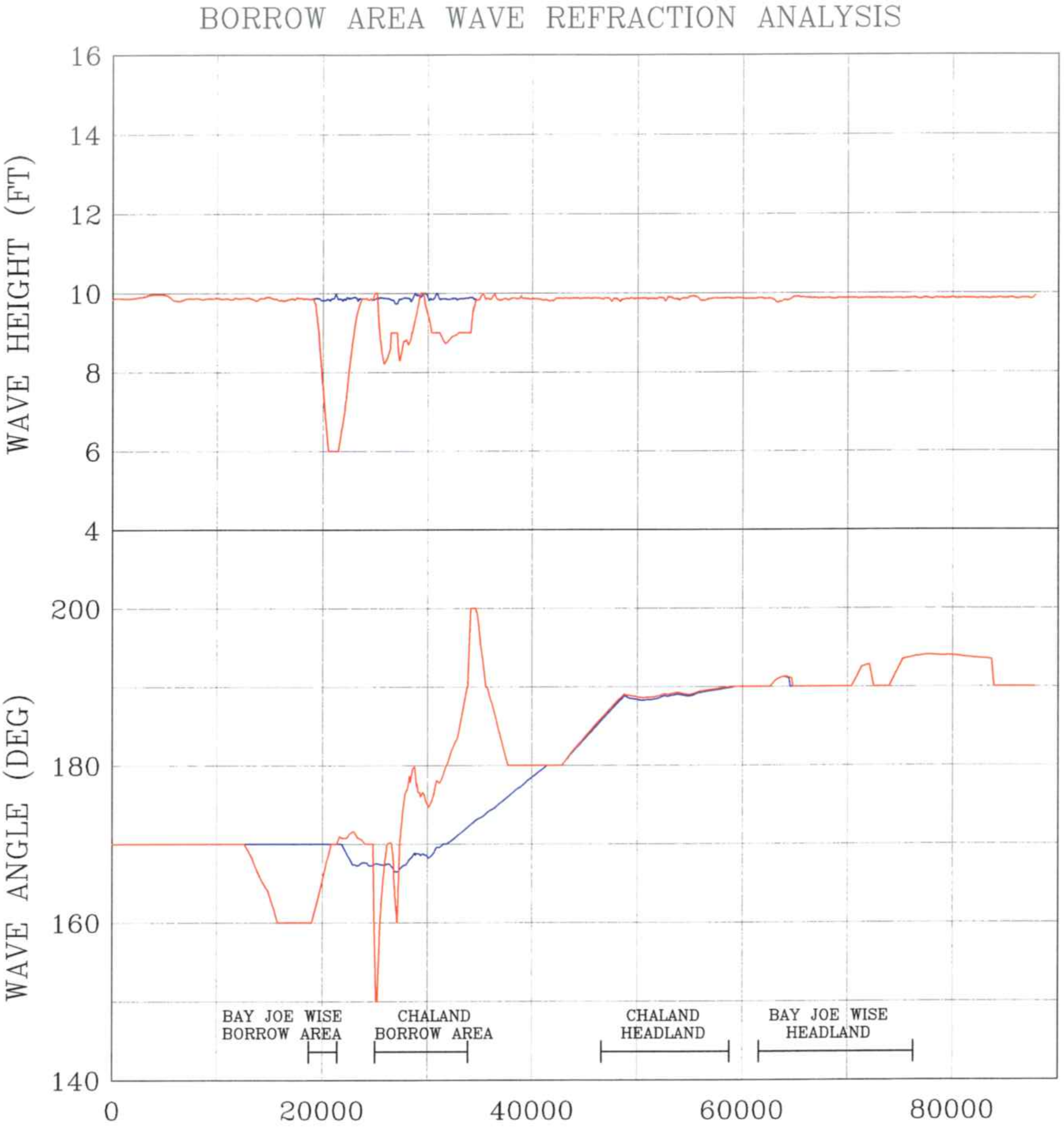
02132STW17.DWG

APR 19, 2004

INPUT PARAMETERS:
HEIGHT = 2.5 FT
PERIOD = 5.0 SEC
ANGLE = 191 DEG

LEGEND:
— PRE
— POST

FIGURE 7-49: STWAVE CASE 5 RESULTS



02132STW18.DWG

APR 19, 2004

INPUT PARAMETERS:
HEIGHT = 17.4 FT
PERIOD = 11.0 SEC
ANGLE = 177 DEG

LEGEND:
— PRE
— POST

FIGURE 7–50: STWAVE CASE 6 RESULTS

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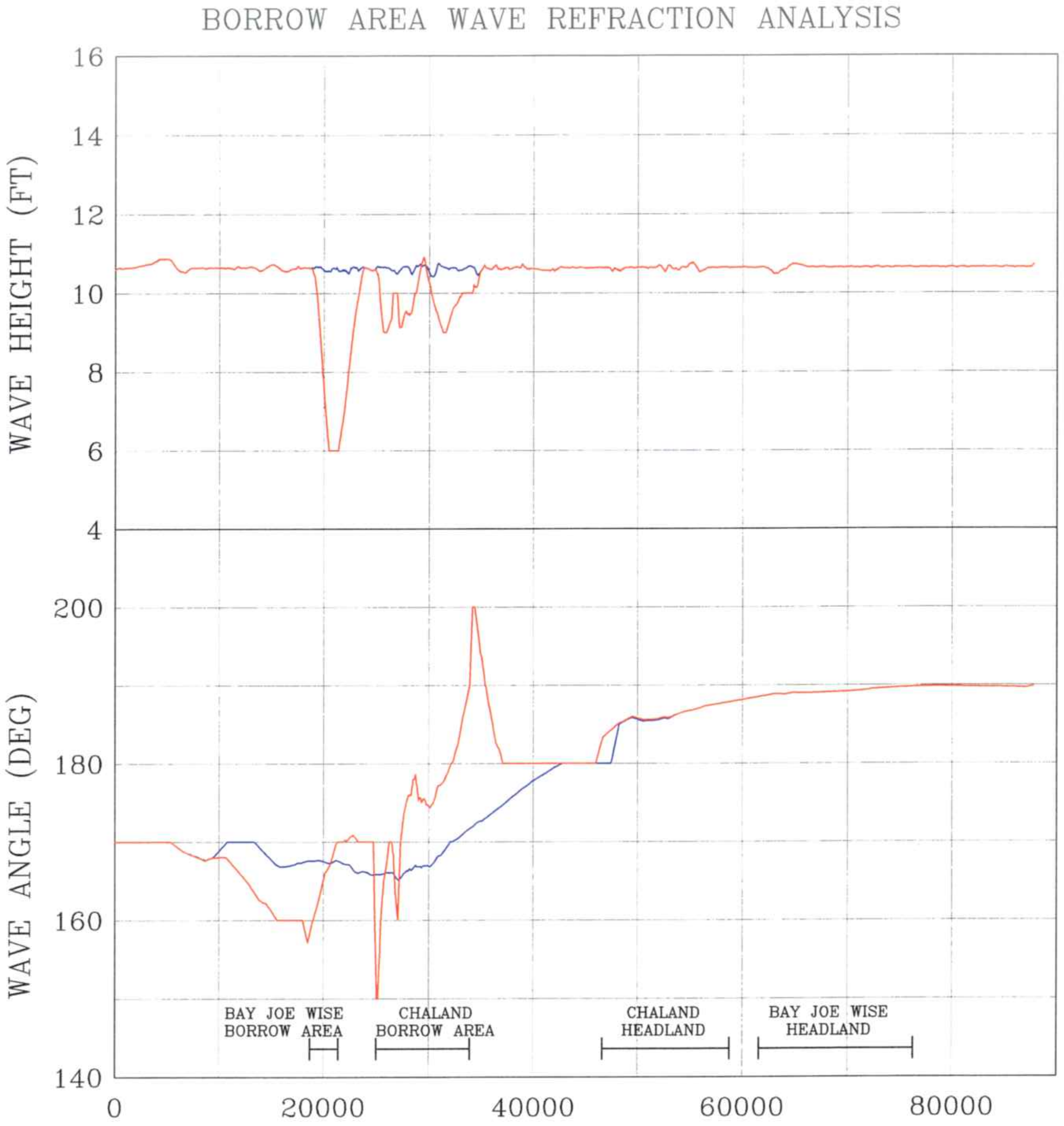


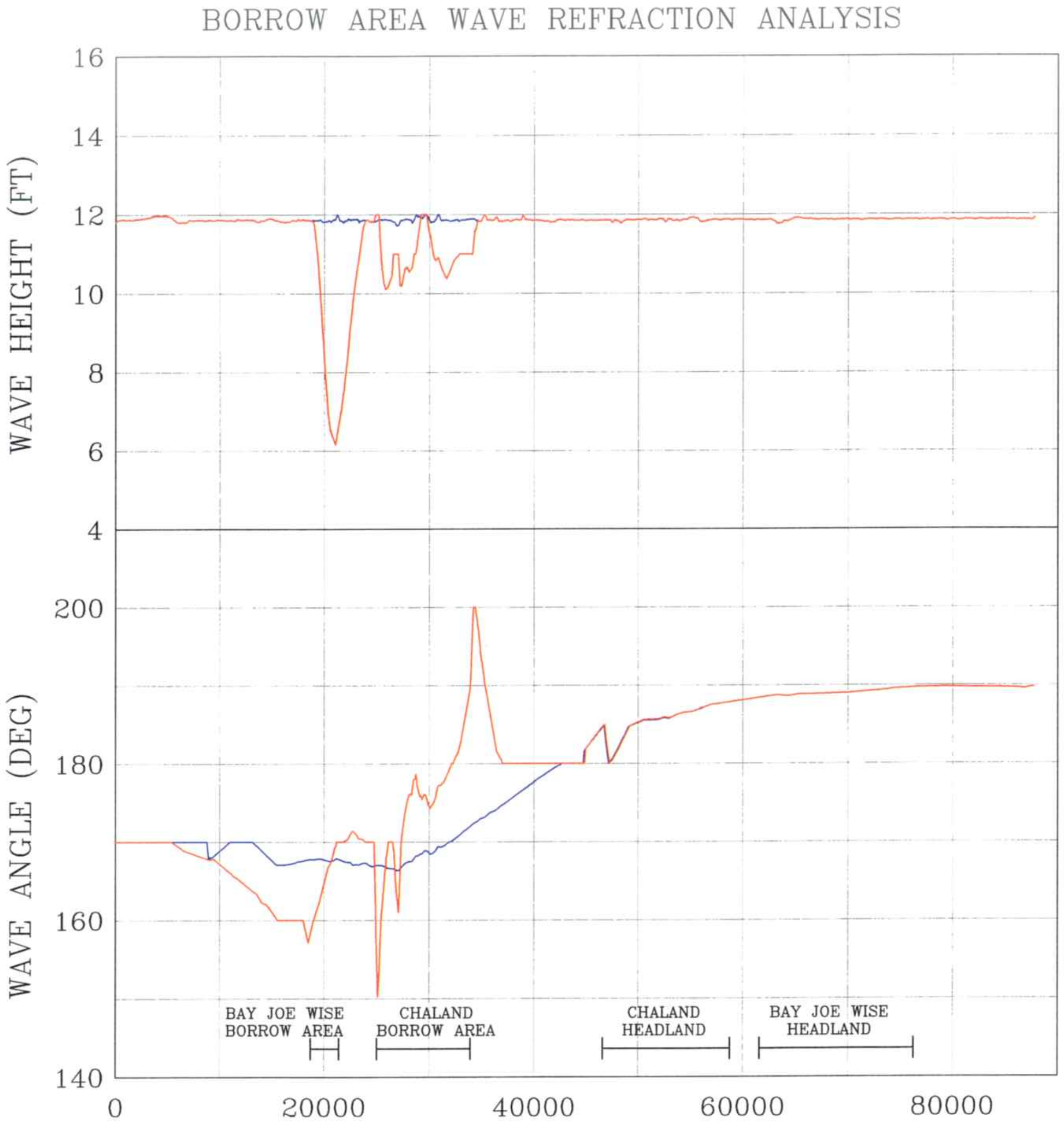
02132STW19.DWG

APR 19, 2004

INPUT PARAMETERS:
HEIGHT = 18.0 FT
PERIOD = 11.7 SEC
ANGLE = 173 DEG

LEGEND:
— PRE
— POST

FIGURE 7-51: STWAVE CASE 7 RESULTS



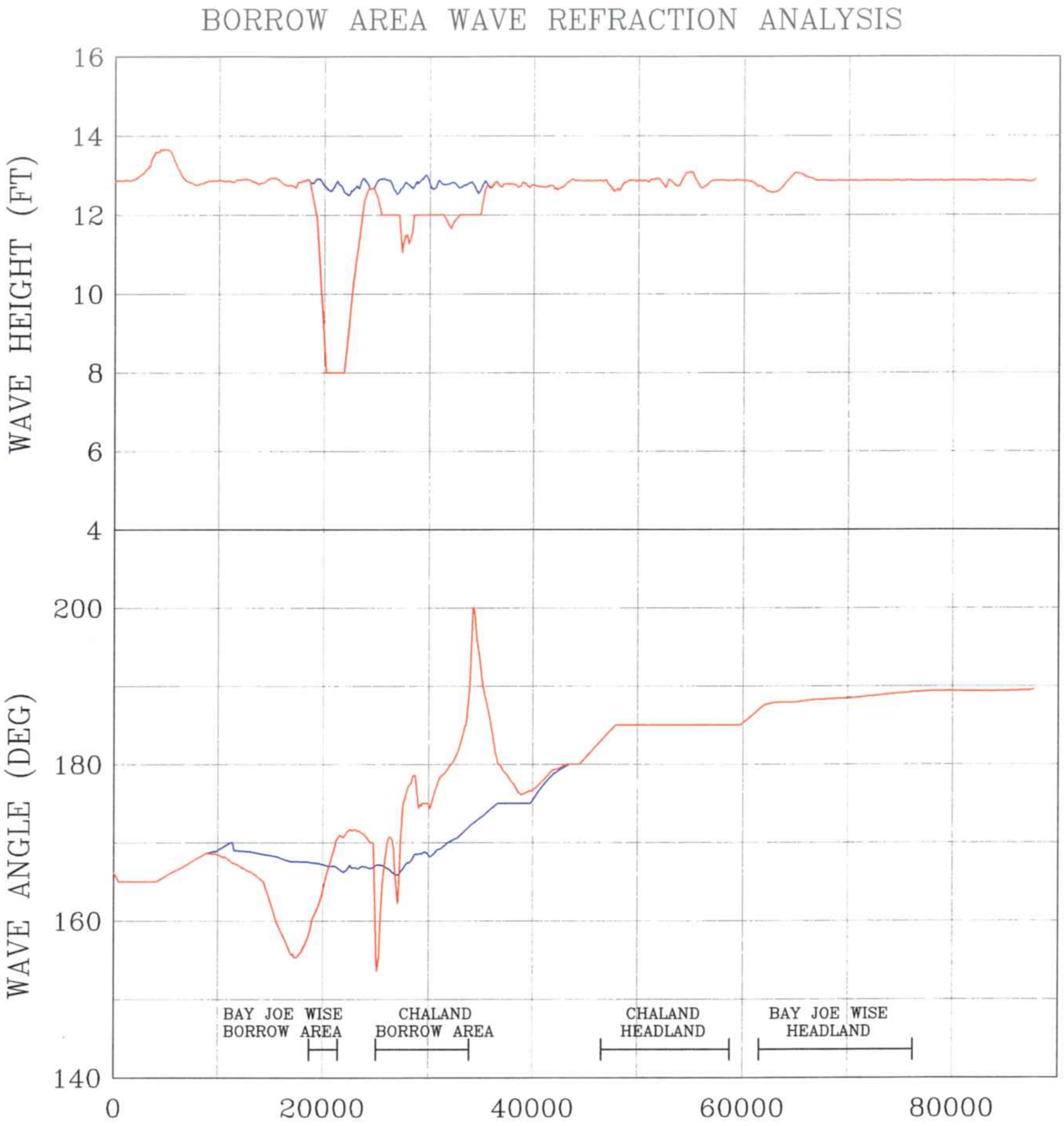
02132STW20.DWG

APR 19, 2004

INPUT PARAMETERS:
HEIGHT = 20.5 FT
PERIOD = 12.4 SEC
ANGLE = 173 DEG

LEGEND:
— PRE
— POST

FIGURE 7–52: STWAVE CASE 8 RESULTS



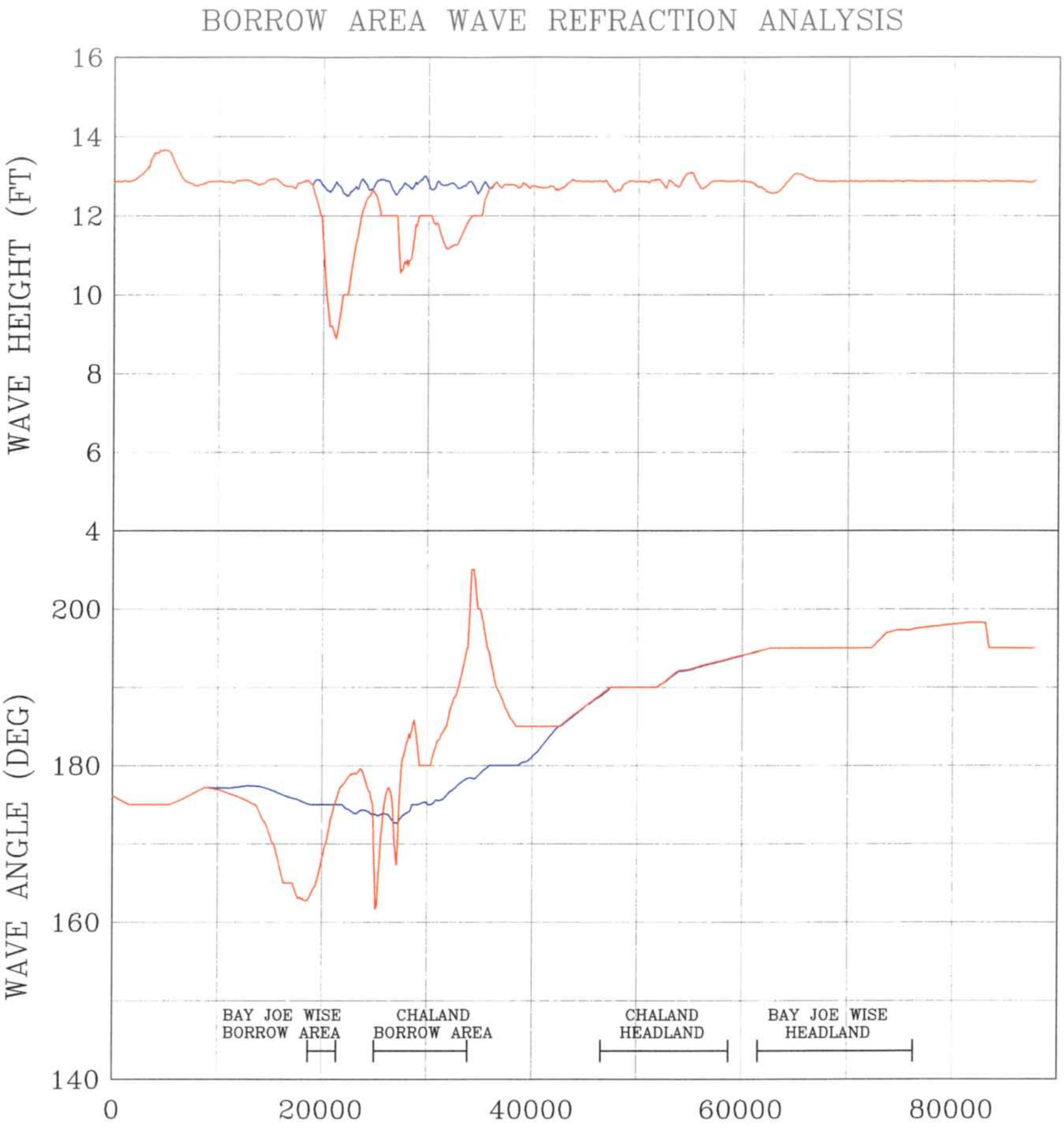
02132STW21.DWG

APR 19, 2004

INPUT PARAMETERS:
HEIGHT = 22.9 FT
PERIOD = 13.2 SEC
ANGLE = 173 DEG

LEGEND:
— PRE
— POST

FIGURE 7–53: STWAVE CASE 9 RESULTS



02132STW22.DWG

APR 19, 2004

INPUT PARAMETERS:
HEIGHT = 22.9 FT
PERIOD = 13.2 SEC
ANGLE = 191 DEG

LEGEND:
— PRE
— POST

FIGURE 7–54: STWAVE CASE 10 RESULTS

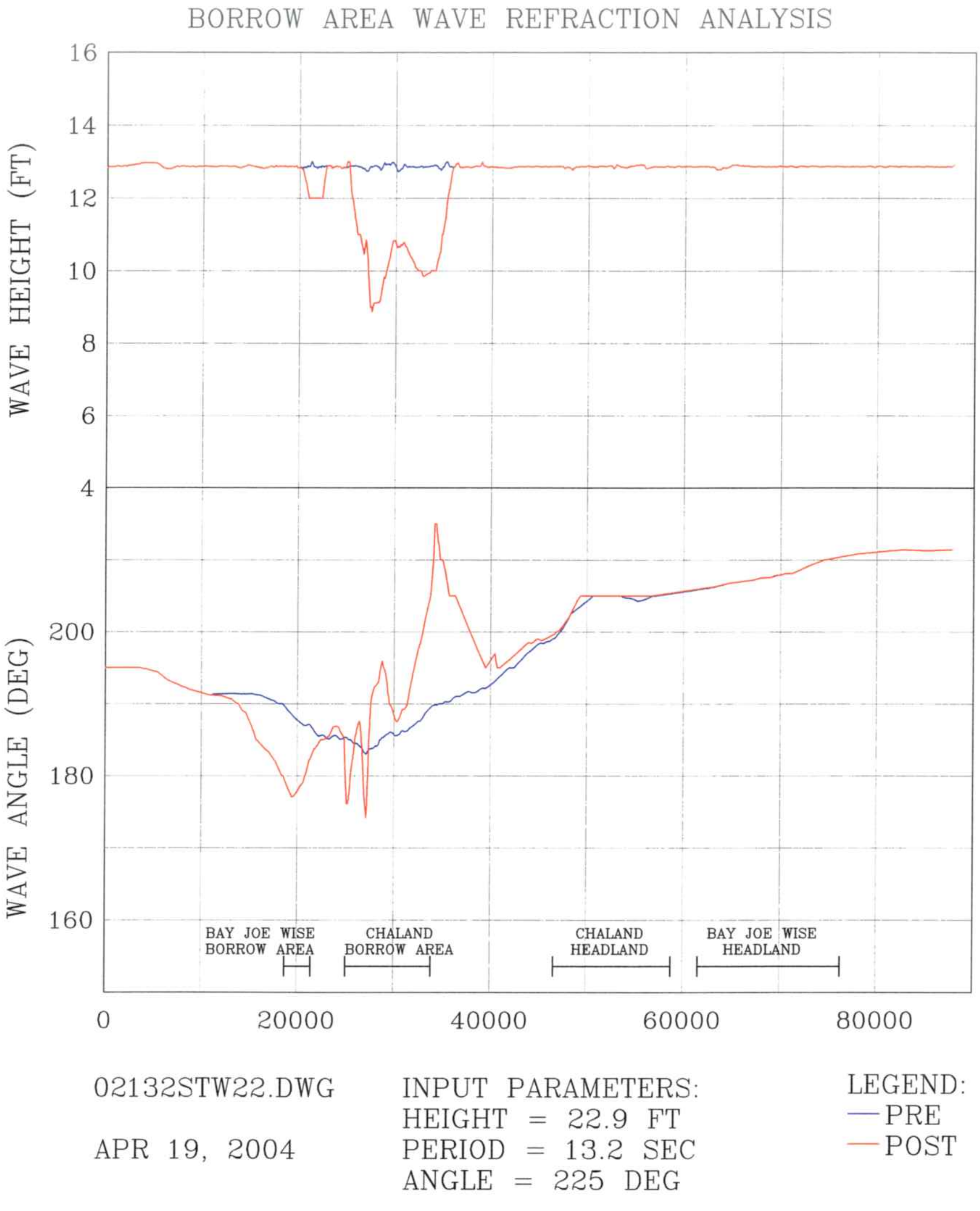


FIGURE 7-55: STWAVE CASE 11 RESULTS

7.3.3 Conclusions

Wave height increases caused by the proposed Bay Joe Wise borrow area were immeasurable at the breaking points. The expected result of the modeled minor decreases in wave height will be minor reductions in sediment transport within the zone of influence of the borrow areas. Additionally, both the plan view images of the results and the cross-sectional comparisons at the breaking points show there is no interaction between the two and the cross sectional comparisons at the breaking points show there is no interaction between the two borrow areas, thus wave height changes are not expected to occur at the proposed Chaland borrow area as a result of the excavation of the proposed Bay Joe Wise borrow area. Thus, it is predicted that excavation of the proposed Bay Joe Wise borrow area will have negligible effects on wave refraction and resultant sediment transport patterns, and no adverse impacts to the adjacent shorelines.

7.4 INLET STABILITY ANALYSIS

7.4.1 Introduction

Following the methodology of O'Brien and Dean (1972), an Escoffier analysis was conducted to analyze the stability of the primary inlets leading from the Gulf of Mexico into Bay Joe Wise as part of the considerations in building a levee and marsh barrier between the Bay and the Gulf. This analysis was conducted to help predict the impact of modifying the inlets during construction, if that becomes necessary.

The Escoffier analysis takes into account tidal forces, the present equilibrium conditions of the inlets, head losses of water moving into and out of the inlets, frictional losses of water moving through the inlets, and the amount of inlet length in which deposition of material can reasonably occur. Using these and other considerations, a relationship between the maximum velocity of water moving through the inlet to the cross sectional area of the inlet was developed. From that relationship, the minimum cross sectional area required to maintain a stable inlet can be found. Also from that relationship, the impact on the maximum water velocity through an inlet from increasing the cross sectional area can be predicted.

7.4.2 Site Characteristics

The group of islands and water channels surrounding Bay Joe Wise and the multiple inlets they form into the Bay do not make up a traditional single inlet directly linking an otherwise land-locked Bay to the Ocean, as is typically assumed in the Escoffier analysis. As such, a somewhat unique analysis approach was undertaken for this study. The major inlets and channels analyzed in the study are shown in Figure 7-56. Observations in the field suggest that two primary channels serve the Bay. These channels have been designated as Bay Joe Wise East and Bay Joe Wise West. From Bay Joe Wise East, field observations suggest the most likely pathways to the Gulf are through Grand Bayou Pass to the south and through Bastian Bay to the east. From Bay Joe Wise West, the most likely path to the Gulf appears to be through Pass Chaland to the west. Pass Chaland,

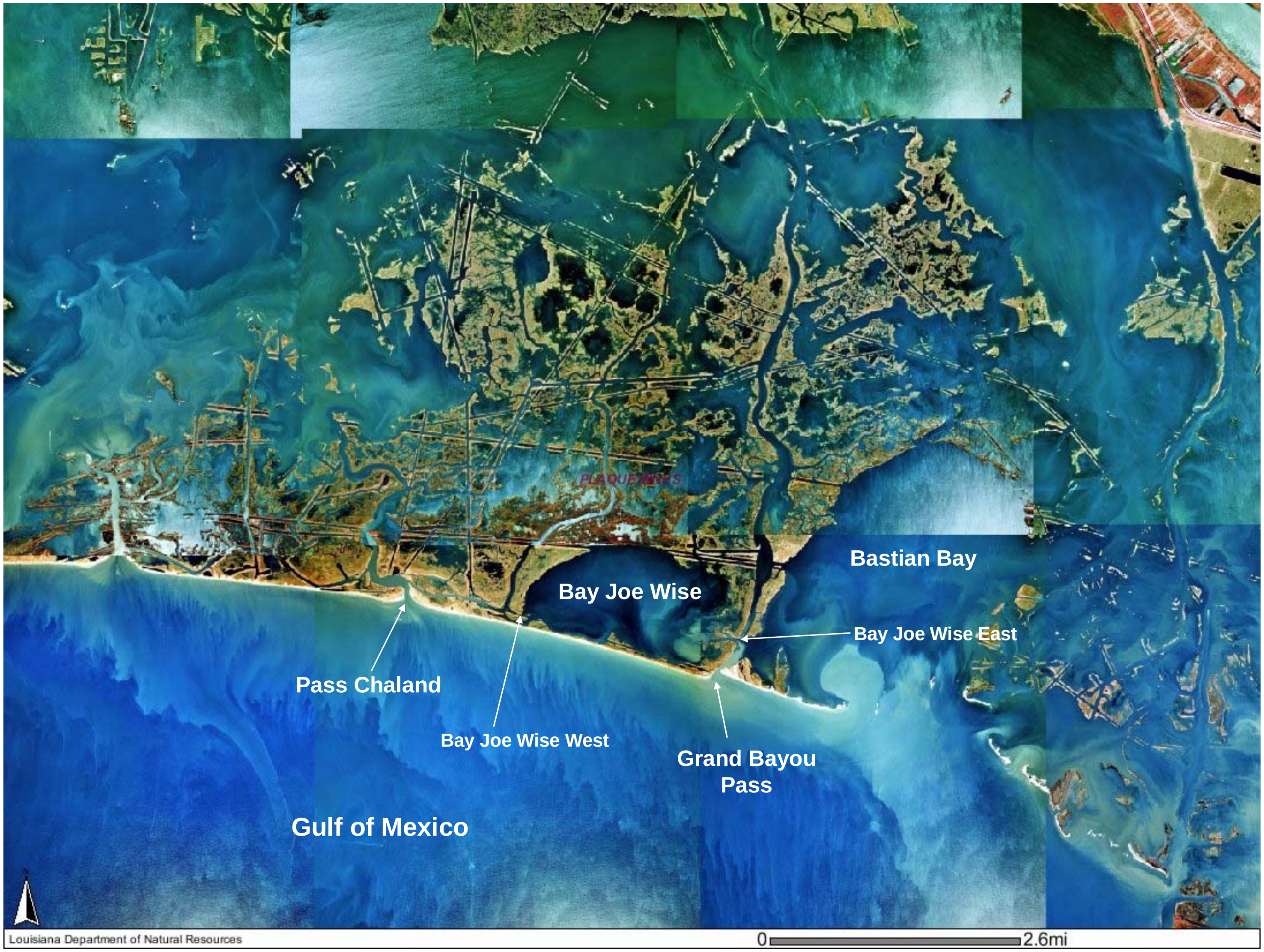


Figure 7-56: Aerial View of the Region Directly Surrounding Bay Joe Wise APR 19, 2004

Grand Bayou Pass, and Bastian Bay are open to a large body of water north of Bay Joe Wise which subsequently has many other inlets to the Gulf.

Due to the open northern boundary and limited existing available hydraulic data of the study area, it is impossible to determine what the effective area of the "Bay" is for the Escoffier analysis simply by measuring an area on the map. For this analysis, the term Bay represents the total water body served by Pass Chaland, Grand Bayou Pass, and the inlets to Bastian Bay. Since all the other input parameters are either known from field work or have well established values for areas such as this, the effective area of the "Bay" was determined through iterative solutions of the Escoffier curve equations.

The input parameters required to solve the Escoffier curve equations and the associated values input in this analysis are shown in Table 7-4. The measured parameters were collected by the SJB-CEC Team during the Tidal Study (Section 4.2). The tidal prism, surface area of the Bay, and fraction of the total Bay area served by each inlet were solved iteratively, and are designated as "calculated" in the table. The derivation of these values along with their final values are presented herein.

Table 7-4: Input and Target Parameters Used for the Calculations

	Symbol	**Grand Bayou Pass**	**Pass Chaland**	**Bastian Bay Inlet**	**Bay Joe Wise East**
Tidal Period (sec):	T	89,280	89,280	89,280	89,280
Cross-Sectional Area of Inlet Throat (ft^2):	Ace	764	1,890	4,460 (estimated)	2,859
Phase Lag (Degrees):	LAG	19.35	19.35	19.35	19.35
Tidal Prism (ft^3):	P	Calculated	Calculated	Calculated	Calculated
Tide Amplitude (ft):	Ao	1.76	1.76	1.76	1.76
Hydraulic Radius (ft):	R	2.46	4.45	2.70	8.41
Total Bay Area (ft^2):	Ab	Calculated	Calculated	Calculated	Calculated
Fraction of Bay Area For Each Inlet (0 to 1, sum should be 1):	ΔAb/Ab	Calculated	Calculated	Calculated	Calculated
Darcy-Weisbach Friction Coefficient:	f	0.03	0.03	0.03	0.03
Sum of Head Loss Due to Entrance and Exit from Inlet (Typically 1.3):	Ken + Kex	1.3	1.3	1.3	1.3
Fraction of Inlet Where Deposition May Occur (0 to 1):	Δl/l	0.75	0.75	0.75	0.75
Maximum Cross Sectional Area to Graph (ft^2):	AREA	5,000	5,000	5,000	5,000
Maximum Measured Velocity (ft/s)	Vmax	3.6	3.0	Unknown	2.0

7.4.3 Calculations

The first step in determining the unknown inputs was to select an area in the Bay system that minimized the primary inlets and channels and therefore minimized the unknown quantities. For this, the Bay Joe Wise East and Pass Chaland inlets were selected, and the Bay area was the body of water primarily served by those inlets. An initial estimate of the Bay area served by these inlets was set at 120,000,000 square feet. Of this area, Bay Joe Wise makes up approximately 56,000,000 square feet and the remaining surface area consisted of the water channels and Bays south of the northern end of Bay Joe Wise as far west as the main water channel that flows into Pass Chaland. Further, it was assumed that each inlet served half of the defined Bay area. The tidal prism for each inlet was calculated by multiplying their respective Bay areas by the tide amplitude (Ao = 1.76 ft).

Generating the Escoffier curves based on those inputs revealed the maximum velocity (Vmax) at the known cross-sectional area of each of the inlets was under predicted compared to the measured values. In order to increase the maximum velocities, the Bay area was increased and the fraction of the Bay served by each inlet was modified until the measured value of Vmax fell on the curve at the correct cross sectional area for each inlet. The unique values that provided that result for this scenario are presented in Table 7-5. Figure 7-57 graphically displays the calculated Escoffier curve. Note in Figure 7-57 that the intersection of the target value of Vmax and the present cross sectional area of each of the inlets occurs to the right hand side of the peak in Vmax. This shows the two inlets are stable under the present conditions and should not be susceptible to closure. To the right of the peak in Vmax, decreases in the cross sectional area caused by deposition of material in the inlet cause the velocity of flow to increase. This increase in flow velocity increases the inlet's ability to scour itself and remain open. Once the cross sectional area decreases to the extent that it falls to the left of the peak in Vmax, subsequent decreases in the area will cause the velocity to decrease making the inlet more susceptible to closure.

Table 7-5: Input Parameters for Bay Joe Wise East and Pass Chaland Scenario

	Symbol	Pass Chaland	Bay Joe Wise East
Tidal Prism (ft^3):	P	135,036,000	137,764,000
Total Bay Area (ft^2):	Ab	155,000,000	155,000,000
Fraction of Bay Area For Each Inlet (0 to 1, sum should be 1):	ΔAb/Ab	0.495	0.505
Bay Area Covered by Inlet (ft^2)	ΔAb	76,725,000	78,275,000

From the previous scenario, it was found that Pass Chaland serves about 77,000,000 square feet of the Bay area. This result was then plugged into a new scenario that replaced the Bay Joe Wise East inlet with Grand Bayou Pass and the inlets leading from Grand Bayou to Bastian Bay. The inlets leading from Grand Bayou to Bastian Bay were assumed to be one equivalent inlet for these calculations.

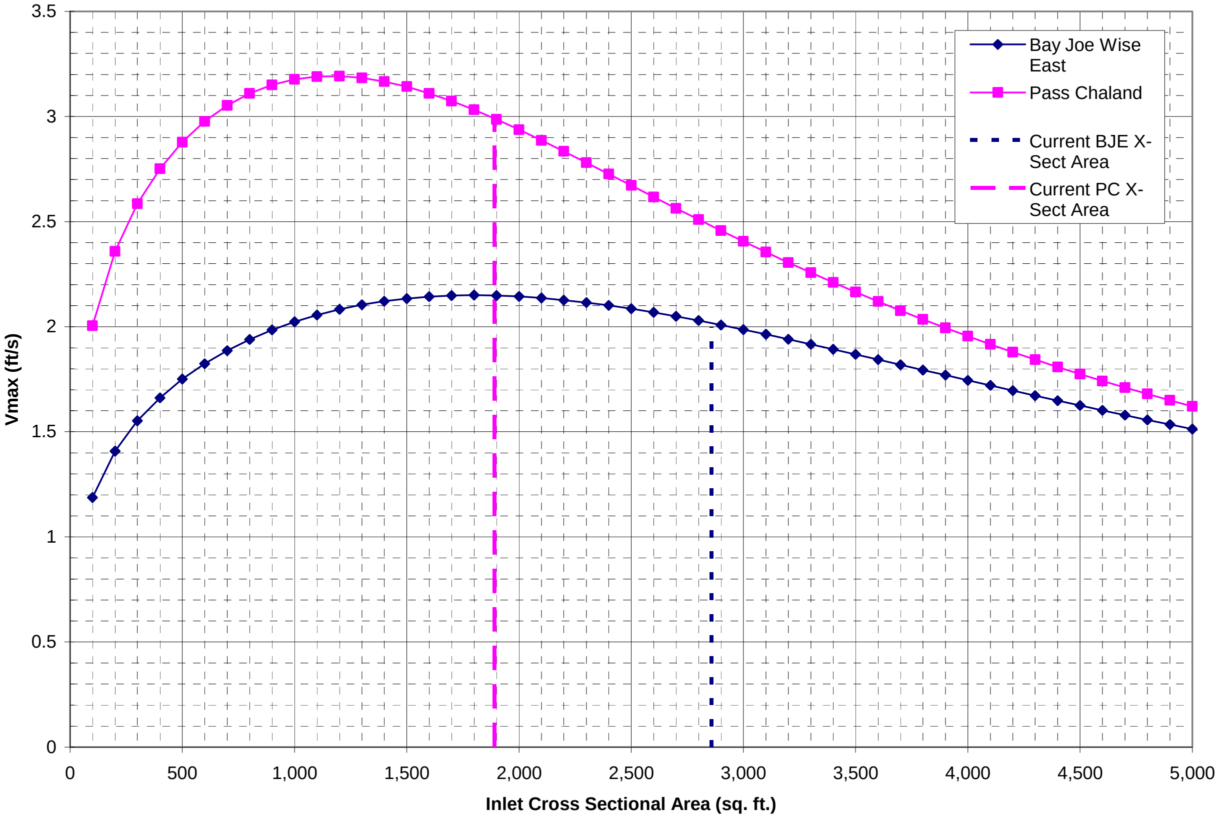


Figure 7-57: Calculated Escoffier Curves for Bay Joe Wise East and Pass Chaland Scenario

The addition of these inlets added about 35,000,000 square feet of Bay surface area to the total Bay area. By manipulating the fraction of the total Bay area served by each inlet, Pass Chaland was maintained at about 77,000,000 square feet, and Grand Bayou Pass was manipulated until Vmax equaled the measured value at the current cross sectional area of the inlet in the Escoffier curve. The ADCIRC model described in Section 7.2 of this report was used to extract an approximate maximum velocity of water flowing through the Bastian Bay inlets, which was equal to 1.3 feet per second. Calculations were performed iteratively until the total Bay area that maintained the proper maximum velocities in Pass Chaland, Grand Bayou Pass, and the Bastian Bay inlets was found. Table 7-6 summarizes the input values used, and Figure 7-58 displays the calculated Escoffier curve.

Table 7-6: Input Parameters for the Grand Bayou, Pass Chaland, and Bastian Bay Scenario

	Symbol	Pass Chaland	Grand Bayou Pass	Bastian Bay Inlet
Tidal Prism (ft^3):	P	135,432,000	65,877,000	133,091,000
Total Bay Area (ft^2):	Ab	190,000,000	190,000,000	190,000,000
Fraction of Bay Area For Each Inlet (0 to 1, sum should be 1):	ΔAb/Ab	0.405	0.197	0.398
Bay Area Covered by Inlet (ft^2)	ΔAb	76,950,000	37,430,000	75,620,000

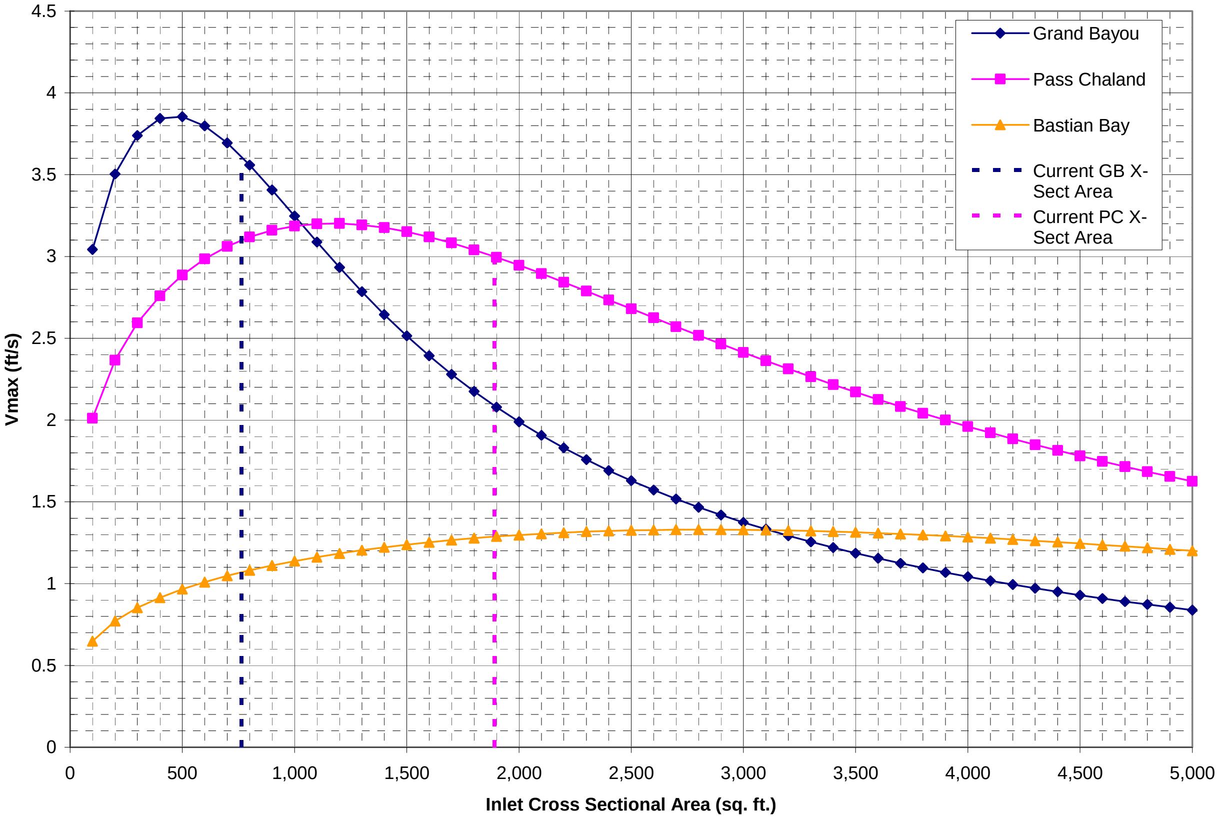


Figure 7-58: Calculated Escoffier Curves for the Grand Bayou, Pass Chaland, and Bastian Bay Scenario

7.4.4 Sensitivity Analysis

The parameter with the highest uncertainty in the model is the fraction of inlet length along which deposition is reasonably anticipated to occur. O'Brien and Dean (1972) reported that typical natural inlets have a depositional length of 1,000 feet. In their sample scenario, the inlet's hydraulically equivalent length was calculated to be 12,200 feet. This suggests a fractional depositional length of 1,000/12,200 or approximately 0.1.

The value of 0.75 was used in the Escoffier analysis presented herein to maintain a conservative estimate of the minimum cross sectional area that needs to be maintained in each inlet to ensure the inlet remains open. The smaller the fraction, the shorter the depositional length, and the smaller the inlet cross sectional area can be to maintain a stable inlet. Also, the hydraulically equivalent inlet lengths for Grand Bayou Pass, Pass Chaland, and the Bastian Bay inlet were calculated to be 1,710 feet, 4,900 feet, and 19,000 feet respectively. If the depositional length of 1,000 feet is independent of the effective length of the inlet, then the fractional inlet length for deposition reaches as high as 0.6 for Grand Bayou Pass (1,000 feet/1,710 feet).

Figures 7-59 and 7-60 present Escoffier curves for Pass Chaland and Grand Bayou Pass respectively, using various values for the fractional depositional length (ΔL/L). When the depositional length is set to zero, the inlet remains stable at any cross sectional area. As the fractional depositional length increases, the inlet's stability decreases to a point where any decrease in cross sectional area will likely result in closure of the inlet.

The Darcy-Weisbach friction coefficient only affects the calculated hydraulically equivalent inlet length, and does not affect the final curves. If the calculations were performed with the depositional length held constant instead of the fractional length of the depositional zone held constant, then the friction coefficient would have an impact on the calculated curves.

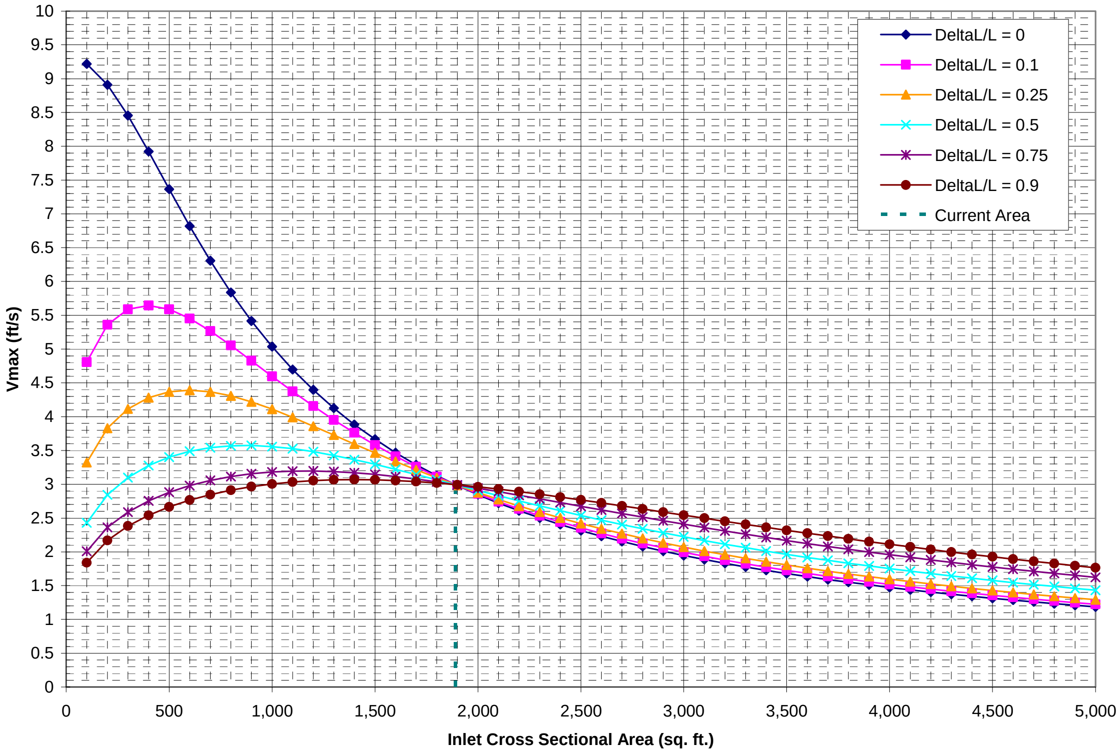


Figure 7-59: Depositional Length Curves for Pass Chaland

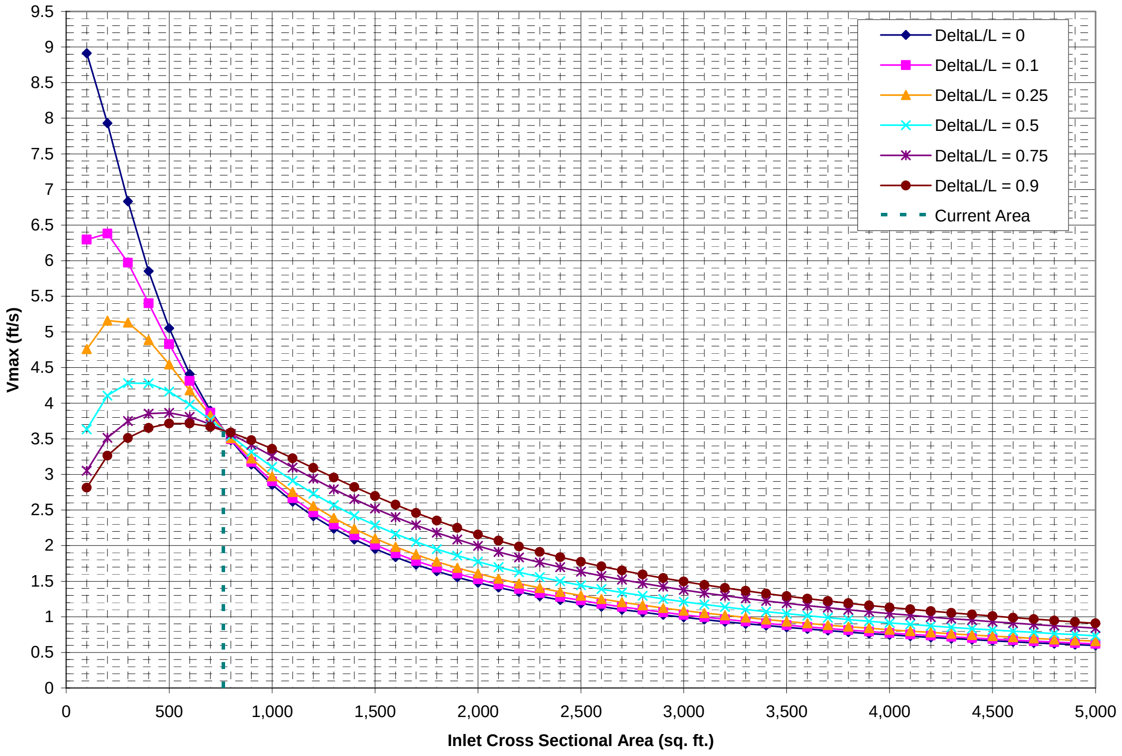


Figure 7-60: Depositional Length Curves for Grand Bayou Pass

With a fractional depositional length of 0.75, the head loss of entering and exiting water to and from the inlet has a fairly negligible effect when varied within a reasonable range. Figures 7-61 and 7-62 display the impact this parameter has on the Escoffier curves for Pass Chaland and Grand Bayou Pass, respectively.

7.4.5 Conclusions

Based on the results displayed in the curves, Pass Chaland appears to be fairly resistant to moderate changes in its cross sectional area. Its cross sectional area can be decreased by about 500 square feet (or by about 26%) before it is subject to closing itself off, and increasing the cross sectional area of the inlet by 1,000 square feet (about 53%) will decrease the flow rate by less than 1 foot per second, that is from 3 feet per second to 2 feet per second.

The smaller inlet, Grand Bayou Pass, is also quite resistant to fairly large changes in its cross sectional area, relative to its present size. Decreasing the cross sectional area of this inlet by less than 250 square feet (about 33%) will likely maintain a stable inlet. Increasing the cross sectional area will also have a relatively small effect on the maximum flow rate through the inlet. If the cross sectional area is increased by 700 square feet (almost twice its original size), the maximum flow velocity will likely decrease from 3.6 feet per second to about 2.6 feet per second for all.

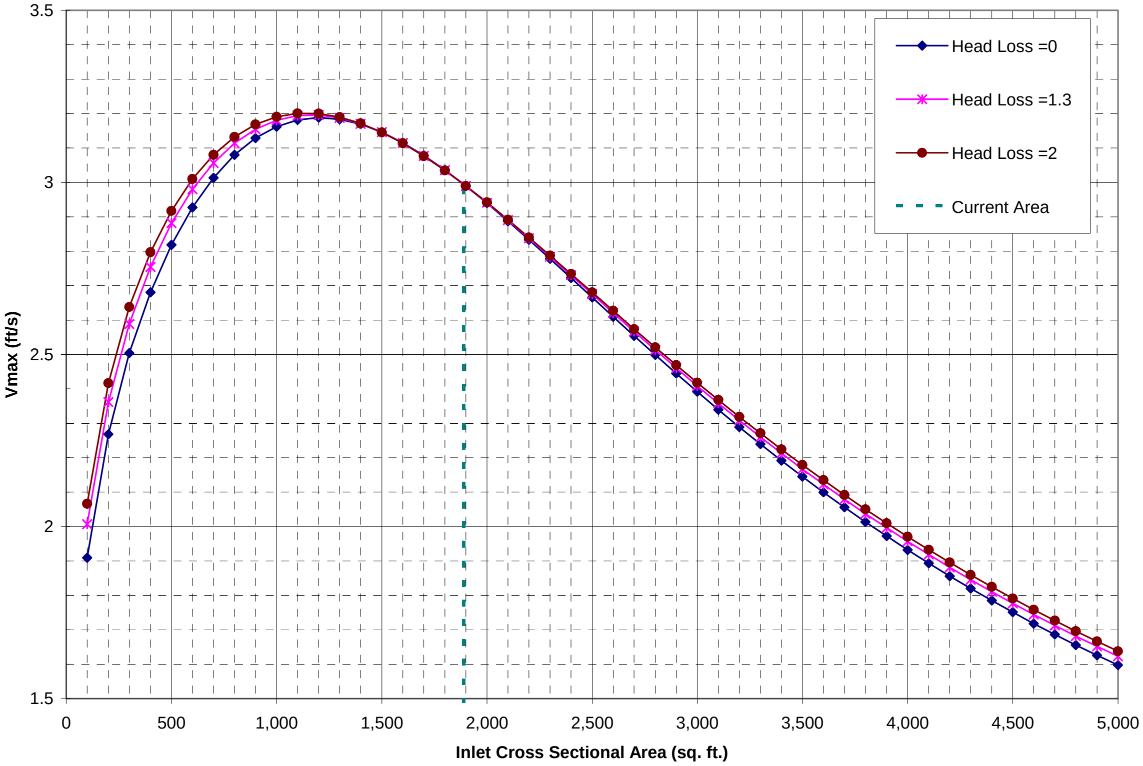


Figure 7-61: Head Loss Curves for Pass Chaland

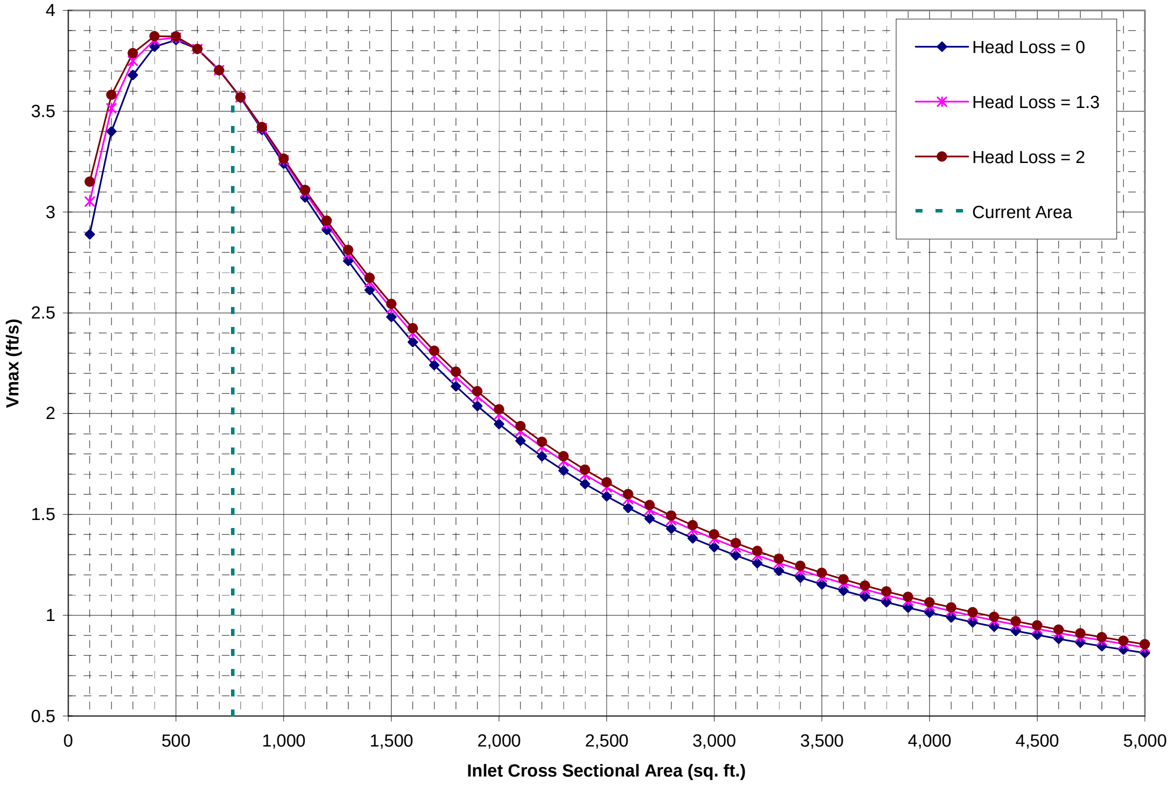


Figure 7-62: Head Loss Curves for Grand Bayou Pass

Since the Escoffier curves vary quite widely depending on the length of the inlet assumed to serve as a depositional zone, further analyses could be done to better determine the length of the inlet in which deposition is occurring. This analysis could be as simple as examining aerial photographs that provide good views of the sea floor around the inlets. An additional analysis that could help improve and verify these calculations would be to measure the current velocities through the inlets leading from Grand Bayou to Bastian Bay. The surface area of the Bay served by these inlets could then be input more accurately into the calculations, and it would be possible to verify that a reasonable surface area can be used to match the Escoffier curve of the Bastian Bay inlets to the actual measurements, as was done for Pass Chaland and Grand Bayou Pass.

8.0 CONTAINMENT DIKES

8.1 DESIGN CRITERIA

8.1.1 Introduction

Three primary dikes will be needed for the Project construction. The first will contain the marsh fill within the template and prevent fill diffusion into the remainder of Bay Joe Wise. The second will separate the beach and dune fill from the marsh fill to maximize the coarser material placed in the seaward portion of the overall fill template. The third will contain the marsh fill within the template along the proposed secondary channel to avoid shoaling and run-off into the newly dredged flow-way between Pass Chaland and Bay Joe Wise. It is anticipated that multiple secondary containment dikes will be constructed within the fill templates to contain the sediment laden water used to deposit the fill material and control return water. During the development of the construction plans and technical specifications in the Final Design Task, the material sources and alternatives shall be evaluated and the preferred alternative for each dike in terms of technical and cost effectiveness shall be recommended for inclusion in the Project.

8.1.2 Tidal Parameters

The mean lower low water (MLLW) elevation and the mean higher high water (MHHW) elevation in the Project area are 0.4 feet NAVD and 1.6 feet NAVD respectively. In order to ensure adequate stability of the dike, MHHW shall be used to determine the water depth in the fill templates, and MLLW elevation shall be used to calculate the height of the dike above the water surface, that is, the freeboard of the dike relative to the water surface.

8.1.3 Safety Factors

STE et al. (2004) determined that for the Project's geologic setting, sediment parameters and design objectives, a dike side slope of 1(V):8(H) would be needed to maintain a stable dike. Table 8-1 provides an excerpt from a table of the safety factors presented in STE et al. (2004). Values of 1.3 or higher are considered safe. Figure 8-1 displays a graph of the stability factor data along with regression lines, regression line equations, and R^2 values of the regression. These regression results shall be used to interpolate the safety factor for varying freeboard heights at water depths of 4 feet and 6 feet, which are typical depths anticipated to be encountered for dike construction. Simple linear regression shall then be performed to approximate the safety factor at specific water depths. This analysis assumes a dike crest width of 20 feet.

8.1.4 Total Effective Settlement

Decreases in the fill and dike elevations are due to the total effective settlement. The total effective settlement accounts for settlement due to the weight of the fill or dike, self-weight consolidation within the fill or dike, geologic subsidence, and sea level rise. The settlement due to the weight of the fill or dike and self-weight consolidation within the fill or dike were calculated by STE et al. (2004) based on the sediment conditions sampled and analyzed in Bay Joe Wise. Both the geologic subsidence and sea level rise occur at an approximate rate of 0.025

feet per year. Figures 8-2 and 8-3 depict the relationships between initial freeboard and total effective settlement extrapolated from calculations by STE et al. (2004) for varying time periods at water depths of 4 and 6 feet.

TABLE 8-1
SLOPE STABILITY ANALYSIS

Initial Freeboard (ft)	Water Depth (ft)	Safety Factor for a Side Slope of 1(V):8(H)
1	4	2.6
2		2
3		1.6
4		1.4
1	6	2.3
2		1.9
3		1.6
4		1.4

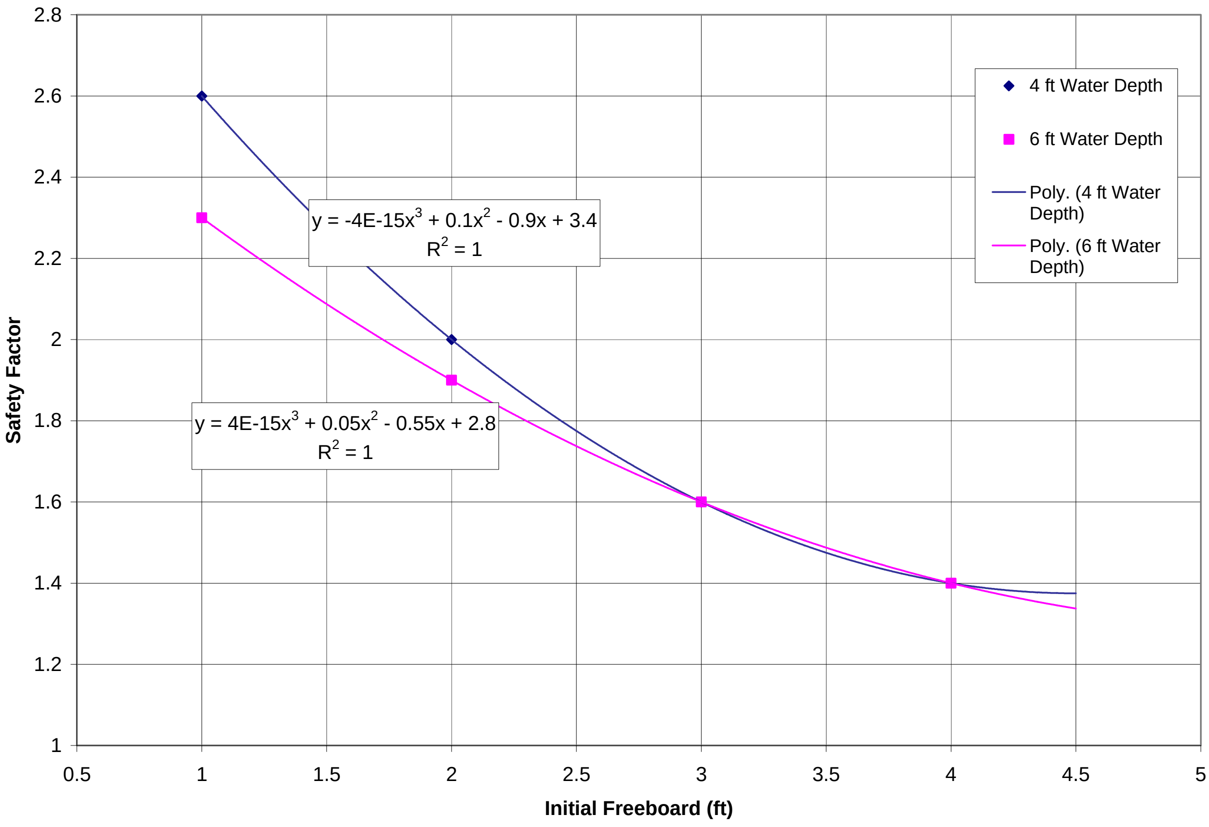
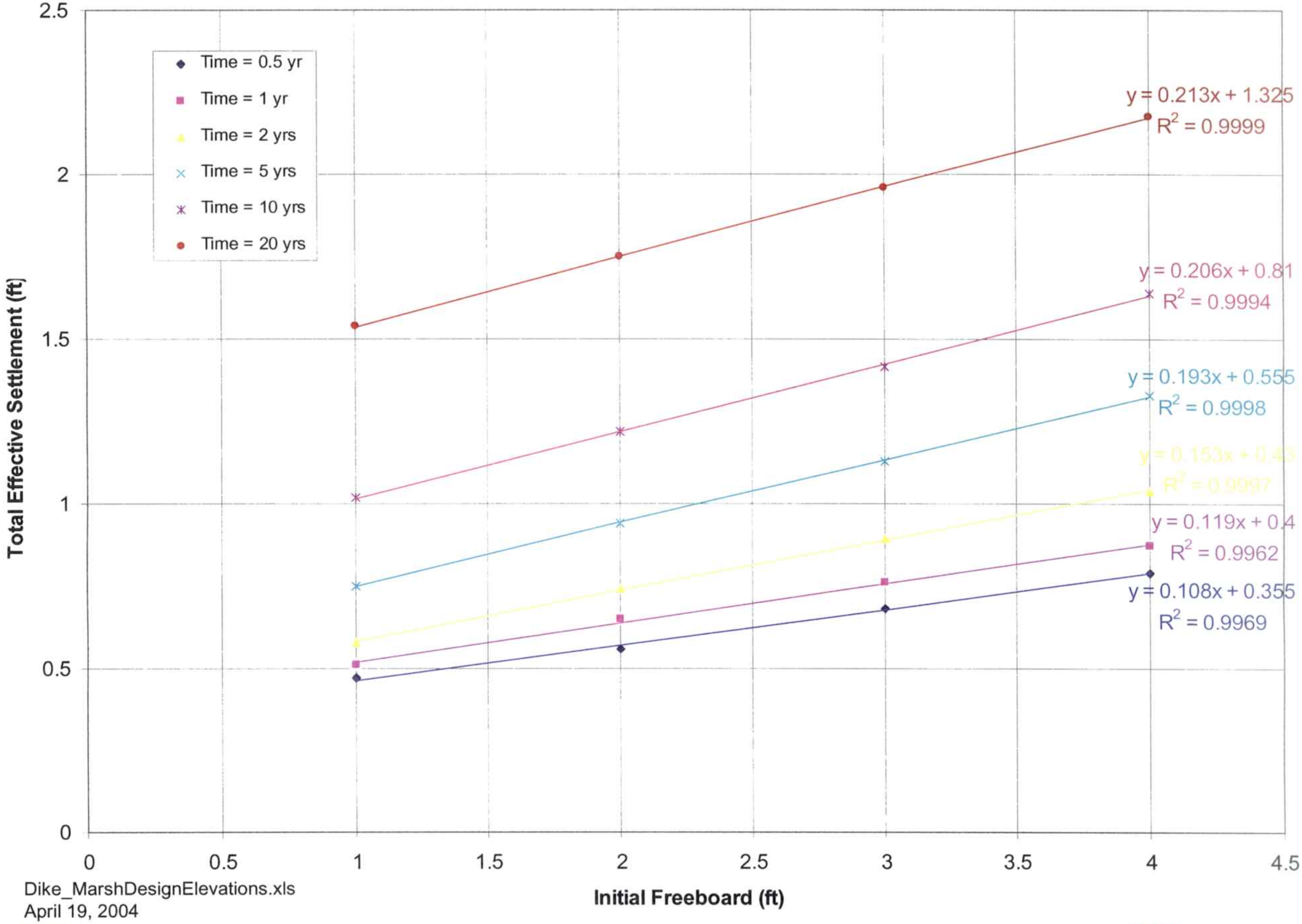


Figure 8-1: Slope Stability Analysis

These relationships shall be used to calculate the total effective settlement for varying freeboard heights and water depths and serve as design criteria for determining the optimal primary dike elevations as well as the optimal marsh fill elevation.



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April 19, 2004

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Figure 8-2: Total Effective Settlement vs Initial Freeboard in 4 Feet of Water

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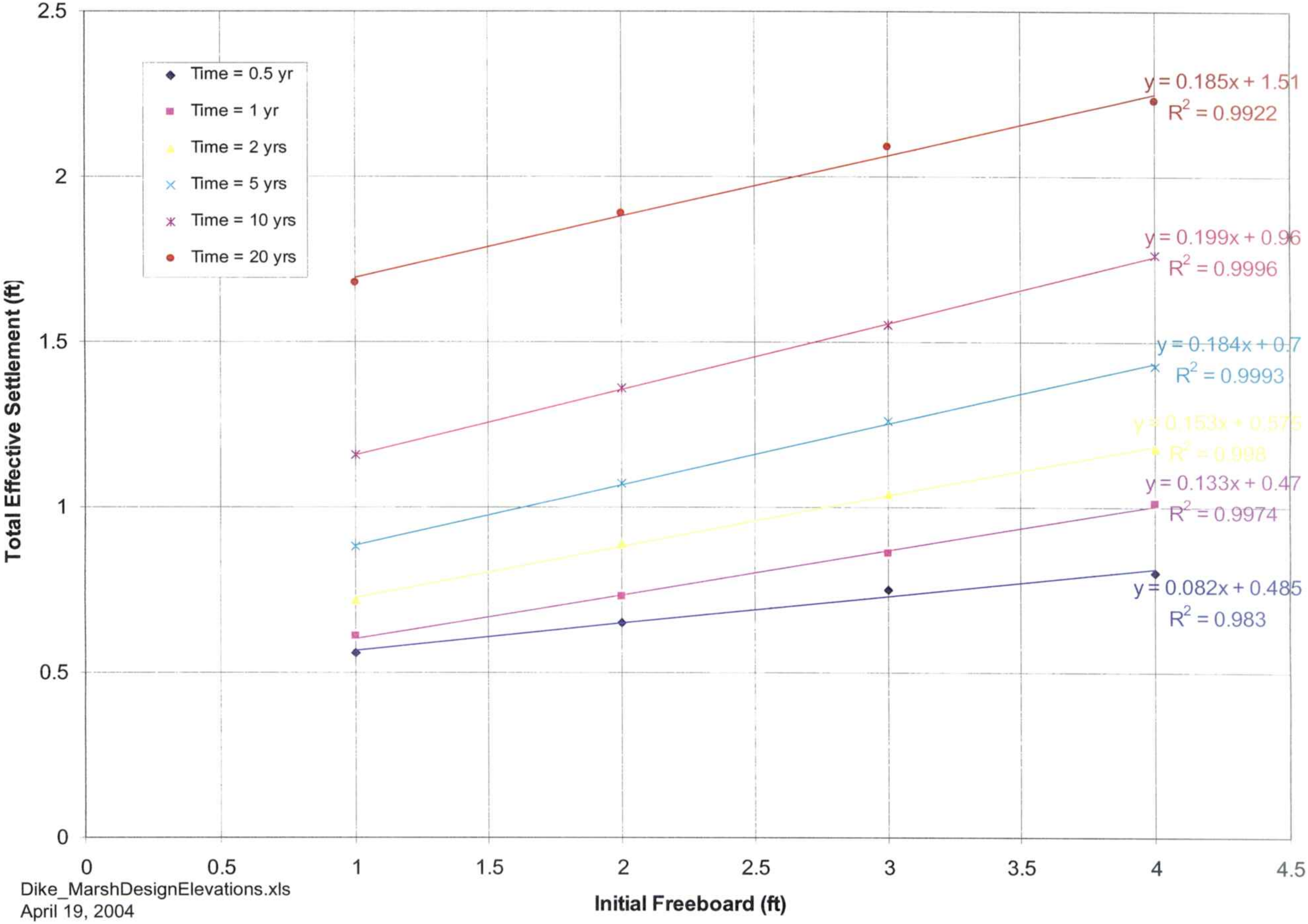

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April 19, 2004

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Figure 8-3: Total Effective Settlement vs Initial Freeboard in 6 Feet of Water

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Fairly rapid settlement caused by the weight of the dike or fill and self-weight consolidation occurs over the first 2 years following construction. Following the initial 2 years, a steadier settling takes place which is dominated by the fairly constant geologic subsidence and sea level rise. Thus, the dike design life is set at 2 years.

8.1.5 Bay Joe Wise Wave Analysis

The primary containment dike that will be used for containing the marsh fill will be exposed to waves from Bay Joe Wise. During the anticipated 6 month period that the fill is dewatering, the containment dikes must reasonably protect the fill from potentially damaging waves. An analysis of the potential wave propagation across the bay under various scenarios has been performed using CEDAS-ACES Version 2.01G (Leenknecht et al., 1992).

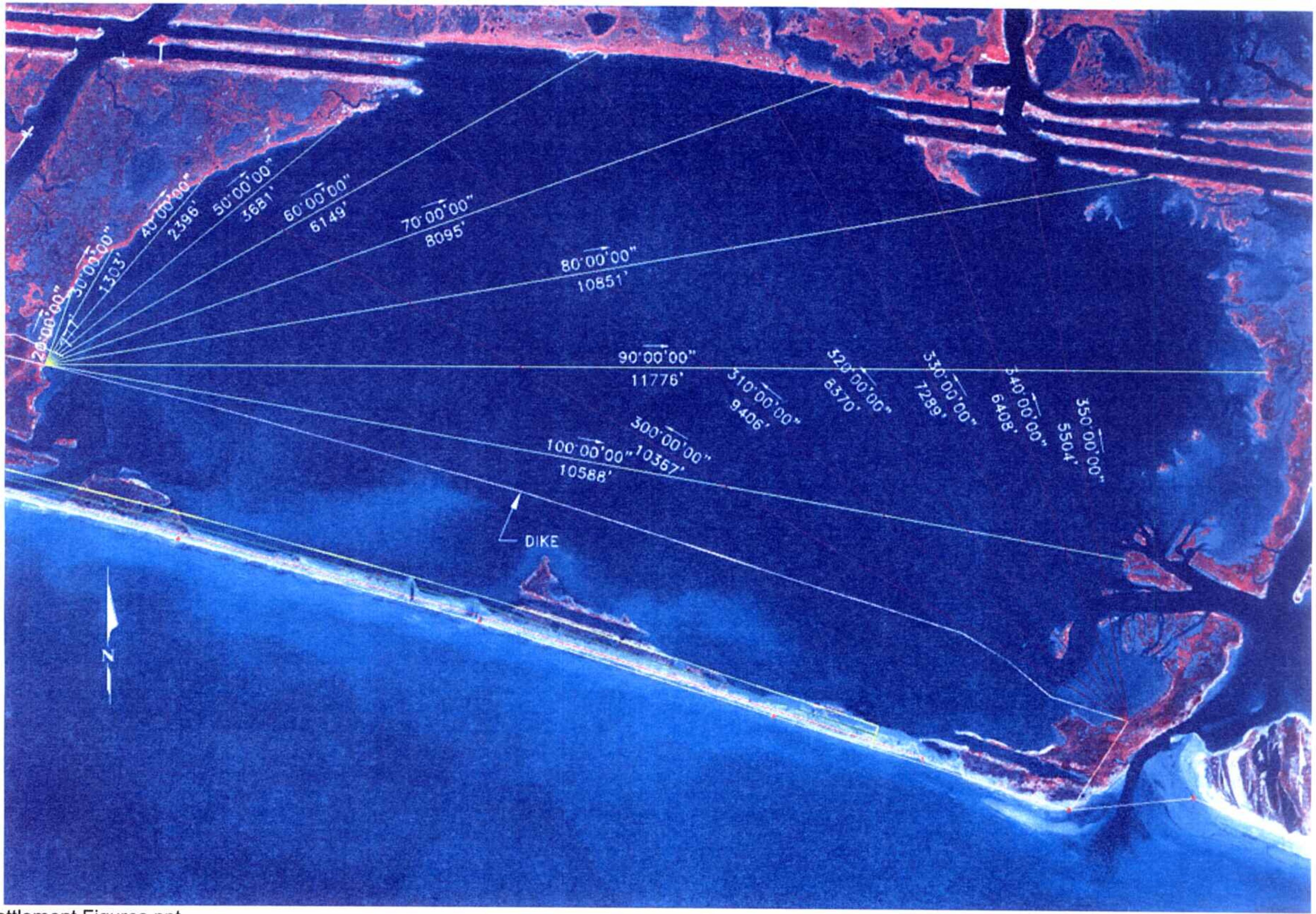
This analysis was conducted at 2 points on the proposed dike. The first point is on the extreme western end of the dike that will potentially be exposed to waves from the bay. Since Bay Joe Wise is much longer in an east-west direction than north-south, this point maximizes the potential fetch length between the dike and the far side of the bay. Similarly, the second point analyzed is on the far eastern end of the dike that may be exposed to waves from the bay. Figure 8-4 displays the two points analyzed along with the measurement lines with the direction and length of the lines posted.

The wind and stage data presented in Section 4.2 were used as input to the CEDAS-ACES model. The minimum ground surface elevation at the toe of the dike is generally -3 feet NAVD, thus the depth data input into CEDAS-ACES equaled the stage information in feet NAVD plus the average 3 foot depth below 0 feet NAVD. Table 8-2 displays results of the predictive scenarios ran with CEDAS-ACES for the annual, 2-year, 3-year, 4-year, and 5-year storm scenarios.

To further evaluate the overtopping potential, an additional analysis of the wave run-up was performed in CEDAS-ACES. Given the information generated by CEDAS-ACES and the side slopes of the proposed dikes of 1(V):8(H), the maximum wave run-up was calculated to be 1.6 feet for the 2 year storm. The 2 year storm stage of 1.6 feet NAVD plus the wave run-up of 1.6 feet gives a total elevation of 3.2 feet NAVD for the design criteria.

Table 8-2: Predicted Wave Heights

Storm	Wave Height East (ft)	Wave Height West (ft)	Stage & Wave East (ft NAVD)	Stage & Wave West (ft NAVD)
Annual	1.1	1.1	2.7	2.7
2-Year	1.1	1.1	2.7	2.7
3-Year	1.5	0.7	4.2	3.4
4-Year	1.8	0.3	5.2	3.7
5-Year	1.9	0.1	5.9	4.1



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April 19, 2004

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Figure 8-4: Fetch Lengths and Associated Angles Across Bay Joe Wise

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8.2 MARSH FILL CONTAINMENT DIKE

8.2.1 Primary Dike

The primary dike for the marsh platform will be sited along the northern boundary of the marsh fill template. The general native soil elevation along this boundary is -3 feet NAVD or shallower. In order to maintain a conservative estimate of material that may be needed to construct this dike, the design toe elevation of -3 feet NAVD shall be used.

Using the total effective settlement relationships with freeboard and water depth, a trial and error analysis was performed to determine the design dike elevation, 4.5 feet NAVD, which meets and exceeds the 2-year design criteria. Figure 8-5 depicts the results of the analysis. The initial freeboard of the dike equals 4.1 feet, which has a safety factor of approximately 1.4. The figure shows the total effective subsidence for six (6) different water depths. These six scenarios range from the dike constructed on dry ground, that is, 0 feet of water, to the dike constructed in 10 feet of water. The total effective subsidence increases for increasing water depth primarily due to the weight of the extra material required to reach the water surface. MHHW and MLLW are denoted on the figures for evaluation of the scenarios. In sections where the dike elevation is above MHHW, the surface of the dike will rarely become inundated with water.

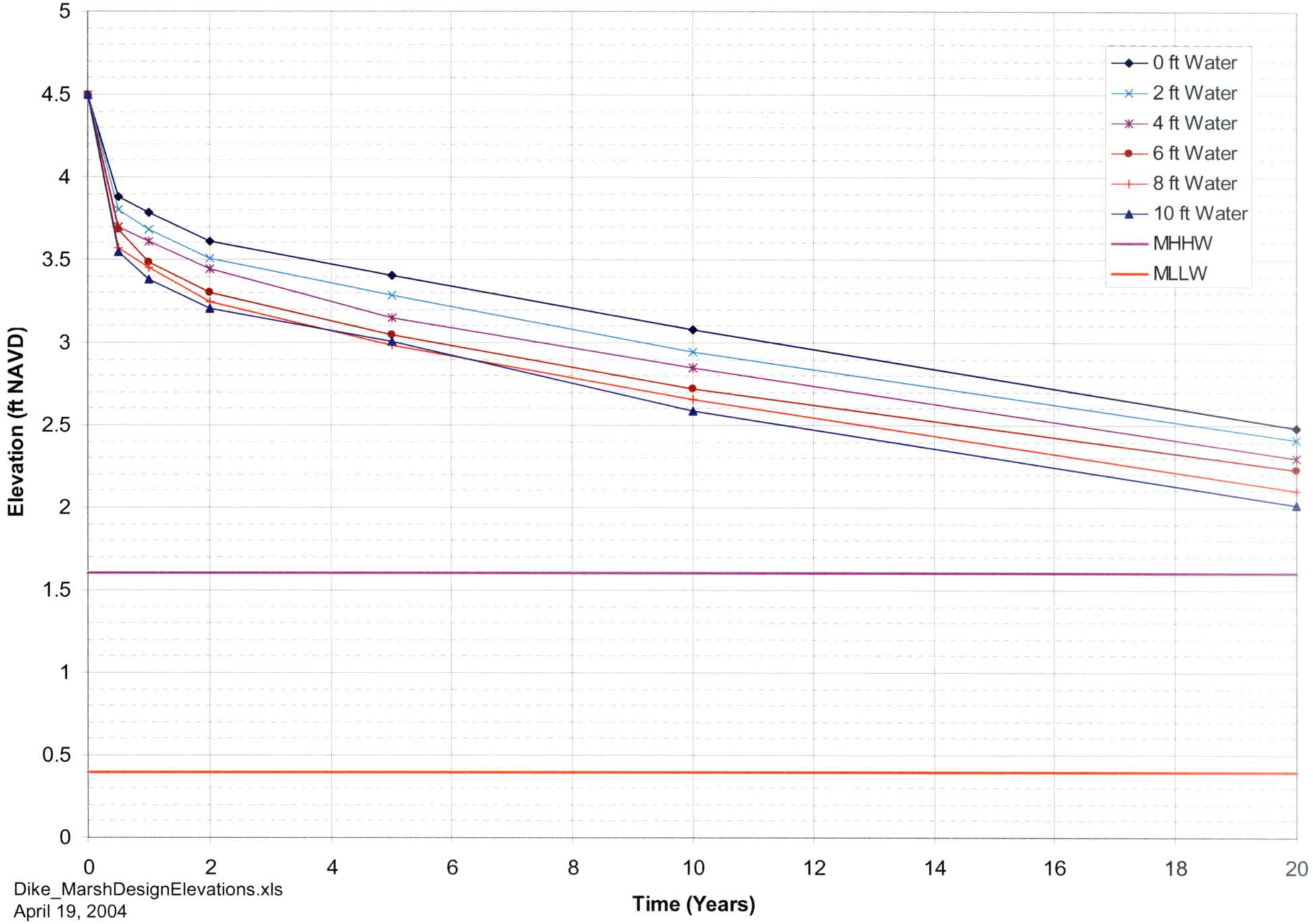
Settlement calculations predict the dike is likely to settle as much as 0.8 feet within the first 6 months immediately following dike construction. Since the fill material for the marsh is expected to take as long as 6 months to completely dewater, a conservative value to use for the crest of the dike for this time period is 3.7 feet NAVD, that is, 4.5 feet NAVD minus 0.8 feet.

Examining the results of the Bay Joe Wise wave analysis, the western end of the dike is only threatened to be overtopped by the 5-year storm scenario. The 4-year storm scenario will produce a water stage and wave height that will just reach the crest of the dike after the full 0.8 feet of settlement. The relative safety at the western end is due in part to the winds originating from the west-northwest in the 3-, 4-, and 5-year storm scenarios. Due to the wind direction in the stronger storms, the eastern end of the dike is almost directly in line with the winds. This orientation makes this end of the dike susceptible to overtopping in a 3-, 4-, or 5-year storm scenario after 6 months of settlement.

Based on the predicted stage and wave height, and the predicted settlement parameters, the proposed primary marsh dike elevation of 4.5 feet NAVD should be sufficient to protect the marsh fill from storms of a magnitude less than or equal to that of the average 2-year storm events. Since the fill should be completely dewatered within a 6 month time period, this should provide a reasonable amount of protection to the fill until it is settled in place.

8.2.2 Marsh Construction Berm

A similar analysis was performed to determine the optimal design elevation of the marsh construction berm, 2.6 feet NAVD, for achieving the Project’s design objective for marsh construction. That is, achieve an elevation such that by Year 3 the marsh elevation is within the tidal zone, defined from MHW to MLW, and remains within this zone through Year 20. Figure 8-6 presents the results of this analysis. Although the marsh fill elevation generally remains above MHHW until Year 5, it remains above MLLW for the 20-Year design life.



Dike_MarshDesignElevations.xls
April 19, 2004

Coastal Engineering Consultants, Inc.

Figure 8-5: Settlement of the Marsh Fill Containment Dike in Various Water Depths

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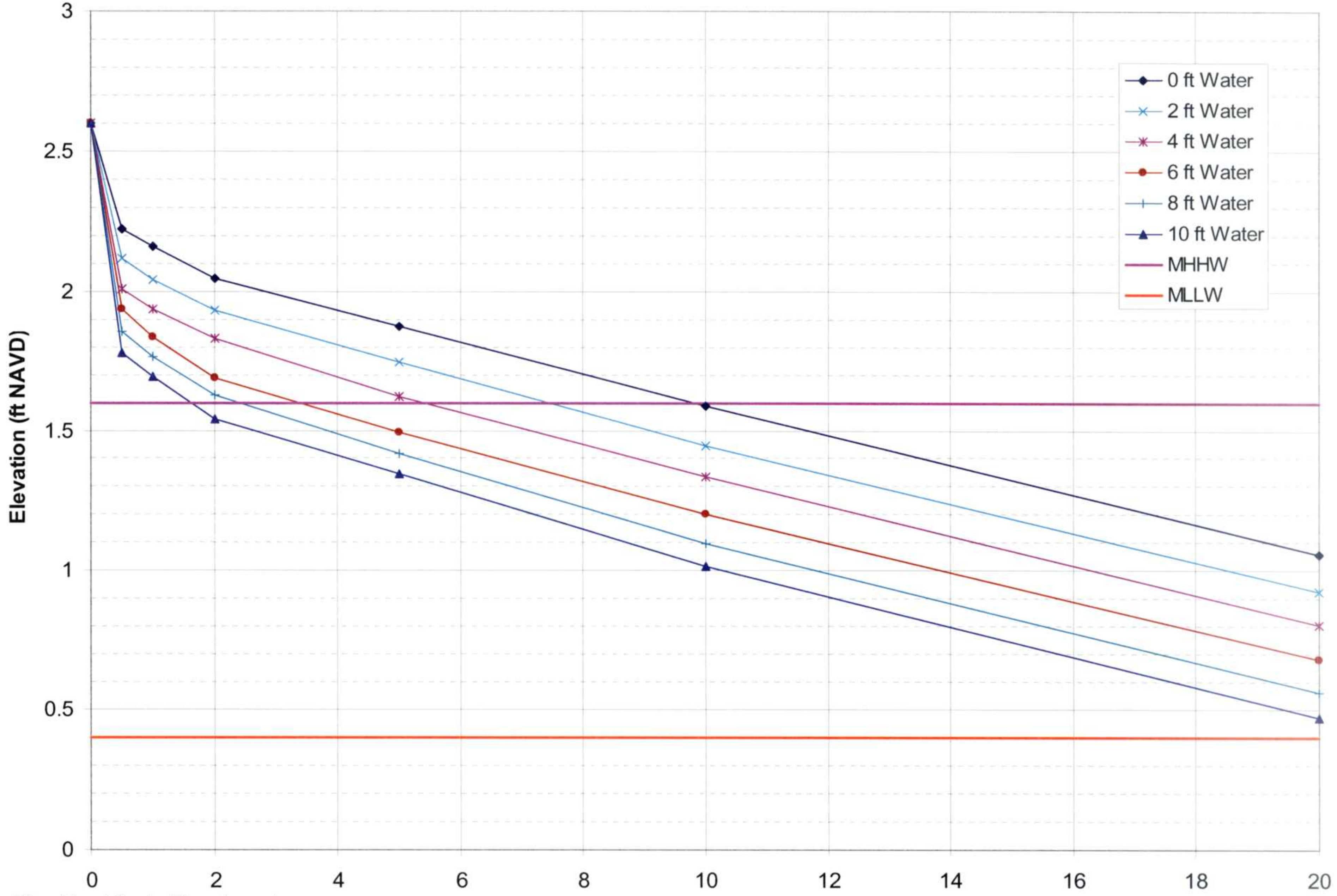

Dike_MarshDesignElevations.xls
April 19, 2004

Coastal Engineering Consultants, Inc.

Figure 8-6: Settlement of the Marsh Fill in Various Water Depths

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8.2.3 Material Sources and Alternatives

The primary marsh containment dike will be approximately 16,000 linear feet long and require approximately 526,000 cubic yards. There are three (3) sources of material for dike construction. They are the inlet ebb shoals, interior channels, and Bay Joe Wise sediments. Field work was accomplished in May 2004 to sample the inlet ebb shoals and interior channels. Based on visual observations, the sediments are comprised primarily of fine sand with silts and clays and should be suitable for dike construction. STE et al. (2004) determined the bay sediments are also suitable for dike construction.

8.3 BEACH AND DUNE FILL CONTAINMENT DIKE

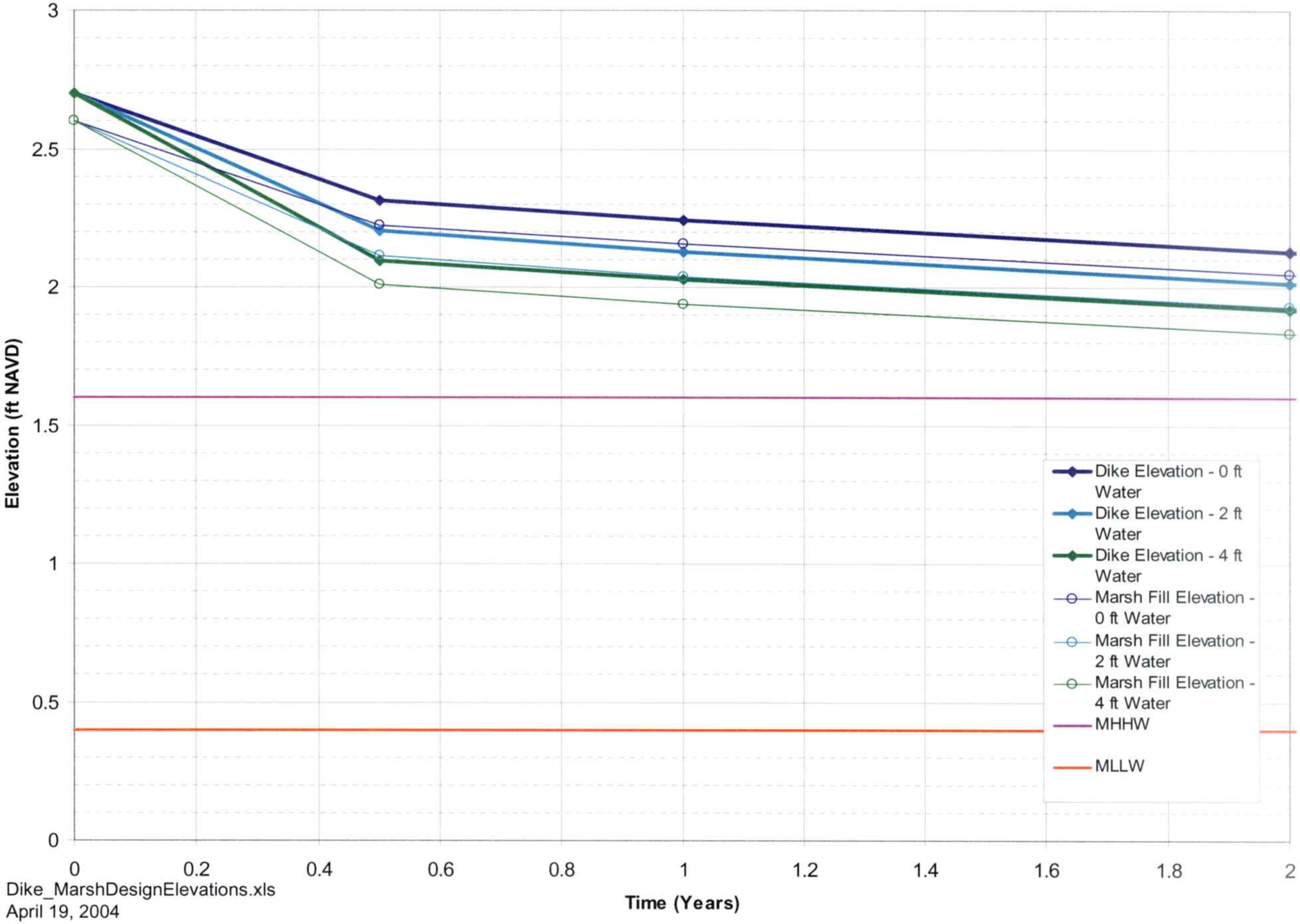
The primary dike for the beach and dune fill will be sited along the southern limit of the marsh fill corresponding to the northern limit of the beach/dune fill interface. The general native soil elevation along this boundary is -1.5 feet NAVD or shallower, which shall be used to maintain a conservative estimate of material that may be needed to construct this dike. The dike will be approximately 14,400 linear feet long and require approximately 229,000 cubic yards. Similar to the marsh dike, there are three (3) sources of material for dike construction, the inlet ebb shoals, interior channels, and Bay Joe Wise sediments.

Using the total effective settlement relationships with freeboard and water depth, a trial and error analysis was performed to determine the design dike elevation, 2.7 feet NAVD, which meets and exceeds the design criteria. Figure 8-7 depicts the results of the analysis. The initial freeboard of the dike equals 2.3 feet, which has a safety factor of over 1.6. The figure shows the total effective subsidence for three (3) different water depths.

Settlement calculations predict the dike is likely to settle as much as 0.6 feet within the first 6 months immediately following dike construction. Since the fill material for the beach and dune is expected to take no more than 6 months to completely dewater, the beach and dune fill containment dike should not be needed beyond that initial 6 month period. As shown in Figure 8-7, the marsh fill is expected to settle at a nearly identical rate as the dikes for at least the first 2 years. As such, the initial elevation of the dike (2.7 feet NAVD) only needs to be slightly higher than the initial elevation of the marsh (2.6 feet NAVD).

As this dike will be sited sufficiently northern of the existing beach and dune, and sufficiently southern of the marsh dike, it is anticipated this dike will be sufficiently sheltered and will not be subjected to storm waves and overtopping, thus the design criteria is limited to settlement. The Technical Specifications (Section 10) address tolerances for dike construction and fill placement.

The existing dune will serve as the southern dike for the beach and dune fill, or where the natural dune no longer exists, one shall be constructed to contain the beach and dune fill. Dewatering of the marsh fill will be directed to the south, into the Gulf, which is detailed in the Technical Specifications.



Dike_MarshDesignElevations.xls
April 19, 2004

Coastal Engineering Consultants, Inc.

Figure 8-7: Settlement of the Beach and Dune Fill Containment Dike in Various Water Depths

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9.0 RECOMMENDED PLAN

9.1 EVALUATION PARAMETERS

The Preliminary Design Phase developed five (5) alternatives for marsh, beach and dune restoration to achieve the Project's design objectives. Because the No Action Alternative, Alternative 1, does not meet the Project's design objectives it was not considered for the recommended plan. The following parameters were evaluated for the rest of the design alternatives.

- ❖ Technical
    - ♦ Maintenance requirements
    - ♦ Mitigation of erosion
    - ♦ Storm protection benefits
- ❖ Environmental
    - ♦ Impacts
    - ♦ Enhancements and benefits
- ❖ Fiscal
    - ♦ Value engineering analysis
    - ♦ Preliminary opinion of cost

9.2 TECHNICAL ANALYSIS

9.2.1 Maintenance Requirements

There are approximately 130 acres of existing marsh, beach and dune barrier island habitat, measured above the Mean Tide Elevation of 1.0 feet NAVD within the proposed fill templates. The design erosion rate for each alternative was computed by taking the volumetric erosion rate of 37,000 cubic yards per year, converting it to surface area in acres by dividing it by the average depth equal to the average berm elevation minus the depth of closure, then multiplying by the 20 year design life. This calculation yielded approximately the same value, 35 acres, for all the alternatives. The maintenance requirement for each alternative was determined by adding the existing and proposed marsh, beach and dune acreages together, subtracting the design erosion rate plus the predicted acreage lost due to the total effective settlement, and comparing it to the design objective of protecting or creating over 161 acres of barrier island habitat at Year-20.

9.2.2 Alternative 2

This alternative proposes to create 250 acres of new marsh to protect and preserve the structural integrity of the Bay Joe Wise Headland following the original project authorization. The design life is projected to be 20 years. It is estimated the new marsh will protect or create over 170 acres of barrier island habitat at Year 20, exceeding the design objective. The proposed borrow area provides a sufficient quantity of compatible sediments for marsh construction. Its design avoids impacts to adjacent shorelines from borrow area excavation.

Although this alternative meets several mandated design objectives, it does not meet all of them. Specifically, it does not address a primary goal of preventing breaching of the barrier shoreline through TY 20. Initial site observations revealed breaching has already occurred. A marsh-only alternative would face construction challenges without a protective seaward barrier. Without a protective "sandy" seaward barrier, constructed marsh would be open to direct wave attack and experience much higher erosion loss rates. The marsh-only alternative would be devoid of the natural barrier island overwash process, lacking key "system" components.

Breaches currently exist along the much diminished barrier shoreline resulting from recent hurricane activity. As coastal processes, for example storm erosion, subsidence, and sea level rise, act on this barrier shoreline, it is predicted the existing beach and dune without restoration will disappear within the first ten years of the Project life. It is already "missing" in several areas. Further, as the constructed marsh platform consolidates, compacts, and subsides; it will become intertidal, 0.4' NAVD to 1.6' NAVD, by TY7 and remain so through TY20 based on the geotechnical analysis described in Section 8. This intertidal platform will be subject to frequent horizontal forces from open gulf wave processes without a beach/dune component and will not provide sufficient protection to prevent breaching of the barrier island.

9.2.3 Alternative 3

This alternative proposes to create 250 acres of new marsh to protect and preserve the structural integrity of the Bay Joe Wise Headland, and 65 acres of new beach and dune to address the severity of gulf-front erosion and close the existing breachment. The beach and dune elevations were designed to provide storm protection for the 5- to 10-year storm events to minimize overtopping into the marsh and prevent further breachment along the shoreline. The design life is projected to be 20 years. It is estimated the new marsh will protect or create over 210 acres of barrier island habitat at Year 20, exceeding the design objective. The proposed borrow area provides a sufficient quantity of compatible sediments for marsh construction. Its design avoids impacts to adjacent shorelines from borrow area excavation.

9.2.4 Alternative 4

This alternative proposes to create 250 acres of new marsh to protect and preserve the structural integrity of the Bay Joe Wise Headland, and 80 acres of new beach and dune to address the severity of gulf-front erosion, close the existing breachment and prevent further breachment along the shoreline. The design life is projected to be 20 years. It is estimated the new marsh will protect or create over 225 acres of barrier island habitat at Year 20, exceeding the design objective. The proposed borrow area provides a sufficient quantity of compatible sediments for marsh construction. Its design avoids impacts to adjacent shorelines from borrow area excavation.

9.2.5 Alternative 5

This alternative proposes to create 335 acres of new marsh to protect and preserve the structural integrity of the Bay Joe Wise Headland, and 50 acres of new beach and dune to address the severity of gulf-front erosion and close the existing breachment. The dune elevation was designed to provide storm protection for the 10-year storm event to minimize overtopping into the marsh and prevent further breachment along the shoreline. The design life is projected to be 20 years. It is estimated the new marsh will protect or create over 210 acres of barrier island habitat at Year 20, exceeding the design objective. The proposed borrow area provides a sufficient quantity of compatible sediments for marsh construction. Its design avoids impacts to adjacent shorelines from borrow area excavation.

9.3 ENVIRONMENTAL ANALYSIS

9.3.1 Impacts

The environmental impacts associated with each alternative include low magnitude impacts to the natural resource communities utilizing the marsh, beach and dune system within the proposed fill templates. Monitoring of similar projects indicates these impacts are short-term, and the communities recolonize rapidly following completion of dredge and fill activities. The Technical Specifications to be developed under the Final Design Task shall include details for best management practices, proper dredging techniques, design safeguards, and frequent monitoring to minimize impacts to the natural resources and water quality.

One additional environmental impact will occur with the construction of Alternative 5. Specifically, in addition to the low magnitude impacts expected to occur to the natural resources within the proposed fill template, the construction of the proposed water exchange channel will negatively impact approximately 8.3 acres of existing healthy marsh. This high magnitude impact is offset by the construction of additional acreage of marsh at ratios ranging from 6:1 to 16:1 when comparing this alternative to the other three (3) alternatives.

9.3.2 Benefits and Enhancements

The alternatives all include proposed construction of 6,000 feet of primary tidal creeks to provide unrestricted tidal exchange and maintain water quality through the new marsh, bay and interior channels. The proposed marsh fill elevation accounts for settlement, consolidation, sea level rise, and subsidence to achieve the tidal zone design objectives. Vegetation shall be planted on the new marsh as well as the dunes where proposed, to achieve the vegetation design objectives.

9.4 FISCAL ANALYSIS

Table 9.1 presents the Preliminary Opinion of Project Cost for Alternatives 2 through 5. The cost opinions include the contracting components for Dredge and Fill and the professional engineering and surveying components for Construction Services. The Dredge and Fill component includes mobilization, demobilization, construction access, dikes, marsh fill, beach and dune fill, sand fencing, secondary access channel, tidal creeks and tidal ponds. Construction Services include pre-, pay- and post-construction surveys, construction observations and construction administration. A 15% contingency is included in the grand total.

Alternative 2 is the least cost alternative noting it does not include the beach and dune fill and related components. Alternative 5 is the second least cost alternative noting the beach and dune fill unit price is the lowest for this alternative. Losses will be reduced as the fill template is designed landward of the existing beach and dune, which will afford protection to the new fill during construction. Alternative 4 is the third least cost alternative noting without the dune component, the beach fill unit price is lower for this alternative than Alternative 3 as less grading is required. Alternative 3 is the highest cost alternative.

TABLE 9-1 PRELIMINARY OPINION OF PROJECT COST

ALTERNATIVE	**DESCRIPTION**	**OPINION OF COST**
2	MARSH ONLY	$11,036,300
3	MARSH, BEACH & DUNE	$22,464,400
4	MARSH AND BEACH	$21,912,400
5	MARSH, LANDWARD BEACH & DUNE	$18,107,200

9.5 SUMMARY AND RECOMMENDATION

Four (4) alternatives have been identified as being feasible to pursue for protecting and preserving the Bay Joe Wise Headland. In order to recommend the optimal alternative, the following ranking criteria were established for the technical, environmental, and fiscal evaluation parameters.

- Achieving design objectives presented in Section 5.1
- Additional acres created or protected over the design objective at Year-20
- Providing 10-year storm protection berm
- Opinion of Cost

Based on the ranking criteria, summarized in Table 9-2, the alternatives scored as follows. Because Alternative 2 did not meet the design objectives, it was not considered in the rest of the analysis.

- Alternative 3 – 2.06
- Alternative 4 – 1.76
- Alternative 5 – 2.26

TABLE 9-2 SUMMARY OF RANKING CRITERIA

Alt	**Met Design Objectives**	**Normalized Acreage**^{1}	**Normalized Elevation**^{2}	**Loss of Marsh (Normalized)**^{3}	**Normalized Cost**^{4}	**Total**
3	Yes	1.30	1.00	0.00	-0.24	2.06
4	Yes	1.40	0.57	0.00	-0.21	1.76
5	Yes	1.30	1.00	-0.04	0.00	2.26

1 Acreage normalized to 161 acres equal to design objective at Year 20.
2 Elevation normalized to +7 feet NAVD equal to 10-year storm protection.
3 Acreage normalized to 226 acres, equal to design objective at Year 1.
4 Cost normalized to $18.1 million dollars equal to least cost alternative (Alternative 5)

Alternative 5 scored the highest while Alternative 3 was next and Alternative 4 was last. Alternative 5 is recommended for the Project as the alternative that best achieves the design objectives and balances the technical, environmental, and fiscal evaluation parameters. Further, the environmental impact associated with Alternative 5 is deemed acceptable as the mitigation ratio for marsh impact ranges from 6:1 to 16:1.

9.6 MARSH, BEACH AND DUNE FILL FINAL DESIGN

Based upon the 30% Design Review Meeting, consensus was reached that Alternative 5 is the recommended plan for Phase 2 Project construction. The following issues were raised and addressed during the final design phase for the recommended plan.

- Reevaluate the fill template along the western end at Bayou Huertes to avoid closing the existing primary channel from Bay Joe Wise to Pass Chaland
- In the event the closure of the primary channel is necessary, reevaluate the project design at the western end to attempt to eliminate the use of steel sheet pile or other structural dikes.
- Based on the results of the SBEACH modeling, the low-wide profile performs similarly to the higher-narrower profile, therefore optimize the fill template to more closely resemble the existing elevations on the headland, specifically, widen the beach fill (increase the density, that is, the cubic yard per linear foot) on the landward side with an equivalent volume that is proposed in the dune template, and retain the higher dune.
- Increase the marsh fill platform to the east through direct fill placement extending to the existing marsh fringe along the Grand Bayou Pass channel. This will enhance the storm protection benefits over the Project life from direct storm attacks out of the east across Bastian Bay.

9.6.1 Western End Redesign

There is insufficient surface area between the primary channel between Bay Joe Wise and Pass Chaland on which to create the marsh, beach and dune fill platform necessary to achieve the design objectives of protecting and preserving the structural integrity of the barrier shoreline through TY20, providing storm protection and preventing breaching. Accomplishment of the objectives results in the fill template encroaching into the primary channel. The fill template along the western end at Bayou Huertes was reevaluated to determine the feasibility of not closing off the existing primary channel. Options considered included realignment of the marsh platform and bolstering of the beach / dune template. Realigning the marsh platform could only be achieved by creating additional fill landward of the primary channel to provide the additional platform necessary to create the design fill density, that is, cubic yards per linear foot. However, there are existing pipeline infrastructure located west of Bayou Huertes that can not be covered, as well as existing healthy marsh that would be adversely impacted by covering, both of which preclude the landward extension of the Project limits. Bolstering the beach and dune fill template could only be achieved by constructing a seaward beach fill. That alternative was eliminated in the alternatives analysis due to the predicted higher erosion rate of the borrow material versus the native sediments. Based on decades of project experience and monitoring, a short, low volume seaward fill would quickly spread alongshore under coastal processes, and the desired storm protection template and structural integrity of the barrier shoreline would not be achieved. Thus, closure of the primary channel is deemed necessary.

An analysis was completed and it was determined that the structural dike could be eliminated. By constructing a beach and dune fill template only, that is, no marsh fill, along the headland fronting Bayou Huertes, the design fill density, that is, cubic yards per linear foot, necessary to meet the design objectives through the Project life can be achieved. Thus the sheet pile dike was eliminated and the western end was redesigned with a beach fill platform and bolstered dune template.

9.6.2 Fill Template Optimization

Based upon the cross-shore modeling results (Section 7), at the 30% design review, consensus was reached that the template could be optimized by going to a lower-wider beach and dune profile. Therefore, the dune fill quantity along the headland from the western to the eastern ends of Bay Joe Wise was added to the beach fill template, first by raising the berm elevation from +4 to +4.5 feet NAVD and second, by increasing the width landward. It is noted the landward extent of the marsh fill platform was held constant, thus the marsh fill width reduced accordingly. During the final design process, it was determined that the dune fill template would be retained in the Project design as there are ample compatible sediments available in the borrow area to construct it, the construction cost estimate including the dune is within the Project budget, and construction of the dune will enhance the Project performance above the design objectives.

9.6.3 Eastern End Redesign

Concern over continued shoreline losses east of Grand Bayou Pass suggested reevaluation of the design for the eastern end of the Project. In order to address direct storm attacks out of the east across Bastian Bay, at the 30% design review, consensus was reached to increase the marsh fill platform to the east through direct fill placement extending to the existing marsh fringe along the Grand Bayou Pass channel. The purpose of the added fill is to enhance the storm protection benefits over the Project life by preventing breaching of the barrier shoreline along the interior shoreline adjacent to Grand Bayou Pass, northerly to the entrance to Bay Joe Wise.

9.6.4 Final Recommended Plan

The Recommended Plan incorporating the above described design changes is presented in Figure 9-1, plan view, and Figure 9-2, typical cross section.

The marsh fill template is designed to provide an approximate 8,000 foot long by 920 foot wide marsh platform, measured at MHW, with an approximate 3,000 foot long taper westward and an approximate 2,500 foot long expansion eastward, to tie into the existing marshes on each end. The surface area of the proposed marsh platform, measured at MHW, is approximately 270 acres. The construction berm elevation is +2.6 feet NAVD and the corresponding fill volume is approximately 1.67 million cubic yards. The required fill volume is 2.67 million cubic yards, including the cut to fill ratio. The marsh template includes excavation of approximately 6,000 feet of primary tidal creeks.

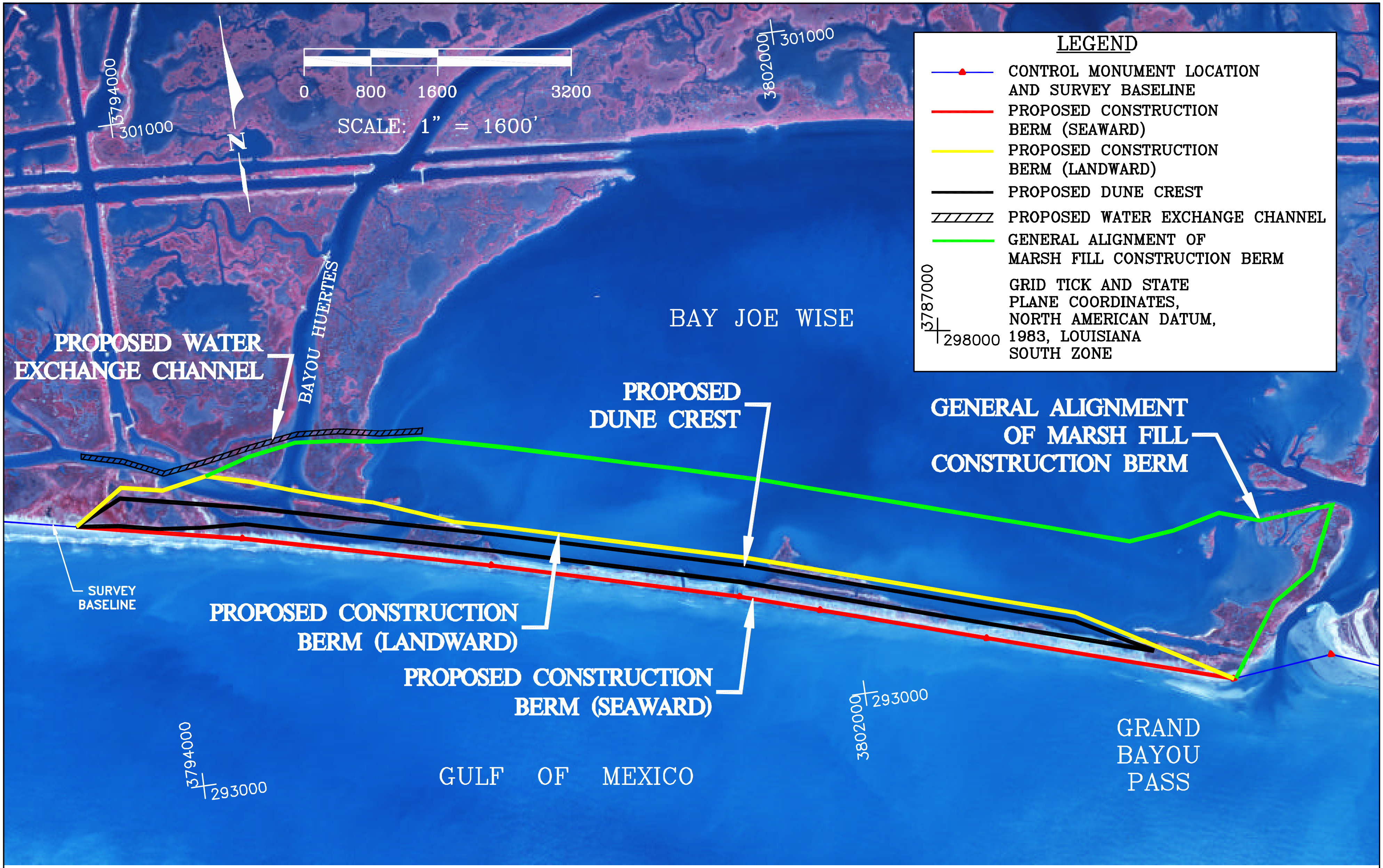

FIGURE 9-1: FINAL DESIGN PLAN VIEW

Coastal Engineering Consultants, Inc. 02132FIG9-1.DWG SEP 19, 2005 SJB GROUP INCORPORATED

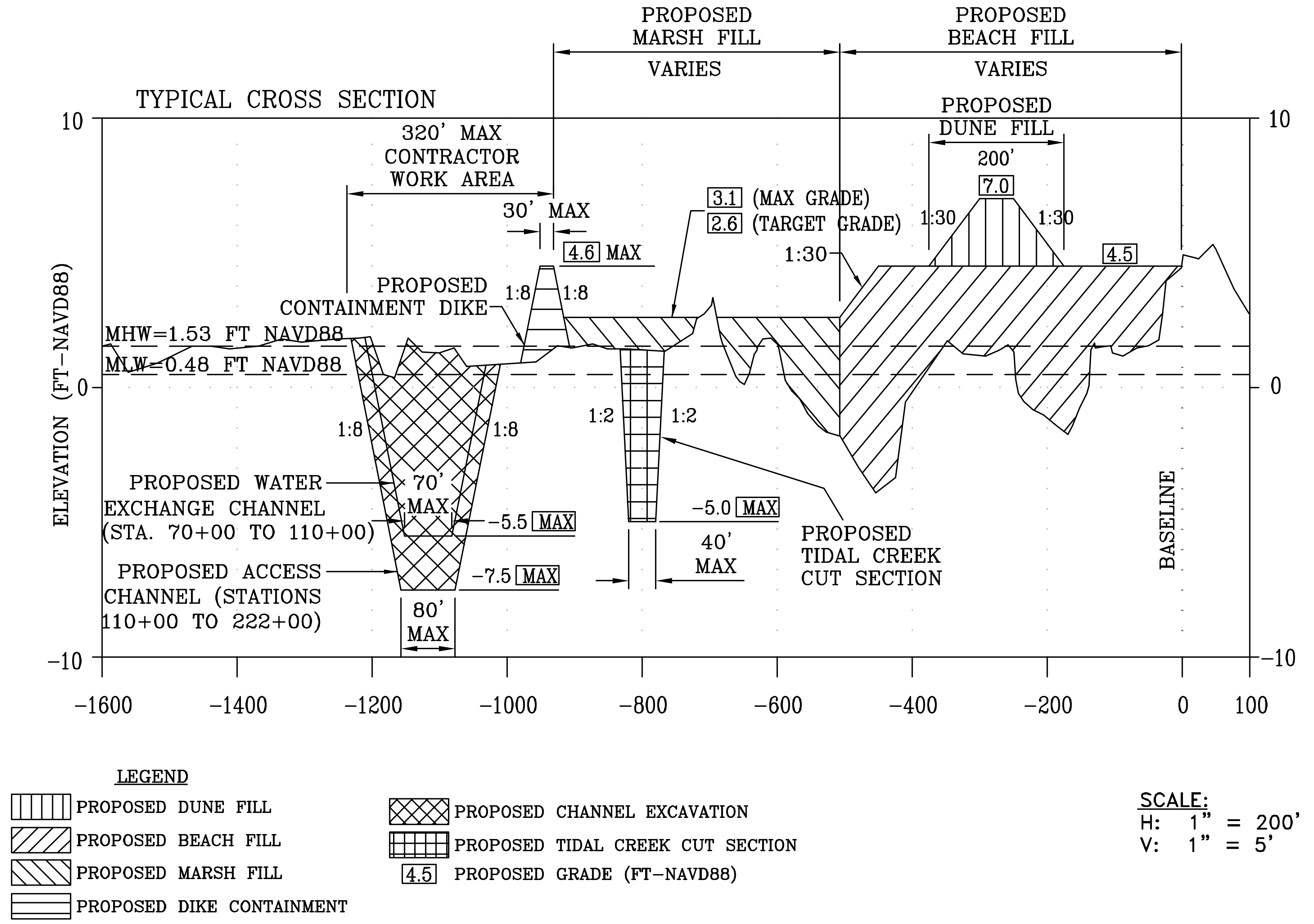

FIGURE 9-2: FINAL DESIGN TYPICAL CROSS SECTION

Coastal Engineering Consultants, Inc.   02132FIG9-2.DWG   SEP 19, 2005   SJB GROUP INCORPORATED

The landward beach and dune fill template is designed to provide an approximate 7,500 foot long beach and dune fill with 2,000 foot taper eastward to tie into the beach and dune on the eastern end, and an approximate 3,000 foot long expansion westward at Bayou Huertes completed by an approximate 1,500 foot long taper to tie into the beach and dune on the western end. The tapers are provided to blend the sediments into the existing grades and maintain a buffer from the inlets on both ends of the Bay Joe Wise Headland. The dune component includes a 50 foot wide crest width at +7 feet NAVD, widening to 190 feet at Bayou Huertes, with 1:30 side slopes. The beach fill template includes a construction berm at +4.5 feet NAVD, with an average width of over 350 feet widening to over 600 feet at Bayou Huertes, and 1:30 side slopes. The surface area of the proposed beach and dune platform, measured at MHW, is approximately 150 acres. The corresponding fill volume is approximately 1.03 million cubic yards and the required fill volume including the overfill and cut to fill ratios is 1.55 million cubic yards.

The water exchange channel template is designed with maximum dimensions of the bottom depth at -5.5 feet NAVD, bottom width at 70 feet, and side slopes of 1:8, with a cross sectional area of 890 square feet measured from Mean High Water. The water exchange channel length is approximately 4,200 feet and the proposed dredge volume is approximately 70,000 cubic yards.

9.7 FINAL OPINION OF CONSTRUCTION COST

Based upon the final design phase incorporating the above described design changes, and review of current unit pricing for the various components of the Project, the Final Opinion Of Construction Cost including 15% contingencies was determined to be $19,617,900.

10.0 TECHNICAL SPECIFICATIONS

Presented herein are the 95% Technical Specifications for use in bidding and constructing the Project. The Technical Appendices referenced herein are not included with this report. They will be included in the Final Technical Specifications as part of the Contract Documents.

PASS CHALAND TO GRAND BAYOU PASS
BARRIER SHORELINE RESTORATION PROJECT (BA-35)

PART III TECHNICAL SPECIFICATIONS

BA-35 TECHNICAL SPECIFICATIONS
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LIST OF APPENDICES

TS-1 SCOPE OF WORK

1.1 General Description

The Work covered under these Plans and Specifications consists of furnishing all plant, labor, materials, and equipment for performing all required Work for the mobilization, demobilization, hydraulic dredging, and placement of fill and other materials in accordance with these Specifications and in conformity to the lines, grades, and elevations shown on the Plans or as directed by Owner. Major tasks associated with this work include, but may not necessarily be limited to, the following.

- Mobilization and demobilization.
- Pre-excavation of tidal creeks to maintain hydraulic exchange and circulation within the marsh.
- Preparation of the fill containment areas, including the placement of any containment dikes and discharge weirs as required for dewatering.
- Hydraulic dredging and placement of marsh fill, beach fill, and dune fill materials.
- Dredging of channels for construction equipment access.
- Dredging of a water exchange channel to maintain flow and exchange between gulf and bay.

1.2 Site Examination

Bidders are required to examine Work Area and make determinations of the character of the borrow materials to be dredged and the condition of the designated fill areas. Material such as logs, stumps, snags, tires, scrap, debris and other obstructions may be encountered within the specified borrow area dredging limits and fill areas. No separate payment for removal and disposal of these obstructions shall be made. No consideration shall be given to any claims for additional payments based on the failure of the Contractor to inspect the sites.

1.3 Placement of Dredged Material

The Contractor shall not deposit dredged material into areas other than those shown on the Plans or stated in Permits without approval of the Owner. Since the fill material is to be placed in relatively small containment areas, it may be necessary to operate the dredge at a low production rate and/or to allow for dredge down time to allow the fill material to settle out prior to discharge from the containment areas.

1.4 Existing Features

The Contractor shall be responsible for investigating, locating and protecting all existing facilities, structures, services, and pipelines on, above, or under the surface of the area where dredging and filling operations are to be performed. The Owner will not be held responsible for damage to the Contractors equipment, employees, subcontractors, adjacent property owners, or anyone else connected with the project due to encountering objects above and below the water line.

Existing features, where indicated on the Plans, are shown only to the extent such information was made available to or discovered by the Engineer during preparation of the Plans. There is no guarantee as to the accuracy or completeness of such information, and all responsibility for the accuracy and completeness is expressly disclaimed. If the Contractor fails to discover an underground installation and damages the same, he shall be responsible for the cost of the repair.

1.5 Basis for Award

Award of this bid shall be to the lowest responsive, responsible bidder meeting the requirements of the specifications set forth herein. The Basis for Award shall be the lowest total bid cost. All unit costs must be entered on the Bid Form.

TS-2 SUBMITTALS

2.1 Work Plan and Schedule

The Contractor shall submit a Work Plan and an estimated Work Schedule, in writing to the Owner and Engineer, at least seven (7) days prior to the pre-construction conference for review and approval. The Owner and Engineer shall have ten (10) days to review the Work Plan and estimated Work Schedule to determine its acceptability. The Work Plan shall include information regarding but not limited to following:

1. Source(s) of all construction materials (company or producer name, mailing and physical address, phone number, and name of contact person).

2. Types of equipment the Contractor proposes to use for construction and delivering construction materials to the delivery site and from the delivery site to the construction site and on the construction site to transport materials, personnel, etc.

3. Construction access and restoration, transport routes, access corridors from the dredge site to the fill areas, storm emergency plan, turbidity controls, and environmental protection.

4. Other information required in the Work Plan are listed throughout these Specifications and are summarized in the Schedule of Submittals in subsection TS-2.4.

The estimated Work schedule shall show the planned schedule of dates and time lines for the major elements of Work required to complete the Work described in these Specifications, including but not limited to the anticipated dates of the following:

1. The anticipated date(s) for site layout, surveying, and staking.

2. The anticipated initiation of delivery of materials and equipment and construction operations at the Work Area.

3. The estimated duration and beginning and ending dates of individual construction operations.

2.2 Pre-Construction Submittals

Fifteen (15) days before construction operations commence or materials are delivered, the Contractor, any Subcontractors, Owner, Engineer, and Inspector(s) shall have a mandatory pre-construction meeting. This meeting shall be held at a mutually agreeable time and place to discuss pertinent details of the Work Schedule, etc. At the pre-construction meeting the Contractor shall provide the following to the Engineer:

1. Communication Plan specifying Contractor chain of command, Owner and Engineer, and Inspector(s) points of contact, corresponding contact information, and procedures for routine and emergency notifications.

2. Safety Plan and report format as specified in “GP-30 SAFETY PROVISIONS”.

3. Change Order and Field Order submittal format.

2.3 Administrative Records

2.3.1 Notice of Intent to Dredge

At least 14 days prior to commencement of Work on this Contract, the Contractor shall notify the Eighth U.S. Coast Guard District, Waterways Management Division at the address below, of his intended operations to dredge and request that it be published in the Local Notice to Mariners. This notification must be given in sufficient time so that it appears in the Notice to Mariners at least seven days prior to the commencement of this dredging operation. A copy of the notification shall be provided to the Owner and Engineer.

USCG Division 8
Waterways Management Division
1615 Poydras Avenue
New Orleans, LA 70112
(504) 589-6196

2.3.2 Relocation of Navigational Aids

Temporary removal of any navigation aids located within or near the areas required to be dredged or filled and material stockpile areas, shall be coordinated by Contractor with the U.S. Coast Guard prior to removal. The Contractor shall not otherwise remove, change the location of, obstruct, willfully damage, make fast to, or interfere with any aid to navigation. The Contractor shall notify the Eighth U.S. Coast Guard District, New Orleans, Louisiana, in writing, with a copy to the Owner and Engineer, seven days in advance of the time he plans to dredge or Work adjacent to any aids which require relocation to facilitate the Work. The Contractor shall contact the U.S. Coast Guard for information concerning the position to which the aids will be relocated.

2.3.3 Dredging Aids

The Contractor shall obtain approval for all dredging aids, including but not limited to temporary navigation aids, warning signs, buoys and lights, he/she requires to conduct the Work specified in this Contract. The Contractor shall obtain a temporary permit from the U.S. Coast Guard for all buoys or dredging aid markers to be placed in the water prior to installation. The permit application shall state the position, color, date to be installed and removed for all dredging aid markers and be submitted to the U.S. Coast Guard. Dredging aid markers and lights shall not be colored or placed in a manner that they will obstruct or be confused with navigation aids. Copies of application and permit shall be submitted to the Owner and Engineer seven (7) days prior to commencement of dredging operations.

2.3.4 Notification of Discovery of Historical or Cultural Sites

If during construction activities the Contractor observes items that may have prehistoric, historical, archeological, or cultural value, the Contractor shall immediately cease all activities that may result in the destruction of these resources and shall prevent his/her employees from trespassing on, removing, or otherwise damaging such resources. Such observations shall be reported immediately to the Owner and Engineer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special dispositions of the finds should be made. The Contractor shall report any observed unauthorized removal or destruction of such resources by any person to the Owner and Engineer so the appropriate State of Louisiana authorities can be notified. The Contractor shall not resume Work at the site in question until State authorities have rendered judgment concerning the artifacts of interest.

2.3.5 Monthly Report of Operations

In addition to the Daily Reports required under TS-19 QUALITY CONTROL, the Contractor shall prepare and submit a Monthly Report of Operations for each month's Work to the Owner and Engineer. The monthly report shall be submitted on or before the 7th of each month, consolidating the previous month's Work. Upon completion of the job, the Contractor shall submit a consolidated job report, combining the monthly reports. The Contractor shall distribute one copy of each report to the Owner and Engineer.

2.3.6 Notice of Misplaced Material

The Contractor shall notify the U.S. Coast Guard, Owner, and Engineer of any misplaced material as stated in the specification TS-17 MISPLACED MATERIAL.

2.4 Summary of Project Submittals

The following table is a summary of all submittals required of the Contractor as part this section and other sections of these Specifications:

BA-35 SCHEDULE OF SUBMITTALS

Specification	Deliverable	Submittal
GP-21	Notice of Readiness of Work	30 Days Prior to Inspection
GP-28	Call Louisiana One Call	Within 7 Days after Notice to Proceed
GP-28	Notify Pipeline and Utility Operators	Within 7 Days after Notice to Proceed
GP-37	Request for Change in Contract Time	Within 15 Days after Unforeseen Event
GP-37	Change in Contract Time Justification	Within 45 Days after Unforeseen Event
GP-44	Claim of Adjustment or Dispute	Prior to Beginning Work on Claim
GP-47	Notice of Completion of Work	After Submittals of Surveys and As-Builts
SP-9	Hurricane and Severe Storm Plan	7 Days Prior to Pre-Construction Conference
TS-2.1	Work Plan and Schedule	15 days after Notice to Proceed
TS-2.2	Communication Plan	At Pre-Construction Conference
TS-2.2	Safety Plan	At Pre-Construction Conference
TS-2.2	Change Order and Field Order Format	At Pre Construction Conference
TS-2.3.1	Notice of Intent to Dredge	14 days prior to Commencement of Work
TS-2.3.4	Notification of Discovery of Historical or Cultural Sites	Immediately for Each Occurrence
TS-2.3.5	Monthly Report of Operations	On or before the 7th of each month
TS-2.3.6	Notice of Misplaced Material	Immediately for Each Occurrence
TS-3.1	Construction Sequence	With Work Plan
TS-6.11	As Built Drawings	Prior to Final Acceptance
TS-6.12	Survey Point Files	Prior to Final Acceptance
TS-8.3	Turbidity Control Plan	With Work Plan
TS-8.4	Borrow Area Cut Sequence	With Work Plan
TS-8.6.1	Dredge Location Method	With Work Plan
TS-8.6.2	Tide Measurement Location	With Work Plan
TS-9.3	Marsh Fill Containment Dike Change Requests	With Work Plan
TS-10.3	Beach Fill Containment Dike Change Requests	With Work Plan

Specification	Deliverable	Submittal
TS-18.2	Description of Daily Nesting Bird Patrols	With Daily Quality Control Report
TS-18.5	Oil and Fuel Storage Locations	With Work Plan
TS-19.1	Daily Quality Control Report	Daily During Construction

TS-3 ORDER OF WORK

3.1 Construction Sequence

The Contractor shall adhere to the following construction sequence requirements:

1. Warning signs shall be placed prior to sidecasting dredged material in locations designated on the Plans from access channels to prevent navigation hazards.
2. Lighted aids to navigation shall be deployed prior to commencement of any dredging operations.
3. The water exchange channel shall be constructed from station 64+65 to 106+50 as shown on the Plans prior to placing any beach or marsh fill material in the vicinity of Bayou Huertes.
4. The tidal creeks must be dredged, surveyed, and accepted prior to any placement of marsh fill.
5. Settlement plates must be placed and surveyed prior to placement of beach or marsh fill material.
6. Containment dikes must be constructed prior to the placement of any beach or marsh fill material.
7. Dune fill segments must be accepted prior to the installation of sand fencing. Sand fencing must be installed within seven days of acceptance of a dune fill segment.
8. Sidecast disposal areas are to be restored by backfilling access channels during demobilization only after all other construction items are complete.

These construction sequence requirements are also reflected on the Plans. The schedule submitted in accordance with TS-2 SUBMITTALS shall reflect these requirements. The Owner and Engineer will entertain the Contractor's proposed sequence for all other construction items outside of these requirements within the confines of the Contract Time set forth in SP-3 TIME OF COMPLETION.

3.2 Environmental Window

Scheduling requirements regarding endangered species are set forth in TS-18 ENVIRONMENTAL PROTECTION.

TS-4 WORK AREA

4.1 Limits of Construction

The construction limits and dredge limits available to the Contractor for accomplishing the Work are documented herein and/or are shown on the Contract Plans. The Contractor may not store plant or equipment including pipeline in excess of what is needed for this Contract within the Work Area.

4.2 Security

The Contractor is permitted to exclude the public from his Work Area as necessary to perform the Work and to operate in accordance with the General and Special Provisions. The Contractor shall exclude the public from access to the discharge end of his pipeline. Enforcement shall be the Contractor's responsibility at no additional cost to the Owner. The enforcement shall be coordinated with local enforcement agencies and will be subject to approval of the Owner.

4.3 Construction Access

The Contractor shall confine his plant, equipment and operations of personnel to areas permitted by law, ordinances, permits and the requirements of the Contract Documents, and shall not unreasonably encumber the premises with plant or equipment. The Contractor is responsible for preparation and restoration of the access area. The Contractor is required to submit a construction access plan and construction access restoration plan prior to its usage. The costs for, but not limited to, earthwork, grading, signage, fencing, and vegetation removal and reinstallation, along with removal and installation of any other facilities in the vicinity of areas delineated as Access Channels on the Plans and in accordance with TS-11 ACCESS AND WATER EXCHANGE CHANNELS are to be included in the lump sum price for Bid Item No. 1 "Mobilization/Demobilization." Similar such costs for access to other areas within the Work Area are to be included in the lump sum price for Bid Item No. 1 “Mobilization/Demobilization” in accordance with TS-5 MOBILIZATION AND DEMOBILIZATION. Disposal of any cleared vegetation, debris and rubbish shall be in a manner acceptable to the Owner and Engineer. All construction areas shall be restored to pre-construction conditions as part of demobilization. Additionally, the Contractor shall adhere to any and all equipment access restrictions set forth in these Specifications.

TS-5 MOBILIZATION AND DEMOBILIZATION

5.1 General Description

Mobilization consists of preparatory work and operations, including those necessary for movement of personnel, equipment, supplies and incidentals to and within the Work Area; the dredging of access channels as specified in TS-11 ACCESS AND WATER EXCHANGE CHANNELS; the establishment of offices, buildings, and other facilities necessary for the Work on the project; the cost of bonds and any required insurance; and other pre-construction expenses necessary for start of the Work, excluding the cost of construction materials. All equipment must be floating at all times during the transit to and from the Site of Work.

5.2 Arbitrary Mobilization by Contractor

The Owner will pay for mobilization and demobilization only once. Should the Contractor demobilize prior to completing the project, such mobilization and subsequent remobilization shall be at no cost to the Owner.

5.3 Ratio of Mobilization and Demobilization Effort

Sixty percent (60%) of the lump sum price will be paid to the Contractor upon completion of mobilization to the Work Area and after commencement of dredging access channels and constructing containment dikes. One hundred (100) feet of access channels and containment dikes must be constructed in a twenty-four (24) hour period before this payment will be made. The Contractor's survey records may be used for verification and the Owner and Engineer, at their discretion, may verify the survey results. The remaining forty percent (40%) will be paid to the Contractor upon completion of demobilization from the Work Area.

5.4 Justification of Mobilization Costs

In the event that the Owner considers the amount in this item, sixty percent (60%) and forty percent (40%) which represents mobilization and demobilization respectively does not bear a reasonable relation to the cost of the Work in this Contract, the Owner may require the Contractor to produce cost data to justify this portion of the bid. Failure to justify such price to the satisfaction of the Owner will result in payment of actual mobilization costs, as determined by the Owner at the completion of mobilization, and actual demobilization costs at the completion of demobilization, and payment of the remainder of this item in the final payment under this Contract. The determination of the Owner is not subject to appeal.

5.5 Measurement and Payment

All costs associated with mobilization and demobilization of the entire Contractor's plant, equipment, personnel, and those of his Subcontractors and such others costs as may be denoted in the Contract Documents shall be paid for at the contract lump sum price for

Bid Item No. 1 “Mobilization/ Demobilization”.

TS-6 SURVEYING

6.1 Scope

Transects to be surveyed are shown on the Plans. Benchmark LDNR/CRD R2-22 CHENIER RONQUILLE is located in the Work Area and was installed as part of LDNR's Secondary GPS Network. This benchmark shall be used for horizontal and vertical control. A data sheet for this benchmark is included in Appendix TS-A. The survey baselines shown on the Plans were established for the engineering and design survey and shall be used to reference pay surveys where specified. All surveying work listed in this section shall be performed under the direct supervision of a professional surveyor licensed in State of Louisiana. All drawings shall stamped by the surveyor.

6.2 Temporary Bench Marks (TBM):

Temporary Benchmarks shall be installed at locations necessary to stakeout the project baselines as well as other project features. Horizontal and vertical coordinates shall be determined for all TBMs installed. All TBM's shall reference Benchmark LDNR/CRD R2-22 CHENIER RONQUILLE. The Contractor shall maintain the TBMs for the duration of construction at the Contractor's expense. In the event that a single TBM is disturbed and/or destroyed, the TBM may be reinstalled by a qualified Contractor employee approved by the Owner. If multiple TBMs are destroyed, the Owner may require the TBMs to be reinstalled by a professional surveyor licensed in the State of Louisiana.

6.3 Accuracy and Methodology

Need info from DNR.

6.4 Fill Area Surveys

A pre-construction survey of the natural ground elevations of the beach and dune and marsh fill areas shall be made in order to calculate a fill volume. It shall consist of transects spaced 200' apart and oriented perpendicular to the survey baseline. Elevations shall be recorded at points every 50 ft along each transect line in the marsh fill and 25 ft along each transect line in the beach and dune fill. An elevation shall also be taken where beach and dune fill areas meet marsh fill areas. This point shall be denoted on all transects.

The exact same transects shall be surveyed again when the Contractor requests payment for filling operations. The area contained in each transect shall then be calculated if the post construction elevations are accepted by the Engineer. Conditions for acceptance are outlined in TS-9 MARSH FILL and TS-10 BEACH AND DUNE FILL. The volume for each fill section shall be calculated by multiplying the average transect cross sectional area by the length of the fill segment (average end area method) or other method approved by the Engineer. Volume calculations shall be submitted to the Engineer for verification. The pre-construction surveys must be submitted to and approved by the Engineer prior to beginning filling operations to ensure that fill quantities have not significantly changed.

6.5 Borrow Area

The borrow area shall be surveyed both before and after construction. A progress survey shall also be conducted as directed by the Engineer after the overburden is removed. Survey transects shall be spaced 200’ apart, perpendicular to the borrow area center line, and extend 200’ past the limit of the overburden cut unless otherwise shown on the Contract Plans. The pre-construction surveys must be submitted to and approved by the Engineer prior to beginning excavation to ensure that borrow area elevations have not significantly changed. All bathymetric surveys must be corrected for tidal fluctuations and wave action to the referenced datums.

6.6 Overburden Disposal Area

The overburden disposal area shall be surveyed both before and after construction. Survey transects shall be spaced 500’ apart, North – South in direction, and extend 200’ past the limit of overburden disposal as shown on the Plans. The drawings for pre-construction surveys must be submitted to and approved by the Engineer prior to beginning excavation to ensure that overburden disposal area elevations have not significantly changed. All bathymetric surveys must be corrected for tidal fluctuations and wave action to the referenced datums.

6.7 Access Channels

Access channels shall be surveyed after construction is completed. Transects shall be surveyed perpendicular to the access channel centerline every 500 feet and shall include side cast disposal areas and containment dikes. Points to be surveyed include top and bottom of cut for both sides of the channel and the channel bottom mid point. Transects shall extend 50 feet beyond the channel. If the adjacent side cast disposal areas and containment dikes are present, transects shall extend 50 feet past these features. Containment dike surveys shall include the toe and crown elevations on each side of the dike. These surveys will be checked by the Owner and Engineer for permit compliance and restoration of side cast disposal areas to original conditions.

6.8 Water Exchange Channel

The water exchange channel shall be surveyed immediately after its construction is completed and again at the completion of overall construction. Transects shall be surveyed perpendicular to the water exchange channel centerline every 200 feet. Points to be surveyed include top and bottom of cut for both sides of the channel and the channel bottom mid point. Transects shall extend 50 feet beyond the channel. These surveys will be checked by the Owner and Engineer for to ensure that the design channel width, and slopes and elevation have been achieved to maintain water exchange between the gulf and bay. Construction of beach, dune, and marsh fill sites will not be authorized to begin until water exchange channel width, elevations, and slopes are approved.

6.9 Tidal Creeks

The tidal creeks shall be surveyed prior to their construction and immediately after their construction is completed. Transects shall be surveyed perpendicular to the tidal creek centerlines every 200 feet. These surveys will be used for volume and payment calculations. The volume for each tidal creek section shall be calculated by multiplying the average transect cross sectional area by the length of the segment (average end area method) or other method approved by the Owner or Engineer. Volume calculations shall be submitted to the Owner and Engineer for verification. The surveys will also be checked by the Owner and Engineer to ensure that the design channel width, slopes, and minimum elevations, have been achieved within the specified tolerances to ensure that the marsh fill will properly settle to form these features. Construction of beach, dune, and marsh fills will not be authorized to begin until the tidal creeks are approved.

6.10 Sand Fencing

Horizontal locations of approved sections of installed sand fencing shall be recorded at fencing end points and at locations every 1000 feet in between.

6.11 Settlement Plates

The elevation of the top of each settlement plate shall be recorded and reported to the nearest tenth of a foot (0.1’) NAVD 88. Elevations shall be recorded upon installation and again weekly throughout the duration of construction. The final elevation shall be listed on the as-built drawings.

6.12 Magnetometer Survey

A magnetometer survey has been performed in preparation for this project in an effort to verify locations of pipelines and other underwater obstructions in the project area. Survey results are presented in Appendix TS-B. This does not relieve the Contractor of responsibilities set forth in GP-27 COOPERATION WITH PUBLIC UTILITIES or GP-28 UTILITIES AND IMPROVEMENTS.

6.13 Drawings

As-built drawings and all other survey drawings required by these Specifications shall be submitted to the Owner and Engineer in digital AutoCAD format and 11” X 17” hard copy. As-built drawings shall incorporate all field changes, change orders, and show the actual quantities of fill material placed. All revisions shall be shown in red and be easily distinguishable from the original design. The drawings shall be stamped by a professional surveyor licensed in the State of Louisiana and submitted to the Owner and Engineer for approval prior to final acceptance.

6.14 Point Files

Point files shall be submitted in electronic format to the Owner and Engineer. The point files shall contain the following information:

- Point number
- Northing and Easting (Louisiana State Plane South NAD 83 US. FT.)
- Elevation (reported to the nearest 0.1’ NAVD 88 FT.)
- Point Description

6.15 Ratio of Pre- and Post-Construction Surveying Effort

Sixty percent (60%) of the lump sum price will be paid to the Contractor upon completion of pre-construction surveys and the remaining forty percent (40%) will be paid to the Contractor upon approval of as-built drawings and electronic submittals.

6.16 Justification of Surveying Costs

In the event that the Owner considers the amount in this item, sixty percent (60%) and forty percent (40%) which represents pre- and post-construction surveys, respectively as defined in “TS-6.13 Ratio of Pre- and Post-Construction Surveying Effort” does not bear a reasonable relation to the cost of the Work in this Contract, the Owner may require the Contractor to produce cost data to justify this portion of the bid. Failure to justify such price to the satisfaction of the Owner will result in payment of actual surveying costs, as determined by the Owner at the completion of each survey, and payment of the remainder of this item in the final payment under this Contract. The determination of the Owner is not subject to appeal.

6.17 Measurement and Payment

All costs associated with pre- and post-construction surveys as may be denoted in the Contract Documents shall be paid for at the contract lump sum price for Bid Item No. 2 “Surveying”. All surveying required in this section shall be performed by a professional surveyor licensed in the State of Louisiana.

TS-7 CHARACTER OF BORROW MATERIALS

7.1 General Description

The borrow area materials for the project are documented by vibracore samples and classified by the laboratory tests. Three different layers of sedimentary materials have been identified from these analyses.

The top layer is composed of soft clay overburden of varying thickness underlain by a layer of interbedded clay, silt, and sand to be used for marsh fill construction. The bottommost layer is composed of primarily beach compatible sand and shall be used for beach and dune fill construction.

7.2 Inspection of Materials

The dredge site contains substantial quantities of fine grained sediments. The Contractor should note that the fine grained portion of the material may remain in suspension generating turbidity. The Contractor may have to adjust his production rate to control turbidity and meet water quality standards. The Contractor is required to examine the geophysical and geotechnical data included in the Appendix TS-C. The Contractor is also encouraged to make his own investigations pursuant to specification TS-1.2 “Site Examination”.

TS-8 EXCAVATION

8.1 General Description

All excavation for dredge sites including the borrow area and access and water exchange channels shall be performed within the permitted dredge limits as depicted on the Plans and in the Permits. All excavation shall be performed in a uniform and continuous manner so as to avoid creating multiple holes, valleys, or ridges within the section of the area to be dredged. The Contractor shall change the location and depth of excavation within the dredge limits when necessary to avoid non-specification material. Materials such as logs, stumps, snags, scrap and other debris may be encountered within the dredge limits and shall be removed and disposed of by the Contractor. The Contractor shall immediately change the location of the dredging in order to avoid placement of the non-specification materials in the fills. The Contractor shall also notify the Engineer and Owner immediately. The location of unsuitable material encountered within the borrow area dredge site shall be noted on the Contractor's Daily Quality Control Report. The Contractor shall set marker buoys which have been approved by the Engineer and will meet U.S. Coast Guard standards to delineate the borrow area dredge site as it is being excavated. The location and limits of unsuitable material placement within the fill area shall also be noted to allow removal or remediation.

8.2 Hydraulic Excavation and Transport

The method of transporting materials from the borrow area to the beach, dune, and marsh fills, and overburden disposal area shall be done by hydraulic dredge and pipeline. A DREDGE DATA SHEET is included in General Provisions and must be completed and submitted with the bid. The dredge equipment and attendant plant shall be in satisfactory operating condition, capable of efficiently performing the Work as set forth in the plans and specifications, and shall be subject to inspection by the Owner or Engineer prior to beginning the Work, and at all times during construction. All vessels shall meet the requirements in SP-14 MARINE VESSELS AND MARINE ACTIVITIES.

The proposed location of the submerged pipeline must be approved by the Owner and Engineer prior to installation. Pipelines shall be routed around natural resource areas including emergent shoals and oyster beds, and the construction equipment shall avoid the natural resource areas. The Contractor will be allowed a maximum of three pipeline corridors to the fill sites. The pipeline corridors shall be no wider than 100 feet and the Contractor shall specify their locations in his/her Work Plan. If dredge discharge lines cross a navigable channel, the lines must be submerged and shall at no time reduce the depth and width of the existing channel in which it is placed. When the submerged line is placed in shallow water, outside the navigable channel, where the possibility exists for small outboard powered skiffs to cross over the submerged pipeline, the pipeline shall be marked with fluorescent orange buoys and signs stating “DANGER SUBMERGED PIPELINE” every 150 ft. throughout the length of the submerged pipeline. Costs incurred by the Contractor for compliance with this section should be included in the mobilization and demobilization cost in the Bid Price. The Contractor shall be required to conduct the Work in such a manner as to maintain vessel traffic.

The Contractor shall maintain a tight discharge pipeline at all times. The joints shall be so constructed as to preclude spillage and leakage. The development of a leak shall be promptly repaired and the dredge shall be shut down until completed repair has been made to the satisfaction of the Owner and Engineer. Failure to repair leaks or change the method of operations will result in suspension of dredging operations. If a technique is used for this project that requires anchoring of barges within the Work Area, only barges using spud-type anchoring or anchoring to driven piles shall be allowed. Conventional anchoring may only be used in the dredge site. No anchoring shall be allowed outside of the approved Work Area unless approved by the Owner. If pilings are used for anchorage, the pilings shall be well marked and removed in their entirety upon completion of the Contractor's operations. The Contractor shall provide and maintain lights and warning signals to insure safety in the vicinity of all disposal operations including marsh, beach, and dune fills and the overburden disposal area. Any damages to private or public property resulting from the Contractor's operations shall be repaired by the Contractor at his/her expense.

8.3 Dewatering and Turbidity Control

Dredging and filling operations shall be done in a manner that will minimize turbidity of the water at each dredge site and at the discharge sites from the beach, dune and marsh fills. Discharge water from the fill sites shall be directed towards the Gulf. No discharge will be allowed towards Bay Joe Wise to the North of the project area. If excess turbidity occurs, the Contractor shall change the operating procedure to reduce the degree of turbidity. The Contractor may use turbidity control structures for dewatering if necessary. All turbidity control structures must be removed prior to demobilization. The Contractor shall submit a turbidity control plan including descriptions, drawings, and locations of all turbidity control measures used as part of his Work Plan.

8.4 Borrow Area Cut Sequence

The borrow area delineated on the Plans contains three sedimentological units. The top unit is composed of soft clay overburden of varying thickness which the Contractor must dispose of as specified in TS-8.5 “Overburden Disposal”. Immediately underlying the overburden is a layer of interbedded clay, silt, and sand averaging 10 feet in thickness to be used for marsh fill construction. The bottom-most unit delineated in the borrow area is composed of mostly beach compatible sand averaging 12 feet in thickness and shall be used for beach and dune fill. The Contractor is allowed to over-dredge this unit by no more than 5 feet. If material is dredged below this allowable depth, the Contractor may be subject to deductions set forth in TS-8.6 “Deductions for Non-Conforming Work.” The Contractor must submit a proposed borrow area cut sequence with the Initial Work Plan for approval by the Owner and Engineer prior to dredging operations.

8.5 Overburden Disposal

The Contractor shall place overburden materials in the approved disposal area shown on the Plans. Any overburden material placed outside of specified area shall be removed and re-deposited into the approved area or as directed by the Owner and Engineer at the Contractor’s expense in accordance with TS-17 MISPLACED MATERIAL.

8.6 Dredge Location Control

8.6.1 Horizontal Location

The Contractor is required to have electronic positioning equipment that will locate the dredge when operating in the borrow area. The Contractor shall keep this equipment functioning on the dredge at all times during construction and when the dredge is within one (1) mile of the borrow area or the fills. The Contractor is required to calibrate the equipment as required by the manufacturer. Proof of calibration shall be submitted to the Owner and Engineer. Continuous locations of the dredge shall be made at all times during dredging operations. The location is to be by computed coordinates in the Louisiana State Plane South Coordinate System, NAD 1983 (Lambert Conformal Conic) with a probable range error not to exceed 15 feet. Positions shall be recorded at least every ten (10) minutes and furnished daily as part of the Contractor's Daily Quality Control Reports, along with a drawing of the track of the dredge in relation to the dredge site. The Contractor's method of location of the dredge shall be submitted to the Owner and Engineer for review and approval with the Contractor’s Work Plan.

8.6.2 Dredging Elevations

The Contractor is also required to have a dredging depth indicator capable of gauging the depth being dredged at all times for each piece and type of dredging plant being utilized. The instrument may be a graph type paper or electronic recorder. The paper or depth record produced by this instrument shall be submitted daily with the Daily Quality Control Report. Flagging or marking the winch cables is not an acceptable option to fulfill this instrument requirement. The indicators shall be in plain view of operators and Inspector(s) and be adjusted to the reference datum, NAVD 1988. The Contractor shall use measured tides to adjust dredging depth to the reference datum. Tide measurements must be taken on the gulf side of the project area away from Pass Chaland, Grand Bayou Pass or any other tidal inlet. The tide measurement location must be submitted in the Contractor’s Work Plan for review and approval by the Owner and Engineer. All tide measuring equipment and apparatus must be removed prior to demobilization.

8.7 Deduction for Non-Conforming Work

No excavation shall occur below the permitted dredging depth or outside the permitted dredging limits defined in the Contract and Permits. This provision does not apply to the slopes of the dredge cut; that is, the Contractor will not be held responsible for material running from outside the dredging limits when excavating at an edge of a dredge site. Material that is obtained from unpermitted areas will not be paid for under this Contract. Excavation in any area not depicted on the Plans is a violation of Permits for this Work. If pre- and post-construction surveys in the dredge site and construction observations determine that excavation has been performed outside or below the permitted limits resulting in placement of non-compatible beach, dune, or marsh fill, the quantity of material dredged from these areas will be computed and subtracted from the pay quantity. Locations outside and below the permitted limits of the borrow area dredge site may contain material deposits that are undesirable for beach, dune, or marsh fill. Further, the Contractor shall remediate the beach, dune, or marsh fills to remove non-compatible materials excavated from unpermitted areas as required by the permitting agencies and at no additional cost to the Owner.

TS-9 MARSH FILL

9.1 General Description

Marsh fill operations shall consist of removing and satisfactorily placing specified materials in accordance with these Specifications and in conformity to the lines, grades, and elevations shown on the Plans or as directed by the Owner and Engineer.

9.2 Suitable Fill Materials

Materials suitable for marsh fill include clay, silts, and fine sand. Analysis of vibracores included in Appendix TS-C indicates the presence of a layer of interbedded clay, silt, and sand immediately underlying a clay overburden layer in the borrow area as shown on the Plans. The Contractor shall target this layer of material for marsh fill. Overburden materials shall be disposed of as specified in TS-8.5 “Overburden Disposal”. Dredge discharge shall be monitored for suitable fill materials. If non-specification materials are encountered, the Contractor shall take actions specified in TS-8 EXCAVATION.

9.3 Marsh Fill Containment Dike

The containment dikes shall be constructed such that the discharge from the marsh fill shall not be allowed to flow back into the Access and Water Exchange Channel or other areas to the North of the Work Area. Discharge will only be allowed to the South towards the gulf. A description of dewatering and turbidity control measures shall be submitted with the Contractor’s Work Plan in accordance with TS-8 EXCAVATION for review and approval by the Owner and Engineer prior to commencement of dredging operations. The boundaries of the containment dikes are depicted on the Plans. Containment dikes shall be erected to the lines, grades, and elevations specified in the drawings as necessary to prevent discharge into said areas. Dike material shall be taken from either the access and water exchange channels or in-situ material within the hydraulic fill placement areas and re-filled during hydraulic dredge and fill operations. All associated costs with placing hydraulic fill in in-situ borrow channels for containment dike construction shall be at no direct pay.

The boundaries of the containment dikes are based on the field conditions present at the time of the survey. The Contractor may request a change of alignment or an addition of linear footage if field conditions have changed significantly from those represented on the Plans. All requests must be submitted in writing in the Contractor’s Work Plan for review and approval by the Owner and Engineer. Any revision resulting in a change of length will be accomplished by a Change Order. Otherwise, the revision will be accomplished by a Field Order. A permit modification will be required if the length, width, or elevation of the proposed dikes is greater than shown in the Plans. No additional construction time will be granted to obtain permit modifications.

The containment dikes shall be accessed through existing open water to the extent possible. Any access route that requires travel across existing marsh must first be approved by the Owner, Engineer, or Inspector(s) and be allowed by the Permits. Travel across existing marsh will be allowed only within the designated Work Area.

9.4 Material Handling

The Contractor shall, prior to placement of fill, remove all snags, trees, stumps, driftwood, sharp objects, and similar debris lying within the limits of the marsh fill section. All materials removed shall be disposed of in areas provided by and at the expense of the Contractor and approved by the Owner and Engineer. Grading and other construction equipment shall not be permitted outside the Contractor's Work Area as shown on the Plans except for designated ingress and egress to and from the Work Area as provided by the construction access locations.

The marsh fill material shall be placed and brought to rest in the template to the lines, grades and cross sections indicated on the Plans unless otherwise provided for herein or directed by the Owner or Engineer. The Contractor shall not stockpile pipe or any other equipment or debris outside of the Contractor’s Work Area as shown on the Plans and as required by TS-17 MISPLACED MATERIAL. Additionally, the Contractor will be responsible for restoring unauthorized disposal areas to pre-construction conditions at his own expense as specified in TS-18 ENVIRONMENTAL PROTECTION. The marsh is subject to changes and the elevations in the marsh at the time the Work is done may vary from the elevations shown on the Plans.

The Owner and Engineer reserve the right to vary the width and grade of the marsh fill template from the lines and grades shown on the Plans. The cross sections shown on the Plans were used for the purpose of calculating bid quantities of marsh fill. Pay quantities will be based on pre- and post-construction surveys in accordance with TS-6 SURVEYING.

9.5 Fill Elevation Tolerance

Placement of hydraulic fill material in the marsh fill shall be to the elevations and areas shown on the Plans.   The **target marsh fill elevation = 2.6’ NAVD 88** with a tolerance of + or – 0.5’. The **minimum marsh fill elevation = 2.1’ NAVD 88** and the **maximum marsh fill elevation = 3.1’ NAVD88**.

9.6 Measurement, Payment and Acceptance

9.6.1 Payment for Marsh Fill

Price and payment shall constitute full compensation for furnishing all plant, labor, materials and equipment for dredging, satisfactory placement of specified material into the designated marsh fill, and performing all Work as specified herein. Payment for marsh fill will be made at the contract unit price per cubic yard for Bid Item No. 3 “Marsh Fill”.   The price per cubic yard for marsh fill segments will be paid to the Contractor upon acceptance of surveys and volume calculations as specified in TS-6 SURVEYING.

Payment for dredging per cubic yard placed within the marsh fill template shall be subject to the tolerances specified in TS-9.5 “Fill Elevation Tolerance”. The fill quantity will be the volume between the natural ground and the fill elevation as calculated under section TS-6 SURVEYING. Marsh fill segments under consideration for payment must undergo a waiting period for 30 days without any additional placement of fill material before payment surveys will be made.

9.6.2 Acceptance of Marsh Fill

Segments of marsh fill with elevations below the **minimum elevation of 2.1’ NAVD 88** will not be accepted. Additional marsh fill must be pumped into these areas and resurveyed before acceptance will be considered. Once payment surveys are accepted they will be considered post-construction surveys. Although the Contractor will be allowed to overfill marsh fill areas not to exceed the **maximum elevation of 3.1’ NAVD 88**, no payment will be made for material above the **target elevation of 2.6’ NAVD 88**. Any material placed above the maximum elevation may be subject to removal by the Contractor if required by the Owner or Engineer at no additional cost to the Owner. The Contractor may install grade stakes to monitor marsh fill elevations at no direct pay. If the Contractor uses grade stakes, they must be removed prior to demobilization.

9.6.3 Payment Requests for Marsh Fill

The Contractor may request payment for marsh fill placement on a monthly basis. Payments shall be based on completed and approved adjacent fill sections. The Contractor will be eligible for initial payment when a minimum of three (3) adjacent fill sections (750 feet) have been surveyed and accepted. Subsequent payments requests must also include a minimum of (3) adjacent fill sections.

9.6.4 Payment for Marsh Fill Containment Dikes

Payment for containment dikes will be made at the contract unit price per linear foot for Bid Item No. 4 “Marsh Fill Containment Dikes”. All required maintenance of the dikes shall be performed by the Contractor at no direct pay. Price and payment shall constitute full compensation for furnishing all labor, materials and equipment for construction and maintenance of all required marsh fill containment dikes and performing all Work as specified herein.

9.7 Tidal Creeks

Tidal creeks shall be constructed and accepted in accordance with TS-12 TIDAL CREEKS prior to placing any material in the marsh fill template. All associated costs with placing hydraulic marsh fill in pre-dredged tidal creeks and degrading containment dikes shall be at no direct pay.

9.8 Settlement Plates

Settlement plates shall be placed at locations shown on the plans within the marsh fill site for the purpose of long term settlement monitoring. For material and installation specifications, the Contractor shall refer to TS-14 SETTLEMENT PLATES. Settlement plate locations and elevations shall be recorded in accordance with TS-6 SURVEYING.

TS-10 BEACH AND DUNE FILL

10.1 General Description

Beach and dune fill operations shall consist of removing and satisfactorily placing specified materials in accordance with these Specifications and in conformity to the lines, grades, and elevations shown on the Plans or as directed by the Owner and Engineer.

10.2 Suitable Fill Materials

Analysis of vibracores included in Appendix TS-C indicates the presence of a layer comprised primarily of fine sand of suitable grain size in the borrow area as shown on the Plans. The Contractor shall excavate from this layer for beach and dune fill. This layer underlies a layer of clay overburden and a layer of interbedded clay, silt, and sand. These upper layers shall be excluded from the beach and dune fill sites. The interbedded materials shall be used for marsh fill and the overburden materials shall be disposed of as specified in TS-8 EXCAVATION. Dredge discharge shall be monitored for suitable fill materials. If non-specification materials are encountered, the Contractor shall take actions specified in TS-8 EXCAVATION.

10.3 Beach Fill Containment Dike

The containment dike separating marsh fill from beach fill is NOT depicted on the Plans. The containment must be centered along the marsh fill/beach fill boundary. The Contractor may construct the containment of in-situ material, sand delivered to the fill site via dredging operations, or other approved materials. Proposed materials must be submitted with the Contractor's Work Plan for approval. There are LIS and TGP gas pipelines depicted on the plans near the beach fill containment dike alignment. No excavation will be allowed within 50 ft of the alignment of these pipelines. The Contractor must coordinate construction of the beach fill containment dike with LIS and TGP whose contact information is included in GP-28 UTILITIES AND IMPROVEMENTS.

If in-situ material within the fill areas is used, borrow channels must be re-filled during hydraulic dredge and fill operations. All associated costs with placing hydraulic fill in in-situ borrow channels for containment dike construction shall be at no direct pay. If materials other than fill are used, the Contractor may be required to remove them prior to demobilization at no direct pay. Regardless of methods and materials used, the containment dike elevation must be modified prior to demobilization such that there is a smooth transition from beach fill to marsh fill at the boundary to prevent ponding of water.

The Contractor may request a minor change of alignment if field conditions have changed significantly from those represented on the Plans and limit constructability. All requests must be submitted in writing and be included in the Contractor's Work Plan which should also include the containment method the Contractor proposes to use. Any revision resulting in a change of length will be accomplished by a Change Order. Otherwise, the revision will be accomplished by a Field Order.

10.4 Material Handling

The Contractor shall, prior to placement of fill, remove all snags, trees, stumps, driftwood, sharp objects, and similar debris lying within the limits of the beach fill section. All materials removed shall be disposed of in areas provided by and at the expense of the Contractor and approved by the Owner and Engineer. Grading and other construction equipment shall not be permitted outside the Contractor's Work Area as shown on the Plans except for designated ingress and egress to and from the site as provided by the construction access locations.

The beach and dune fill material shall be placed and brought to rest in the templates to the lines, grades and cross sections indicated on the Plans unless otherwise provided for herein or directed by the Owner and Engineer. Tapers with minimum lengths indicated on the Plans shall be constructed at the ends of the fills wherein construction grades shall be transitioned to meet existing grades. The Contractor shall not stockpile pipe or any other equipment or debris outside of the Contractor’s Work Area as shown on the Plans and as required by TS-17 MISPLACED MATERIAL. Additionally, the Contractor will be responsible for restoring unauthorized disposal areas to pre-construction conditions at his own expense as specified in TS-18 ENVIRONMENTAL PROTECTION. The beach and dune are subject to changes and the elevations on the beach and dune at the time the Work is done may vary from the elevations shown on the Plans.

The Owner and Engineer reserve the right to vary the width and grade of the beach and/or dune template from the lines and grades shown on the Plans in order to establish a uniform beach and/or dune for the entire length of the project. The cross sections shown on the Plans were used for the purpose of calculating bid quantities of beach and dune fill. Pay quantities will be based on pre- and post-construction surveys in accordance with TS-6 SURVEYING.

10.5 Fill Elevation Tolerance

Placement of hydraulic fill material in the beach and dune fills shall be to the elevations and areas shown on the plans. The elevation of the beach fill must be at or above **4.5’ NAVD 88** and the dune fill elevation must be at or above **7.0’ NAVD 88** to be accepted. A tolerance of +0.5’ will be allowed. The Owner or Engineer may require the Contractor to remove material placed above this tolerance at no expense to the Owner. The Contractor may use grade stakes to monitor these elevations.

10.6 Final Grading

Upon completion of construction operations, the beach from the seaward toe of the dune to the Mean High Water Line shall be graded and dressed throughout the beach fill to remove ruts, humps and depressions in the beach surface resulting from construction operations. Grade stakes shall be removed intact. Any excavation required to remove the stakes shall be backfilled.

10.7 Measurement, Payment and Acceptance

10.7.1 Payment for Beach and Dune Fill

Payment shall be made for materials and Work specified for furnishing all plant, labor, materials and equipment for dredge site hydraulic excavation, signs, pipeline crossings, transportation and placement of beach and dune fill; debris removal and disposal as specified in TS-10.4 "Material Handling"; beach profile construction and final grading; turbidity monitoring; environmental protection measures; and, all other appropriate costs in connection therewith or incidental thereto this Work, shall be included in the applicable Contract unit price per cubic yard for Bid Item No. 5 "Beach and Dune Fills". Any material dredged from unauthorized areas will be subtracted from the net amount used for payment, as specified in TS-8.6 "Deduction for Nonconforming Work". The price per cubic yard for beach and dune fill segments will be paid to the Contractor upon acceptance of surveys and volume calculations as specified in TS-6 SURVEYING.

10.7.2 Payment Requests for Beach and Dune Fill

The Contractor may request payment for beach fill placement on a monthly basis. Payments shall be based on completed and approved adjacent fill sections. The Contractor will be eligible for initial payment when a minimum of three (3) adjacent fill sections (750 feet) have been surveyed and accepted. Subsequent payments requests must also include a minimum of (3) adjacent fill sections.

10.7.3 Payment for Beach and Dune Fill Containment Dikes

Payment for containment dikes will be made at the contract unit price per linear foot for Bid Item No. 6 "Beach and Dune Fill Containment Dikes." All required maintenance of the dikes shall be performed by the Contractor at no direct pay. Price and payment shall constitute full compensation for furnishing all labor, materials and equipment for construction and maintenance of all required beach and dune fill containment dikes and performing all Work as specified herein.

10.8 Sand Fencing

Sand fencing shall be installed on accepted segments of dune fill as shown on the Plans to aid in the stabilization of sand and in the retention of wind blown sand within the project area. For material and installation specifications, the Contractor shall refer to TS-13 SAND FENCING.

TS-11 ACCESS AND WATER EXCHANGE CHANNELS

11.1 General Description

Channels shall be constructed to provide access for equipment and materials, a source of borrow material for containment dikes, and an avenue for sufficient water exchange between the gulf and back-bay area. Dredging shall consist of removing and satisfactorily placing all material required to construct the channels.

11.2 Method

No method of dredging will be specified. The Contractor may use any environmentally acceptable method that will complete the Work in accordance to that shown on the Plans. However, the Contractor shall submit to the Engineer the method and equipment intended to be used to complete dredging of the channels as part of the Contractor’s Work Plan. The equipment to be used shall also be listed on the PLANT AND EQUIPMENT SCHEDULE FORM.

11.3 Material Handling

Dredged material shall be deposited in the approved sidecast disposal areas, within the marsh fill template, or used for constructing and maintaining containment dikes. Some of these options may require double handling of material. Material placed in the sidecast disposal areas in the vicinity of Pass Chaland and Grand Bayou Pass must conform to the elevations, grades, and lines specified in the Plans and shall be marked using warning signs as specified in TS-15 WARNING SIGNS. Material remaining in the sidecast disposal areas shall be reworked to ±6” of the pre-construction elevations just before demobilization. Excess material from these areas shall be used to backfill the access channel upon demobilization by the Contractor. Elevations in the access channel resulting from backfilling operations shall also be no higher than +6” of the original bottom depth.

Dredged material from access channels used to construct and maintain containment dikes shall conform to the elevations, grades, and lines specified in the Plans. Spoil material deposited within the marsh template shall conform to elevation tolerances specified in TS-9 MARSH FILL.

Any material that is deposited elsewhere than as indicated on the Plans or as authorized by the Owner and Engineer shall be required to be removed and deposited in approved areas at the Contractor's expense as specified in TS-17 MISPLACED MATERIAL. Additionally, the Contractor will be responsible for restoring unauthorized disposal areas to pre-project conditions at his own expense as specified in TS-18 ENVIRONMENTAL PROTECTION.

11.4 Tolerances

The limits of dredge work for access and water exchange channels shall conform to the lines and grades shown on the Plans. Tolerances outside these requirements must be approved by the Owner and Engineer.

11.4.1 Access Channel Tolerances

The access channels shall be maintained in a useable configuration dredged as deep and wide as needed for equipment access and containment dike construction but no deeper than the maximum depth of -7.5’ NAVD 88 or wider than the maximum width as shown on the Plans for the duration of the project.

11.4.2 Water Exchange Channel Tolerances

In the area designated for the water exchange channel, the Contractor must achieve the minimum depth of -5.5’ NAVD 88 and minimum width without exceeding the maximum depth of -7.5’ NAVD 88 or maximum width shown on the Plans. Side slopes of the channels shall be excavated to the template as shown on the Plans.

11.5 Navigation

The Contractor shall mark the channels in the vicinity of Pass Chaland and Grand Bayou Pass in accordance with TS-15 WARNING SIGNS and TS-16 LIGHTED AIDS TO NAVIGATION.

11.6 Measurement, Payment, and Acceptance

Access and water exchange channels shall be constructed to the lines and grades shown on the Plans and as specified herein. Price and payment shall constitute full compensation for all materials, labor, supplies and equipment required for dredging the channels and maintaining the dredged channels to the required depth for the duration of construction.

11.6.1 Payment for Access Channels

Access channels shall be constructed at no direct pay. The Contractor shall account for all costs associated with constructing access channels in Bid Item No. 1, “Mobilization/Demobilization”.

11.6.2 Payment for Water Exchange Channels

Water exchange channels shall be paid for at the contract price per linear foot for Bid Item No. 7, “Water Exchange Channel”. Sixty percent (60%) of the price per linear foot will be paid to the Contractor upon initial completion of the water exchange channel and acceptance of the initial surveys as specified in TS-6 SURVEYING. The remaining forty percent (40%) of the price per linear foot will be paid upon completion of construction and acceptance of post-construction surveys as specified in TS-6 SURVEYING.

TS-12 TIDAL CREEKS

12.1 General Description

Channels shall be constructed to provide hydraulic exchange and circulation within the marsh. Tidal Creeks shall be dredged prior to placing marsh fill. These pre-dredged tidal creeks will encourage settlement of marsh fill after construction thereby promoting tidal exchange in these areas during the life of the project. Dredging shall consist of removing and satisfactorily placing all material required to construct the channels.

12.2 Method

No method of dredging will be specified. The Contractor may use any environmentally acceptable method that will complete the Work in accordance to that shown on the Plans. However, the Contractor shall submit to the Owner and Engineer the method and equipment intended to be used to complete dredging of the tidal creeks as part of the Contractor's Work Plan. The equipment to be used shall also be listed on the PLANT AND EQUIPMENT SCHEDULE FORM.

12.3 Material Handling

Dredged material shall be deposited within the marsh fill template or used for constructing and maintaining containment dikes. Some of these options may require double handling of material. Spoil material from tidal creeks used to construct and maintain containment dikes shall conform to the elevations, grades, and lines specified in the Plans. Spoil material deposited within the marsh template shall conform to elevation tolerances specified in TS-9 MARSH FILL. All associated costs with placing hydraulic marsh fill in pre-dredged tidal creeks and degrading containment dikes shall be at no direct pay.

Any material that is deposited elsewhere than as indicated on the Plans or as authorized by the Owner or Engineer shall be required to be removed and deposited in approved areas at the Contractor's expense as specified in TS-17 MATERIAL HANDLING. Additionally, the Contractor will be responsible for restoring unauthorized disposal areas to pre-construction conditions at his own expense as specified in TS-18 ENVIRONMENTAL PROTECTION.

12.4 Tolerances

The limits of dredge Work shall conform to the lines and grades shown on the Plans. Tolerances outside these requirements must be approved by the Owner and Engineer. Tidal creeks shall be dredged to the width shown on the Plans and to a depth of -19' NAVD 88 with a tolerance of ±6". Excavated material shall be deposited as specified in 12.3 "Material Handling". Side slopes of the channels shall be excavated to the template as shown on the Plans.

12.5 Measurement, Payment, and Acceptance

Tidal creeks shall be constructed to the lines and grades shown on the Plans and as specified herein and shall be paid for at the contract price per cubic yard for Bid Item No. 8, “Tidal Creeks”. Price and payment shall constitute full compensation for all materials, labor, supplies and equipment required for dredging the tidal creeks and properly placing the material as specified herein. The price per cubic yard will be paid to the Contractor upon acceptance of surveys and volume calculations as specified in TS-6 SURVEYING.

TS-13 SAND FENCING

13.1 General Description

Sand fencing shall be installed on accepted segments of dune fill in accordance with the Plans to aid in the stabilization of sand and in the retention of wind blown sand within the project area. Sand fencing must be installed within seven days following payment acceptance of a dune fill segment. A double row of fencing shall be constructed to obtain the maximum effectiveness for the location. Section lengths and configurations may vary. Gaps, as shown on the Plans will separate the beginning and end of each fence section to facilitate movement through the fencing. Sand fencing shall be fastened to wooden fence posts at the top, middle and bottom. The wire shall be corrosion resistant and affixed with no less than three (3) tie clips around the posts. At the end of fence sections, two wraps of wiring shall be used at each fence wire and at the top and bottom. Additional rows of fencing, or parts thereof, may be installed at various locations should site conditions warrant it. Tie clips or wire must be approved by the Owner or Engineer prior to construction. Three (3) wraps of the wire shall be used at all tie locations on the fence.

13.2 Materials

13.2.1 Posts

Fence posts shall be 4” x 4” posts ten (10) feet long driven six (6) feet into the ground and placed ten (10) feet on center. The posts shall be vertically plumb, the alignment shall be in straight lines.

13.2.2 Fencing

Sand fencing shall be standard, weather resistant snow fencing. Sand fence shall be furnished in rolls of 50 feet or 100 feet. The sand fence is to be composed of the following elements:

a. Slats: Slats shall be made of No. 1 aspen or spruce measuring 3/8 thick, 1-1/2 inch wide by 4 feet long. The maximum distance between slats shall not exceed 2-1/4 inches. It shall be weather proofed by an acceptable pressure treatment method.

b. Fence Wire: Wire for securing slats shall be good commercial quality steel that has been hot-dipped galvanized with a minimum gauge rating of 13. The wire shall be twisted around the slats sufficiently to penetrate the slat to hold it in place. Wire strands shall not exceed ten (10) inches and shall not be closer than four (4) inches from slat ends.

c. Tie Wire: The wire that is used to tie the fence to the post shall be galvanized and shall be at least one gauge larger than the individual wires used for the fencing.

d. <u>Overlaps</u>: Where sections of sand fence are joined, a minimum of six (6) inches of each section shall overlap. The overlaps shall be secured using three (3) wraps of wiring at four (4) places: top, bottom, middle top and middle bottom as specified.

13.3 Installation

<u>13.3.1 Alignment</u>

Sand fence location and alignment shall be in conformance with the Plans unless otherwise required or approved by the Owner or Engineer in order to accommodate site conditions that exist at the time of installation. The sand fence shall be installed on the Gulf of Mexico side of the post. Such location and alignment changes should not reduce the contract quantity of fencing materials.

<u>13.3.2 Equipment</u>

Equipment used for the installation of fence posts, the transportation of fencing materials, and movement of personnel shall be appropriate for the Work, listed on the Plant and Equipment Schedule form, and approved by the Owner and Engineer. To be appropriate, Contractor's equipment shall be of the type that shall not cause non-repairable damage to surface area of the beach and dune when properly used. All equipment proposed for use on the beach and dune shall be acceptable to the Owner and Engineer prior to mobilization. Equipment operators shall be fully instructed with regards to avoiding damage to the beach and dune surfaces and vegetation. At the discretion of Owner and Engineer, the Contractor may be required to restore beach surface elevations changed by 0.5 feet or more by the Contractor during mobilization, construction or demobilization.

<u>13.3.3 Vegetated Areas</u>

Fence installations shall be on the dune platform only. Fence installation may be in both vegetated and non-vegetated areas. In vegetated areas, ingress and egress of equipment and personnel and the movement and placement of fence materials shall be restricted and must be closely supervised by the Contractor. In non-vegetated areas, these factors shall be less restrictive but must be controlled; access to and from any non-vegetated area shall not be through vegetated areas. Unwarranted damage to the beach and dune environment shall be justification for the immediate removal of those responsible from the Work Area.

<u>13.3.4 Storage</u>

Fencing materials stored within the Work Area shall be placed in an easily accessible location that has been approved by the Owner or Engineer. Stored materials shall be placed and maintained in a neat, orderly, and safe manner.

13.4 Measurement and Payment

Sand fencing shall be measured for payment by the linear foot completely installed in accordance with the Plans and Specifications and such approved changes as made thereto. Splice overlaps mentioned shall not be measured for payment. Sand fencing shall be paid for at the contract price per linear foot for Bid Item No. 9, “Sand Fencing”. Sand fencing location shall also be surveyed and recorded as specified in TS-6 SURVEYING.

TS-14 SETTLEMENT PLATES

14.1 General Description

This Work consists of furnishing and assembling the materials needed to construct and install settlement plates in accordance with these Specifications and the project Plans or as directed by the Owner and Engineer. Settlement plates will be used to monitor elevations of the marsh fill at locations where soil borings were sampled during project design. The soil borings are included as part of the geotechnical report included in Appendix TS-D. Settlement plates shall be placed at locations shown on the Plans within marsh fill template.

14.2 Materials

Settlement plates shall be fabricated with a four foot (4') x four foot (4') x one fourth inch (¼") plate with a three inch (3") diameter riser pipe connected to the center of the plate with a 3/16" continuous fillet weld. The pipe length shall be the length specified on the Plans, and the top shall be closed with a cap. All materials shall be made of ASTM A36 steel and after fabrication, the settlement plate shall be hot dipped galvanized.

14.3 Zinc Coating

Zinc coating shall be applied in a manner and thickness quality conforming to ASTM A-123. In all cases where zinc coating is destroyed by cutting or other causes, the affected areas shall be re-galvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coating less than 2 ounces shall be re-galvanized by a repair compound.

14.4 Installation

The settlement plates shall be installed within the marsh fill template at locations shown on the Plans or as directed by the Owner and Engineer. Settlement plates must be placed such that the vertical pipe conforms to a vertical plumb standard of no more than 10.5º from true vertical. Settlement plates shall also be marked with bright colored flagging or reflector tape.

The Contractor shall exercise care when placing any construction materials in the vicinity of the settlement plates. Any damaged settlement plates shall be replaced by the Contractor at no expense to the Owner. Damaged settlement plates are defined as plates which would not accurately represent elevation of the project feature in question as determined by the Owner and Engineer. Leveling of the plate bed shall be accomplished by removing the minimum amount of earth or debris necessary to produce an even foundation and in such manner that the density of the plate bed will remain at the same density as the undisturbed adjacent ground. Leveling of the plate bed by the addition of fill will not be permitted.

14.5 Measurement, Payment and Acceptance

Acceptance of settlement plates will be made after associated segments of marsh fill are accepted. Settlement plates shall be surveyed as specified in TS-6 SURVEYING. Settlement plates will be measured per each, complete and installed. Payment will be made at the contract unit price for Bid Item No. 10, “Settlement Plates”.

TS-15 WARNING SIGNS

15.1 General Description

This Work consists of furnishing and assembling the materials needed to construct and install shoal signs near sidecast disposal areas and red and green day markers near Pass Chaland and Grand Bayou Pass as shown on the Plans and in accordance with the U.S. Coast Guard standards. The warning signs shall also be removed prior to demobilization in accordance with these Specifications and the Plans or as directed by the Owner or Engineer.

15.2 Materials

15.2.1 Signs

Each of the warning signs shall be fabricated from 125 gauge 61TS Aluminum or approved equal, covered with white, engineer grade, reflecting sheeting; black screened lettering and design; and orange, engineer grade reflective border. Signs shall meet all U.S. Coast Guard Standards.

15.2.2 Piling

Piling shall be 12" diameter (nominal end) x 40 ft long timber piling and driven to the proper depth, as shown on the Plans. All timber pilling shall conform to LA DOTD 2000 Stand Specification Sections 812 and 1014. The Contractor may use temporary buoys in lieu of pilings for warning sign installation. Buoys must approved by the Owner and Engineer.

15.2.3 Hardware and Connections

All nuts, bolts and washers shall be hot galvanized. Nylon washers shall be provided at both ends of all bolts. Connection angles shall be 2” x 2 ¼ ” and hot dip galvanized and shall extend within 6 inches of sigh edges on the top and bottom. Timber blocking shall be pressure treated pine or fir with a minimum length of 18 inches.

15.3 Installation

The warning signs shall be installed at locations shown on the Plans or as directed by the Owner or Engineer. The top of the pile shall be 12 feet above mean high water (1.53’ NAVD 88.)

15.4 Removal

All pilings or pipes shall be removed to depth at least 5’ below existing ground. All material removed shall become property of the Contractor and shall be removed and disposed of in a manner approved by the Owner and Engineer from the Work Area prior to demobilization. Materials being disposed of be in accordance with title 33, part VII, sub-part 1 (Solid Waste) of the Louisiana Environmental Regulatory Code, latest revision. The Contractor is responsible for any and all costs associated with the disposal of removed materials.

15.5 Measurement, Payment and Acceptance

Warning signs will be paid per each installed, maintained, and removed. Payment will be made at the contract unit price for Bid Item No. 11, “Warning Signs”.

TS-16 LIGHTED AIDS TO NAVIGATION

16.1 General Description

Lighted aids to navigation are required to maintain safe working conditions for construction in navigable waters. The Contractor shall provide, install, maintain, and remove lighted aids as specified herein at no direct pay. Any damage to existing U.S. Coast Guard or private navigation aids caused by the Contractor shall be repaired by the Contractor to U.S. Coast Guard standards at no expense to the Owner.

16.2 Installation

Lighted dredging aids to navigation shall be installed prior to any dredging equipment entering the borrow area or laying any pipeline from the borrow area to the fill areas. The aids to navigation shall be lighted for 24-hour operation. Light characteristics for the aids shall be flashing yellow. If buoys are used they shall be yellow with reflective international orange square patches or stripes. If pile structures are used, they shall display yellow dayboards with reflective international orange borders. The aids may be lettered. The Contractor shall notify the U.S. Coast Guard in accordance with subparagraph "Notice of Intent to Dredge" as specified in TS-2 SUBMITTALS. The notification shall contain maps and descriptions of lighted aids for inclusion in the Notice to Mariners.

16.3 Operation and Maintenance

The Contractor shall operate and maintain all the lighted aids. Should lighted dredging aids to navigation leave positioned locations, the Contractor shall reposition within 24 hours.

16.4 Removal

The Contractor shall remove all lighted dredging aids to navigation, piles, chains, anchors, etc. from the project area upon completion of this project.

16.5 Location for Installation

Lighted dredging aids to navigation shall be installed at the tabulated points-of-intersection and at 500 feet minimum spacings that define Work limits in the borrow area, access corridors, and the Contractor's Work area at the gulf side of the beach fill. The appropriate type, whether buoyed or piles, shall be installed with the above marking and lighting scheme.

16.6 Signs for Navigation Warnings

Additional signage shall be used to delineate sidecast disposal areas and navigation through Pass Chaland and Grand Bayou Pass as specified in TS-15 WARNING SIGNS.

TS-17 MISPLACED MATERIAL

17.1 In Water

Should the Contractor, during the progress of the Work, lose, dump, throw overboard, sink, or misplace any material, plant, or equipment, which in the opinion of the Owner and Engineer may be dangerous to, or obstruct navigation, the Contractor shall recover and remove the same with the utmost dispatch at no expense to the Owner. The Contractor shall give immediate notice, with description and location of such obstructions, to the U.S. Coast Guard, Owner and Engineer and when required, mark or buoy such obstructions until the same are removed.

This includes placement of dredged overburden materials in the approved disposal area shown on the Plans and as required by TS-8.5 “Overburden Disposal”. Any overburden material placed outside of specified areas shall be removed and re-deposited into the approved area or as directed by the Owner or Engineer at the Contractor’s expense.

In the event of refusal, neglect, or delay in compliance with the above requirements, such obstructions may be removed by the Owner, and the cost of such removal may be deducted from any money due or to become due to the Contractor or may be recovered under his bond.

17.2 On Land

Should the Contractor, during the progress of the Work misplace any dredge material, plant, equipment, or other materials outside of what is authorized within the Work Area without the approval of the Owner or Engineer, the Contractor shall recover and remove the same with the utmost dispatch. The Contractor shall give immediate notice, with description and location of such misplaced materials to the Owner and Engineer. Misplaced materials shall be removed at the Contractor’s expense. This may require redeposit of misplaced dredge materials as directed by the Owner or Engineer. Additionally, the Contractor will be responsible for restoring unauthorized disposal areas to pre-construction conditions at his own expense as specified in TS-18 ENVIRONMENTAL PROTECTION.

TS-18 ENVIRONMENTAL PROTECTION

18.1 General Description

For the purpose of this specification, environmental protection is defined as the retention of the environment in its natural state to the greatest possible extent during project construction and to enhance the natural appearance in its final condition. Environmental protection requires consideration of air, water, and land, and involves, solid waste-management as well as other pollutants. In order to prevent any environmental pollution arising from the construction activities in the performance of this Contract, the Contractor and his Subcontractors shall comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

18.2 Endangered Species

Requirements outlined in this specification regarding protection of migratory and other species of birds is valid only if the Contractor conducts the Work after April 15, 2006. If the Contractor plans to conduct the Work prior to April 15 2006, the Owner or Engineer shall be contacted for additional requirements.

Certain bird species are protected by the U.S. Fish and Wildlife Service and the Louisiana Department of Wildlife and Fisheries. Protected bird species most likely to be encountered include, but are not limited to, least terns, black skimmers, and brown pelicans. The Contractor is invited to employ personnel familiar with protected birds to allow for easy identification of birds encountered during the execution of work under this contract. Throughout the period of construction, the Contractor shall patrol, twice daily, gulf-side beaches, associated sand flats and overwash areas, and island fill areas to identify any nesting birds.

This effort includes not only existing beaches, dunes and sand flats, but dunes, dune slopes, beach berms, and other areas of island fill created during the execution of work. The Contractor shall especially patrol/traverse unvegetated or sparsely vegetated sand flats overwash areas, and island fill areas such as the created dune, which are prime nesting habitat. Such patrols shall continue throughout the period of construction, or until all work (including grading and shaping, sand fence installation, and access activities) is completed for acceptance segments. In the event that the Contractor discovers any evidence of nests or eggs of any protected bird species, the Contractor shall immediately cease work in the immediate vicinity of the nest and shall immediately notify the Owner.

The Contractor shall include a description of daily patrols (personnel, locations, time), the patrol results (any bird observations, species observed, location, behavior, nests found), and any actions taken as a result of such patrols or observations, in the DAILY QUALITY CONTROL REPORT included in TS-19 QUALITY CONTROL.

18.3 Water Quality

The Contractor shall adhere to all water quality regulations set for by the Permits and these Specifications. The Contractor shall also employ measures set forth in TS-8.3 Dewatering and Turbidity Control and TS-18.5 Pollution Control to protect water quality in the vicinity of the project.

18.4 Vegetation and Landscaping

18.4.1 Prevention of Landscape Defacement

The Contractor shall not deface, injure, or destroy trees, shrubs or marsh vegetation, nor remove or cut them without the approval of the Owner or Engineer. Exceptions can be made within the fill template if approved by the Owner and Engineer. Ropes, cables, or guys shall not be fastened to or attached to any existing nearby trees. Where the possibility exists that trees may be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment or operations, the Contractor shall adequately protect such trees. Monuments and markers shall be protected before construction operations commence and throughout the duration of construction.

18.4.2 Restoration of Landscape Damage

Any trees, shrubs, beach or marsh vegetation, or other landscape features scarred or damaged by the Contractor’s equipment or operations shall be restored to a condition satisfactory to the Owner and Engineer. Restoration of scarred and damaged trees, shrubs or vegetation shall be performed in an approved manner by experienced workmen. Trees, shrubs, or vegetation damaged beyond restoration shall be removed and disposed of by Contractor in a manner approved by Owner and Engineer. Trees, shrubs, or vegetation that are to be removed because of damage shall be replaced at the Contractor’s expense by nursery-grown trees, shrubs, or vegetation of the same species or a species approved by the Owner and Engineer. The size and quality of nursery-grown trees, shrubs, or vegetation shall also be approved by the Owner and Engineer. Final payment shall be withheld until the restoration activities are made and approved by the Owner.

18.5 Pollution Control

18.5.1 Location of Storage Facilities

The Contractor’s storage, which is required in the performance of the Work, shall be located upon existing cleared portions of the Work Area or areas to be cleared, and shall require written approval of the Owner and Engineer. The Contractor shall not store oil or fuel on the beach, dune, or marsh, or equipment that is not required for the daily construction activities. The Contractor shall specify where oil and fuels will be stored in his/her Work Plan. A metal pan with sides a minimum of four (4) inches high shall be placed under the equipment on the beach or adjacent area during refueling. The pan shall have a capacity equal to the capacity of the fuel cans used and catch any spills or leaks during the refueling activity. Fuel caught in the pan shall be contained and either transported off-site or used in the equipment. Under no condition shall the material be discharged on the beach, dune, marsh, adjacent lands or Gulf waters. If the Contractor's fuel cells exceed the thresholds set forth in 40 CFR 112, the Contractor shall provide a spill plan and containment equipment accordingly.

18.5.2 Post-Construction Cleanup or Obliteration

The Contractor shall obliterate all signs of construction Work Area, waste materials, or any other vestiges of construction as directed by Owner and Engineer. Any damages caused by the Contractor outside of the constructed features shall be restored to pre-construction conditions.

18.5.3 Spillage

Special measures shall be taken to prevent bilge pumpage or effluent, chemicals, fuels, oils, greases, bituminous materials, waste washing, herbicides and insecticides, and concrete drainage from entering State waters.

18.5.4 Disposal

Disposal of any materials, wastes, effluent, trash, garbage, oil, grease, chemicals, etc., in areas adjacent to streams or other waters of the State shall not be permitted. If any waste material is dumped in unauthorized areas, the Contractor shall remove the material and restore the area to its pre-construction condition before being disturbed. If necessary, contaminated ground shall be excavated, disposed of as directed by the Owner and replaced with suitable fill material, compacted and finished with topsoil and planted as required to re-establish vegetation.

18.6 Existing Oil Pipelines, Structures, and Wells

The Contractor shall be responsible for locating and avoiding all oil pipelines and facilities in accordance with GP-26 COOPERATION WITH PUBLIC UTILITIES and GP-27 UTILITIES AND IMPROVEMENTS. In the event that an oil spill occurs as a result of construction activities the Contractor shall call the Louisiana Emergency Hazardous Materials Hotline at (877) 925-6595 and the National Response Center at (800) 424-8802. The Contractor shall also respond in accordance with section 2463 of the Louisiana Oil Spill Prevention and Response Act of 1991 and the Oil Pollution Act of 1990. These documents can be downloaded at http://www.losco.state.la.us/regulations.htm.

TS-19 QUALITY CONTROL

19.1 General Description

The Contractor shall establish and maintain quality control for operations under this section to assure compliance with the Contract Documents and maintain records of this quality control for materials, equipment and construction operations including, but not limited to, the items included herein. A DAILY QUALITY CONTROL REPORT Form has been included in this section which the Contractor shall use for keeping quality control records. These reports shall be submitted to the Owner and Engineer at weekly progress meetings.

19.2 Pre-Construction Meeting

Within 30 days of the Effective Date of the Contract, a pre-construction conference shall be held as specified in GP-8 PRELIMINARY CONFERENCE.

19.3 Preparatory Review

(To be conducted prior to commencing WORK)

a. Check location of dredge areas and conditions of beach areas to be filled.
b. Present plan of action for filling the marsh, beach and dune and excavating access channels and water exchange channels.
c. See that all plant and equipment is approved and is in satisfactory working condition.
d. Check safety requirements and, particularly, public safety.
e. Check the Work Area for structures that could be susceptible to damage or which would have further damage caused by the Contractor's activity.
f. Gain permission from USCG and other agencies for marking and placement of Aids to Navigation and Warning to Mariners.

19.4 Initial Review

(To be conducted after a representative sample of WORK is complete)

a. Check for proper lines, grades, and elevations.
b. Check finished area for proper dressing and elimination of ruts, humps and depressions.
c. Check any structures at the Work Area for damage by Contractor's equipment.

19.5 Follow-Up Reviews

(To be conducted daily to assure compliance with results of initial review)

a. Check items mentioned in preparatory and initial review.
b. Damage or defects.

A copy of these records, as well as results of corrective action taken, shall be furnished to the Owner and Engineer.

DAILY QUALITY CONTROL REPORT FORM

Insert Daily Report Form Here.

10.0 REFERENCES

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APPENDIX A

SUPPLEMENTAL FIELD SURVEY REPORT

Coastal Engineering Consultants, Inc.

SJB GROUP INCORPORATED

SUPPLEMENTAL FIELD SURVEY REPORT

PASS CHALAND TO GRAND BAYOU PASS BARRIER SHORELINE RESTORATION (BA-35)

LDNR CONTRACT NO. 2511-03-09
CEC FILE NO. 02.132

JUNE 20, 2005

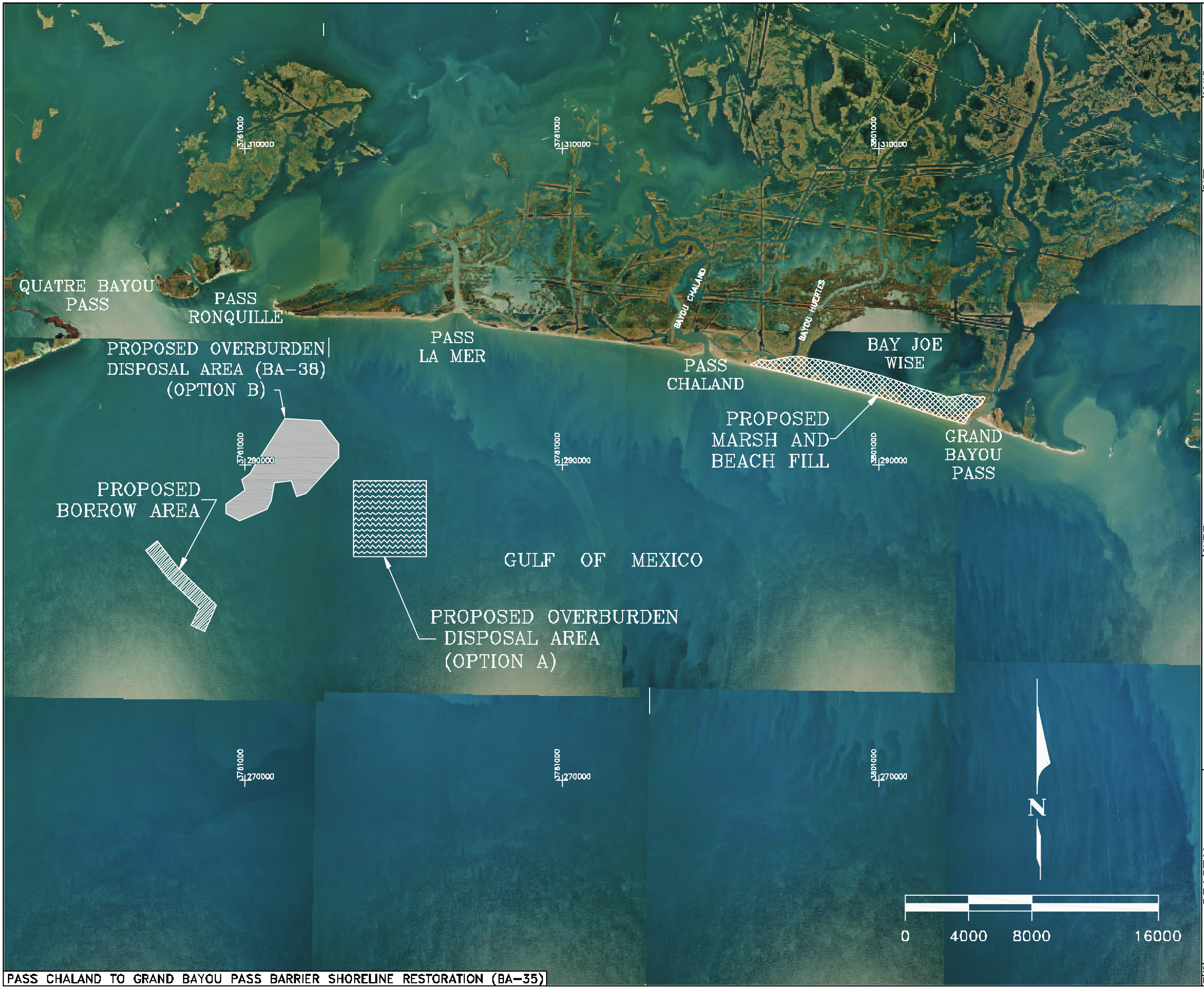
1.0 INTRODUCTION

This Survey Report summarizes the completed field work in support of the implementation of the Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration Project (BA-35, CWPPRA Priority Project List 11) for the National Marine Fisheries Service (NMFS) and the Coastal Restoration Division of the Louisiana Department of Natural Resources (LDNR). This Project is funded and authorized in accordance with the provisions of the Coastal Wetlands Planning, Protection, and Restoration Act (16 U.S.C.A., Sections 3951-3956) and has been approved by the PL 101-646 Task Force.

The objective of this Project is to protect and preserve the structural integrity of the barrier shoreline along the Gulf of Mexico. A location map is shown in Figure 1. The Project, as planned, would include design of a marsh platform approximately 1,000 feet wide contiguous with the northern side of the Gulf shoreline of Bay Joe Wise. It is estimated that approximately 2.68 million cubic yards of dredged material consisting of clays, silts and sands will be required to construct the marsh platform. Further, LDNR desires to include a beach and dune component to address the severity of erosion along the gulf-front shoreline and multiple breachments that have occurred due to recent storm and hurricane damage. It is estimated that approximately 1.34 million cubic yards of dredged material consisting primarily of sand will be required to construct the beach and dune component. Lastly, a water exchange channel is recommended to maintain the current flow-way and circulation patterns between Pass Chaland and Bay Joe Wise. It is estimated that an approximate 4,000-foot long channel will have to be dredged with a corresponding volume of approximately 66,000 cubic yards.

Phase I is a non-construction phase and includes engineering and design, landrights, monitoring plan development, baseline monitoring, and Project administration. This phase will be used to evaluate the economic and technical feasibility of the conceptual Project, and, if proven feasible, to provide detailed plans and specifications and other documentation required for construction.

SJB Group, Inc. (SJB) in association with Coastal Engineering Consultants, Inc. (CEC) is pleased to present this Report that outlines the topographic, bathymetric, depth of closure, pipeline location and geotechnical surveys completed to supplement the initial surveys conducted by SJB et. al. (2003) and provide additional data for the Final Design Phase of the Project.



PASS CHALAND TO GRAND BAYOU PASS BARRIER SHORELINE RESTORATION (BA-35)

CLIENT:
LOUISIANA DEPARTMENT OF NATURAL RESOURCES

TITLE:
FIGURE 1: PROJECT LOCATION MAP

DATE: MAY 23, 2005
SCALE: 1"=8000'
DRAWN: KEV
CHECKED: MTP
ACAD NO. 02132FIG1
FILE NO. 02132

NO.	DATE	BY	REVISION DESCRIPTION

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SHEET 1 OF
FILE NO.: 02132-FIG1

2.0 SCOPE OF SERVICES

2.1 Topographic Surveys

A topographic survey was conducted in locations where the island had been previously breached by storms to assess changes in the breaches that may have occurred and provide detailed topography for input in the Hydrodynamic Modeling tasks used to evaluate the various design alternatives.

A topographic survey was conducted in the marsh along the proposed secondary channel alignment developed during the Preliminary Design Phase to provide detailed topography to aid in the final design of the fill template, containment dike and dredge cut for this section of the Project.

2.2 Bathymetric Surveys

During the Geotechnical Investigation (Alpine, et. al. 2004), a potential sediment soruce was identified and vibracore sampling confirmed the presence of suitable sediments outside the limits of the budgeted geophysical surveys (side-scan, bathymetry, and seismic). A bathymetric survey of the proposed borrow area was thus performed to provide detailed bathymetry necessary for the final design of the borrow area.

Bathymetric surveying was also conducted from the Empire Marina to the Project area via Bayou Chaland as well as Grand Bayou channel to attempt to identify the optimal route for construction access and transporting equipment to the Project area.

2.3 Depth of Closure

As the Bay Joe Wise Headland is a sand starved system due to significant erosion experienced, recent survey profile comparisons may not fully reflect the seaward limit of active sand transport defined as the depth of closure.

A field study was conducted to attempt to ascertain the depth of closure by measuring the sand cover thickness over the underlying cohesive profile. The technique employed included sampling the sediment at specific locations along the shoreline and at specific elevation intervals along the profile. The upper stratum was collected via coring and visual observations were made to measure the sand cover thickness. At a seaward elevation the sand layer diminished as the sediments turn to silts, mud and clays. This elevation was determined to be consistent with the analyses presented in the Coastal Processes Report (SJB and CEC, 2004) and recommended for the depth of closure.

2.4 Pipeline Location Surveys

Jet probe investigations were performed to a depth of 10 to 11 feet below the ground surface to attempt to identify the location and depth of cover for the existing gas and oil pipelines buried throughout the Project area. The location and depth data are necessary for final design of the secondary channel and containment dike, as well as the construction access corridors through the inlets and interior channels.

2.5 Geotechnical Surveys

Core samples were collected to an approximate depth of seven feet below the ground surface in the Pass Chaland and Grand Bayou Pass flood and ebb shoals. These samples were laboratory tested to determine the grain size and sediment characteristics. The sediment data are necessary for final design of the construction access corridors through the inlets and interior channels. Further, the sediments will be evaluated for compatibility with containment dike construction.

3.0 TOPOGRAPHIC SURVEYS

3.1 Methodology

The topographic survey was conducted utilizing a Leica SR530 Global Positioning System capable of doing static and real time kinematic (RTK) surveying. The baseline was established utilizing static observations from the reference monument "Cheniere". SJB previously located the "Cheniere" monument that was set for LDNR as part of their secondary GPS network that was set by Morris P. Hebert Surveying, Inc (SJB et. al. 2003). This monument was used as the reference point for the entire survey and was used as check point on a daily basis. Daily positions were determined and compared to the published positional information for this monument to ensure the integrity of the survey. The published coordinates for this point are:

Lat	29d 18' 26" N
Long	89d 43' 29" W

Ellipsoid Height 10.002 feet

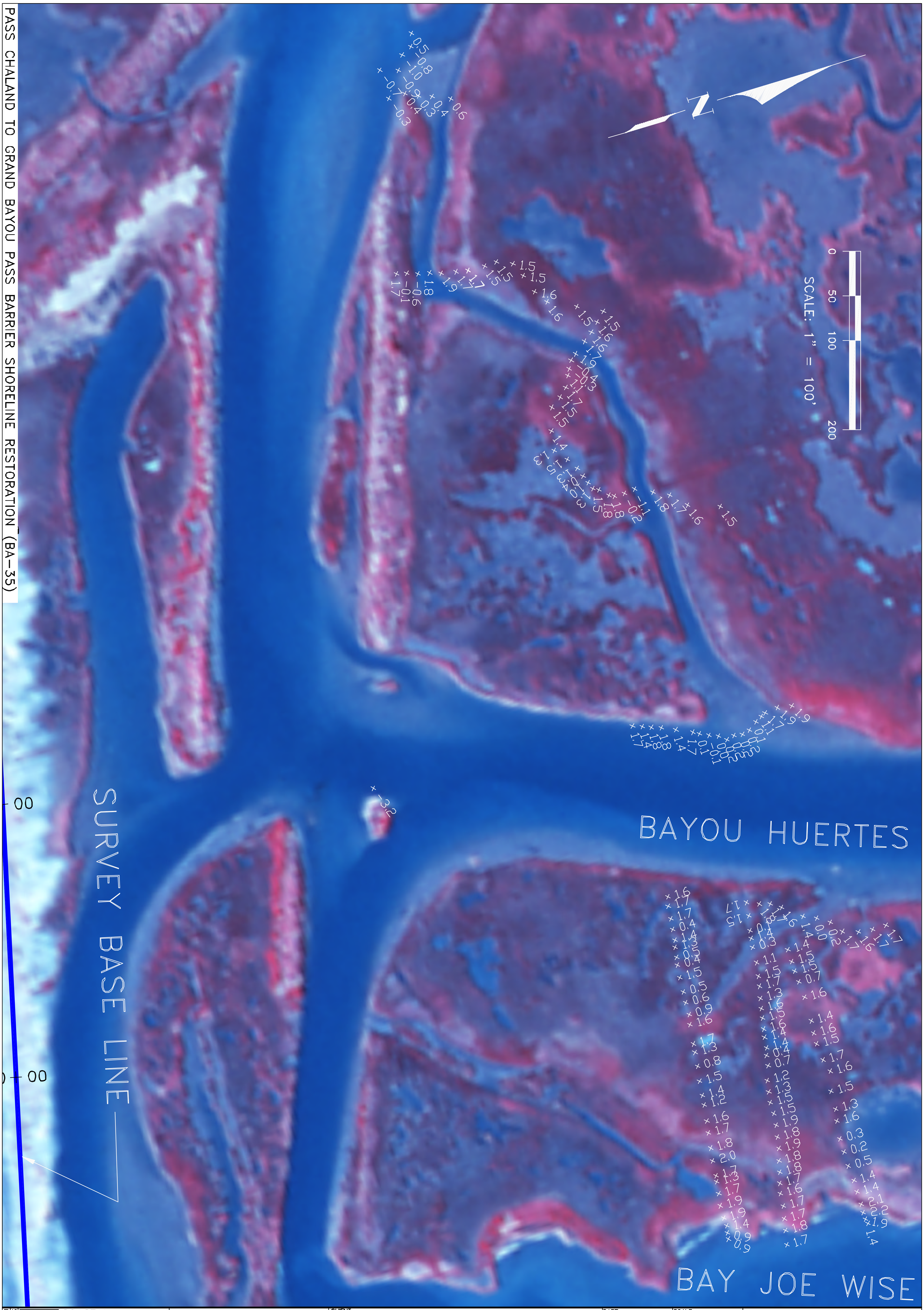
3.2 Beach Surveys

SJB performed ground surface elevation measurements at several monuments on the barrier island to measure the amount of erosion that has occurred since the last survey was conducted on the island. New surveys were also conducted over four (4) lines running perpendicular to the two existing breaches running across the barrier island from the Gulf to Bay Joe Wise.

3.3 Marsh Surveys

Three survey lines were run from Bayou Huertes to Bay Joe Wise along the proposed water exchange channel that would be dredged as part of the proposed restoration project. One survey line was run down the middle of the proposed channel, another line was run approximately 100 feet north of the center line and a third line was run approximately 100 feet south of the center line. Additional marsh survey points were measured within the proposed channel on the west side of Bayou Huertes. These additional lines were run north and south of the existing small tidal creek that runs within the proposed channel alignment. Topographic points were measured at a typical spacing of 15 feet (Figure 2).

PASS CHALAND TO GRAND BAYOU PASS BARRIER SHORELINE RESTORATION (BA-35)



SHEET 2 OF
FILE NO.: 02132-FIG2

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CLIENT: LOUISIANA DEPARTMENT OF NATURAL RESOURCES

TITLE: FIGURE 2: TOPOGRAPHIC MEASUREMENTS

DATE: MAY 23, 2005
SCALE: 1" = 100'
DRAWN: KEV
F.B.
CHECKED: MTP
PG.
SEC.
TWP.
RNG.
ACAD NO. 02132FIG2
REF. NO. 02.132

NO.	DATE	BY	REVISION DESCRIPTION

4.0 BATHYMETRIC SURVEYS

The bathymetric surveys were conducted using a 22-foot vessel powered by an outboard motor, an Innerspace 448 depth sounder with an appropriately mounted transducer, a DGPS antenna mounted on the boat, and the program Hypack Max from Coastal Oceanographics, Inc. for the hydrographic guidance software.

All survey equipment was properly calibrated for the project. Bar checks to calibrate the fathometer were performed for verification of accuracy at the beginning of each survey day. Tidal measurements were made throughout the duration of each survey to allow for tidal corrections to fathometer soundings.

The vertical accuracy of the profile data meets or exceeds the GPS-derived heights (0.2 to 0.5 foot) standard. The horizontal positioning system accuracy of the data was within 5 feet and the off-line horizontal deviation was maintained within 30 feet, where applicable and where conditions allowed.

Bathymetry of the proposed borrow area was measured along 21 total lines as shown in Figure 3. Eighteen (18) of these lines passed perpendicular through the borrow area and three (3) of the lines ran parallel to the center of the borrow area. The perpendicular lines were typically 2,000 feet long, and the parallel lines were typically 7,000 feet long.

Surveys of the channels from the Empire Marina to the site were performed using the same equipment and procedures. A one-line survey transect aligned with the deepest known channel along each route was generally run as shown in Figure 4. However, when shallow water was encountered, a criss-crossing route was taken in order to find the deepest channel and identify the width of the deepest channel through the shallower areas.

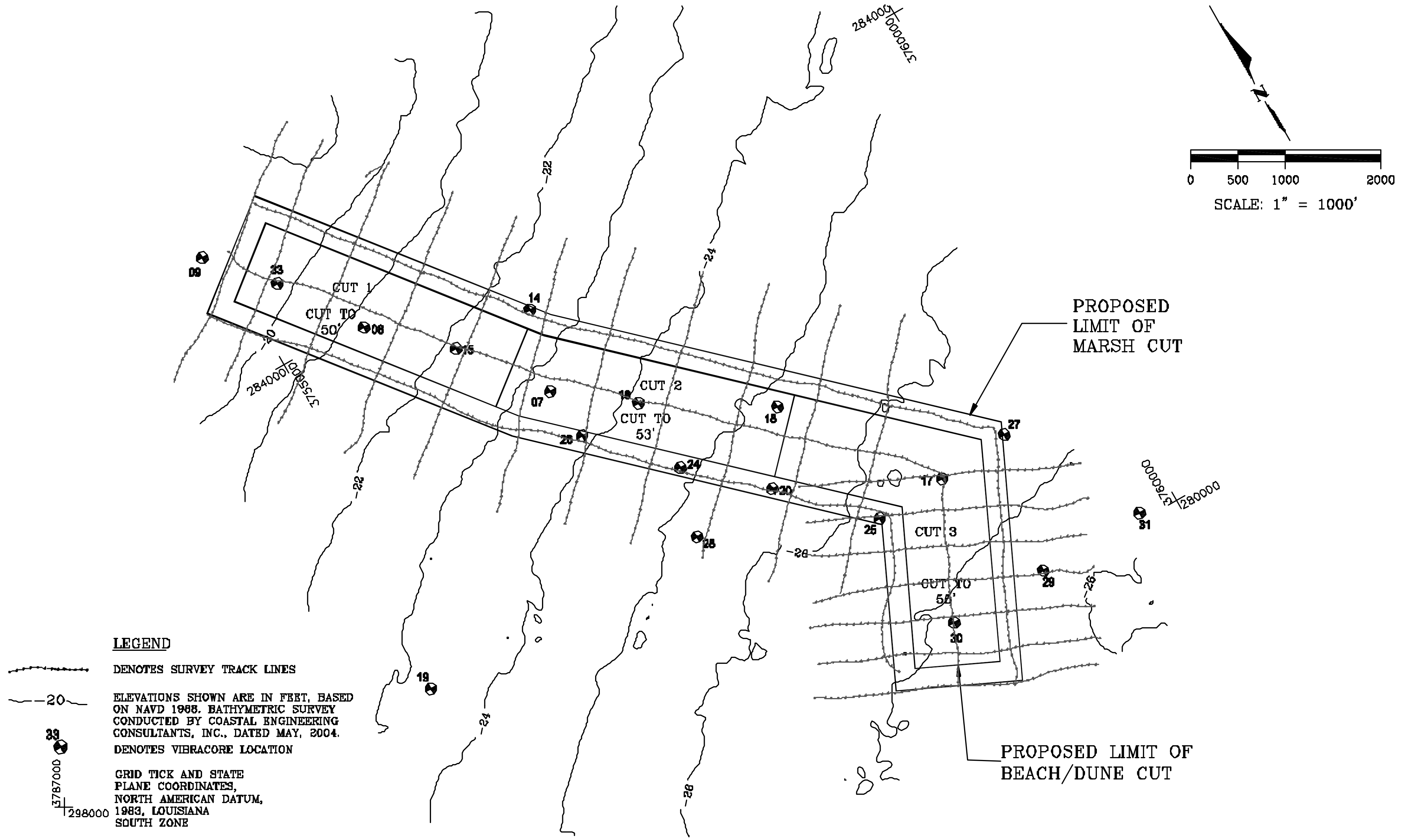


FIGURE 3: BATHYMETRIC SURVEY OF PROPOSED BORROW AREA

Coastal Engineering Consultants, Inc.

02132-FIG3.DWG

MAY 23, 2005

SJB GROUP INCORPORATED

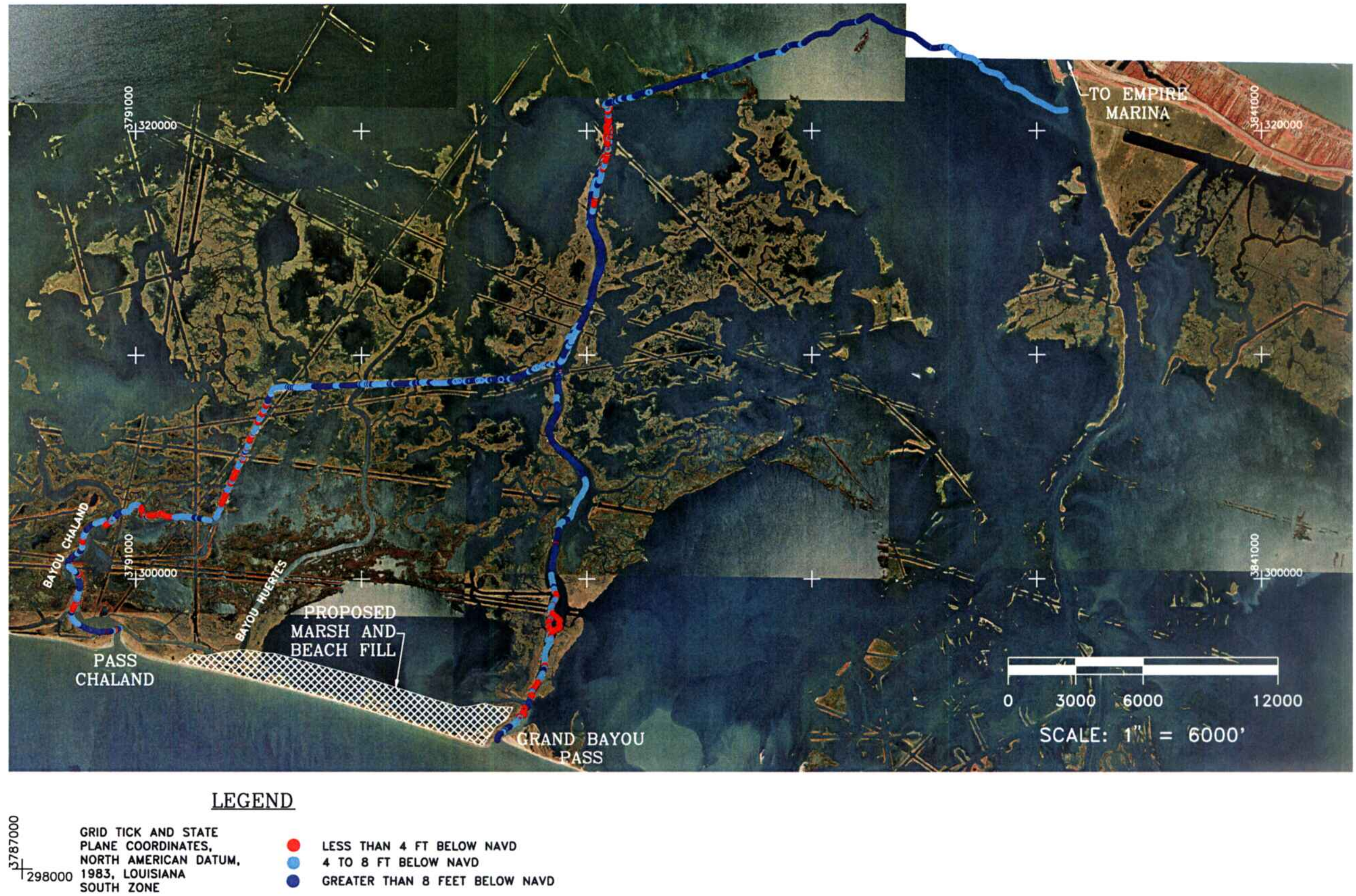


FIGURE 4: BATHYMETRIC SURVEY FROM EMPIRE TO BAY JOE WISE

Coastal Engineering Consultants, Inc. 02132–FIG4.DWG MAY 23, 2005 SJB GROUP INCORPORATED

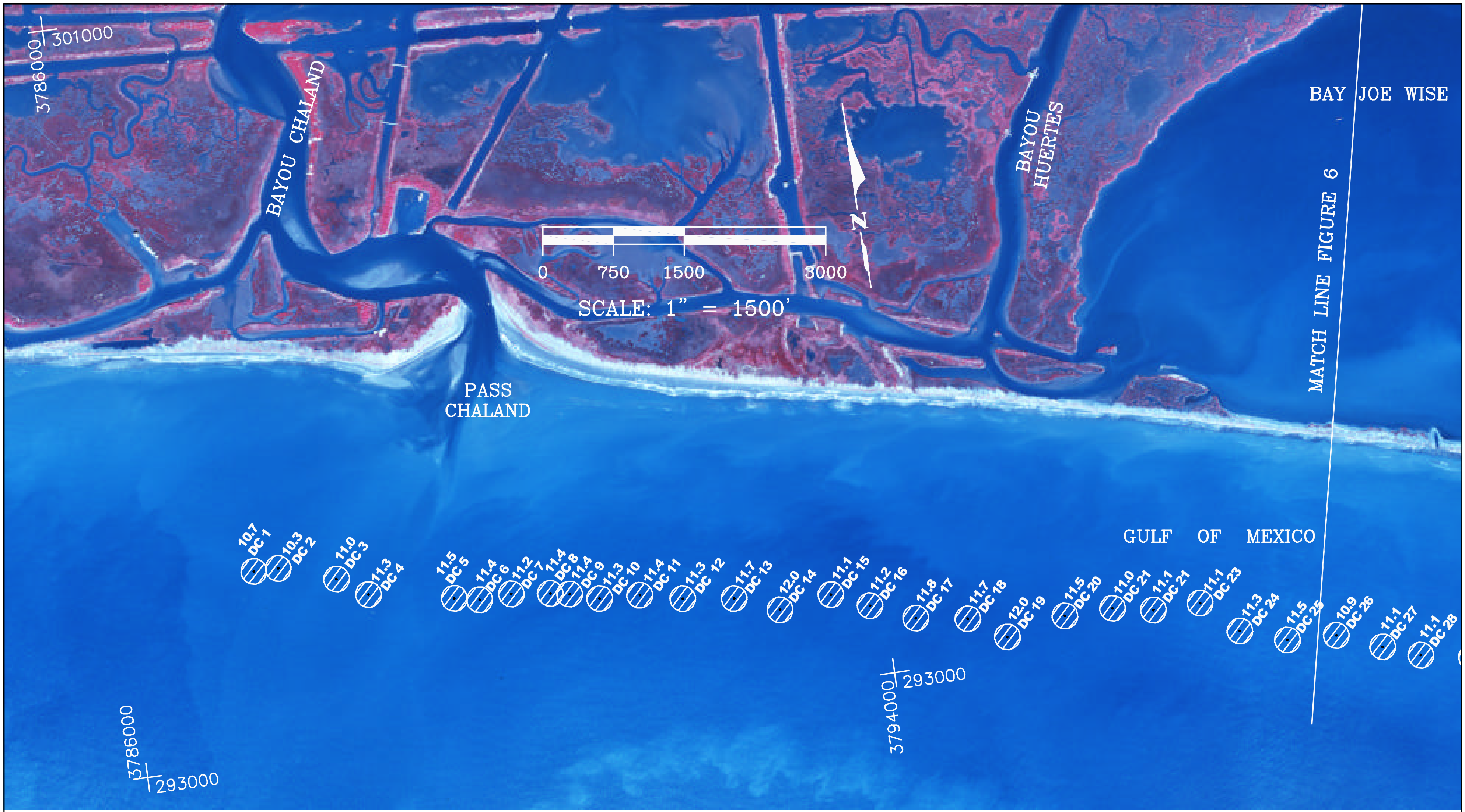
5.0 DEPTH OF CLOSURE

The calculation of depth of closure is critical to the Project design for determining the expected beach fill erosion rates and evaluating project performance. As the Bay Joe Wise Headland is a sand starved system due to the significant erosion experienced, recent survey profile comparisons may not fully reflect the seaward limit of active sand transport. Since previous empirical methods employed vary in the estimated value for depth of closure due to the limited profile and bathymetric comparisons, as well as varying from the reported depth of closure for the adjacent projects (Coastal Planning & Engineering, 2003, Weston Solutions, Inc. 2003), an additional field analysis was undertaken.

Analysis of historic profiles provided an initial estimate for the depth of closure to be located at an approximate elevation of -10 feet NAVD. As such, the search for the depth of closure began at that approximate elevation. A fifteen foot pole was used to “feel” the sediments on the Gulf bottom at that depth. At -10 feet NAVD, the floor was observed to be hard and gritty, suggesting the presence of sand. Probing of the sediments continued in this manner seaward until the pole hit soft material that it easily sunk into. The boat was anchored at this depth, and sediment cores were collected from the area identified as mud by the feel of the pole and from a few feet landward where the bottom had been identified as sand by the feel of the pole. The core samples confirmed the sediment material had been properly identified by the remote probing technique.

Once the probing methodology had been tested, the depth of closure was measured along a line that extended from slightly west of Pass Chaland to slightly east of Grand Bayou Pass, with probing of the Gulf bottom conducted approximately every five-hundred (500) feet. When the location of the depth of closure was identified, the DGPS unit on the boat was used to record the location in Hypack, and the fathometer was used to record the depth of water. Tide readings were made using the Leica SR530 Global Positioning System every 30 minutes in order to correct the fathometer readings to the appropriate datum (NAVD 88). The equipment used was calibrated as described in Sections 3.1 and 4.0.

A total of fifty-two (52) depth of closure measurements were made. The locations of the measurements and results are displayed in Figures 5 and 6. Based on the average of the measurements, the depth of closure was determined to be approximately -11 feet NAVD.



LEGEND

3787000 298000 GRID TICK AND STATE PLANE COORDINATES, NORTH AMERICAN DATUM, 1983, LOUISIANA SOUTH ZONE

▨ 11.3 DC 10 DEPTH OF CLOSURE SAMPLE LOCATION DEPTH IN FEET BELOW NAVD 1988

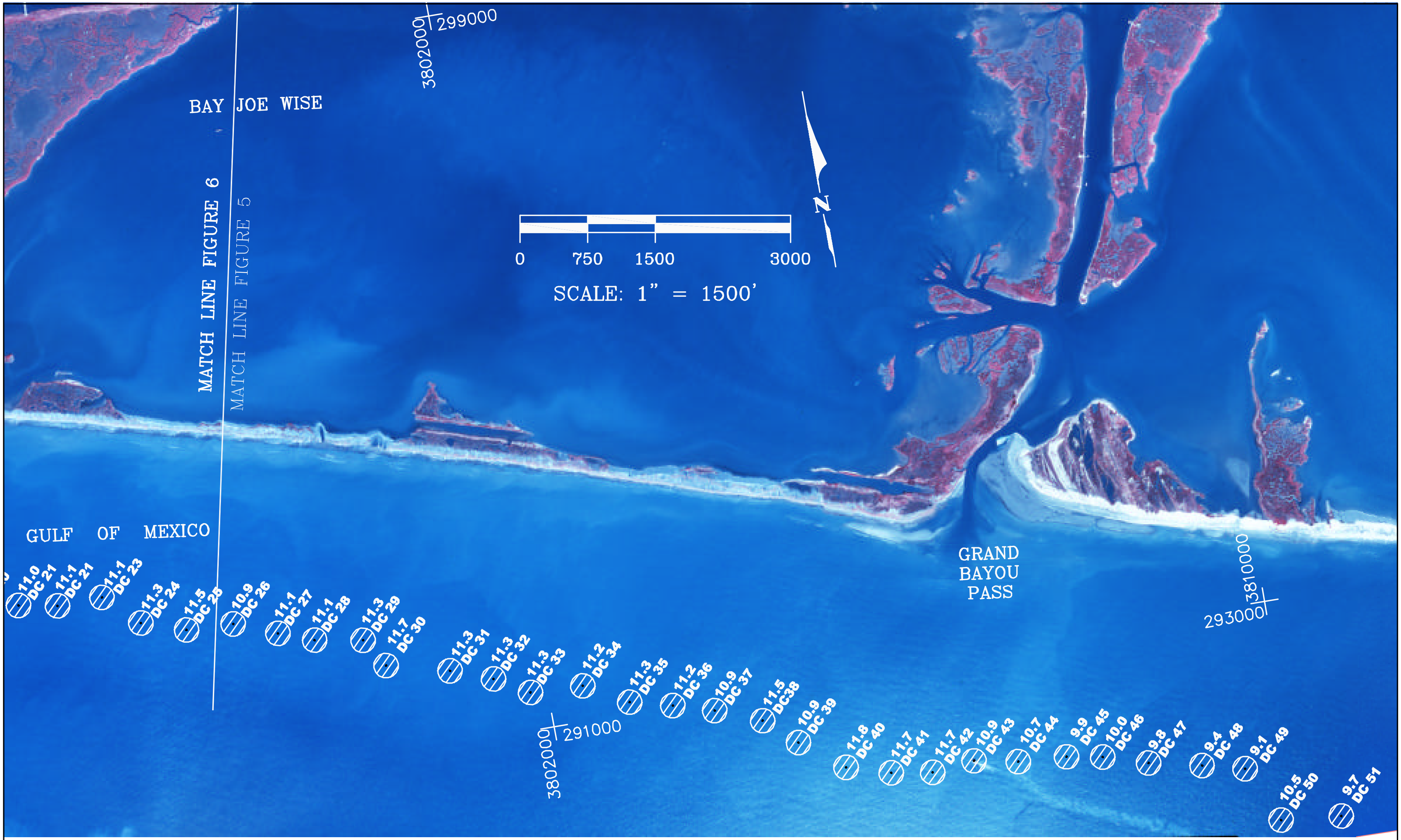
FIGURE 5: DEPTH OF CLOSURE

Coastal Engineering Consultants, Inc.

02132–FIG5and6.DWG

MAY 23, 2005

SJB GROUP
INCORPORATED



LEGEND

3787000
298000 **GRID TICK AND STATE PLANE COORDINATES, NORTH AMERICAN DATUM, 1983, LOUISIANA SOUTH ZONE**

▨ 11.3 DC 10 **DEPTH OF CLOSURE SAMPLE LOCATION DEPTH IN FEET BELOW NAVD 1988**

FIGURE 6: DEPTH OF CLOSURE

Coastal Engineering Consultants, Inc.

02132–FIG5and6.DWG

MAY 23, 2005

SJB GROUP INCORPORATED

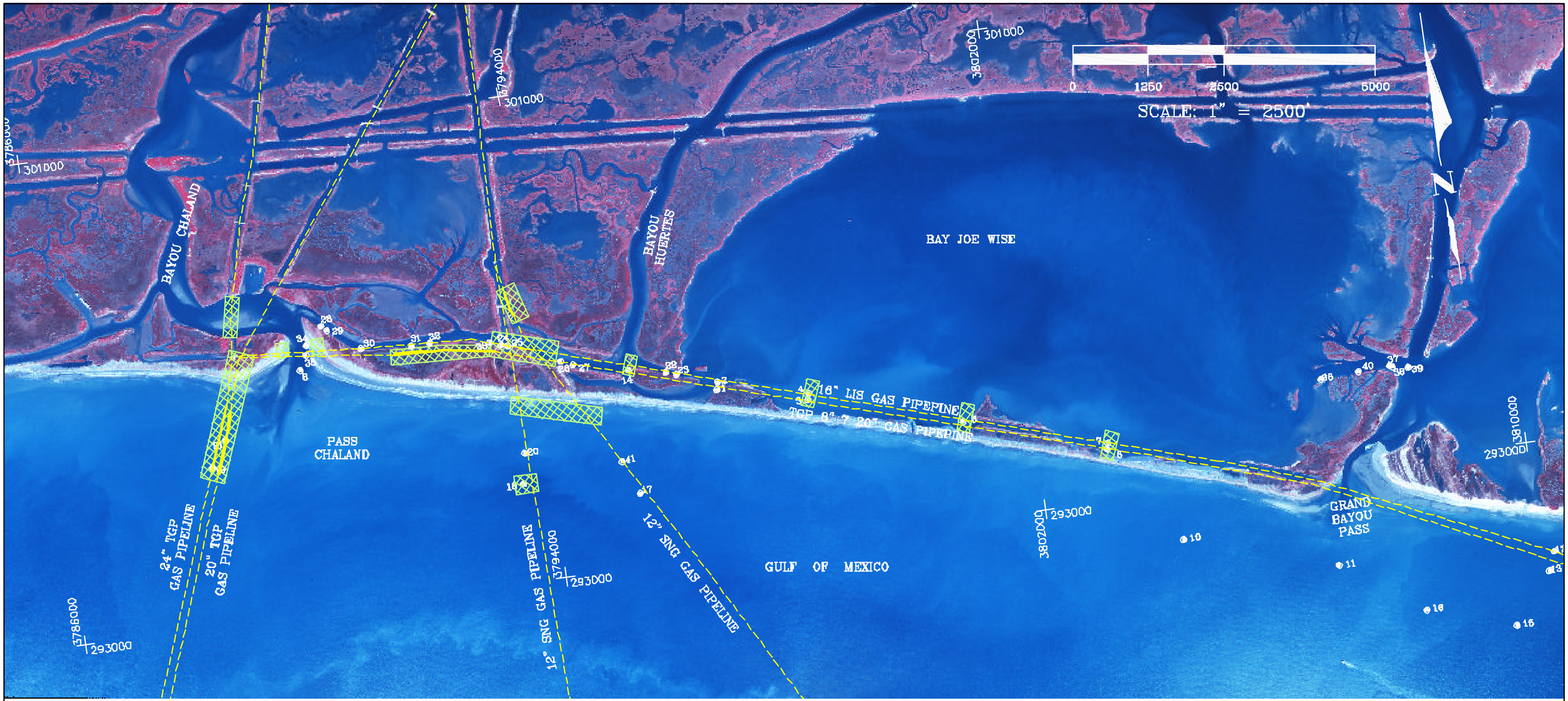
6.0 PIPELINE LOCATION SURVEYS

Approximate pipeline locations provided by the Louisiana Department of Natural Resources (LDNR) and null points from the previous magnetometer survey (SJB et. al., 2003) were used to identify the alignment of submerged or subsurface pipelines. Underwater utility detection equipment was then used to help approximate the specific alignment of the pipelines and stake their locations in the field. Jet probing was conducted to confirm the presence of each pipeline, identify its depth, approximate its diameter, and measure the depth of cover.

Probing in most cases was conducted with a hollow metal rod approximately 0.75 inches in diameter and approximately ten (10) feet in length. For one of the identified pipes that was buried less than four (4) feet deep, a thin metal rod approximately four (4) feet long was manually pushed into the marsh to locate the top of the pipe and approximate the pipe's diameter. In all cases, probing started at the staked location and advanced approximately four (4) to six (6) inches at a time to one side of the stake. This was continued for fifty (50) to one-hundred (100) feet. If the pipe was not found on that side of the stake, the process was repeated to the opposite side of the stake. Steps of four (4) to six (6) inches were used since historical data showed the smallest pipe in the area to be eight (8) inches in diameter. These small increments helped guarantee any pipes eight (8) inches in diameter or larger would be found if the depth of cover was less than ten (10) feet.

For pipelines probed with the ten (10) foot rod, water was forced through the rod with a pump, creating a water "jet". This "jet" of water forced sediment away from the tip of the rod, allowing the rod to be pushed into the ground down to approximately ten (10) feet below the ground surface. Once a pipeline was encountered, its diameter was approximated by inserting the probe a few inches to one side or the other of the initial "hit" on the pipeline. This fine scale probing was continued until each edge and the middle of the pipeline were found. Probing was then continued roughly ten (10) feet in the presumed direction of the pipeline to help confirm the alignment of the pipeline. Once two or three points were found on the pipeline, the alignment of the pipeline could be extrapolated a larger distance, and the distance between probes increased.

Six (6) pipelines were attempted to be mapped using this technique (Figure 7). Several other search areas were probed over lengths of 100 feet or more that failed to reveal any pipelines buried down to ten (10) feet below ground surface. The locations of the pipeline "hits" and probe locations are displayed in Figure 8.



LEGEND

3787000
298000 GRID TICK AND STATE PLANE COORDINATES, NORTH AMERICAN DATUM, 1983, LOUISIANA SOUTH ZONE

◉8 NULL POINT MAGNETOMETER HITS

ASSUMED PIPELINE LOCATIONS

PIPELINE SEARCH AREAS

PIPELINE LOCATIONS

NOTE:
PIPELINE AND WELL HEAD DATA TAKEN FROM USGS NATIONAL WETLAND RESEARCH CENTER,
MAP ID: USGS_NWRC_2004_04_0150

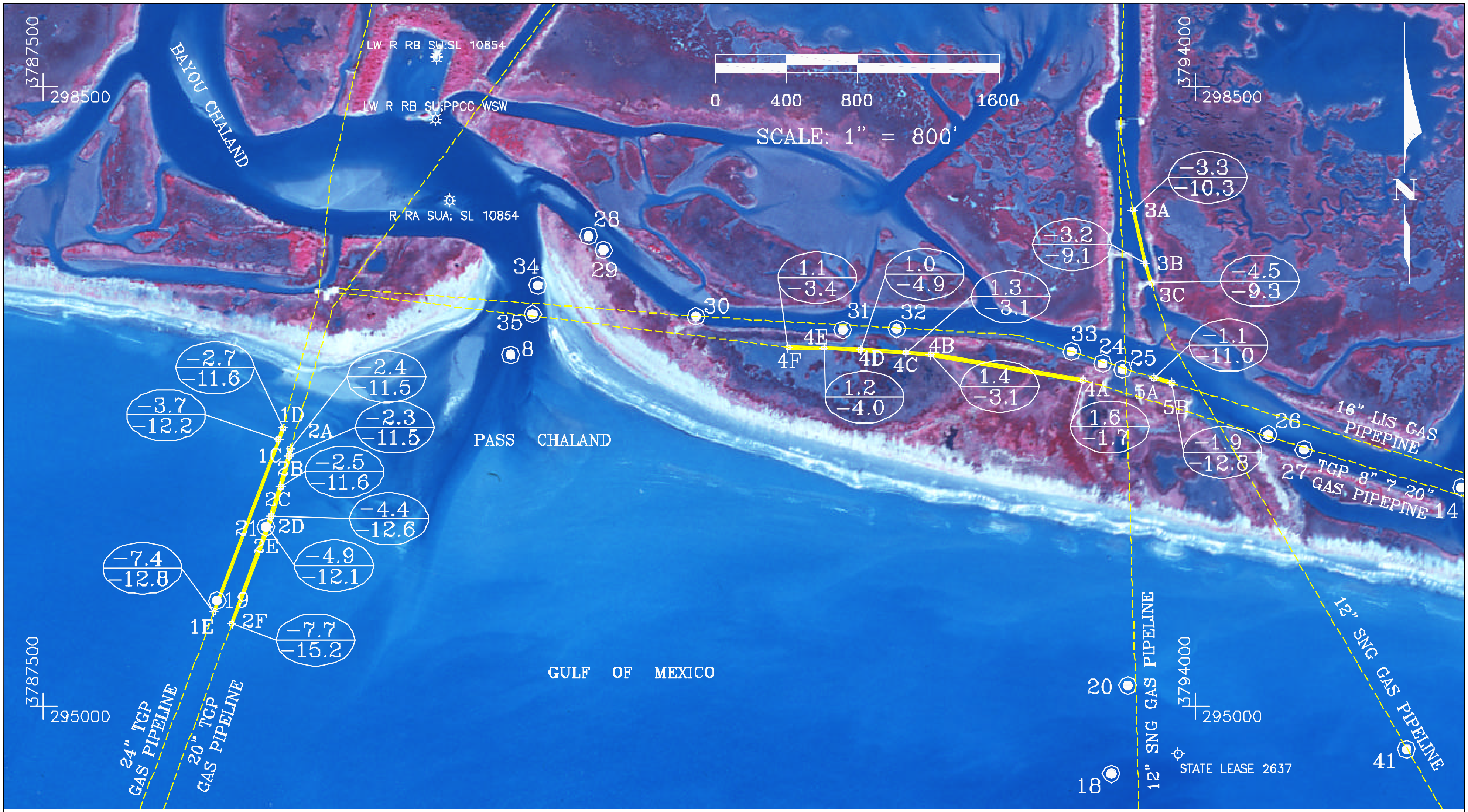
FIGURE 7: PIPELINE SEARCH AREA LOCATION MAP

Coastal Engineering Consultants, Inc.

02132–FIG7.DWG

MAY 23, 2005

SJB GROUP INCORPORATED



LEGEND

3787000 298000 GRID TICK AND STATE PLANE COORDINATES, NORTH AMERICAN DATUM, 1983, LOUISIANA SOUTH ZONE

2F -7.7 -15.2 JET PROBE LOCATION ELEVATION OF NATURAL GRADE ELEVATION OF CROWN OF PIPE

STATE_LEASE ⌖ WELL HEAD LOCATIONS

◉8 NULL POINT MAGNETOMETER HITS

– – – ASSUMED PIPELINE LOCATIONS

▬ PIPELINE LOCATIONS

NOTE:
PIPELINE AND WELL HEAD DATA TAKEN FROM USGS NATIONAL WETLAND RESEARCH CENTER, MAP ID: USGS_NWRC_2004_04_0150

FIGURE 8: JET PROBE AND PIPELINE LOCATION SURVEY

Coastal Engineering Consultants, Inc. 02132-FIG8.DWG MAY 23, 2005

SJB GROUP INCORPORATED

7.0 GEOTECHNICAL SURVEYS

Eight (8) vibracore samples were collected within the anticipated contractor access channels to ascertain the quality of the sediments. The cores were penetrated six (6) to seven (7) feet below ground surface using an eight (8) foot stainless steel fence post, 2.5 inches in diameter, and a concrete vibrator. After the sediment was collected in the tube, it was extruded onto a plastic liner on the beach for visual analysis and photographs. Following the initial analysis and photographs, representative samples from the entire length of the core were collected in plastic bags for potential future laboratory analysis. The locations of the cores are displayed in Figure 9.

Core photographs and logs are displayed in Appendix A. Core 2 penetrated only six (6) feet below ground surface because resistance was encountered that prevented further penetration of the tube. Based on the amount of shells found at the bottom of that particular core, it is likely that a substantial layer of shells was encountered which prevented advancement of the tube beyond the six foot depth. Some cores show a recovery of greater than 100%. This occurred due to the technique used to examine the cores. The core material was extruded from the steel post on the beach on-site. In some cases, the material was stretched out, creating a longer soil column than what was actually collected. Likewise, some cores are reported with less than 100% recovery. This may have occurred for two reasons. First, some material may have been lost out of the bottom of the tube before it could be capped during the coring. This is especially common when the material at the bottom of the core is a very coarse grained material such as crushed shell. The other factor that may have caused this is again in the extrusion process. As the material was extruded from the steel pipe, a portion of the material may have compacted in some sections.

Most of the cores contained fine sand from the top of the core to the bottom of the core, with varying amounts of shell fragments. The only exception was Core 4 which contained a thin layer of silt and clay between the depth intervals of 5.3 feet below ground surface and 5.5 feet below ground surface. Based on visual observations of the sediments, the material is compatible for use in Project construction including the beach, dune, marsh fills, and the containment dikes. These visual observations were confirmed with laboratory testing performed by Soil Testing Engineers, Inc. that computed the mean grain sizes of the sediments from the cores that ranged between 0.07 mm to 0.14 mm. One core had a mean grain size of 0.38 mm, but it believed that a high concentration of shells in the core resulted in the large mean grain size, which is not necessarily indicative of a larger sand grain size. The laboratory results are presented in Appendix A.

LEGEND

3787000 298000 GRID TICK AND STATE PLANE COORDINATES, NORTH AMERICAN DATUM, 1983, LOUISIANA SOUTH ZONE

VS-2 VIBRACORE LOCATION

FIGURE 9: CORE LOCATIONS

Coastal Engineering Consultants, Inc. 02132-FIG9.DWG MAY 23, 2005 SJB GROUP INCORPORATED

8.0 CONCLUSIONS

The topographic surveys of the marsh near the proposed water exchange channel provide supplemental data to be used in the final design of the water exchange channel. The bathymetric survey of the proposed borrow area provides additional data to be used in the final design of the borrow area and compute the volume of available sediment for marsh, beach and dune fill. Bathymetric surveys of the channels leading from Empire Marina to the site have shown the optimal route for contractor access is via the Empire Jetty and Gulf of Mexico. Dredging would be required to provide access for dredge equipment through the other routes explored.

Based on the field study, the depth of closure for the project area was determined to be approximately -11 feet NAVD.

Several oil and gas pipelines were located and field verified by the jet probing investigation. Several other pipelines reported in historical data could not be found, indicating they are most likely buried to depths exceeding ten (10) feet below ground surface.

Field observations of the samples collected from the vibracores indicates the material in the flood and ebb shoals is suitable for project construction of the marsh, beach and dune fill and containment dikes. Laboratory analyses of the sediment samples further verified the suitability of this material as fill.

9.0 REFERENCES

Alpine Ocean Seismic Survey, Inc., Coastal Engineering Consultants, Inc. and SJB Group, Inc. 2004. *Final Report, Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration (BA-35), Offshore Geophysical and Geotechnical Survey for LDNR Contract No. 2511-03-09.* Submitted to SJB Group, Inc. and Louisiana Department of Natural Resources, Coastal Resources Division.

Coastal Planning & Engineering, Inc. 2003. "Chaland Headland and Pelican Island Barrier Shoreline Restoration 30% Design Review." Report submitted to Tetra Tech EM Inc., Baton Rouge, Louisiana.

SJB Group, Inc., Coastal Engineering Consultants, Inc., and Alpine Ocean Seismic Survey, Inc. 2003. *Topographic, Bathymetric and Magnetometer Survey Report, Pass Chaland to Grand Bayou Pass, Barrier Shoreline Restoration (BA-35), LDNR Contract No. 2511-03-09.* Submitted to Louisiana Department of Natural Resources, Coastal Resources Division.

SJB Group, Inc. and Coastal Engineering Consultants, Inc. 2004. *Coastal Processes Report, Pass Chaland to Grand Bayou Pass, Barrier Shoreline Restoration (BA-35), LDNR Contract No. 2511-03-09.* Submitted to Louisiana Department of Natural Resources, Coastal Resources Division.

Weston Solutions, Inc. 2003. "Draft East and West Grand Terre Island Restoration (BA-30) Draft Preliminary Engineering Design/Feasibility."

APPENDIX SF-A

A.0 GEOPHYSICAL DETAILS

Pictures of the sediment cores are included in figures A-1 through A-8. Core logs are included in Figures A-9 through A-16. A copy of the laboratory test results follow at the end of the appendix.

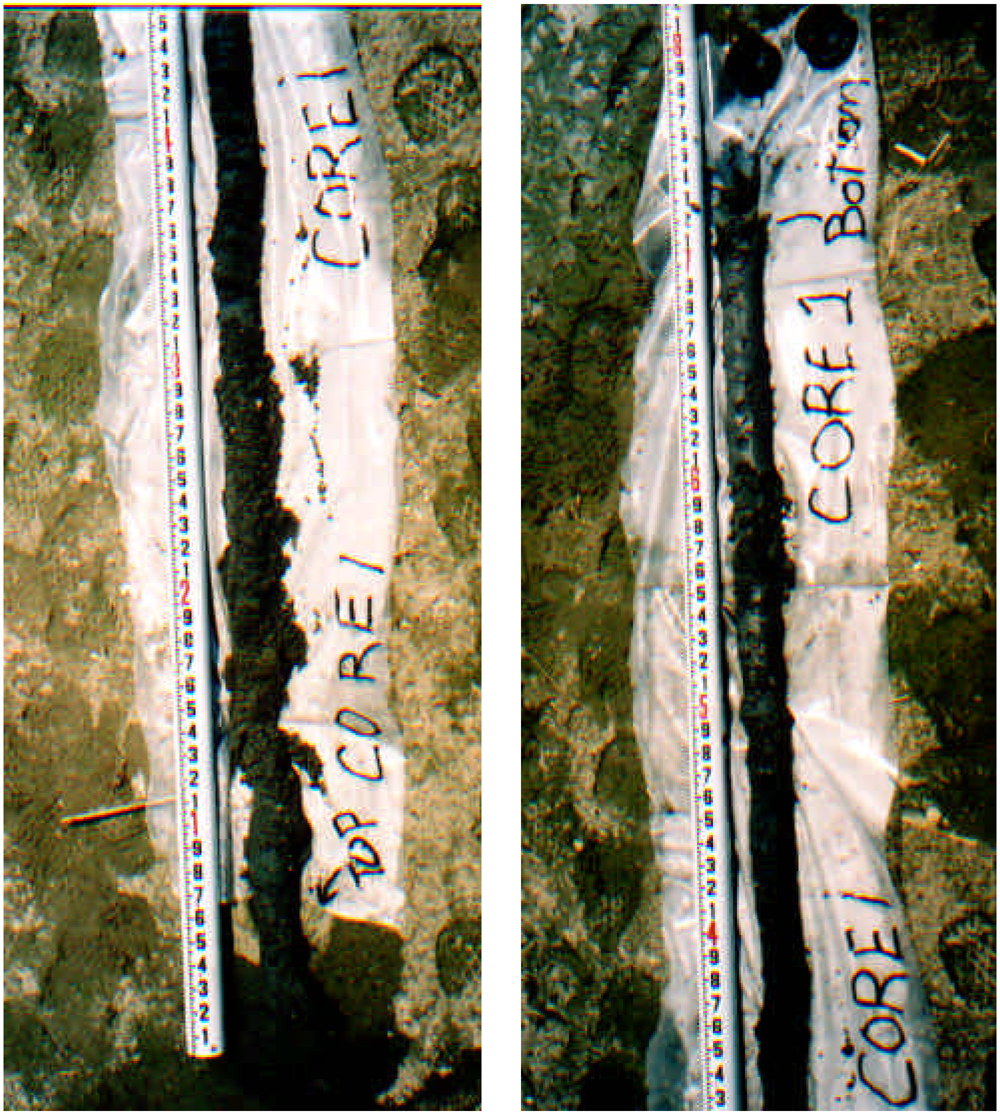


Figure A-1: Core 1 Pictures

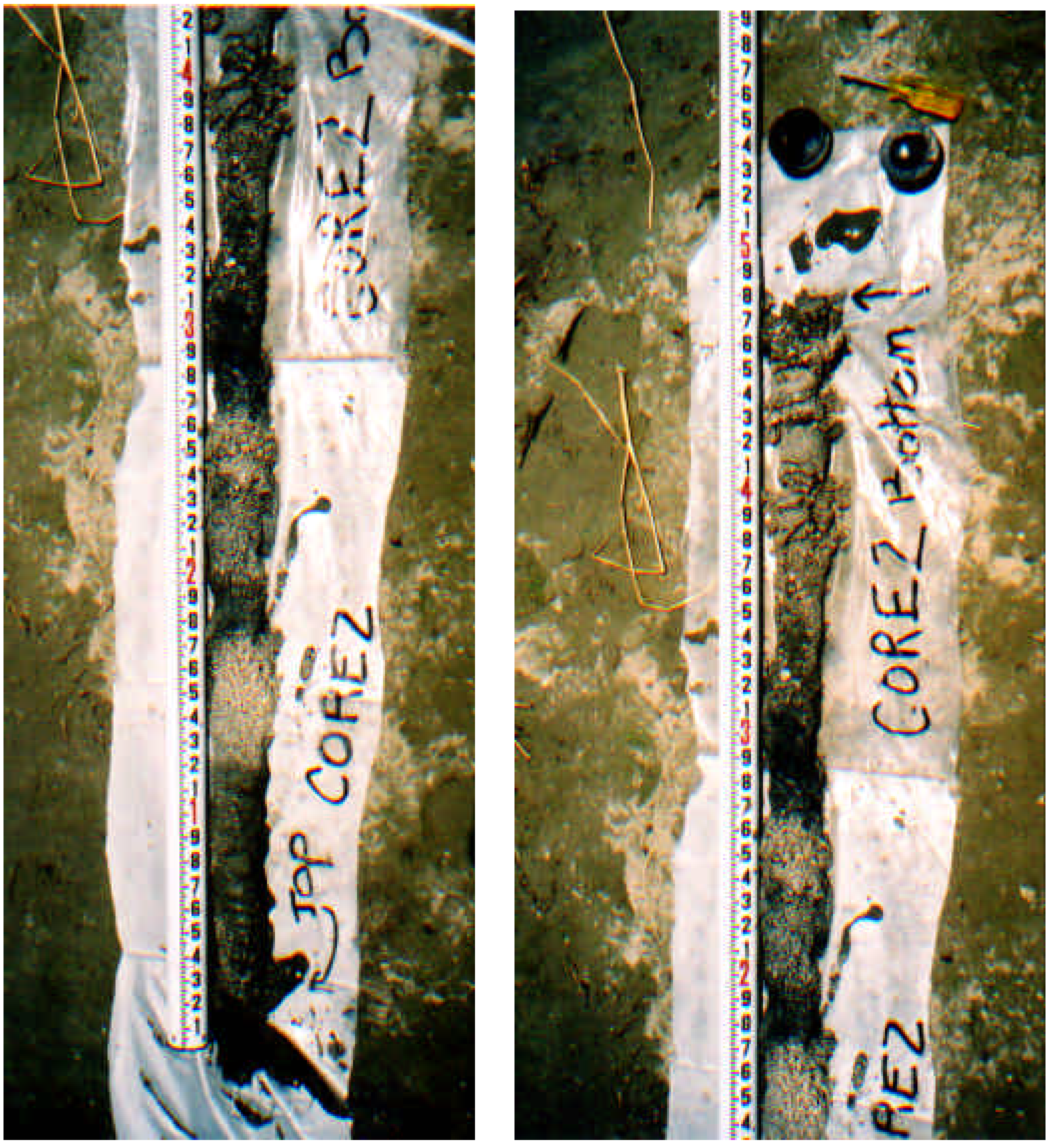


Figure A-2: Core 2 Pictures

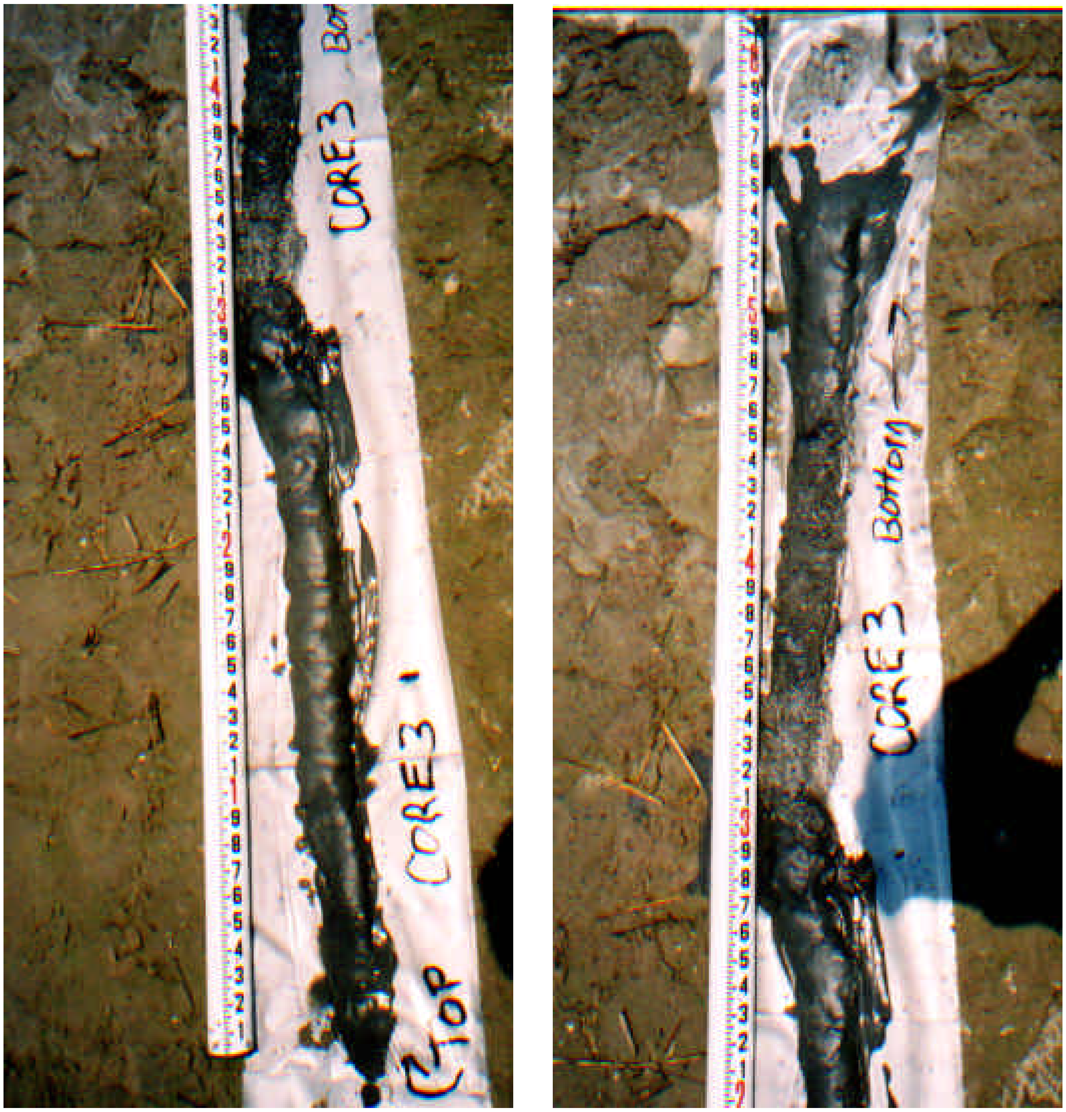


Figure A-3: Core 3 Pictures

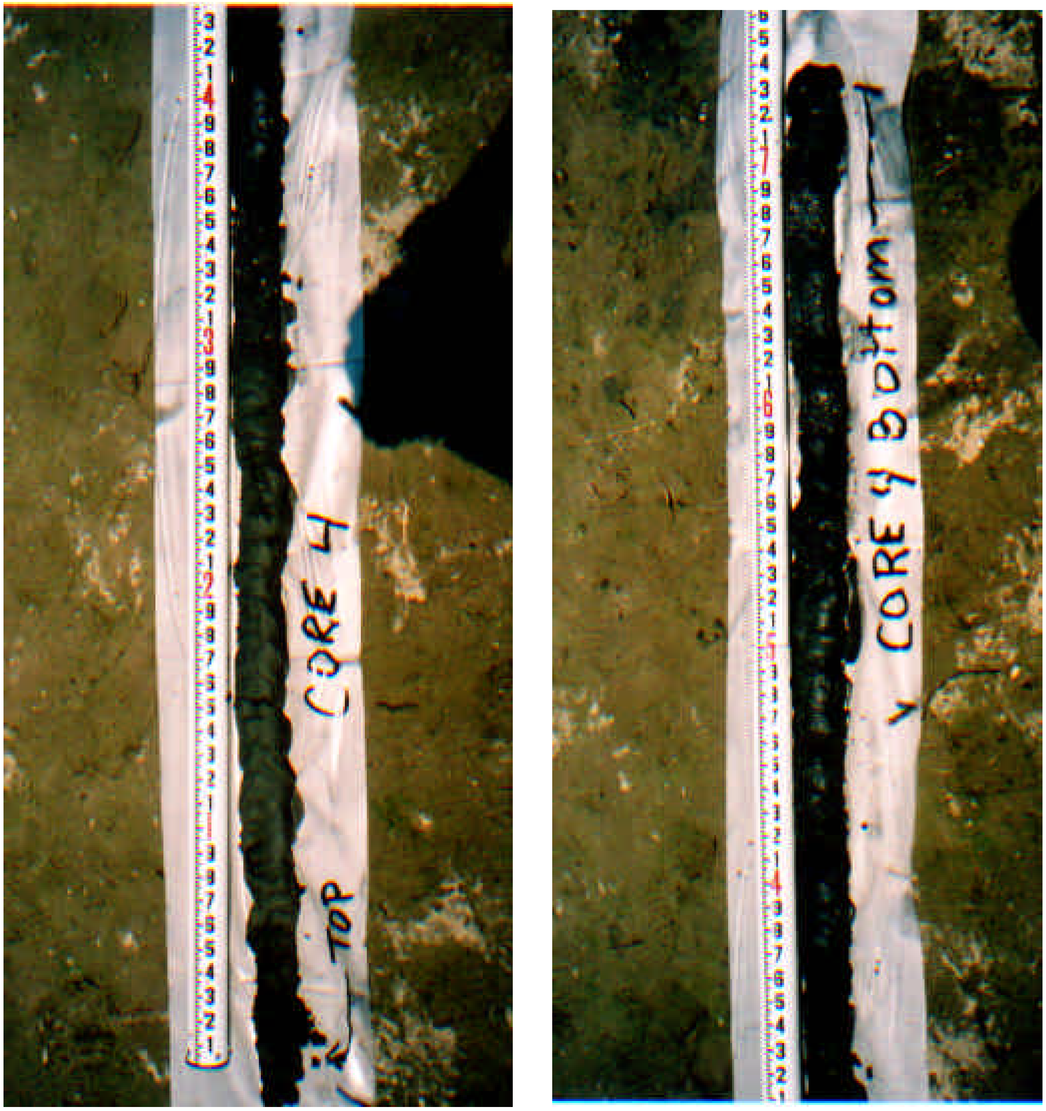


Figure A-4: Core 4 Pictures

Figure A-5: Core 5 Pictures

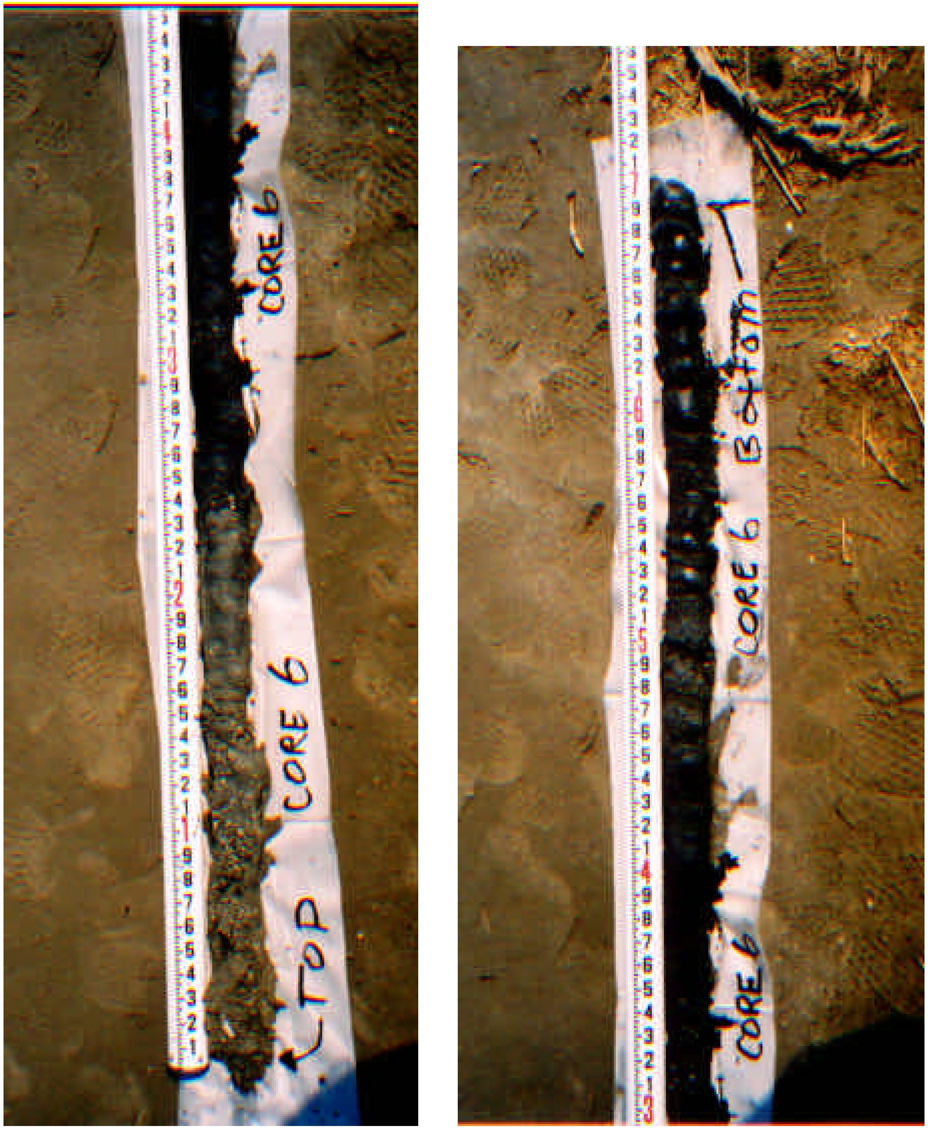


Figure A-6: Core 6 Pictures

Figure A-7: Core 7 Pictures

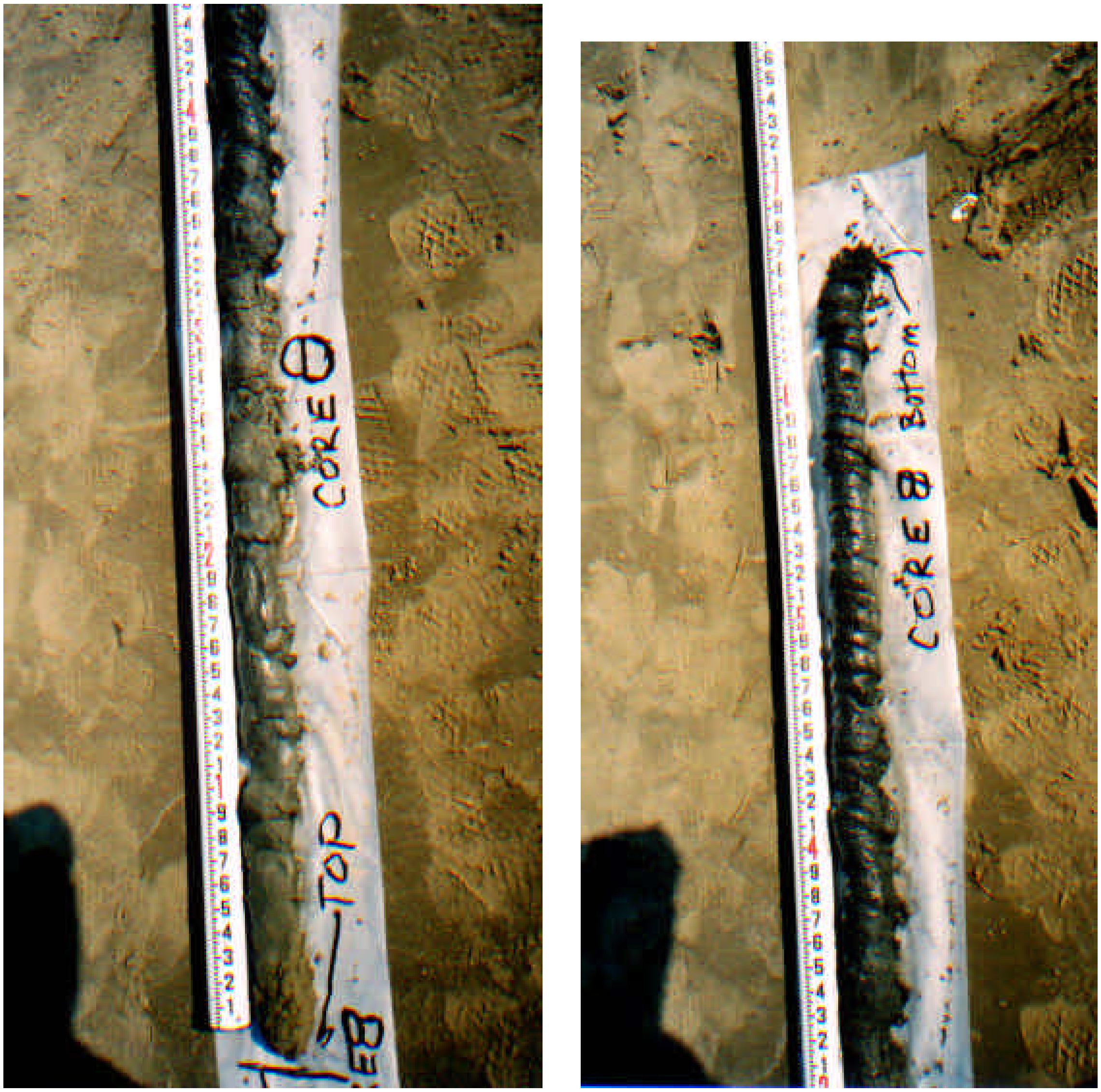


Figure A-8: Core 8 Pictures

Figure A-9: Core Log VS-1

CORE LOG

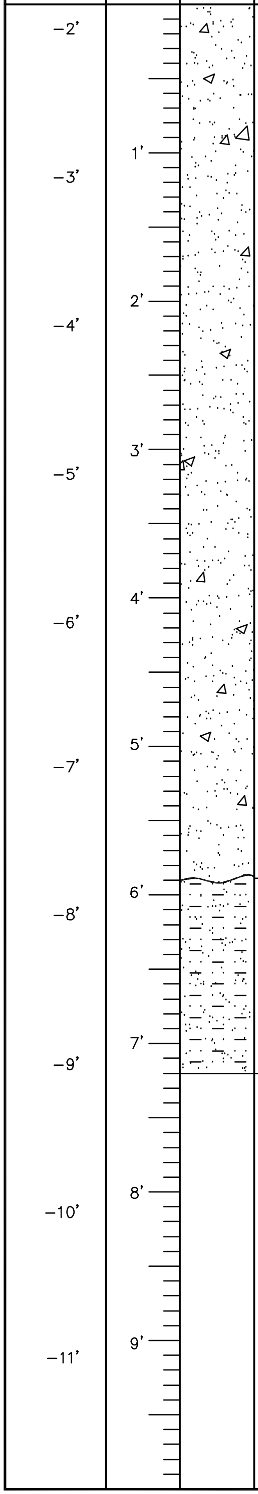
DIVISION: COASTAL ENGINEERING

INSTALLATION:

SHEET 1 OF 8 SHEETS

1. PROJECT: PASS CHALAND TO GRAND BAYOU PASS (BA-35)
2. LOCATION: NORTHING: 296,286 EASTING: 3,789,518
3. DRILLING AGENCY: –
4. HOLE NO. *(As shown on drawing title and file number)*: VS-1
5. NAME OF DRILLER: COASTAL ENGINEERING
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK: –
9. TOTAL DEPTH OF HOLE: APPROX. 6.5 FT.
10. SIZE AND TYPE OF BIT: VIBRACORE
11. DATUM FOR ELEVATION SHOWN *(TBM, BSL, TOC, BLS, or NGVD)*: NAVD
12. MANUFACTURER'S DESIGNATION OF DRILL: N/A
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED – UNDISTURBED –
14. TOTAL NUMBER OF CORE BOXES: –
15. ELEVATION OF GROUNDWATER: N/A
16. DATE HOLE: STARTED MAY 8, 2003 COMPLETED MAY 8, 2003
17. ELEVATION TOP OF HOLE: APPROX. –1.8 FT
18. TOTAL CORE RECOVERY FOR BORING: 120 %
19. SIGNATURE OF GEOLOGIST

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	WELL CONST. DETAILS e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g



DARK GRAY FINE SAND WITH SHELL FRAGMENTS (SP–SM)

SOIL HORIZON

DARK GRAY TO BLACK SAND SILT AND CLAY (SM–SC)

E.O.B.

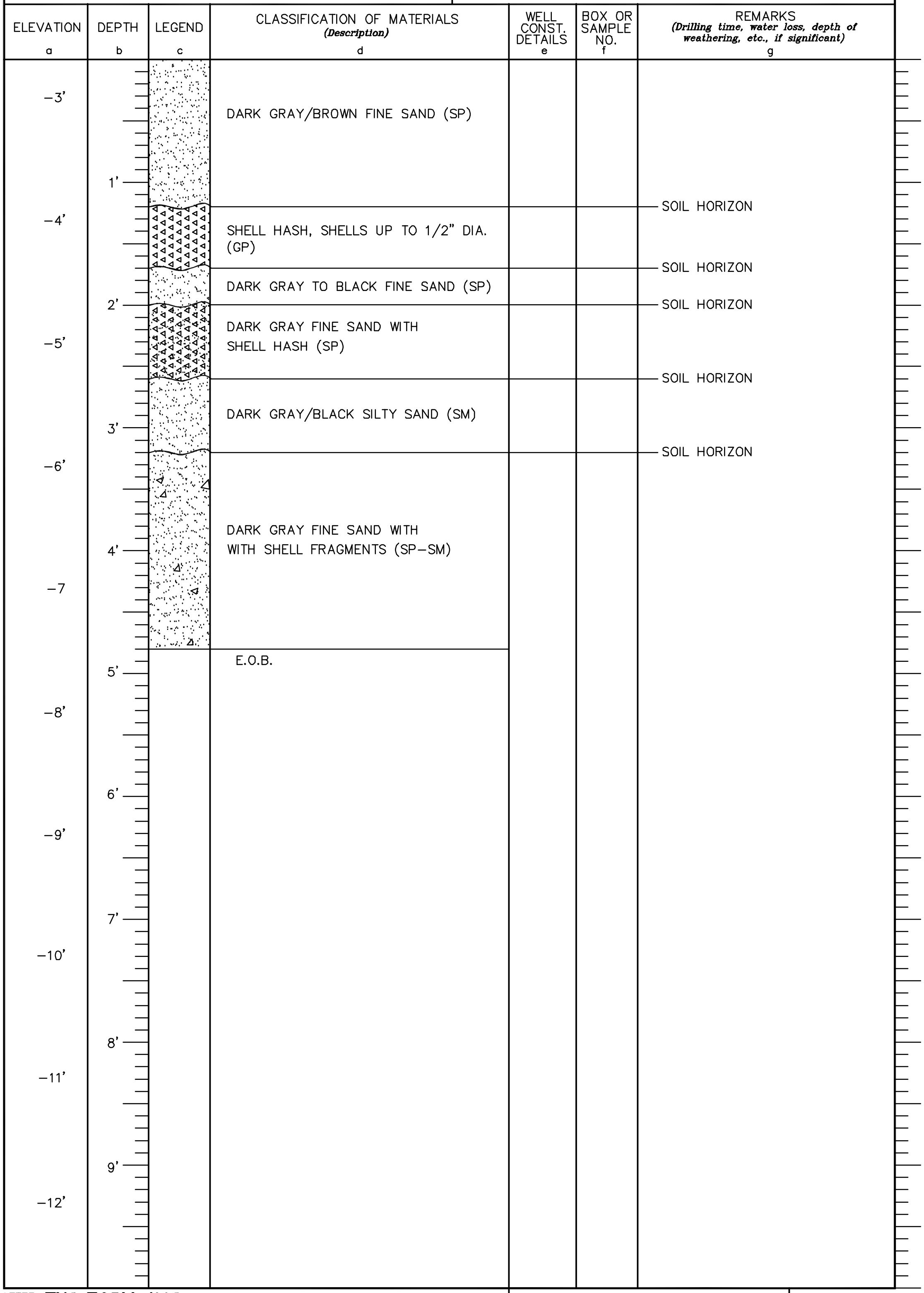
AFTER ENG FORM 1836 MAR 71

PROJECT

HOLE NO.

CORE LOG	DIVISION COASTAL ENGINEERING	INSTALLATION	SHEET 2 OF 8 SHEETS

1. PROJECT PASS CHALAND TO GRAND BAYOU PASS (BA-35)
2. LOCATION NORTHING: 296,284 EASTING: 3,790,087
3. DRILLING AGENCY –
4. HOLE NO. *(As shown on drawing title and file number)* VS-2
5. NAME OF DRILLER COASTAL ENGINEERING
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____________ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK –
9. TOTAL DEPTH OF HOLE APPROX. 6.0 FT.
10. SIZE AND TYPE OF BIT VIBRACORE
11. DATUM FOR ELEVATION SHOWN *(TBM, BSL, TOC, BLS, or NGVD)* NAVD
12. MANUFACTURER'S DESIGNATION OF DRILL N/A
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED – UNDISTURBED –
14. TOTAL NUMBER OF CORE BOXES –
15. ELEVATION OF GROUNDWATER N/A
16. DATE HOLE STARTED MAY 8, 2003 COMPLETED MAY 8, 2003
17. ELEVATION TOP OF HOLE APPROX. -2.7 FT
18. TOTAL CORE RECOVERY FOR BORING 80 %
19. SIGNATURE OF GEOLOGIST



CLASSIFICATION OF MATERIALS *(Description)* d	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g
DARK GRAY/BROWN FINE SAND (SP)	SOIL HORIZON
SHELL HASH, SHELLS UP TO 1/2" DIA. (GP)	SOIL HORIZON
DARK GRAY TO BLACK FINE SAND (SP)	SOIL HORIZON
DARK GRAY FINE SAND WITH SHELL HASH (SP)	SOIL HORIZON
DARK GRAY/BLACK SILTY SAND (SM)	SOIL HORIZON
DARK GRAY FINE SAND WITH WITH SHELL FRAGMENTS (SP-SM)	
E.O.B.	

AFTER **ENG FORM 1836** MAR 71 PROJECT HOLE NO.

Figure A-10: Core Log VS-2

Figure A-11: Core Log VS-3

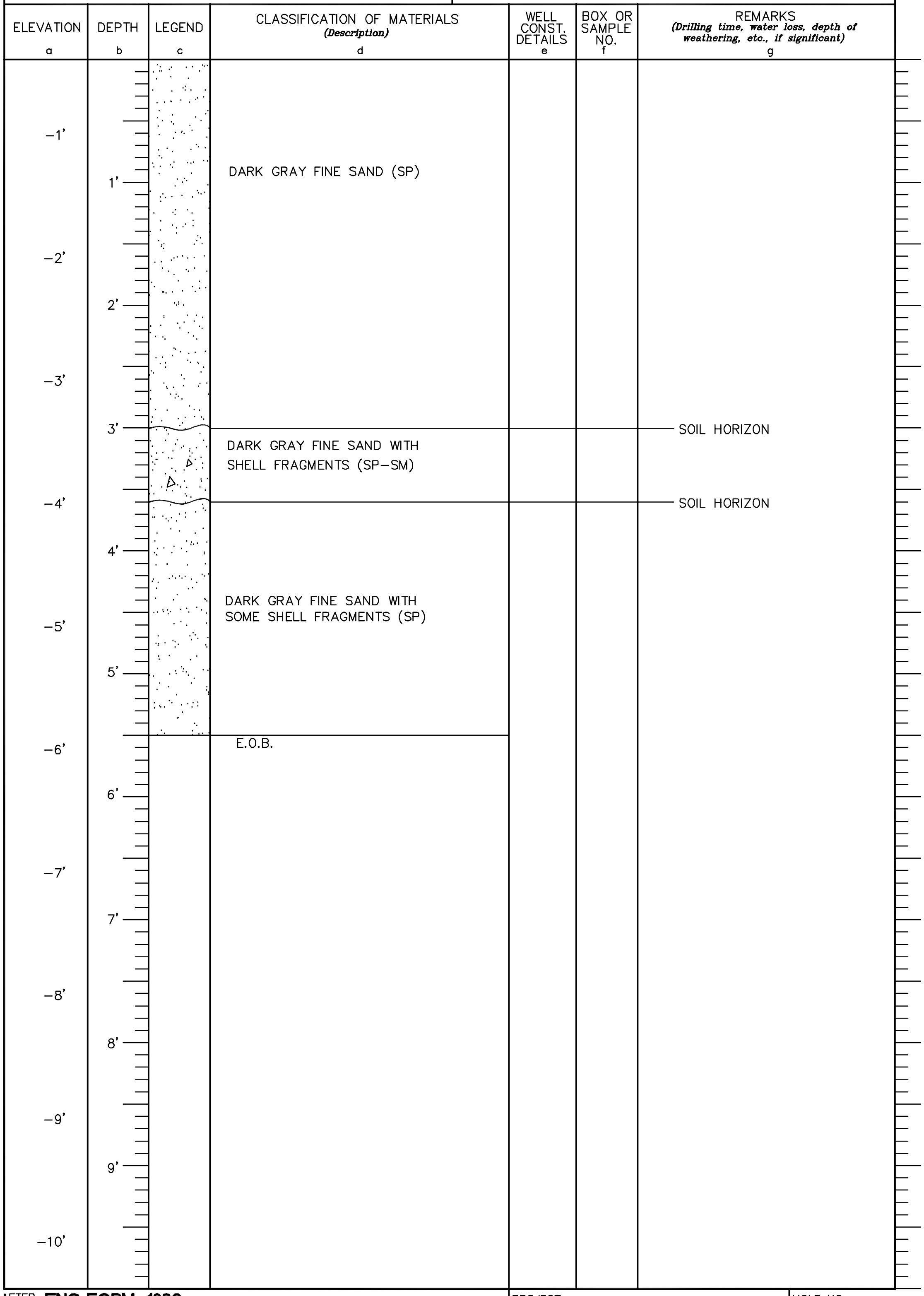
CORE LOG

DIVISION COASTAL ENGINEERING

INSTALLATION

SHEET 3 OF 8 SHEETS

1. PROJECT PASS CHALAND TO GRAND BAYOU PASS (BA-35)
2. LOCATION NORTHING: 297,884 EASTING: 3,790,422
3. DRILLING AGENCY –
4. HOLE NO. *(As shown on drawing title and file number)* VS-3
5. NAME OF DRILLER COASTAL ENGINEERING
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____________ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK –
9. TOTAL DEPTH OF HOLE APPROX. 6.3 FT.
10. SIZE AND TYPE OF BIT VIBRACORE
11. DATUM FOR ELEVATION SHOWN *(TBM, BSL, TOC, BLS, or NGVD)* NAVD
12. MANUFACTURER'S DESIGNATION OF DRILL N/A
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED – UNDISTURBED –
14. TOTAL NUMBER OF CORE BOXES –
15. ELEVATION OF GROUNDWATER N/A
16. DATE HOLE STARTED MAY 8, 2003 COMPLETED MAY 8, 2003
17. ELEVATION TOP OF HOLE APPROX. -0.4 FT
18. TOTAL CORE RECOVERY FOR BORING 79 %
19. SIGNATURE OF GEOLOGIST



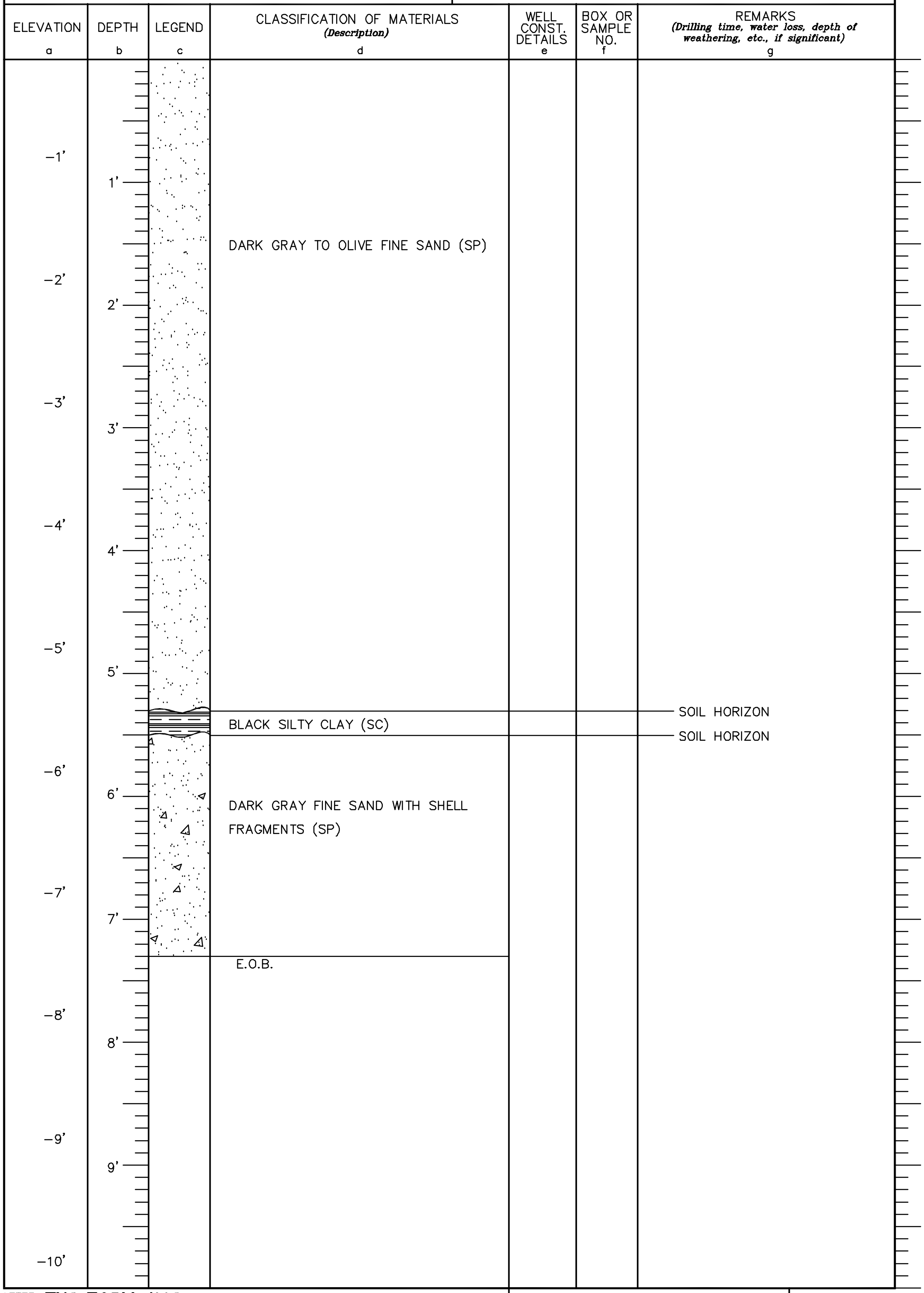
AFTER **ENG FORM 1836** MAR 71

PROJECT

HOLE NO.

CORE LOG | DIVISION: COASTAL ENGINEERING | INSTALLATION | SHEET 4 OF 8 SHEETS

1. PROJECT: PASS CHALAND TO GRAND BAYOU PASS (BA–35)
2. LOCATION: NORTHING: 297,584 EASTING: 3,790,760
3. DRILLING AGENCY: –
4. HOLE NO. *(As shown on drawing title and file number)*: VS–4
5. NAME OF DRILLER: COASTAL ENGINEERING
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK: –
9. TOTAL DEPTH OF HOLE: APPROX. 6.7 FT.
10. SIZE AND TYPE OF BIT: VIBRACORE
11. DATUM FOR ELEVATION SHOWN *(TBM, BSL, TOC, BLS, or NGVD)*: NAVD
12. MANUFACTURER'S DESIGNATION OF DRILL: N/A
13. TOTAL NO. OF OVER–BURDEN SAMPLES TAKEN: DISTURBED – UNDISTURBED –
14. TOTAL NUMBER OF CORE BOXES: –
15. ELEVATION OF GROUNDWATER: N/A
16. DATE HOLE: STARTED MAY 8, 2003 COMPLETED MAY 8, 2003
17. ELEVATION TOP OF HOLE: APPROX. –0.2 FT
18. TOTAL CORE RECOVERY FOR BORING: 104 %
19. SIGNATURE OF GEOLOGIST



AFTER **ENG FORM 1836** MAR 71 | PROJECT | HOLE NO.

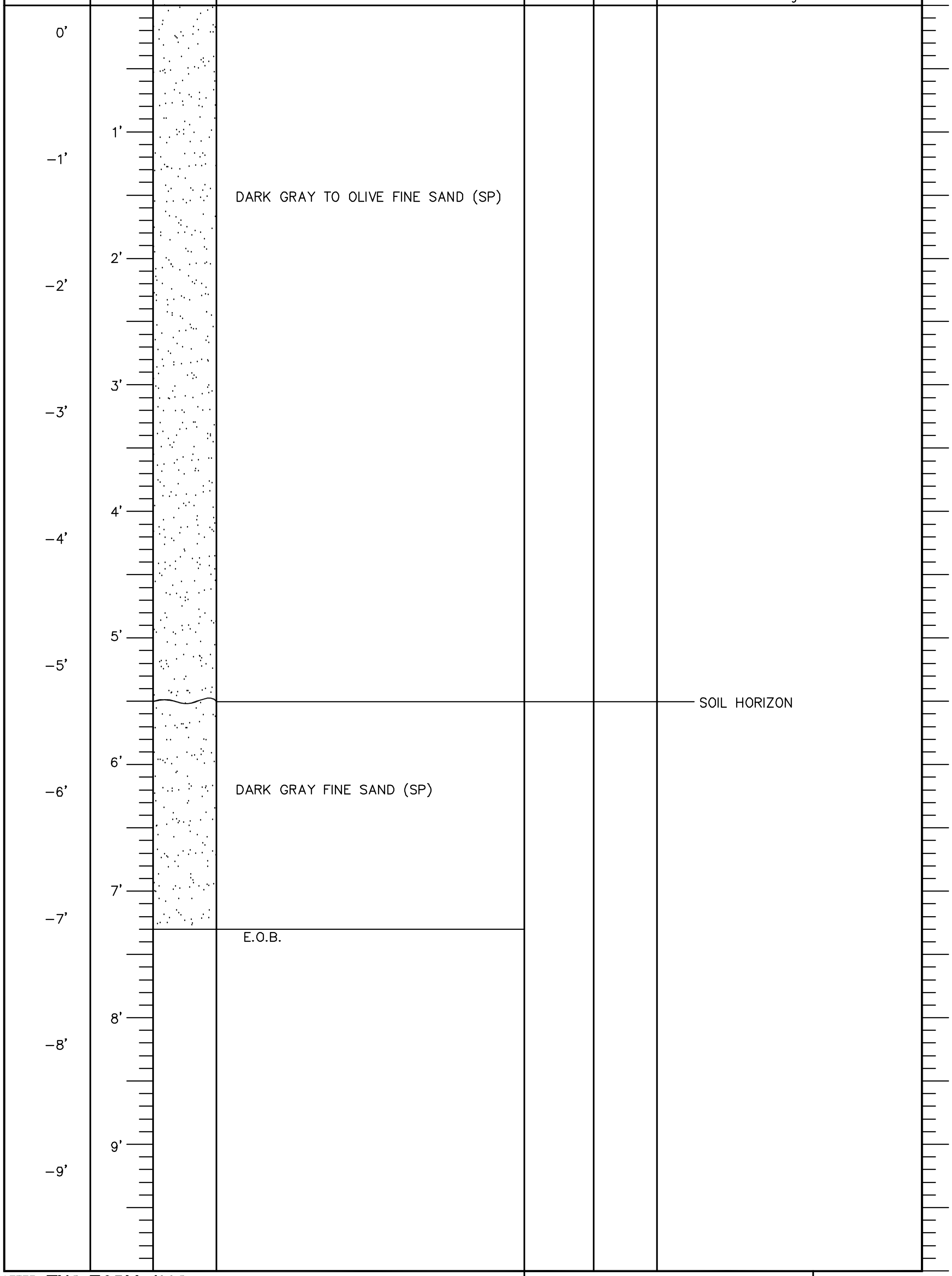
Figure A-12: Core Log VS-4

Figure A-13: Core Log VS-5

CORE LOG	DIVISION COASTAL ENGINEERING	INSTALLATION	SHEET 5 OF 8 SHEETS

1. PROJECT PASS CHALAND TO GRAND BAYOU PASS (BA-35)
2. LOCATION NORTHING: 293,361 EASTING: 3,807,858
3. DRILLING AGENCY –
4. HOLE NO. *(As shown on drawing title and file number)* VS-5
5. NAME OF DRILLER COASTAL ENGINEERING
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____________ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK –
9. TOTAL DEPTH OF HOLE APPROX. 7.0 FT.
10. SIZE AND TYPE OF BIT VIBRACORE
11. DATUM FOR ELEVATION SHOWN *(TBM, BSL, TOC, BLS, or NGVD)* NAVD
12. MANUFACTURER'S DESIGNATION OF DRILL N/A
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED – UNDISTURBED –
14. TOTAL NUMBER OF CORE BOXES –
15. ELEVATION OF GROUNDWATER N/A
16. DATE HOLE STARTED MAY 8, 2003 COMPLETED MAY 8, 2003
17. ELEVATION TOP OF HOLE APPROX. +0.2 FT
18. TOTAL CORE RECOVERY FOR BORING 104 %
19. SIGNATURE OF GEOLOGIST

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	WELL CONST. DETAILS e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g



CORE LOG

DIVISION COASTAL ENGINEERING

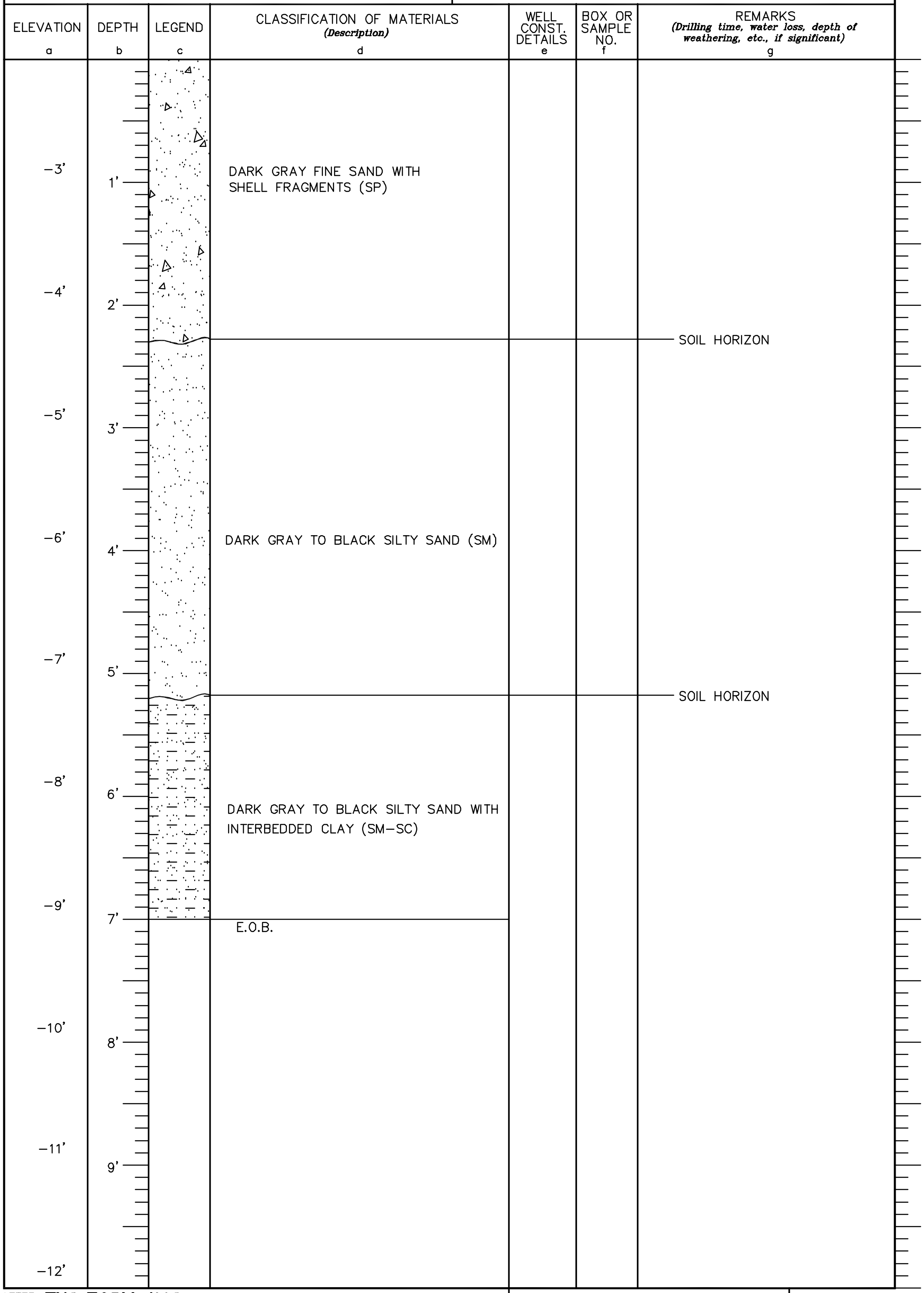
INSTALLATION

SHEET 6 OF 8 SHEETS

1. PROJECT PASS CHALAND TO GRAND BAYOU PASS (BA–35)
2. LOCATION NORTHING: 291,839 EASTING: 3,807,005
3. DRILLING AGENCY –
4. HOLE NO. *(As shown on drawing title and file number)* VS–6
5. NAME OF DRILLER COASTAL ENGINEERING
6. DIRECTION OF HOLE

☒ VERTICAL ☐ INCLINED__________ DEG. FROM VERT.

7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK –
9. TOTAL DEPTH OF HOLE APPROX. 7.0 FT.
10. SIZE AND TYPE OF BIT VIBRACORE
11. DATUM FOR ELEVATION SHOWN *(TBM, BSL, TOC, BLS, or NGVD)* NAVD
12. MANUFACTURER'S DESIGNATION OF DRILL N/A
13. TOTAL NO. OF OVER– BURDEN SAMPLES TAKEN DISTURBED – UNDISTURBED –
14. TOTAL NUMBER OF CORE BOXES –
15. ELEVATION OF GROUNDWATER N/A
16. DATE HOLE STARTED MAY 8, 2003 COMPLETED MAY 8, 2003
17. ELEVATION TOP OF HOLE APPROX. –2.1 FT
18. TOTAL CORE RECOVERY FOR BORING 100 %
19. SIGNATURE OF GEOLOGIST



AFTER **ENG FORM 1836** MAR 71

PROJECT

HOLE NO.

Figure A-14: Core Log VS-6

CORE LOG

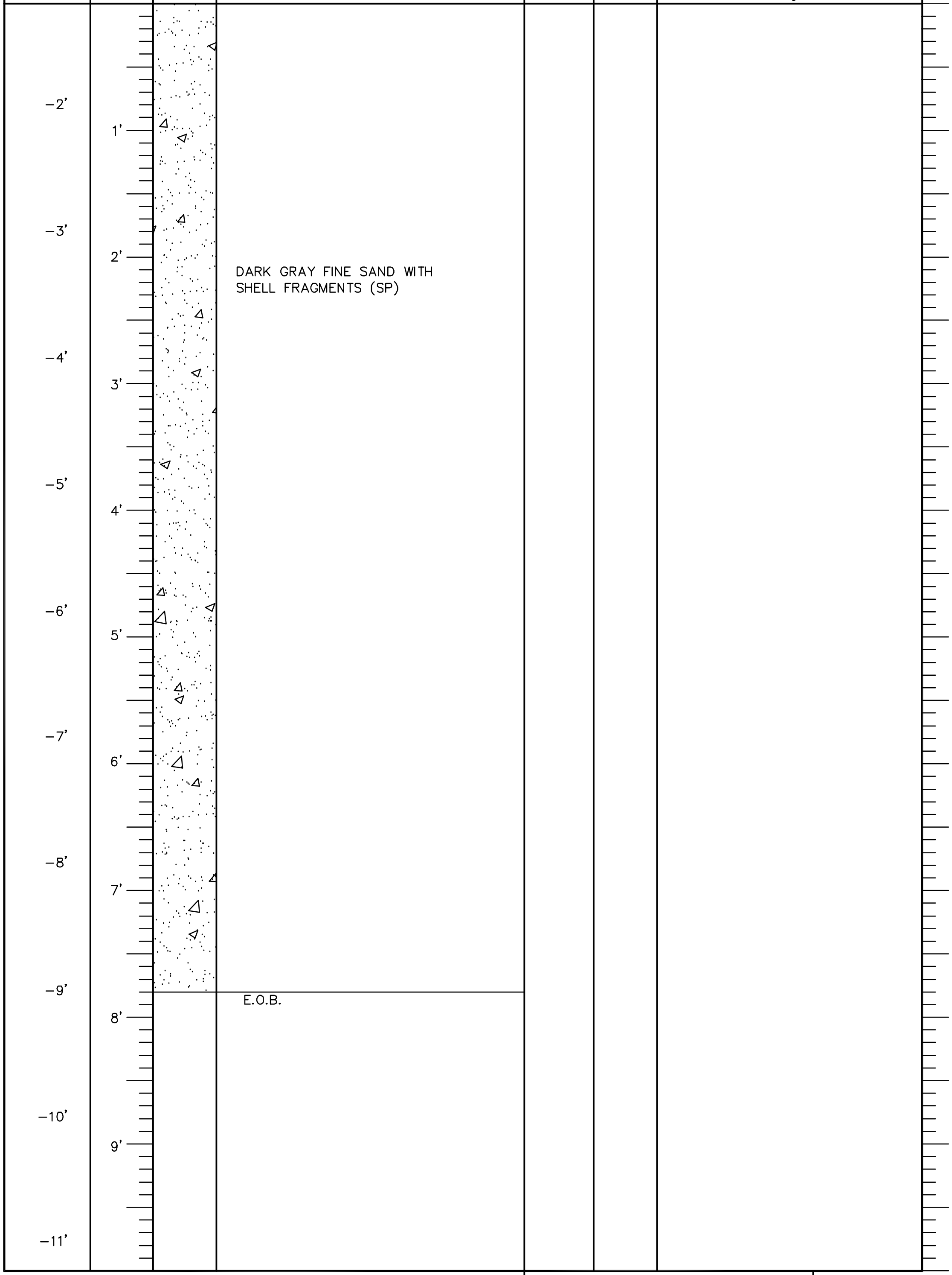
DIVISION COASTAL ENGINEERING

INSTALLATION

SHEET 7 OF 8 SHEETS

1. PROJECT PASS CHALAND TO GRAND BAYOU PASS (BA-35)
2. LOCATION NORTHING: 292,357 EASTING: 3,807,264
3. DRILLING AGENCY –
4. HOLE NO. *(As shown on drawing title and file number)* VS-7
5. NAME OF DRILLER COASTAL ENGINEERING
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ________ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK –
9. TOTAL DEPTH OF HOLE APPROX. 7.0 FT.
10. SIZE AND TYPE OF BIT VIBRACORE
11. DATUM FOR ELEVATION SHOWN *(TBM, BSL, TOC, BLS, or NGVD)* NAVD
12. MANUFACTURER'S DESIGNATION OF DRILL N/A
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED – UNDISTURBED –
14. TOTAL NUMBER OF CORE BOXES –
15. ELEVATION OF GROUNDWATER N/A
16. DATE HOLE STARTED MAY 8, 2003 COMPLETED MAY 8, 2003
17. ELEVATION TOP OF HOLE APPROX. –1.2 FT
18. TOTAL CORE RECOVERY FOR BORING 111 %
19. SIGNATURE OF GEOLOGIST

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	WELL CONST. DETAILS e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g



DARK GRAY FINE SAND WITH SHELL FRAGMENTS (SP)

E.O.B.

AFTER **ENG FORM 1836** MAR 71

PROJECT

HOLE NO.

Figure A-15: Core Log VS-7

CORE LOG

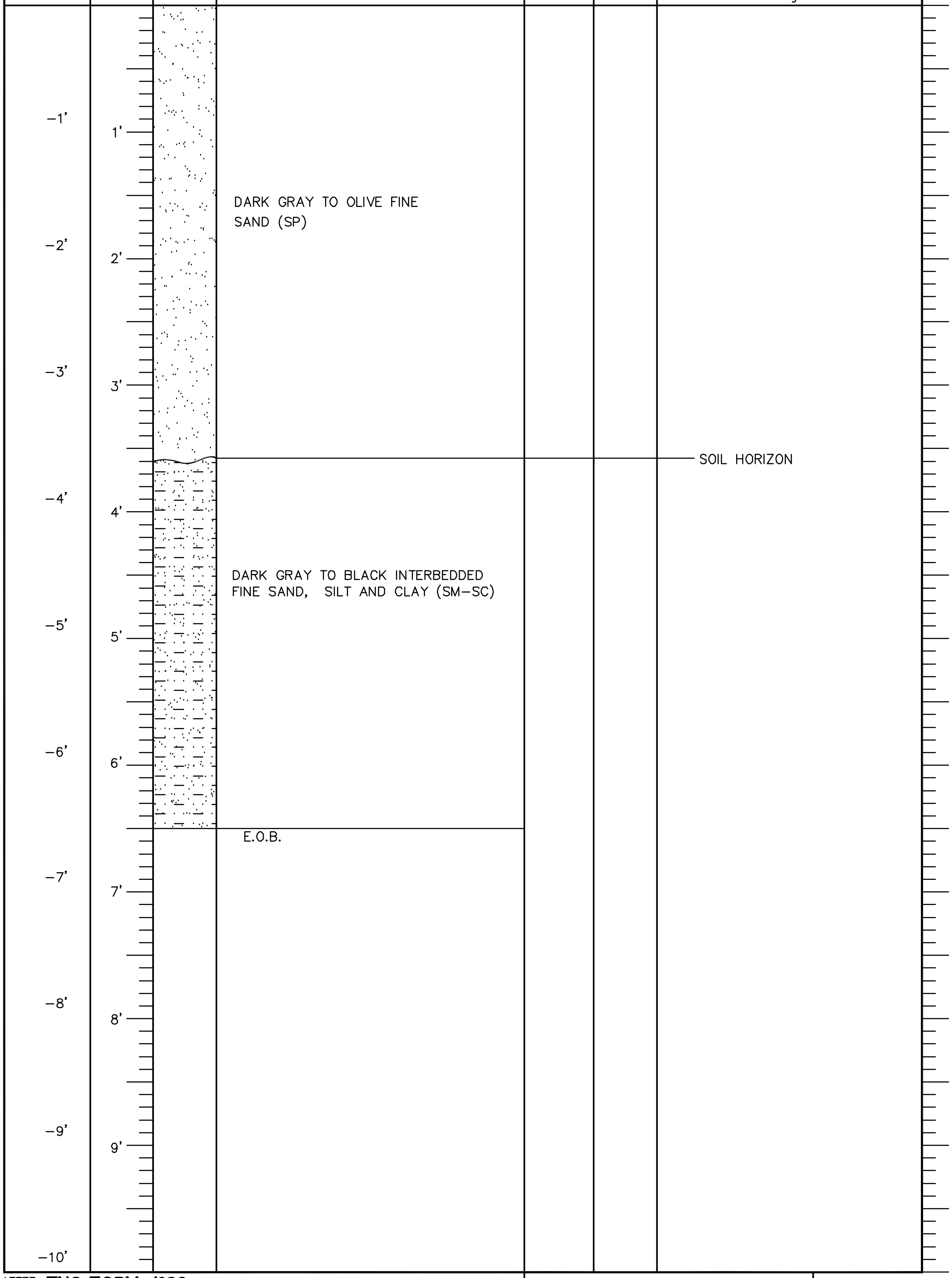
DIVISION COASTAL ENGINEERING

INSTALLATION

SHEET 8 OF 8 SHEETS

1. PROJECT PASS CHALAND TO GRAND BAYOU PASS (BA-35)
2. LOCATION NORTHING: 293,751 EASTING: 3,808,167
3. DRILLING AGENCY –
4. HOLE NO. *(As shown on drawing title and file number)* VS-8
5. NAME OF DRILLER COASTAL ENGINEERING
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____________ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK –
9. TOTAL DEPTH OF HOLE APPROX. 7.0 FT.
10. SIZE AND TYPE OF BIT VIBRACORE
11. DATUM FOR ELEVATION SHOWN *(TBM, BSL, TOC, BLS, or NGVD)* NAVD
12. MANUFACTURER'S DESIGNATION OF DRILL N/A
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED – UNDISTURBED –
14. TOTAL NUMBER OF CORE BOXES –
15. ELEVATION OF GROUNDWATER N/A
16. DATE HOLE STARTED MAY 8, 2003 COMPLETED MAY 8, 2003
17. ELEVATION TOP OF HOLE APPROX. -0.1 FT
18. TOTAL CORE RECOVERY FOR BORING 93 %
19. SIGNATURE OF GEOLOGIST

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	WELL CONST. DETAILS e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g



DARK GRAY TO OLIVE FINE SAND (SP)

SOIL HORIZON

DARK GRAY TO BLACK INTERBEDDED FINE SAND, SILT AND CLAY (SM-SC)

E.O.B.

Figure A-16: Core Log VS-8

AFTER **ENG FORM 1836** MAR 71

PROJECT

HOLE NO.

STE
Soil Testing Engineers, Inc.
316 HIGHLANDIA DRIVE (70810) • P.O. BOX 83710 (70884) • BATON ROUGE, LOUISIANA
PHONE (225) 752-4790 • FAX (225) 752-4878 • www.STEofLA.com

GORDON P. BOUTWELL, JR., Ph.D.
CHING N. TSAI, Ph.D.
CHAD M. POCHE, MS
CHARLES S. HEDGES, MS
KELLIE T. McNAMARA
BEYONG SEOCK LIM, Ph.D.
KEITH SPAMPNETO
RICARDO de ABREU, Ph.D.

REGISTERED PROFESSIONAL ENGINEERS

September 10, 2004

Coastal Engineering Consultants
3106 S. Horseshoe Drive
Naples, Florida 34102

Attn: Dr. Michael Stephen, PhD. P.G.

Re: Grain Size Analysis
Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration
Coastal, Louisiana
STE File: 03-1033

Dear Dr. Stephen:

Mr. Kevin Vought of CEC submitted eight samples numbered VS-1 through VS-8 for grain size analyses (ASTM D422). The grain size analysis curves along with their descriptive statistics for each sample are attached to this letter. Other pertinent information is tabulated below.

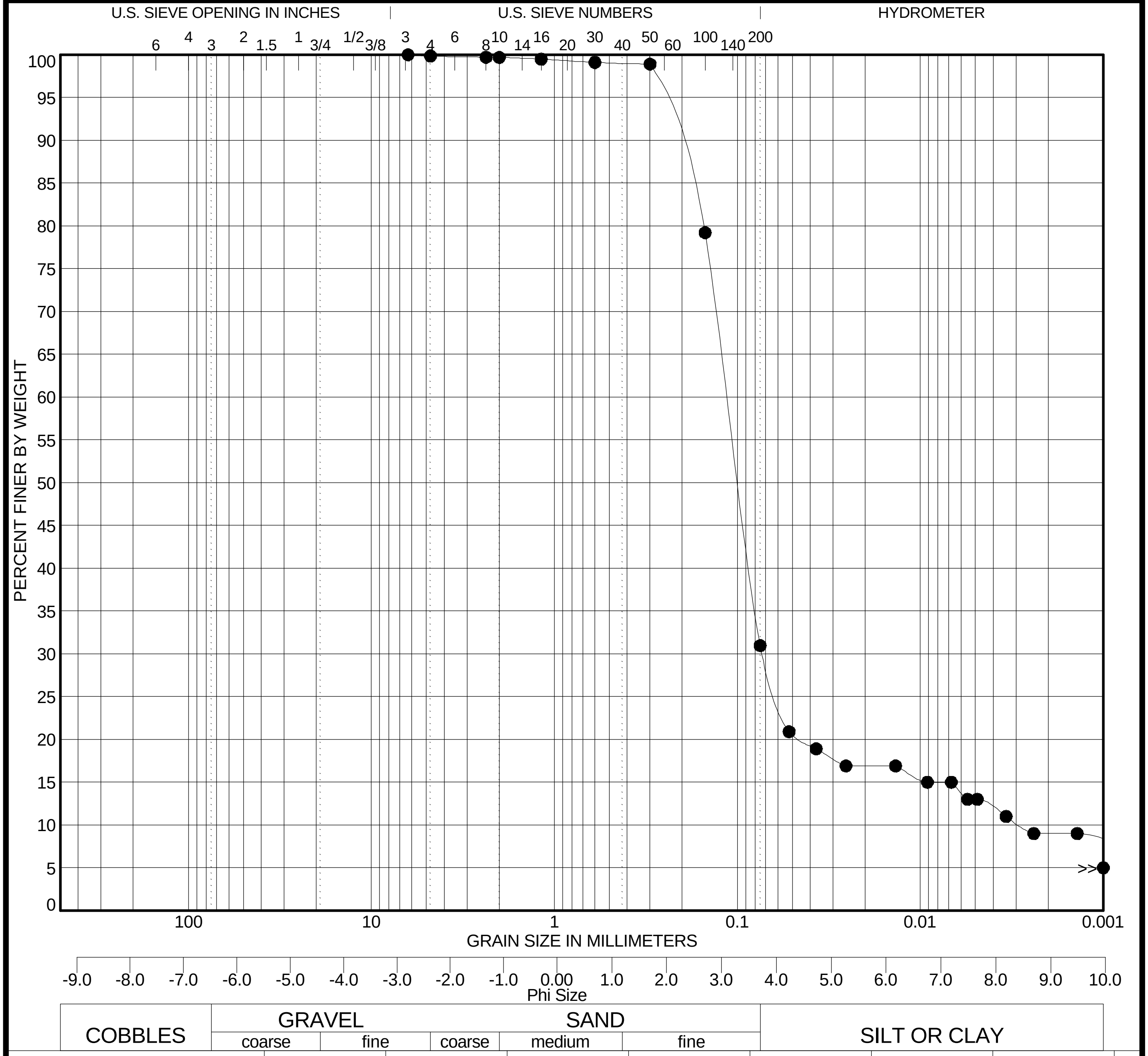
Sample ID	Silt Content (%)	Dry Weight (g)	Wash Weight (g)
VS-1	18.0	166.8	43.1
VS-2	5.0	158.0	10.3
VS-3	4.0	134.8	5.0
VS-4	6.0	145.1	7.0
VS-5	4.0	141.0	5.6
VS-6	9.2	153.5	24.9
VS-7	5.5	127.2	7.7
VS-8	25.8	136.9	59.5

We will be pleased to discuss any questions you may have concerning this report. It has been a pleasure working with you on this project and we look forward to serving you in the future.

Sincerely,
Soil Testing Engineers, Inc.

Ching-Nien Tsai, Ph.D., P.E.
Chief Engineer

Rep-let 03-1033



	Specimen Identification	D05 (mm)	D16 (mm)	D25 (mm)	D50 (mm)	D75 (mm)	D84 (mm)	D95 (mm)
●	**VS-01**	**0.001**	**0.011**	**0.06**	**0.099**	**0.141**	**0.178**	**0.261**

	Specimen Identification	Cc	Cu	Mean (mm)	Mean (Phi)	Median (mm)	Sorting	Skewness	Kurtosis
●	**VS-01**	**16.1**	**39.8**	**0.096**	**3.38**	**0.099**	**0.087**	**0.096**	**1.316**

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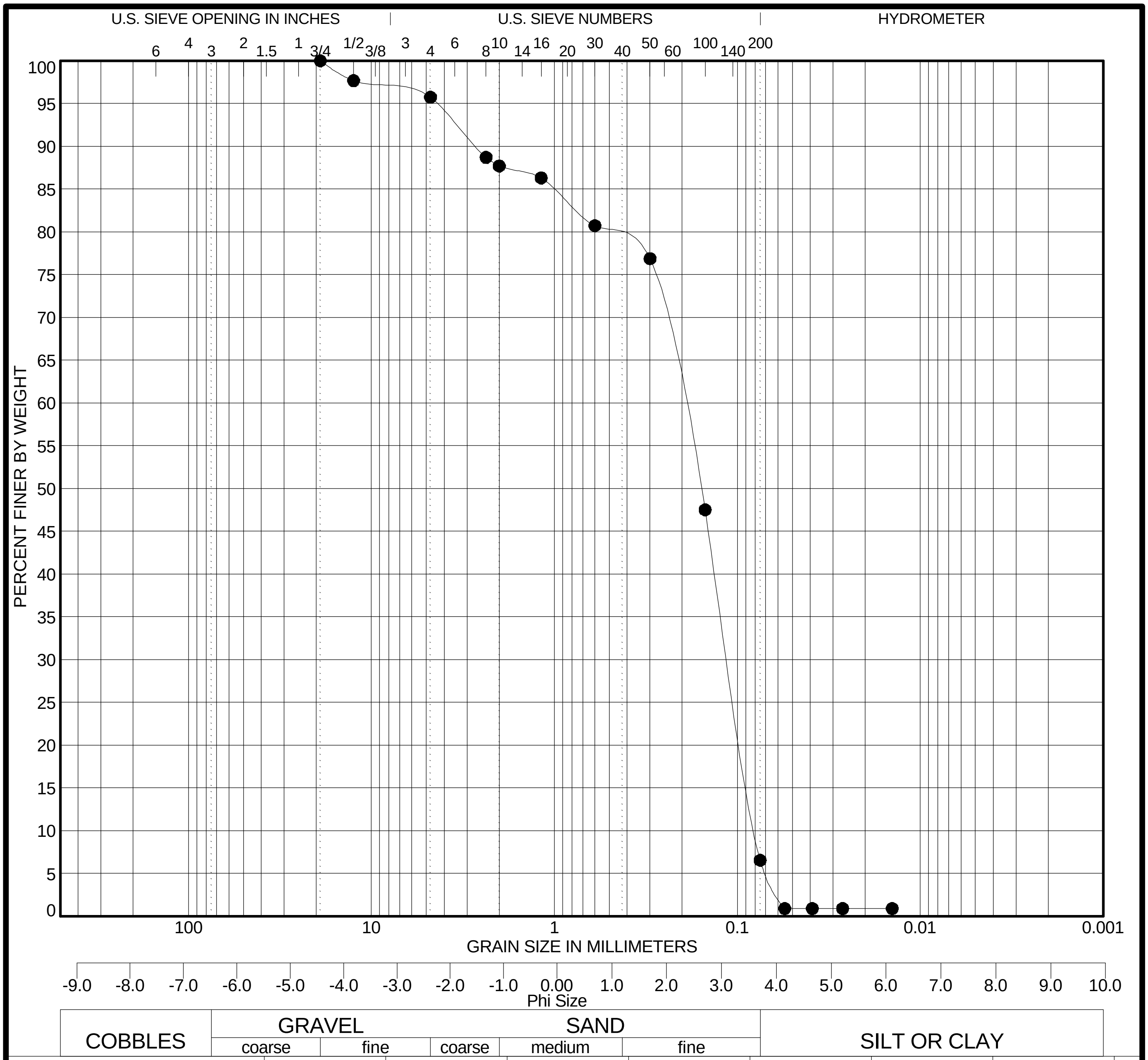
GRAIN SIZE DISTRIBUTION

Project: Pass Chaland to Grand Bayou Pass

Location: Barrier Shoreline Restoration

Number: 03-1033

03-1033 GRAIN SIZE FOR VS BORINGS 031033RR.GPJ US LAB.GDT 09/10/04



	Specimen Identification	D05 (mm)	D16 (mm)	D25 (mm)	D50 (mm)	D75 (mm)	D84 (mm)	D95 (mm)
●	**VS-02**	**0.069**	**0.088**	**0.102**	**0.159**	**0.287**	**0.892**	**4.413**

	Specimen Identification	Cc	Cu	Mean (mm)	Mean (Phi)	Median (mm)	Sorting	Skewness	Kurtosis
●	**VS-02**	**0.8**	**2.5**	**0.380**	**1.40**	**0.159**	**0.903**	**0.891**	**9.623**

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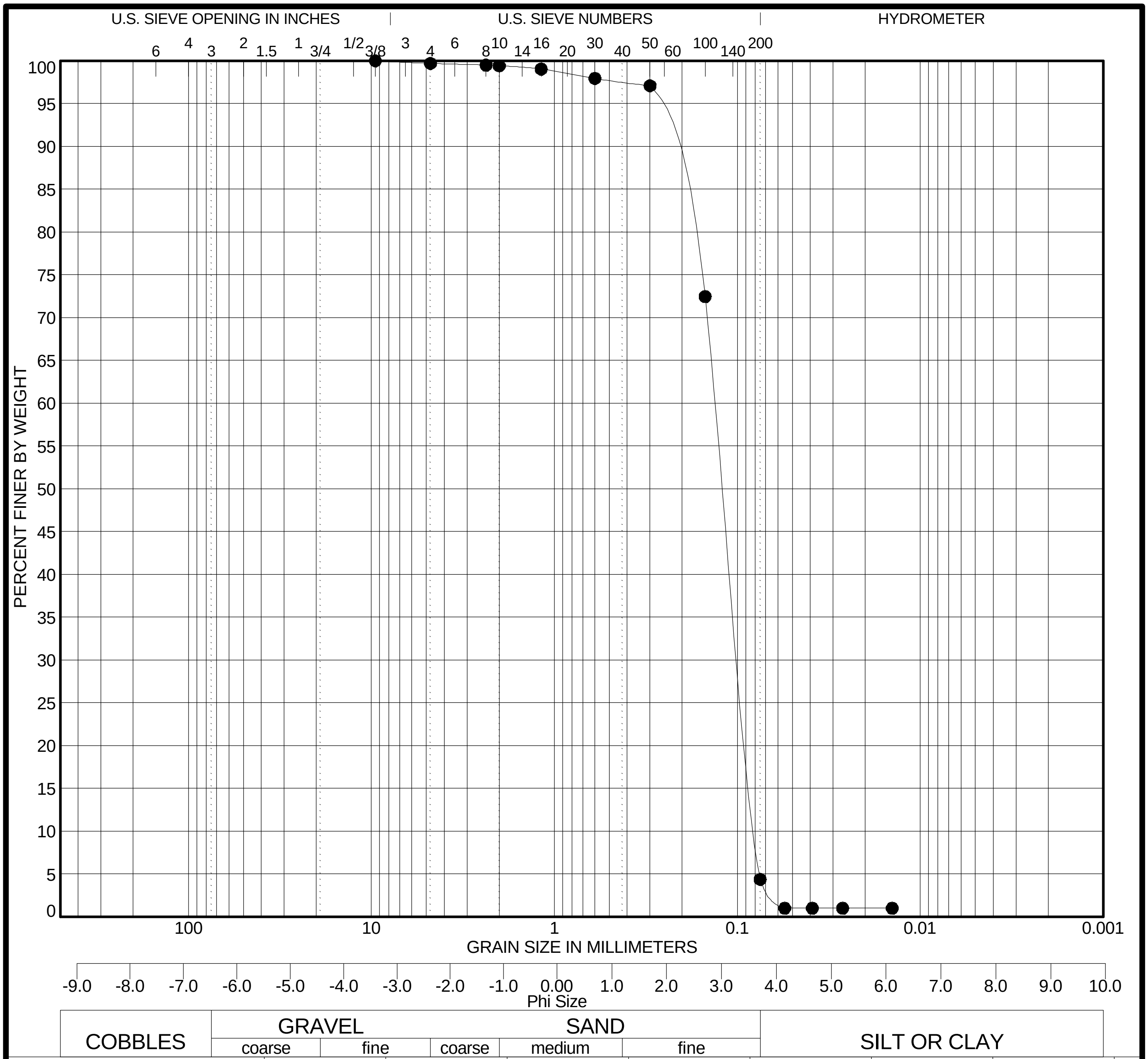
GRAIN SIZE DISTRIBUTION

Project: Pass Chaland to Grand Bayou Pass

Location: Barrier Shoreline Restoration

Number: 03-1033



Specimen Identification	D05 (mm)	D16 (mm)	D25 (mm)	D50 (mm)	D75 (mm)	D84 (mm)	D95 (mm)
● **VS-03**	**0.075**	**0.084**	**0.093**	**0.119**	**0.161**	**0.208**	**0.283**

Specimen Identification	Cc	Cu	Mean (mm)	Mean (Phi)	Median (mm)	Sorting	Skewness	Kurtosis
● **VS-03**	**0.9**	**1.7**	**0.137**	**2.87**	**0.119**	**0.105**	**0.506**	**1.254**

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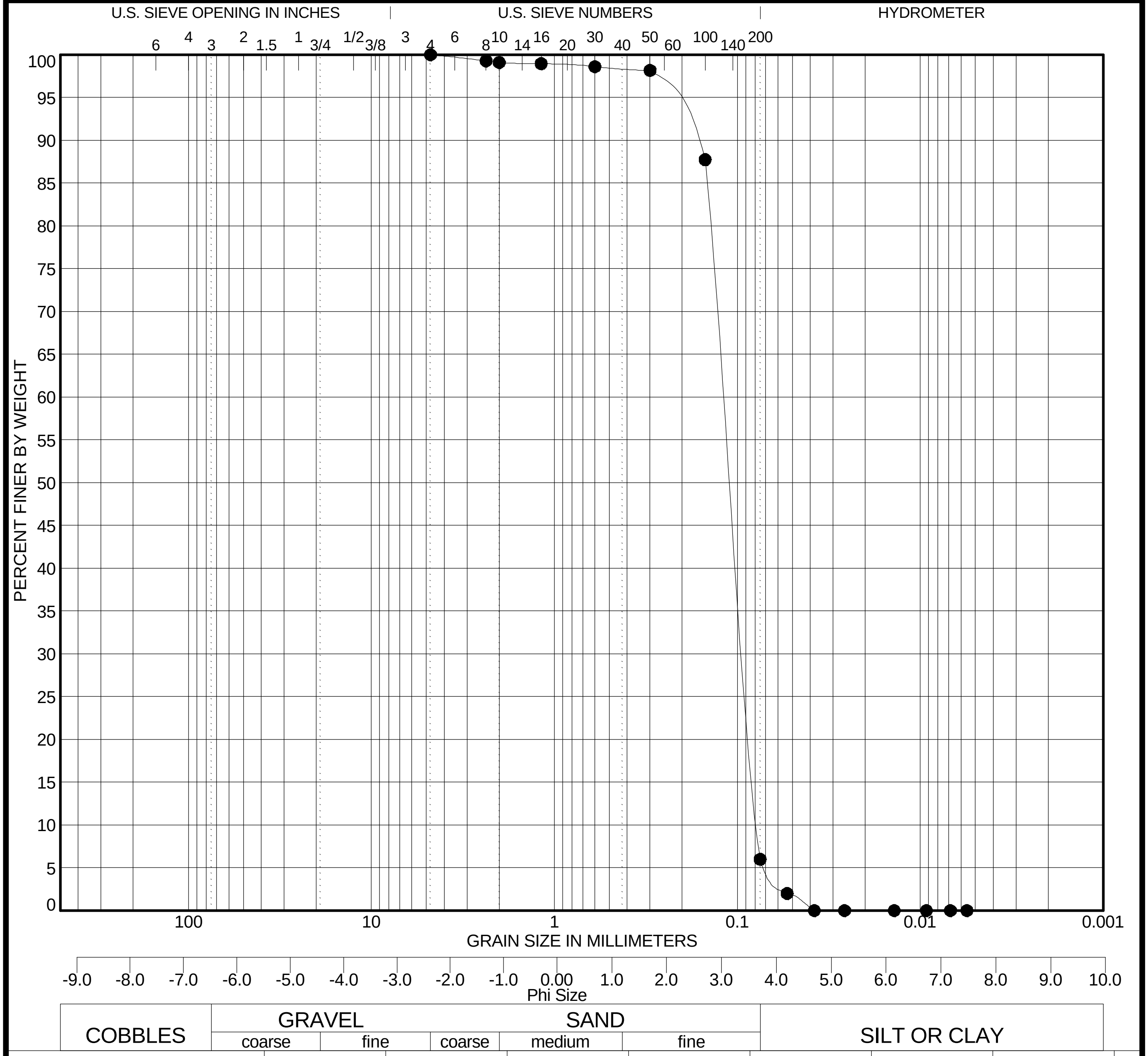
GRAIN SIZE DISTRIBUTION

Project: Pass Chaland to Grand Bayou Pass

Location: Barrier Shoreline Restoration

Number: 03-1033



	Specimen Identification	D05 (mm)	D16 (mm)	D25 (mm)	D50 (mm)	D75 (mm)	D84 (mm)	D95 (mm)
●	**VS-04**	**0.069**	**0.082**	**0.088**	**0.109**	**0.135**	**0.145**	**0.243**

	Specimen Identification	Cc	Cu	Mean (mm)	Mean (Phi)	Median (mm)	Sorting	Skewness	Kurtosis
●	**VS-04**	**0.9**	**1.5**	**0.112**	**3.16**	**0.109**	**0.083**	**0.342**	**1.517**

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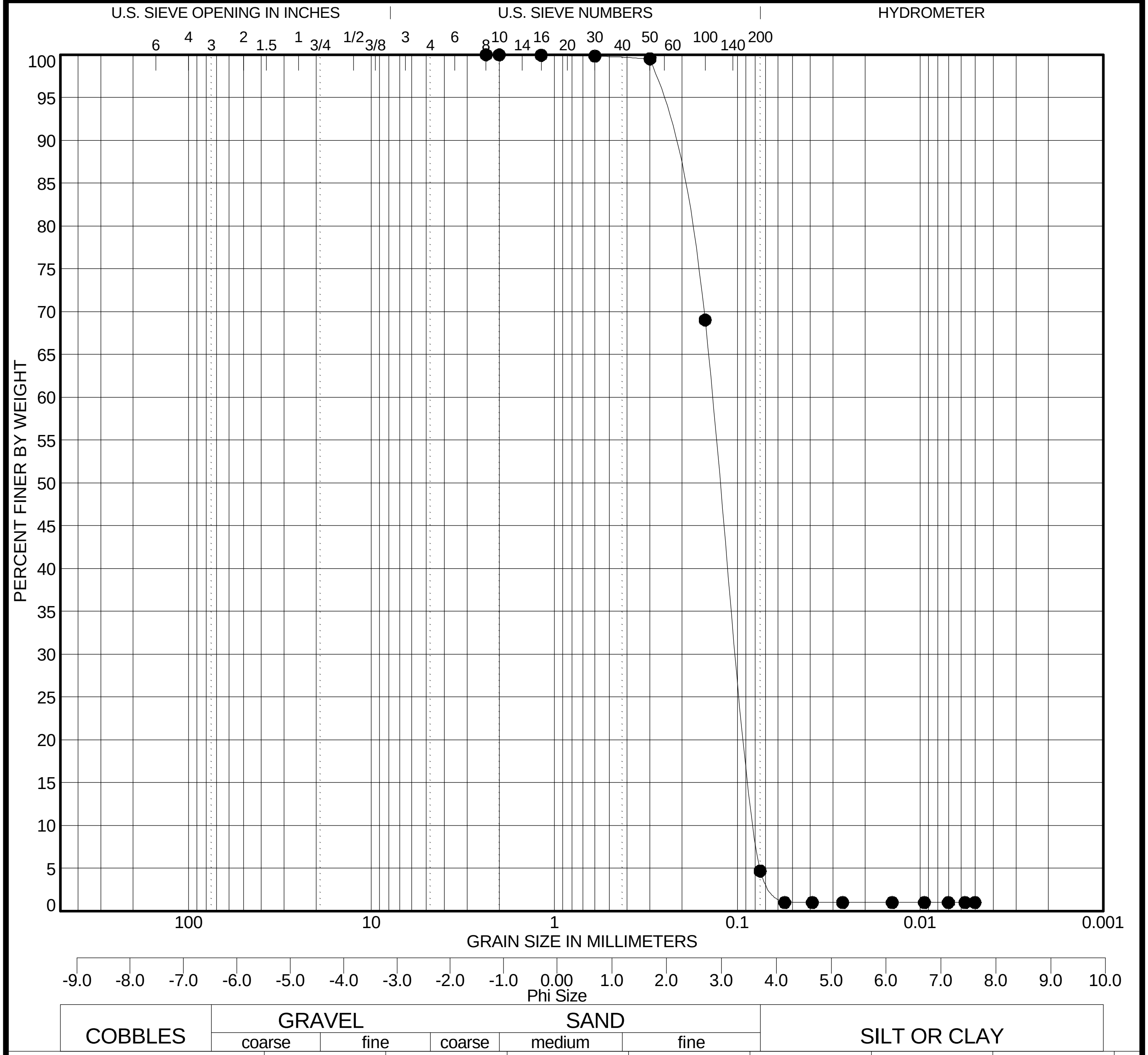
GRAIN SIZE DISTRIBUTION

Project: Pass Chaland to Grand Bayou Pass

Location: Barrier Shoreline Restoration

Number: 03-1033



	Specimen Identification	D05 (mm)	D16 (mm)	D25 (mm)	D50 (mm)	D75 (mm)	D84 (mm)	D95 (mm)
●	**VS-05**	**0.075**	**0.085**	**0.093**	**0.122**	**0.172**	**0.211**	**0.271**

	Specimen Identification	Cc	Cu	Mean (mm)	Mean (Phi)	Median (mm)	Sorting	Skewness	Kurtosis
●	**VS-05**	**0.9**	**1.7**	**0.139**	**2.85**	**0.122**	**0.104**	**0.467**	**1.017**

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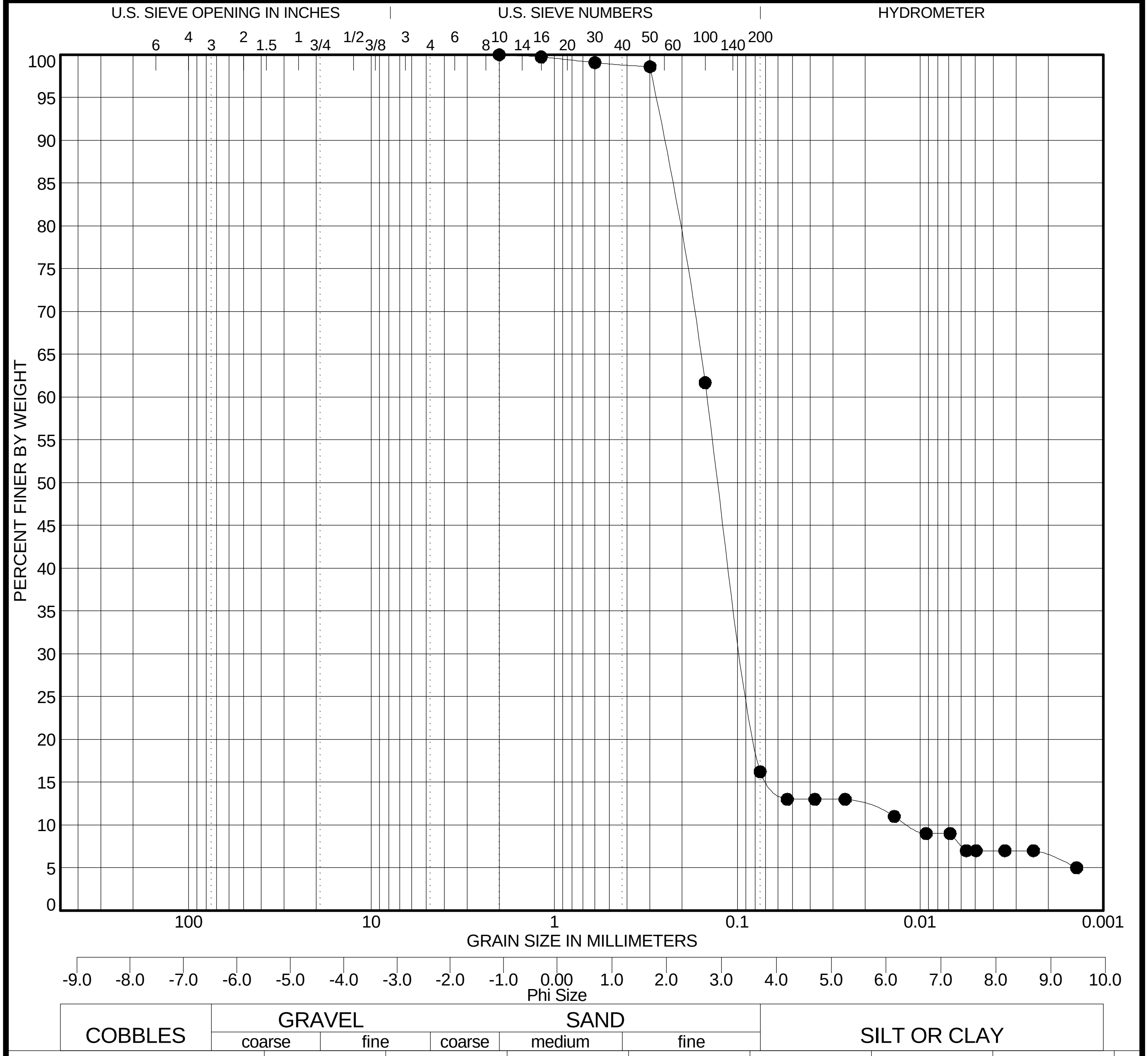
GRAIN SIZE DISTRIBUTION

Project: Pass Chaland to Grand Bayou Pass

Location: Barrier Shoreline Restoration

Number: 03-1033



	Specimen Identification	D05 (mm)	D16 (mm)	D25 (mm)	D50 (mm)	D75 (mm)	D84 (mm)	D95 (mm)
●	**VS-06**	**0.001**	**0.073**	**0.086**	**0.126**	**0.193**	**0.228**	**0.28**

	Specimen Identification	Cc	Cu	Mean (mm)	Mean (Phi)	Median (mm)	Sorting	Skewness	Kurtosis
●	**VS-06**	**5.2**	**12.9**	**0.142**	**2.82**	**0.126**	**0.118**	**0.210**	**1.069**

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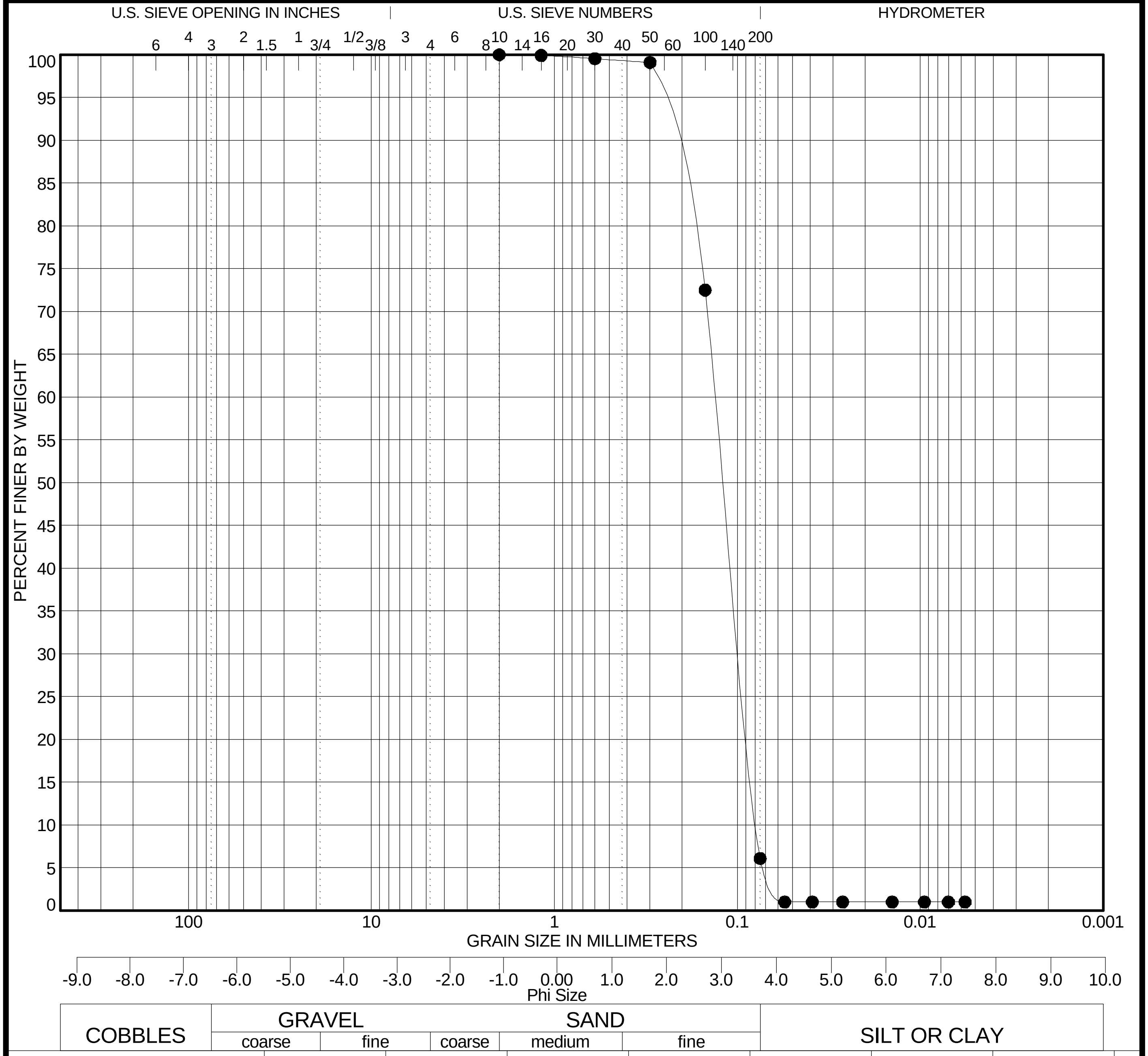
GRAIN SIZE DISTRIBUTION

Project: Pass Chaland to Grand Bayou Pass

Location: Barrier Shoreline Restoration

Number: 03-1033



	Specimen Identification	D05 (mm)	D16 (mm)	D25 (mm)	D50 (mm)	D75 (mm)	D84 (mm)	D95 (mm)
●	**VS-07**	**0.07**	**0.083**	**0.091**	**0.119**	**0.16**	**0.202**	**0.27**

	Specimen Identification	Cc	Cu	Mean (mm)	Mean (Phi)	Median (mm)	Sorting	Skewness	Kurtosis
●	**VS-07**	**0.9**	**1.7**	**0.135**	**2.89**	**0.119**	**0.102**	**0.452**	**1.188**

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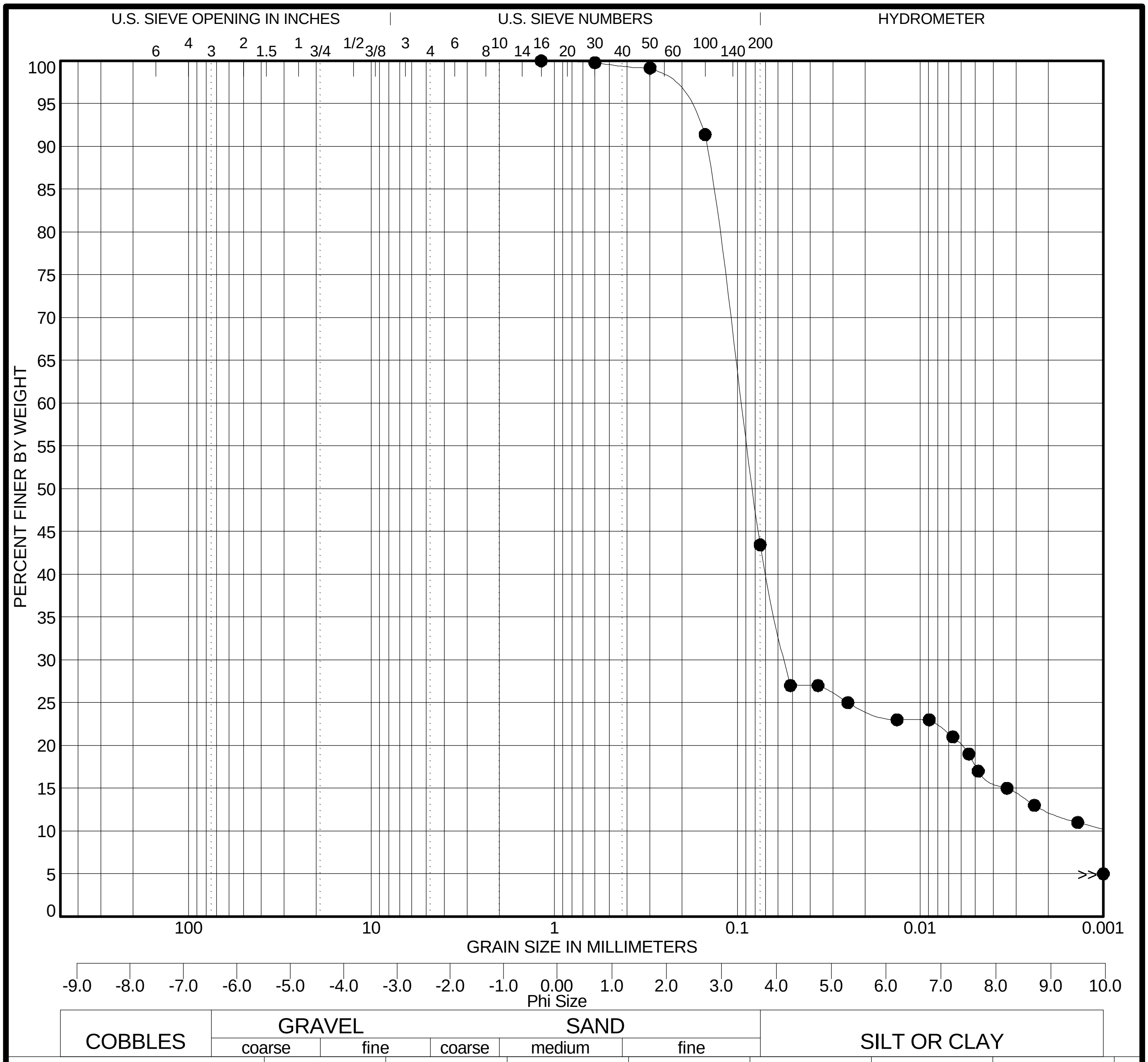
GRAIN SIZE DISTRIBUTION

Project: Pass Chaland to Grand Bayou Pass

Location: Barrier Shoreline Restoration

Number: 03-1033



	Specimen Identification	D05 (mm)	D16 (mm)	D25 (mm)	D50 (mm)	D75 (mm)	D84 (mm)	D95 (mm)
●	**VS-08**	**0**	**0.004**	**0.025**	**0.082**	**0.118**	**0.135**	**0.207**

	Specimen Identification	Cc	Cu	Mean (mm)	Mean (Phi)	Median (mm)	Sorting	Skewness	Kurtosis
●	**VS-08**	**35.6**	**106.9**	**0.074**	**3.76**	**0.082**	**0.066**	**0.008**	**0.912**

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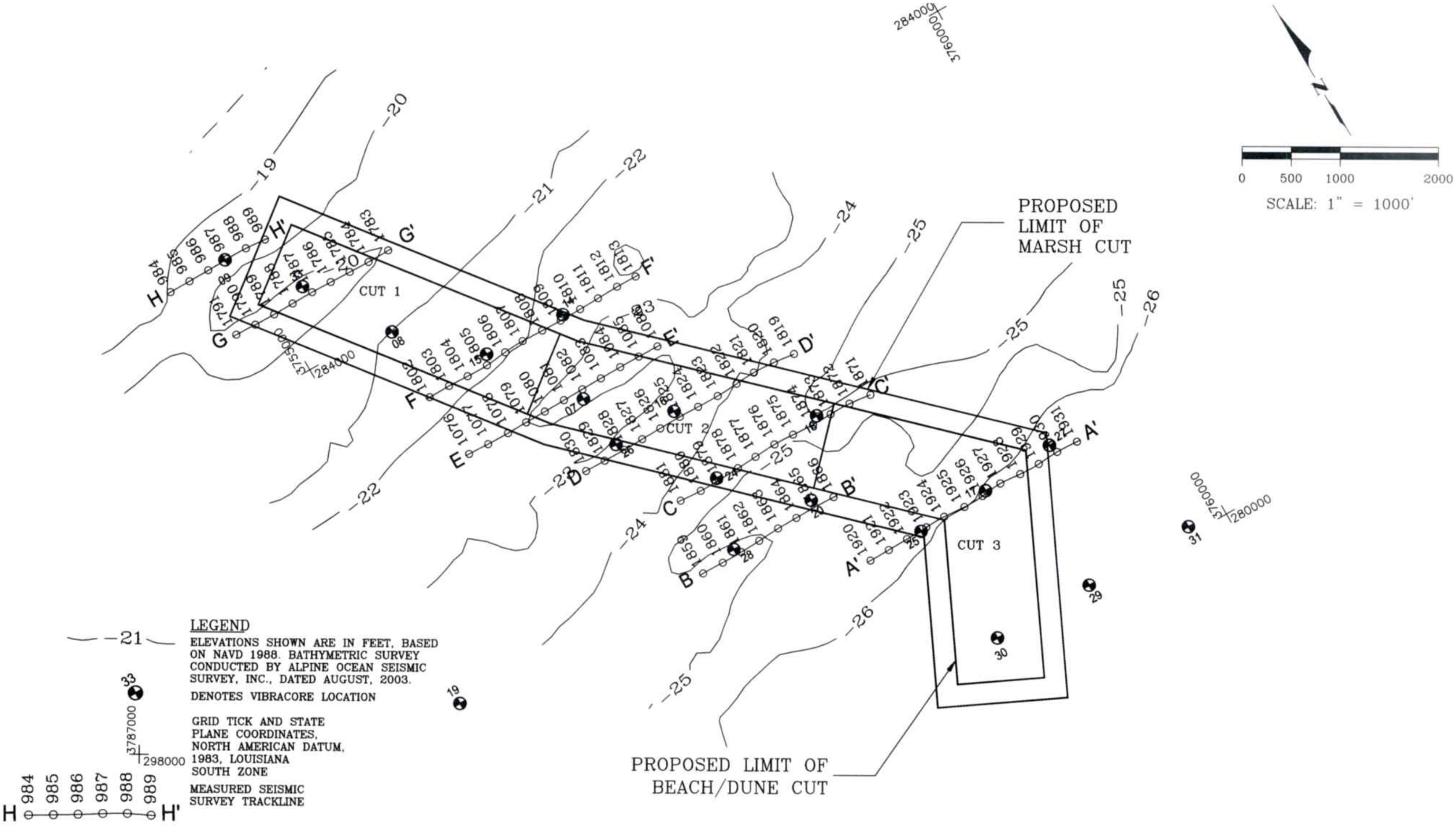
GRAIN SIZE DISTRIBUTION

Project: Pass Chaland to Grand Bayou Pass
Location: Barrier Shoreline Restoration
Number: 03-1033

APPENDIX B

BORROW AREA GEOTECHNICAL AND GEOPHYSICAL DATA



LEGEND

—21— ELEVATIONS SHOWN ARE IN FEET, BASED ON NAVD 1988. BATHYMETRIC SURVEY CONDUCTED BY ALPINE OCEAN SEISMIC SURVEY, INC., DATED AUGUST, 2003.

33 DENOTES VIBRACORE LOCATION

3787000 298000 GRID TICK AND STATE PLANE COORDINATES, NORTH AMERICAN DATUM, 1983, LOUISIANA SOUTH ZONE

H 984 985 986 987 988 989 H' MEASURED SEISMIC SURVEY TRACKLINE

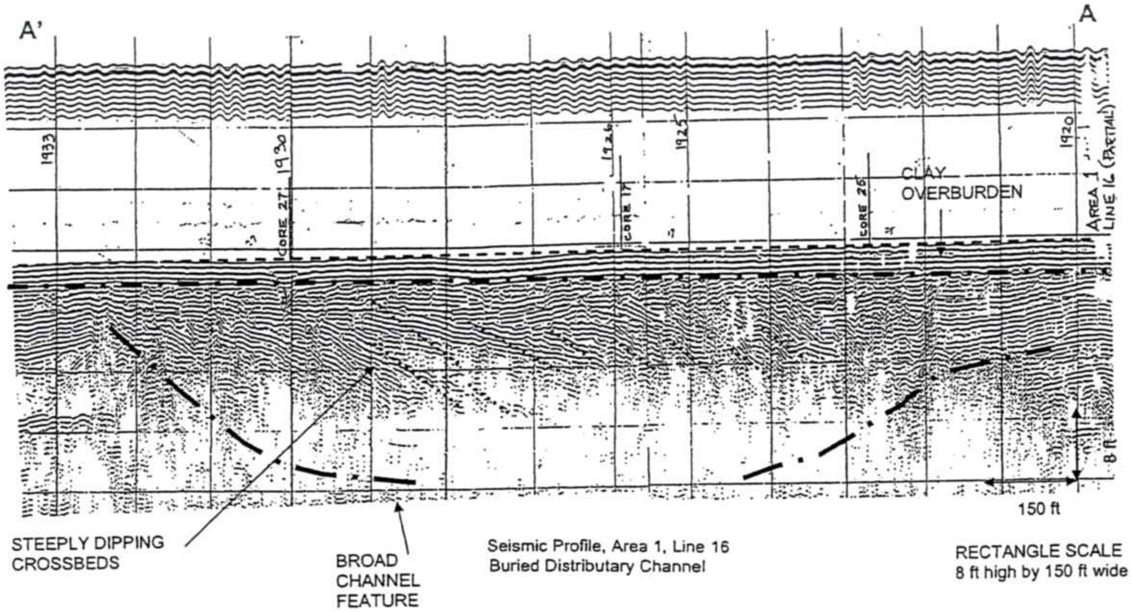
SEISMIC LINE LOCATION MAP

Coastal Engineering Consultants, Inc.

02132APDXB.DWG

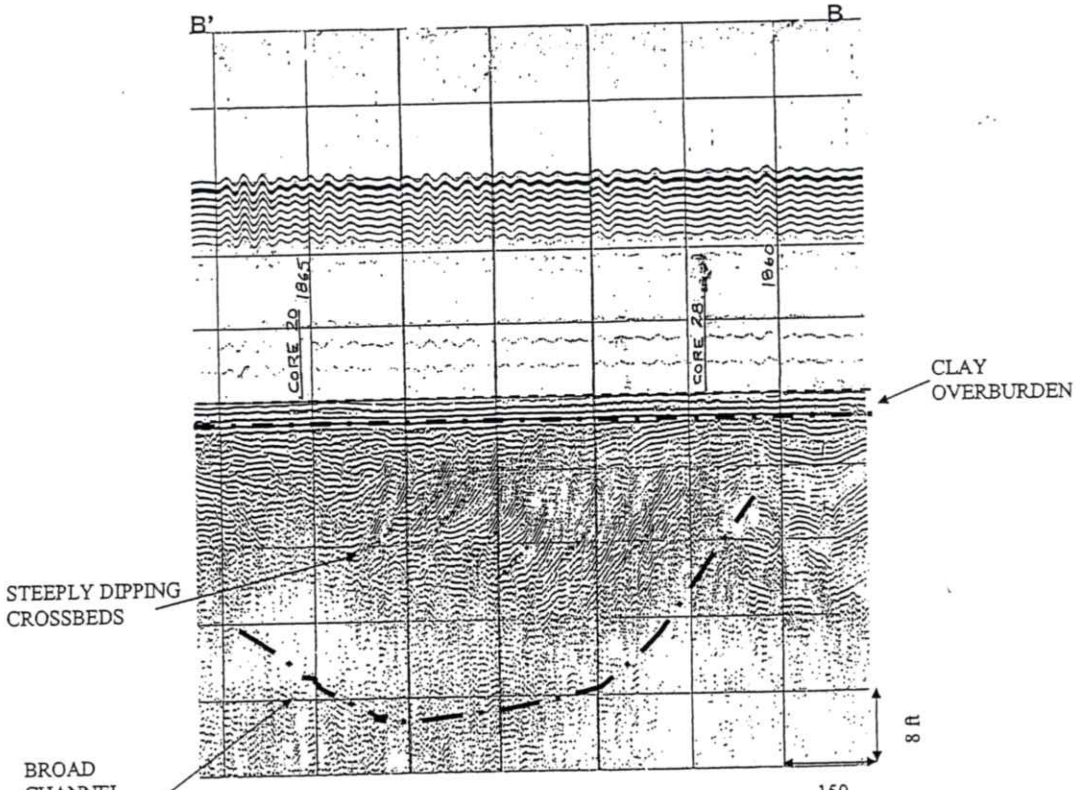
JULY 12, 2004

SJB GROUP INCORPORATED



Seismic Profile, Area 1, Line 16
Buried Distributary Channel

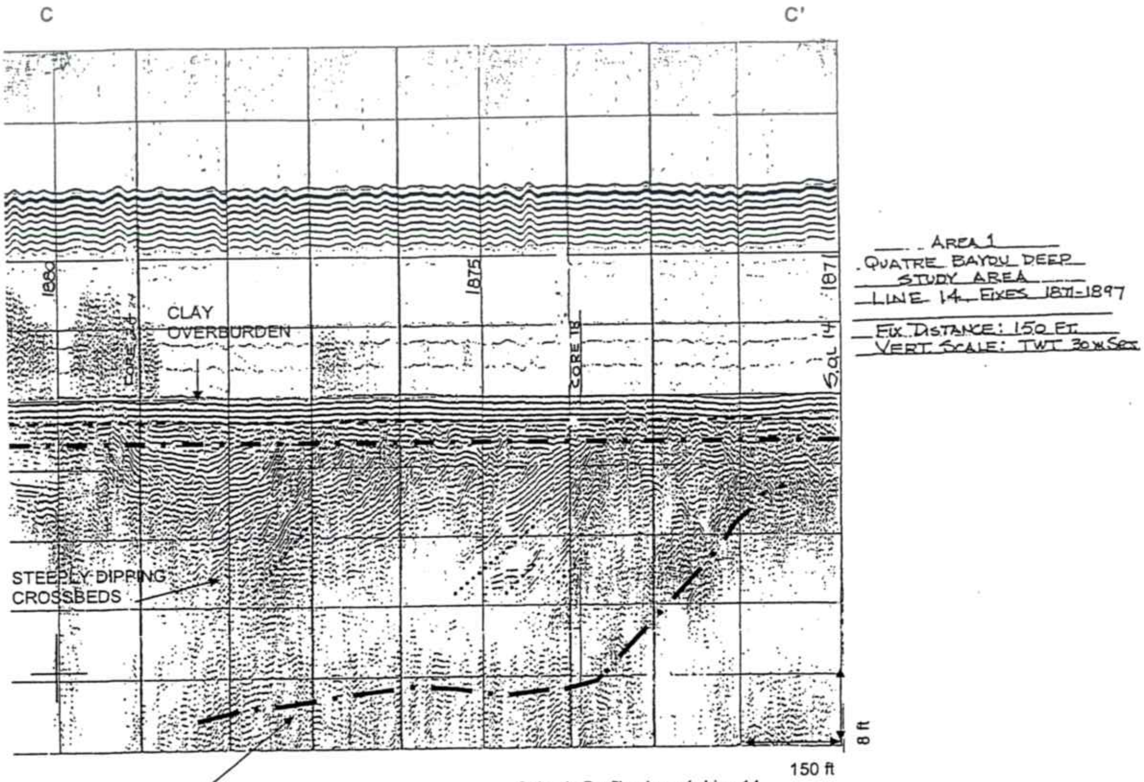
RECTANGLE SCALE
8 ft high by 150 ft wide



BROAD
CHANNEL
FEATURE

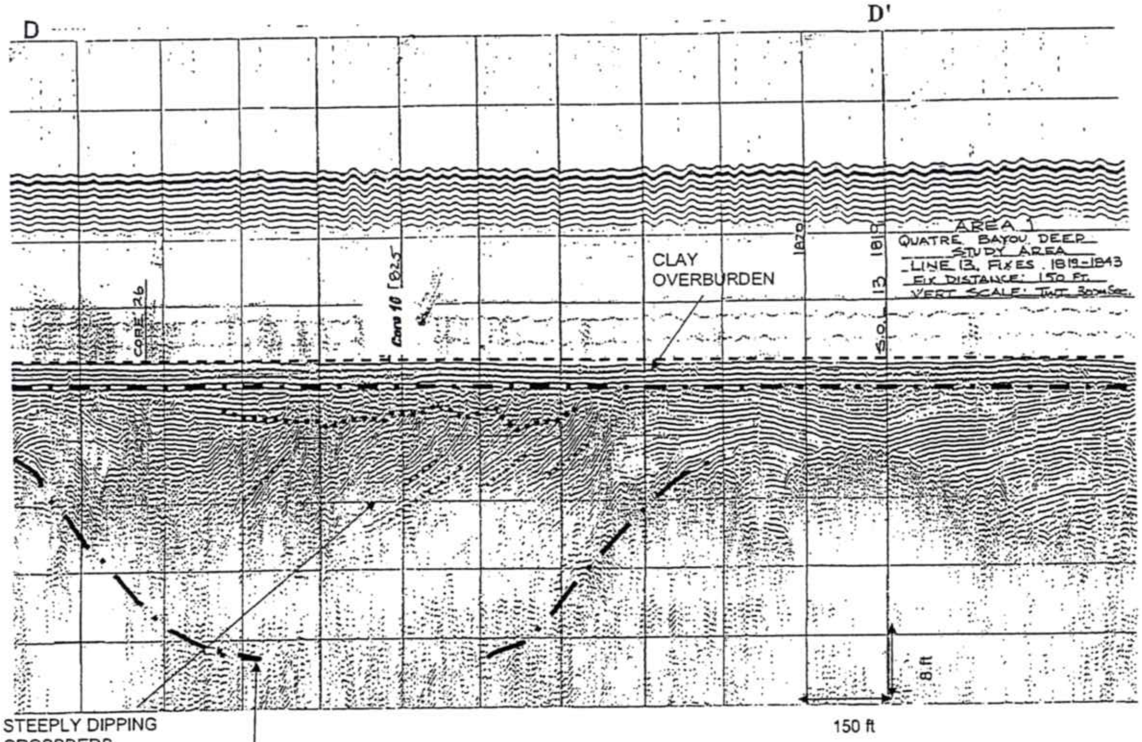
Seismic Profile, Area 1, Line 15
Buried Distributary Channel

RECTANGLE SCALE
8 ft high by 150 ft wide



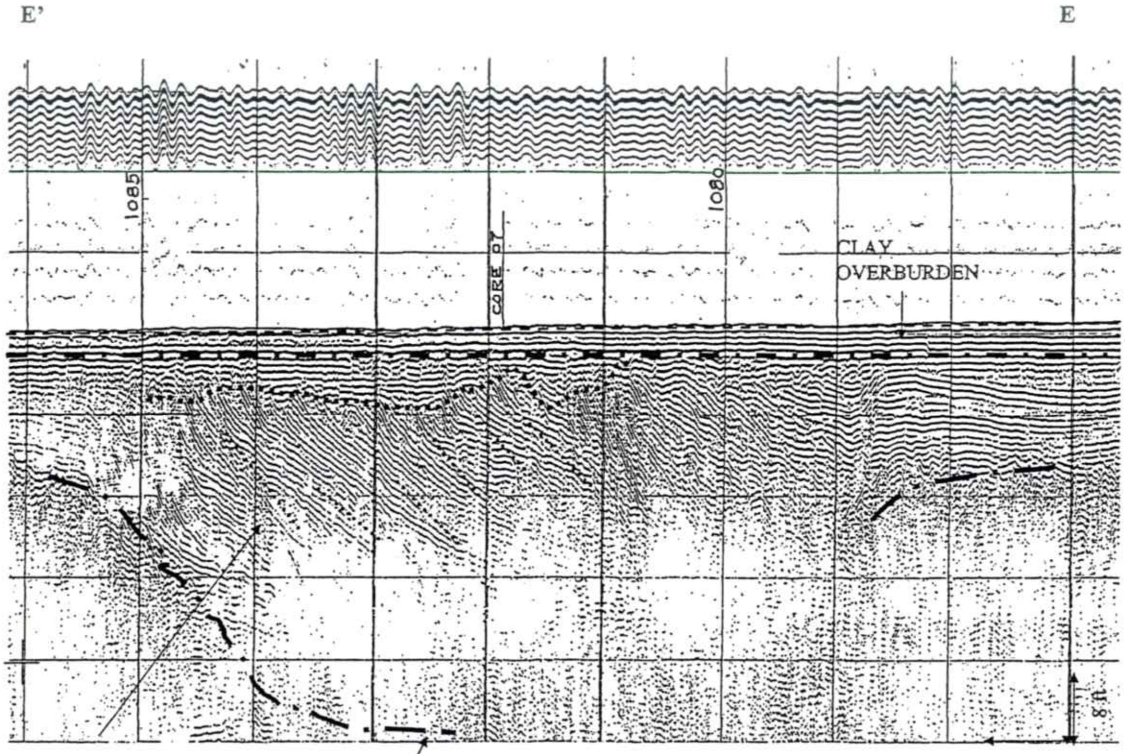
Seismic Profile, Area 1, Line 14
Buried Distributary Channel

RECTANGLE SCALE
8 ft high by 150 ft wide



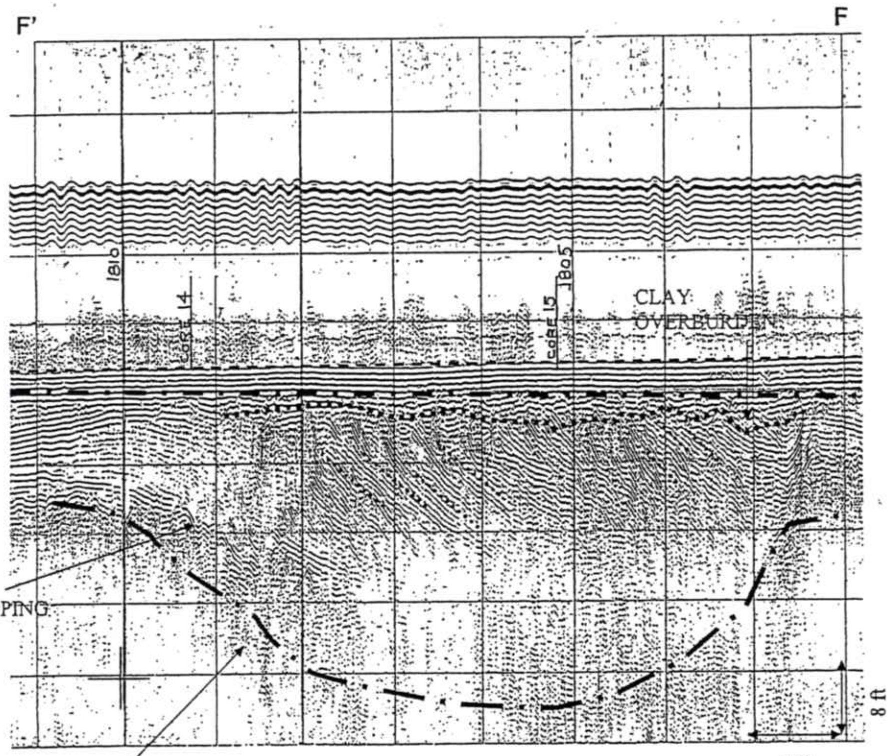
Seismic Profile, Area 1, Line 13
Buried Distributary Channel

RECTANGLE SCALE
8 ft high by 150 ft wide



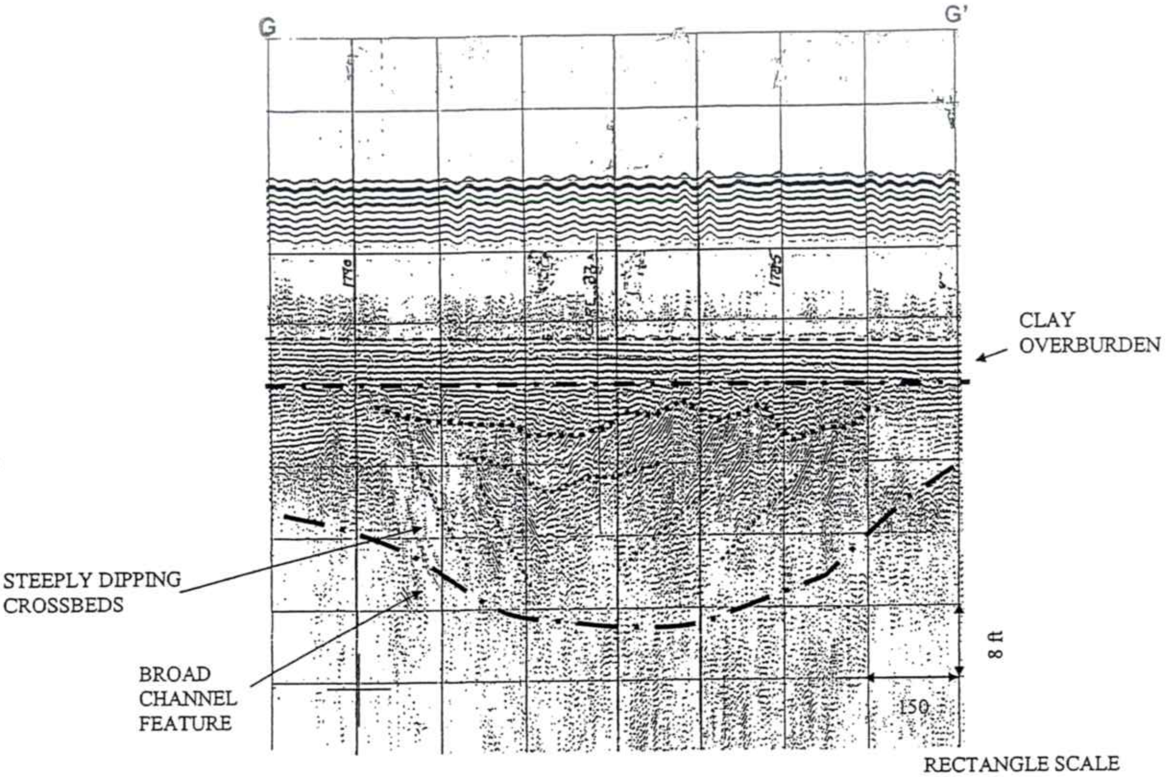
Seismic Profile, Area 1, Line 10
Buried Distributary Channel

RECTANGLE SCALE
8 ft high by 150 ft wide



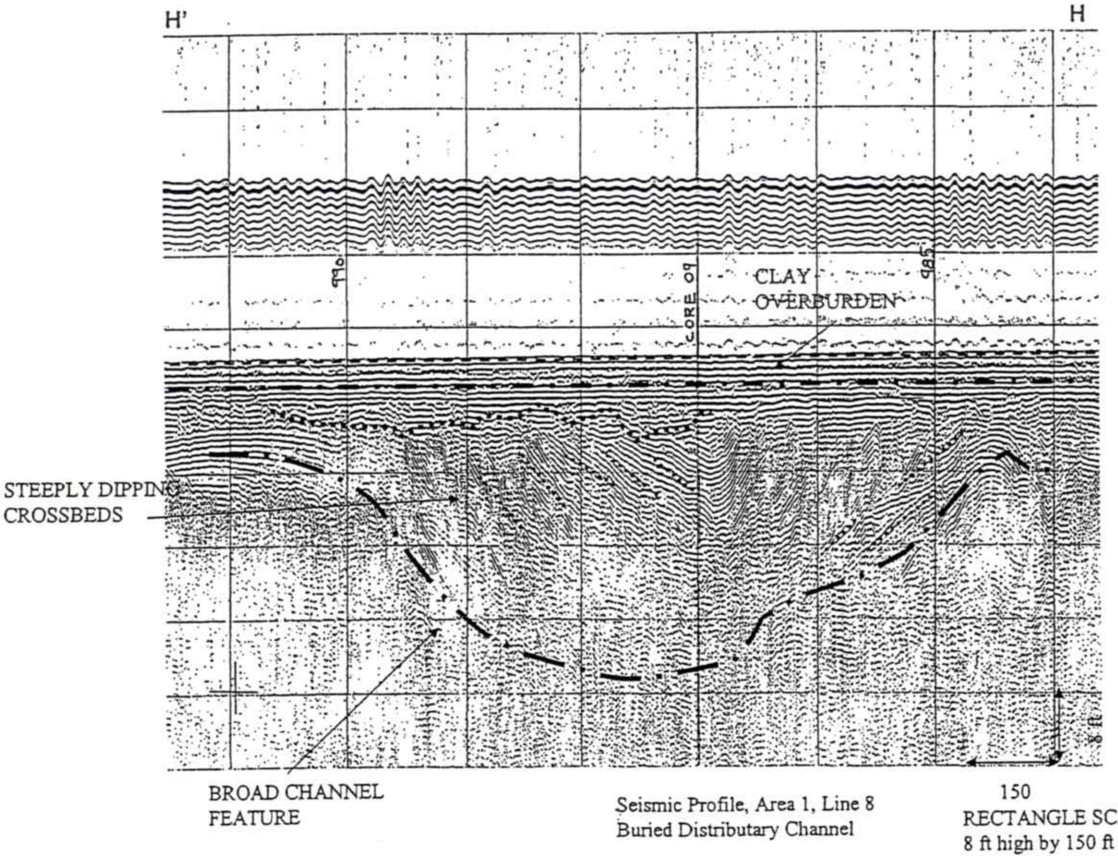
Seismic Profile, Area 1, Line 12
Buried Distributary Channel

RECTANGLE SCALE
8 ft high by 150 ft wide



RECTANGLE SCALE
8 ft high by 150 ft wide

Seismic Profile, Area 1, Line 11
Buried Distributary Channel



Seismic Profile, Area 1, Line 8
Buried Distributary Channel

RECTANGLE SCALE
8 ft high by 150 ft wide

Penetration Graph for Core No. 14, Run 1

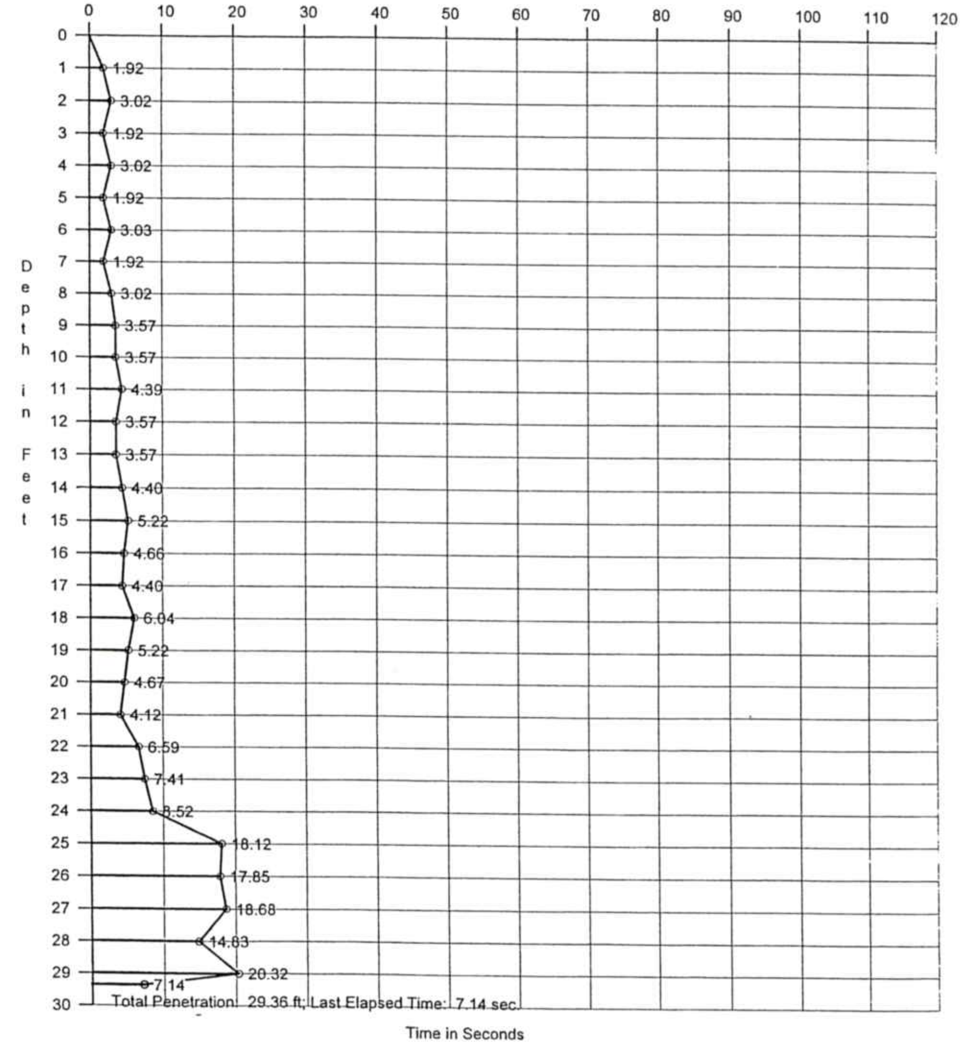
Date: 8/27/03
Start Time: 1:15:24 PM
End Time: 1:18:41 PM

Penetration: 29.36 ft
Recovery: 29.00
W. D. Corrected: 22.6 ft
W. D. Raw: 24.2 ft

Easting: 3756705.81
Northing: 283463.19
Coord. System: LA SOUTH 83

Lat: 2916.2556
Long: 08950.4483
Datum: WGS-84

Comment:



Hole No. VB-03-14

DRILLING LOG

DIVISION	
INSTALLATION	
SHEET 1 OF 1 SHEETS	
1. PROJECT	Barrier Island Restoration (BA-35)
2. LOCATION (Coordinates or Station)	N 283,463.2 E 3,756,705.8
3. DRILLING AGENCY	Alpine Ocean Seismic Survey
4. HOLE NO. (As shown on drawing title and file number)	VB-03-14
5. NAME OF DRILLER	J. Cole
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. PENETRATION (ft)	29.4
8. RECOVERY (ft)	29.0
9. TOTAL CORE RECOVERY (%)	99.0
10. SIZE AND TYPE OF BIT	
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL	Vibracore
13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 2 COMPOSITE 1
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 8/27/03 COMPLETED 8/27/03
17. ELEVATION TOP OF HOLE	-22.6
18. TOTAL CORE RECOVERY FOR BORING	99 %
19. GEOLOGIST	W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No. Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-22.6	0.0		Dark gray CLAY			Composite Sample 1: 23'-30' 79.5% Sand 13.3% Silt 7.2% Clay Mean: 0.076 mm
-27.6	5.0		Dark gray SILT			
-27.8	5.2		Dark gray SILTY CLAY			
-44.6	22.0		Dark gray silty FINE SAND			
-45.0	22.4		Dark gray CLAY			
-45.6	23.0		Dark gray silty FINE SAND		1 23.0 27.0	64.5% Sand 23.4% Silt 12.0% Clay Mean: 0.032 mm
-47.7	25.1		Dark gray CLAY			
-48.1	25.5		Dark gray silty SAND, with a clay lens at 26.1-26.3'		2 27.0 30.0	73.0% Sand 18.3% Silt 8.6% Clay Mean: 0.043 mm
-52.6	30.0					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

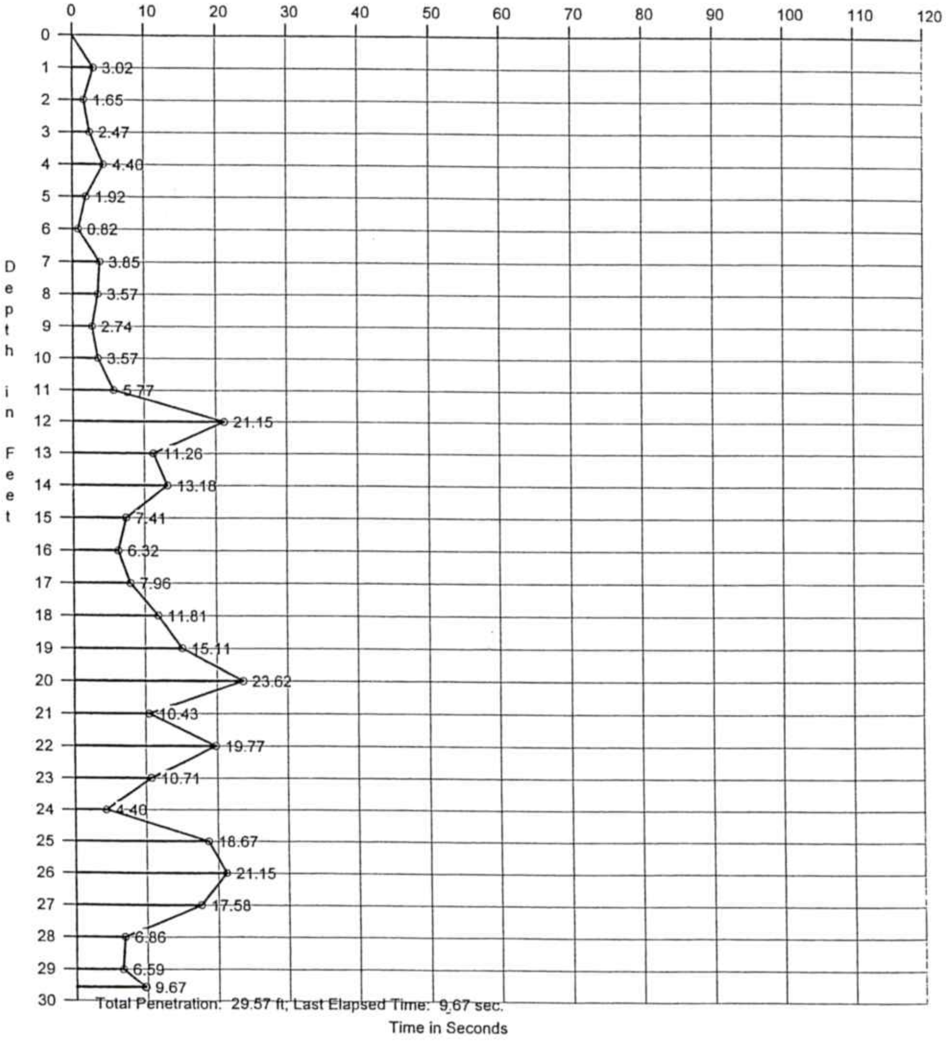
PROJECT Barrier Island Restoration (BA-35)

HOLE NO. VB-03-14

Penetration Graph for Core No. 26, Run 1

Date: 8/29/03	Penetration: 29.57 ft	Easting: 3756579.02	Lat: 2916.0975
Start Time: 8:33:55 AM	Recovery: 30.0	Northing: 282503.48	Long: 08950.4745
End Time: 8:38:33 AM	W. D. Corrected: 24.1 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 25.5 ft		

Comment:



Hole No. VB-03-26

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT
Barrier Island Restoration (BA-35)

2. LOCATION (Coordinates or Station)
N 282,503.5 E 3,756,579.0

3. DRILLING AGENCY
Alpine Ocean Seismic Survey

4. HOLE NO. (As shown on drawing title and file number) VB-03-26

5. NAME OF DRILLER
J. Cole

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.

7. PENETRATION (ft) 29.6

8. RECOVERY (ft) 30.0

9. TOTAL CORE RECOVERY (%) 101.0

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
MLLW

12. MANUFACTURER'S DESIGNATION OF DRILL
Vibracore

13. TOTAL NO. OF SAMPLES TAKEN : INTERVAL 4 : COMPOSITE 1

14. TOTAL NUMBER CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE : STARTED 8/29/03 : COMPLETED 8/29/03

17. ELEVATION TOP OF HOLE -24.1

18. TOTAL CORE RECOVERY FOR BORING 101 %

19. GEOLOGIST
W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No. Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-24.1	0.0		Sample Washed Out, assumed to be CLAY			Composite Sample 1: 9.8'-29.6' 75.8% Sand 14.1% Silt 10.0% Clay Mean: 0.051 mm
-33.9	9.8		Dark gray silty SAND		1 9.8 13.0	95.3% Sand 3.3% Silt 1.4% Clay Mean: 0.164 mm
-36.1	12.0	▨	Dark gray CLAY			
-38.1	14.0		Dark gray sandy SILT, with trace clay in thin lenses		2 14.0 19.0	95.9% Sand 2.7% Silt 1.3% Clay Mean: 0.199 mm
					3 19.0 24.0	97.9% Sand 1.2% Silt 0.8% Clay Mean: 0.212 mm
-46.2	22.1	▨	Dark gray CLAY			
-48.1	24.0		Dark gray silty FINE SAND		4 24.0 29.6	47.3% Sand 40.6% Silt 12.1% Clay Mean: 0.036 mm
-50.2	26.1		Dark gray-brown PEAT			
-50.5	26.4		Dark gray silty FINE SAND			
-53.7	29.6					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT
Barrier Island Restoration (BA-35)

HOLE NO.
VB-03-26

Penetration Graph for Core No. 24, Run 1

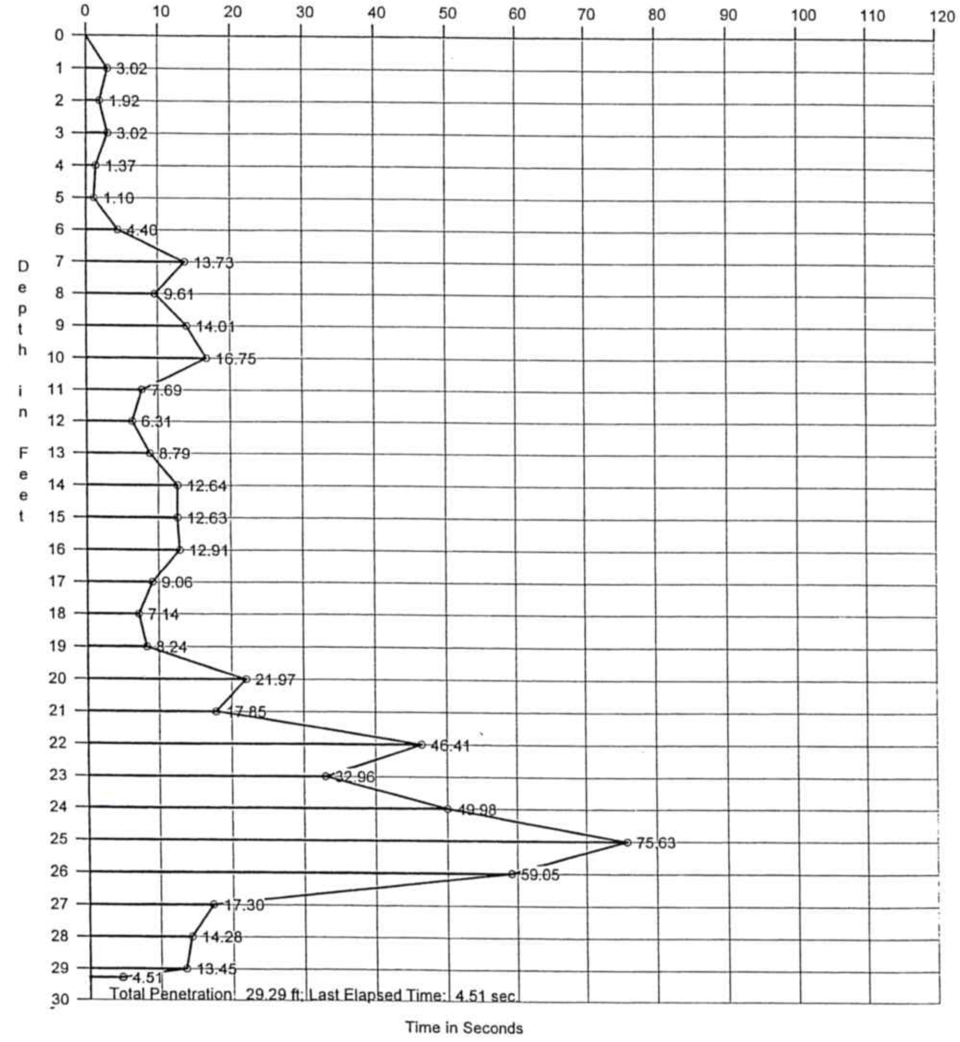
Date: 8/28/03
Start Time: 2:01:28 PM
End Time: 2:09:56 PM

Penetration: 29.29 ft
Recovery: 30.0
W. D. Corrected: 25.0 ft
W. D. Raw: 26.5 ft

Easting: 3757067.54
Northing: 281957.53
Coord. System: LA SOUTH 83

Lat: 2916.0064
Long: 08950.3840
Datum: WGS-84

Comment:



Hole No. VB-03-24

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT Barrier Island Restoration (BA-35)		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) N 281,957.5 E 3,757,067.5		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY Alpine Ocean Seismic Survey		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore	
4. HOLE NO. (As shown on drawing title and file number)	VB-03-24	13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 4 COMPOSITE 2
5. NAME OF DRILLER J. Cole		14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED 8/28/03 COMPLETED 8/28/03
7. PENETRATION (ft)	29.3	17. ELEVATION TOP OF HOLE	-25.0
8. RECOVERY (ft)	30.0	18. TOTAL CORE RECOVERY FOR BORING	102 %
9. TOTAL CORE RECOVERY (%)	102.0	19. GEOLOGIST	W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-25.0 -32.4	0.0 7.4	▨	Dark gray CLAY			Composite Sample 1: 0'-15' 65.3% Sand 18.7% Silt 16.0% Clay Mean : 0.031 mm (See Notes 1 and) Composite Sample 2: 15'-30' 76.6% Sand 12.7% Silt 10.7% Clay Mean: 0.051 mm (See Notes 1 and 2)
-35.0	10.0	░	Dark gray silty FINE SAND		1 7.4 10.0	93.7% Sand 4.0% Silt 2.3% Clay Mean: .0177 mm
-35.9	10.9	▨	Dark gray CLAY			
-36.4	11.4	░	Dark gray FINE SAND			
-37.7	12.7	▨	Dark gray CLAY			
-44.8	19.8	░	Dark gray silty FINE SAND		2 12.7 17.6 3 17.8 24.9	86.9% Sand 7.7% Silt 5.5% Clay Mean 0.164 mm (See Notes 1 and 2) 79.9% Sand 11.0% Silt 9.1% Clay Mean: 0.064 mm
-46.2	21.2	▨	Dark gray CLAY			
-46.9	21.9	░	Dark gray silty FINE SAND			
-47.2	22.2	▨	Dark gray CLAY			
-47.4	22.4	░	Dark gray silty FINE SAND			
-48.0	23.0	▨	Dark gray CLAY			
-54.2	29.2	░	Dark gray silty FINE SAND		4 24.9 30.0	96.6% Sand 2.0% Silt 1.4% Clay Mean: 0.208 mm

ENG FORM MAR 71 1836 PREVIOUS EDITIONS ARE OBSOLETE.

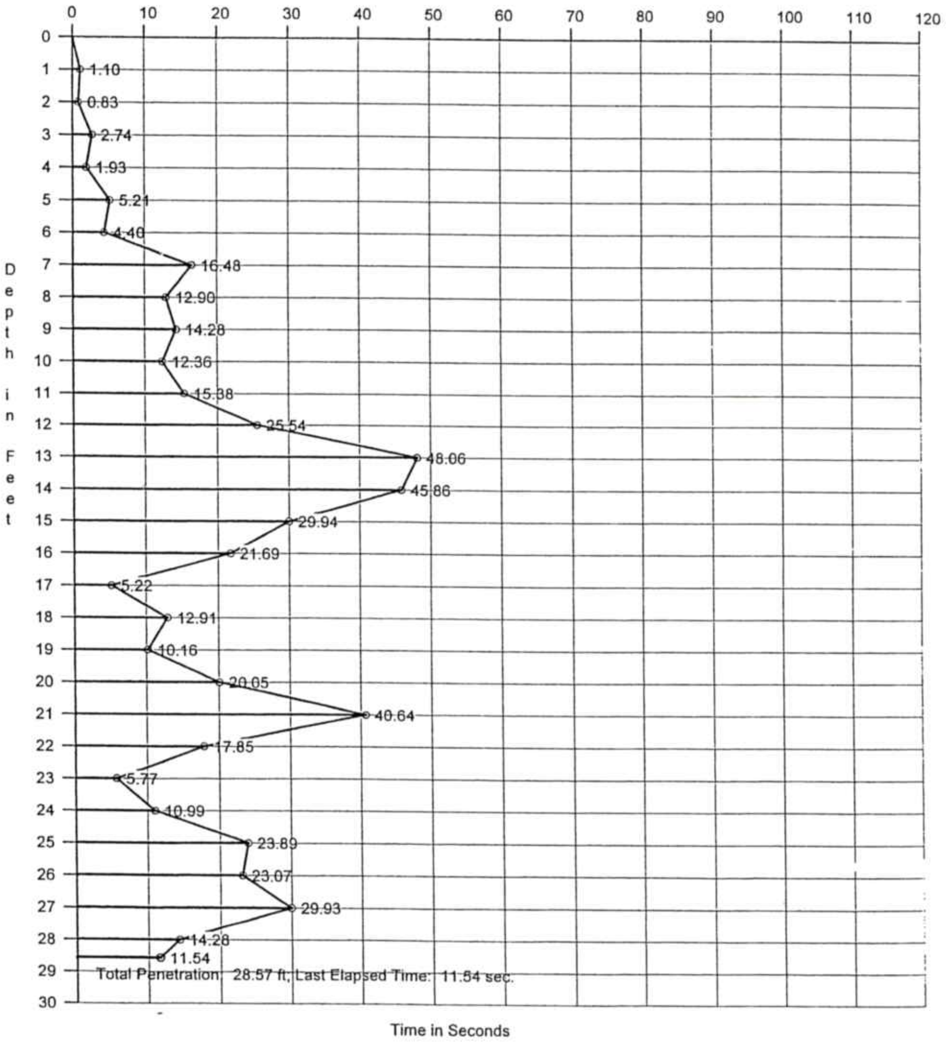
PROJECT Barrier Island Restoration (BA-35)

HOLE NO. VB-03-24

Penetration Graph for Core No. 20, Run 1

Date: 8/28/03	Penetration: 28.57 ft	Easting: 3757560.26	Lat: 2915.9302
Start Time: 9:01:57 AM	Recovery: 28.2	Northing: 281501.90	Long: 08950.2924
End Time: 9:10:02 AM	W. D. Corrected: 25.7 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 27.1 ft		

Comment:



Hole No. VB-03-20

DRILLING LOG	DIVISION
INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT	Barrier Island Restoration (BA-35)
2. LOCATION (Coordinates or Station)	N 281,501.9 E 3,757,560.3
3. DRILLING AGENCY	Alpine Ocean Seismic Survey
4. HOLE NO. (As shown on drawing title and file number)	VB-03-20
5. NAME OF DRILLER	J. Cole
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. PENETRATION (ft)	28.6
8. RECOVERY (ft)	28.2
9. TOTAL CORE RECOVERY (%)	99.0
10. SIZE AND TYPE OF BIT	
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL	Vibracore
13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 5 COMPOSITE 1
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 8/28/03 COMPLETED 8/28/03
17. ELEVATION TOP OF HOLE	-25.7
18. TOTAL CORE RECOVERY FOR BORING	99 %
19. GEOLOGIST	W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No Depth Interval, ft f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-25.7	0.0		Dark gray Clay with scattered shells in upper 0.5 foot			Composite Sample 1: 3.6'-28.5' 64.6% Sand 20.0% Silt 15.4% Clay Mean: 0.029 mm
-29.3	3.6		Dark gray silty FINE SAND		1 3.6 8.0	90.2% Sand 7.4% Silt 2.5% Clay Mean: 0.149 mm
-33.0	7.3		Dark gray CLAY			
-33.1	7.4		Dark gray silty FINE SAND		2 8.0 12.0	68.0% Sand 17.0% Silt 15.0% Clay Mean: 0.027 mm
-35.2	9.5		Dark gray SILT			
-35.9	10.2		Dark gray CLAY			
-36.2	10.5		Dark gray laminated SILT and CLAY			
-37.0	11.3		Dark gray fine to medium SAND		3 12.0 17.6	94.6% Sand 3.6% Silt 1.8% Clay Mean: 0.171 mm
-41.2	15.5		Dark gray silty SAND with clay laminae			
-43.3	17.6		Dark gray CLAY with silt nodules			
-45.2	19.5		Dark gray-brown organic PEAT layer			
-46.2	20.5		Dark gray silty FINE SAND		4 20.0 23.6	95.6% Sand 2.7% Silt 1.8% Clay Mean: 0.212 mm
-49.3	23.6		Dark gray CLAY			
-50.4	24.7		Dark gray silty FINE SAND		5 24.7 28.5	54.8% Sand 37.1% Silt 8.2% Clay Mean: 0.051 mm
-51.9	26.2		Gray fine SAND with light brown silt and clay laminae			
-54.2	28.5					

ENG FORM MAR 71 1836 PREVIOUS EDITIONS ARE OBSOLETE.

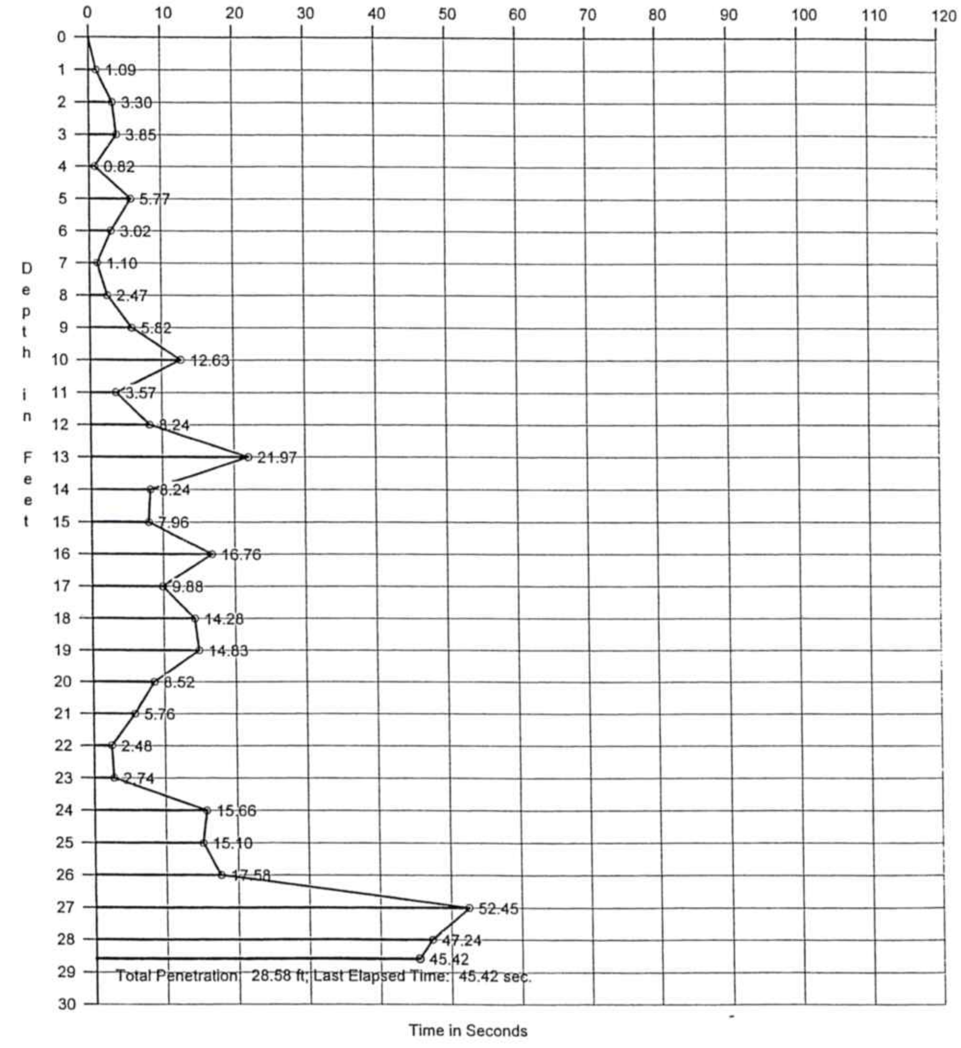
PROJECT Barrier Island Restoration (BA-35)

HOLE NO. VB-03-20

Penetration Graph for Core No. 25, Run 1

Date: 8/28/03	Penetration: 28.58 ft	Easting: 3758113.19	Lat: 2915.8360
Start Time: 2:57:38 PM	Recovery: 30.0	Northing: 280938.26	Long: 08950.1897
End Time: 3:03:37 PM	W. D. Corrected: 26.5 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 27.6 ft		

Comment:



Hole No. VB-03-25

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT Barrier Island Restoration (BA-35)
2. LOCATION (Coordinates or Station) N 280,938.3 E 3,758,113.2
3. DRILLING AGENCY Alpine Ocean Seismic Survey
4. HOLE NO. (As shown on drawing title and file number) VB-03-25
5. NAME OF DRILLER J. Cole
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. PENETRATION (ft) 28.6
8. RECOVERY (ft) 30.0
9. TOTAL CORE RECOVERY (%) 105.0
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore
13. TOTAL NO. OF SAMPLES TAKEN INTERVAL 4 COMPOSITE 1
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER
16. DATE HOLE STARTED 8/28/03 COMPLETED 8/28/03
17. ELEVATION TOP OF HOLE -26.5
18. TOTAL CORE RECOVERY FOR BORING 105 %
19. GEOLOGIST W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	Sample No. Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-26.5	0.0		Dark gray CLAY			Composite Sample 1: 7.6'-19.9' 70.3% Sand 15.3% Silt 14.5% Clay Mean: 0.031 mm
-34.1	7.6		Dark gray silty SAND		1 7.6 12.0	90.7% Sand 7.0% Silt 2.3% Clay Mean: 0.165 mm
-39.2	12.7		Dark gray CLAY		2 12.0 17.5	96.2% Sand 2.4% Silt 1.4% Clay Mean: 0.196 mm
-39.7	13.2		Dark gray silty SAND			
-40.0	13.5		Dark gray CLAY			
-40.5	14.0		Dark gray silty SAND			
-42.2	15.7		Dark gray CLAY			
-42.5	16.0		Dark gray silty SAND			
-44.0	17.5		Dark gray CLAY		3 17.5 19.9	95.5% Sand 2.9% Silt 1.7% Clay Mean: 0.192 mm
-44.3	17.8		Dark gray silty SAND			
-46.4	19.9		Dark gray CLAY			
-47.5	21.0		Dark gray silty SAND			
-47.7	21.2		Dark gray CLAY with shell fragments			
-51.6	25.1		Dark gray silty SAND		4 25.1 28.6	90.0% Sand 7.6% Silt 2.4% Clay Mean: 0.164 mm
-55.1	28.6					

ENG FORM MAR 71 1836 PREVIOUS EDITIONS ARE OBSOLETE.

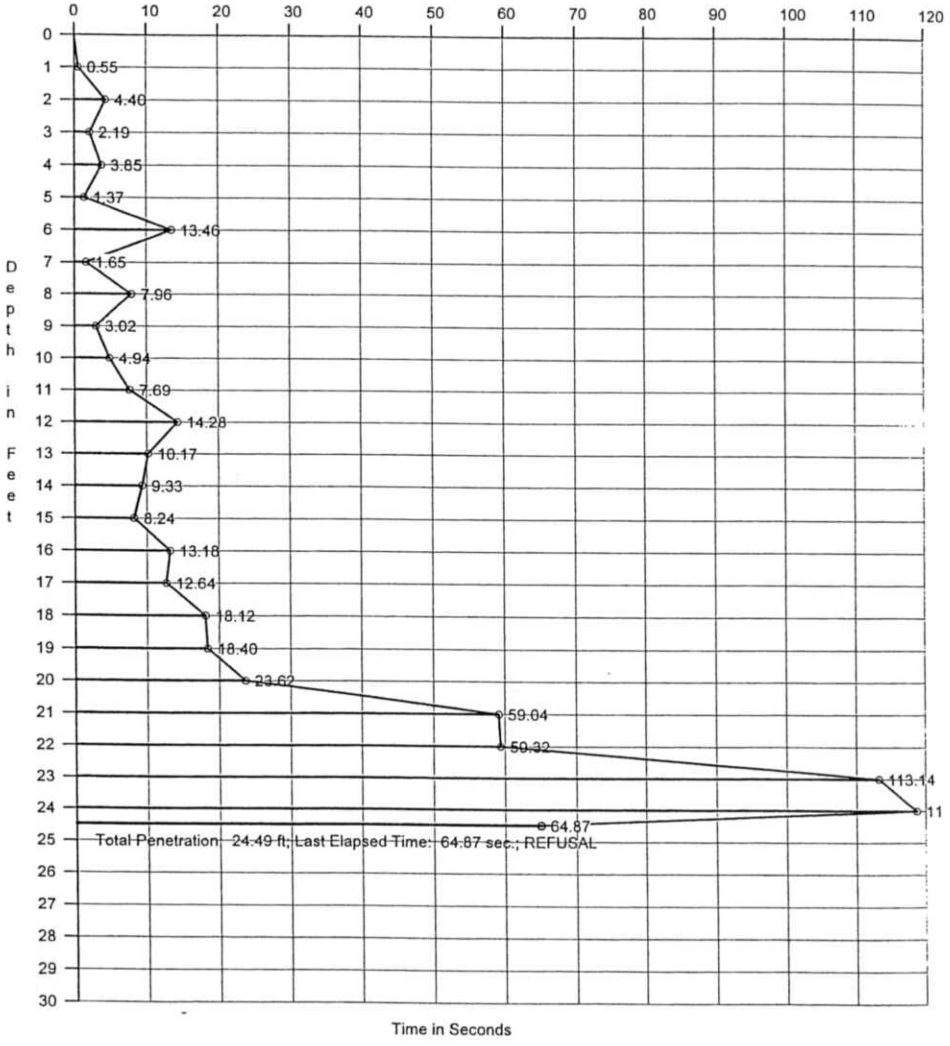
PROJECT Barrier Island Restoration (BA-35)

HOLE NO. VB-03-25

Penetration Graph for Core No. 27, Run 1

Date: 8/29/03	Penetration: 24.49 ft	Easting: 3759177.66	Lat: 2915.8459
Start Time: 9:29:30 AM	Recovery: 24.7	Northing: 281012.01	Long: 08949.9893
End Time: 9:39:24 AM	W. D. Corrected: 27.5 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 28.9 ft		

Comment:



Hole No. VB-03-27

DRILLING LOG

DIVISION		INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT Barrier Island Restoration (BA-35)		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) N 281,012.0 E 3,759,177.7		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY Alpine Ocean Seismic Survey		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore	
4. HOLE NO. (As shown on drawing title and file number)	VB-03-27	13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 4 ; COMPOSITE 1
5. NAME OF DRILLER J. Cole		14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. PENETRATION (ft)	24.5	16. DATE HOLE	STARTED 8/30/03 ; COMPLETED 8/30/03
8. RECOVERY (ft)	24.7	17. ELEVATION TOP OF HOLE	-25.7
9. TOTAL CORE RECOVERY (%)	101.0	18. TOTAL CORE RECOVERY FOR BORING	101 %
		19. GEOLOGIST W. McGuinness	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No. Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-25.7	0.0		Dark gray CLAY			Composite Sample 1: 9.6'-24.5' 93.4% Sand 4.4% Silt 2.2% Clay Mean: 0.163 mm
-29.2	3.5		Dark gray silty CLAY, some fine Sand			
-30.0	4.3		Dark gray CLAY			
-31.3	5.6		Dark gray silty CLAY, some fine Sand			
-31.8	6.1		Dark gray CLAY			
-33.5	7.8		Dark gray silty FINE SAND			
-34.4	8.7		Dark gray CLAY			
-34.7	9.0		Dark gray silty FINE SAND			
-34.9	9.2		Dark gray CLAY			
-35.3	9.6		Dark gray silty FINE SAND		1 9.6 15.0	83.0% Sand 10.7% Silt 6.3% Clay Mean: 0.095 mm
					2 15.0 21.7	74.4% Sand 16.1% Silt 9.5% Clay Mean: 0.039 mm
-47.4	21.7		Dark brown PEAT layer			
-48.1	22.4		Dark gray silty fine SAND		3 21.7 22.4	56.8% Sand 29.8% Silt 13.4% Clay Mean: 0.031 mm
-50.2	24.5				4 22.4 24.5	94.7% Sand 3.3% Silt 1.9% Clay Mean: 0.170 mm

ENG FORM MAR 71 1836 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Barrier Island Restoration (BA-35)

HOLE NO. VB-03-27

Penetration Graph for Core No. 33, Run 1

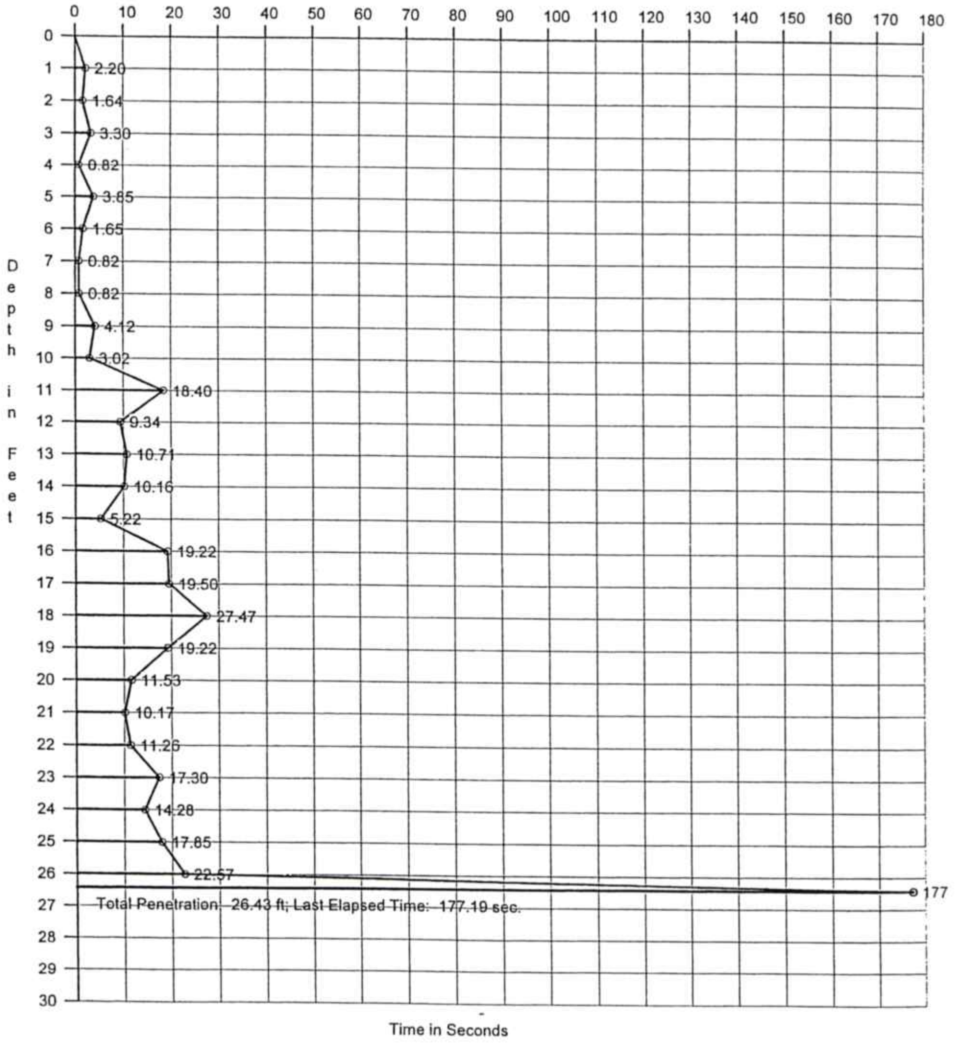
Date: 8/29/03
Start Time: 4:45:57 PM
End Time: 4:53:21 PM

Penetration: 26.43 ft
Recovery: 29.4
W. D. Corrected: 19.8 ft
W. D. Raw: 21.2 ft

Easting: 3755244.59
Northing: 284522.38
Coord. System: LA SOUTH 83

Lat: 2916.4335
Long: 08950.7207
Datum: WGS-84

Comment:



Hole No. VB-03-33

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT
Barrier Island Restoration (BA-35)

2. LOCATION (Coordinates or Station)
N 284,522.4 E 3,755,244.6

3. DRILLING AGENCY
Alpine Ocean Seismic Survey

4. HOLE NO. (As shown on drawing title and file number) VB-03-33

5. NAME OF DRILLER
J. Cole

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.

7. PENETRATION (ft) 26.4

8. RECOVERY (ft) 29.2

9. TOTAL CORE RECOVERY (%) 111.0

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
MLLW

12. MANUFACTURER'S DESIGNATION OF DRILL
Vibracore

13. TOTAL NO. OF SAMPLES TAKEN INTERVAL 3 COMPOSITE 2

14. TOTAL NUMBER CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE STARTED 8/29/03 COMPLETED 8/29/03

17. ELEVATION TOP OF HOLE -19.8

18. TOTAL CORE RECOVERY FOR BORING 111 %

19. GEOLOGIST
W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No. Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-19.8 -24.6	0.0 4.8	▨	Dark gray Clay			Composite 1, 5'-15' 59.3% Sand 24.1% Silt 16.6% Clay Mean: 0.027 mm (See Notes 1 and 2) Composite 2, 15'-29.2' 82.6% Sand 8.9% Silt 8.7% Clay Mean: 0.086 mm (See Notes 1 and 2)
-25.5	5.7	▨	Very soft Dark gray Clay			
-27.1	7.3	▨	Dark gray Clay			
-27.5	7.7	□	Dark gray silty Sand			
-27.9	8.1	▨	Dark gray Clay			
-29.6	9.8	░	Dark gray fine Sand with Silt			
-30.1	10.3	▨	Dark gray Clay			
-30.7	10.9	░	Dark gray fine Sand			
-31.1	11.3	▨	Dark gray Clay			
-31.9	12.1	░	Dark gray fine Sand			
-32.0	12.2	▨	Dark gray Clay			
-32.5	12.7	░	Dark gray fine Sand			
-34.0	14.2	▨	Dark gray Clay			
-40.5	20.7	░	Dark gray fine Sand		1 14.2 20.7	96.8% Sand 2.3% Silt 0.9% Clay Mean: 0.191 mm
-41.3	21.5	▨	Dark gray Clay			
-49.0	29.2	░	Dark gray fine Sand		2 21.5 25.0 3 25.0 29.2	94.1% Sand 3.6% Silt 2.4% Clay Mean: 0.201 mm 96.0% Sand 2.5% Silt 1.5% Clay Mean: 0.215 mm

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

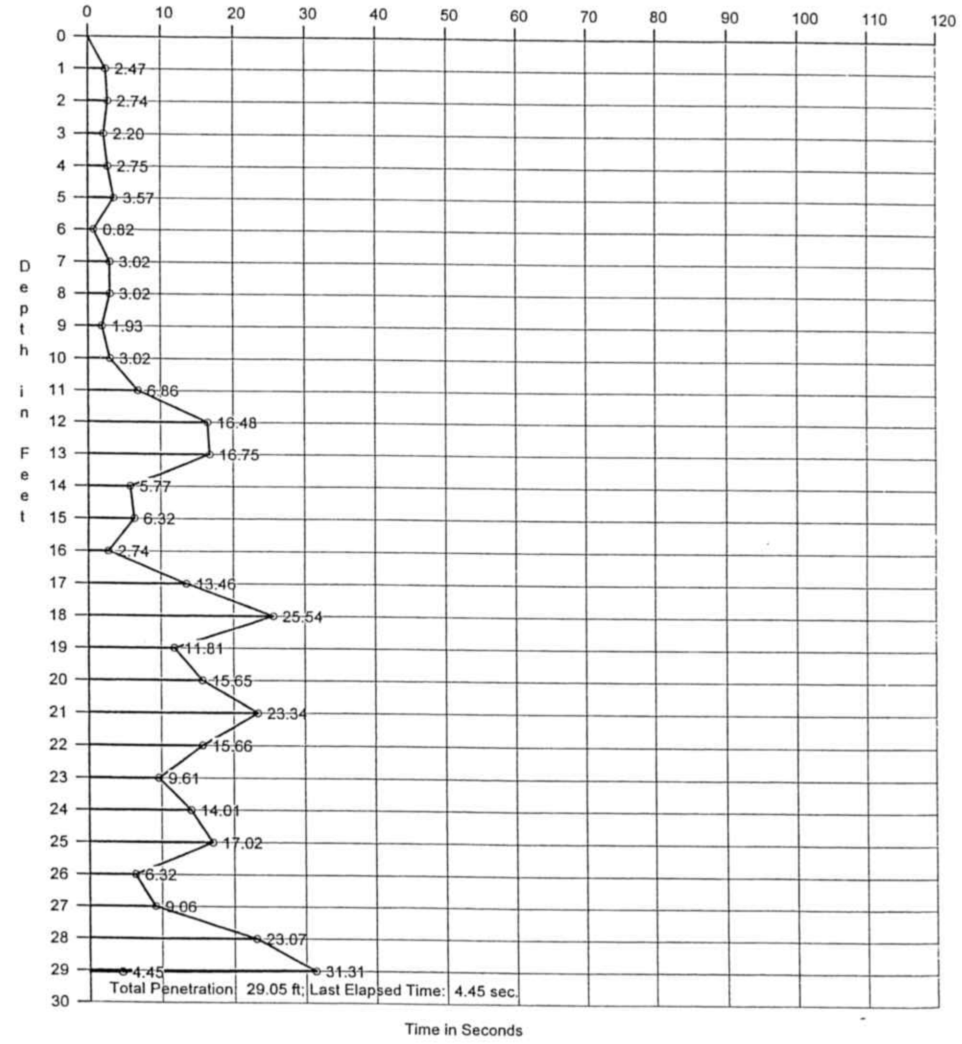
PROJECT
Barrier Island Restoration (BA-35)

HOLE NO.
VB-03-33

Penetration Graph for Core No. 08, Run 1

Date: 8/25/03	Penetration: 29.05 ft	Easting: 3755622.95	Lat: 2916.3372
Start Time: 4:19:35 PM	Recovery: 30.0	Northing: 283943.58	Long: 08950.6509
End Time: 4:24:36 PM	W. D. Corrected: 21.4 ft	Coord. System: la south	Datum: WGS-84
	W. D. Raw: 22.2 ft		

Comment:



Time in Seconds

Hole No. VB-03-08

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT
Barrier Island Restoration (BA-35)

2. LOCATION (Coordinates or Station)
N 283,943.6 E 3,755,622.9

3. DRILLING AGENCY
Alpine Ocean Seismic Survey

4. HOLE NO. *(As shown on drawing title and file number)* VB-03-08

5. NAME OF DRILLER
J. Cole

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.

7. PENETRATION (ft) 29.1

8. RECOVERY (ft) 30.0

9. TOTAL CORE RECOVERY (%) 103.0

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*
MLLW

12. MANUFACTURER'S DESIGNATION OF DRILL
Vibracore

13. TOTAL NO. OF SAMPLES TAKEN INTERVAL 5 COMPOSITE 2

14. TOTAL NUMBER CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE STARTED 8/25/03 COMPLETED 8/25/03

17. ELEVATION TOP OF HOLE -21.4

18. TOTAL CORE RECOVERY FOR BORING 103 %

19. GEOLOGIST
W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	Sample No. Depth Interval, ft. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g
-21.4	0.0	▨	Dark gray Clay			Composite 1: 8.7'-21' 80.2% Sand 12.1% Silt 7.1% Clay Mean: 0.090 mm Composite 2: 21.0'-30.0' 66.4% Sand 19.0% Silt 14.5% Clay Mean: 0.032 mm
-26.9	5.5					
-27.1	5.7	▨	Light brown clay lens			
		▨	Dark gray Clay			
-29.6	8.2					
-29.7	8.3	▨	Dark gray fine Sand			
-30.2	8.8	░	Dark gray Clay		1 8.7 12.6	78.7% Sand 14.2% Silt 7.1% Clay Mean: 0.065 mm
-30.6	9.2	░	Dark gray fine Sand			
-30.7	9.3	░	Dark gray Clay lens			
		░	Dark gray fine Sand			
-32.8	11.4					
		▨░	Dark gray Clay with thin sandy laminae			
-34.1	12.7					
-34.7	13.3	▨	Dark gray Clay			
-34.9	13.5	▨	Dark gray fine Sand			
		▨	Dark gray Clay with a sand lens at 13.7-13.8'			
-36.9	15.5					
		░	Dark gray fine Sand with black organics between 16.4' and 16.8' and a clay lens at 18.4'-18.7'		2 15.5 19.5	84.0% Sand 8.8% Silt 7.2% Clay Mean: 0.119 mm
-40.9	19.5					
-41.2	19.8	▨	Dark gray Clay lens		3 19.5 23.4	81.3% Sand 11.7% Silt 7.6% Clay Mean: 0.086 mm
		░	Dark gray fine Sand			
-42.4	21.0					
		░▨	Dark gray fine Sand with clay layers to 0.2' thick			
-44.8	23.4					
		░	Dark gray fine Sand		4 23.4 27.4	92.9% Sand 4.8% Silt 2.3% Clay Mean: 0.163 mm
-49.1	27.7					
-49.6	28.2	▨	Dark gray Clay		5 27.4 30.0	90.5% Sand 6.8% Silt 2.6% Clay Mean: 0.146 mm
		░▨	Dark gray fine Sand with clay lenses to 0.2' thick			
-51.4	30.0					

ENG FORM MAR 71 **1836** PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT
Barrier Island Restoration (BA-35)

HOLE NO.
VB-03-08

Penetration Graph for Core No. 07, Run 1

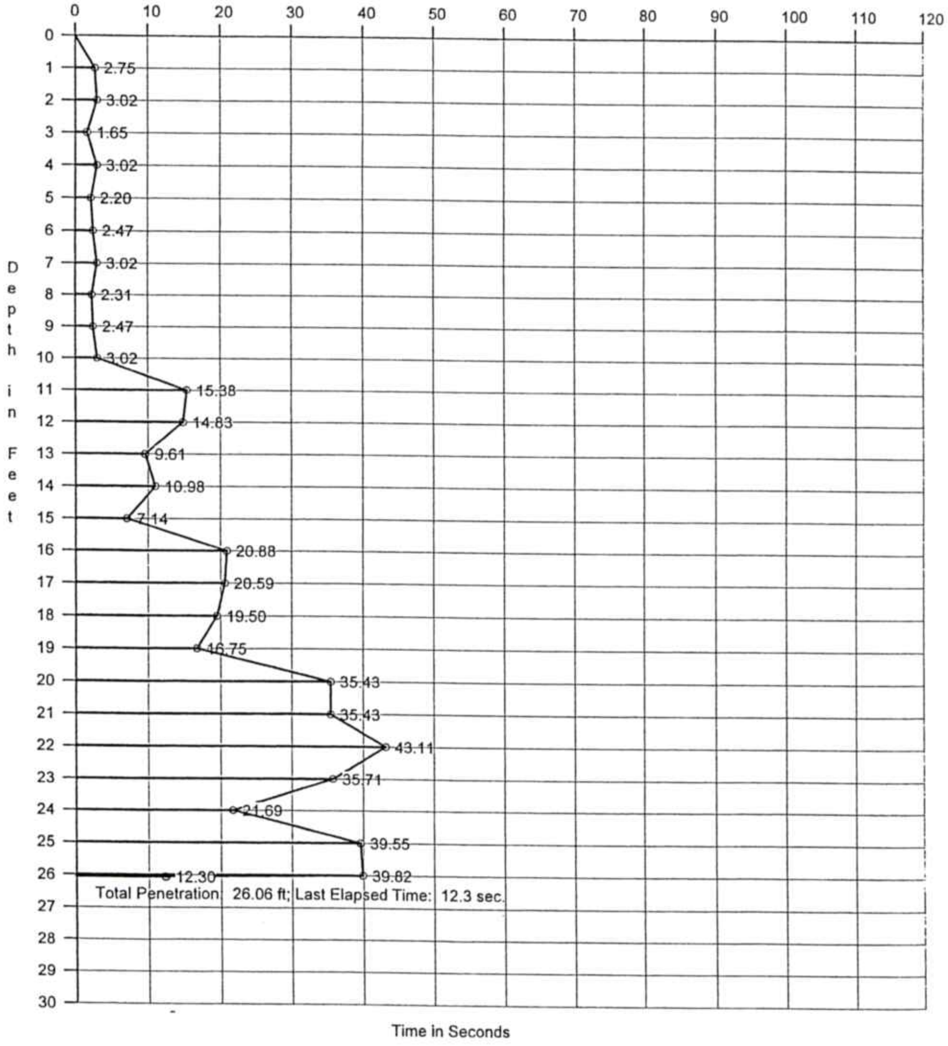
Date: 8/25/03
Start Time: 3:38:16 PM
End Time: 3:45:22 PM

Penetration: 26.06 ft
Recovery: 28.1
W. D. Corrected: 23.3 ft
W. D. Raw: 24.2

Easting: 3756539.1
Northing: 282887.37
Coord. System: la south

Lat: 2916.1609
Long: 8950.4811
Datum: WGS-84

Comment:



Hole No. VB-03-07

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT Barrier Island Restoration (BA-35)
2. LOCATION (Coordinates or Station) N 282,887.4 E 3,756,539.1
3. DRILLING AGENCY Alpine Ocean Seismic Survey
4. HOLE NO. (As shown on drawing title and file number) VB-03-07
5. NAME OF DRILLER J. Cole
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. PENETRATION (ft) 26.1
8. RECOVERY (ft) 28.1
9. TOTAL CORE RECOVERY (%) 108.0
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore
13. TOTAL NO. OF SAMPLES TAKEN INTERVAL 4 COMPOSITE 1
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER
16. DATE HOLE STARTED 8/25/03 COMPLETED 8/25/03
17. ELEVATION TOP OF HOLE -23.3
18. TOTAL CORE RECOVERY FOR BORING 108 %
19. GEOLOGIST W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	Sample No. Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-23.3	0.0	▨	Dark gray Clay with a shell lens at 4.4-4.6'			Composite Sample: 10.8'-27.8' 84.2% Sand 9.7% Silt 6.0% Clay Mean: 0.119 mm (See Notes 1 and 2)
-34.1	10.8	░	Dark gray fine Sand, with a clay layer at 12.7'-12.8'		1 10.8 15.0	86.2% Sand 9.4% Silt 4.2% Clay Mean: 0.108 mm
-38.2	14.9	▨	Dark gray Clay		2 15.0 19.0	85.3% Sand 8.5% Silt 6.3% Clay Mean: 0.124 mm
-38.8	15.5	░	Dark gray fine Sand with some silt			
-39.9	16.6	▨	Dark gray Clay			
-40.3	17.0	░	Dark gray fine Sand, trace silt		3 19.0 23.0	95.8% Sand 2.5% Silt 1.8% Clay Mean: 0.176 mm
					4 23.0 27.8	87.7% Sand 9.6% Silt 2.7% Clay Mean: 0.139 mm
-50.8	27.5	▨	Dark gray Clay lens			
-51.0	27.7		Dark gray fine Sand, trace silt			
-51.1	27.8					

ENG FORM MAR 71 1836 PREVIOUS EDITIONS ARE OBSOLETE.

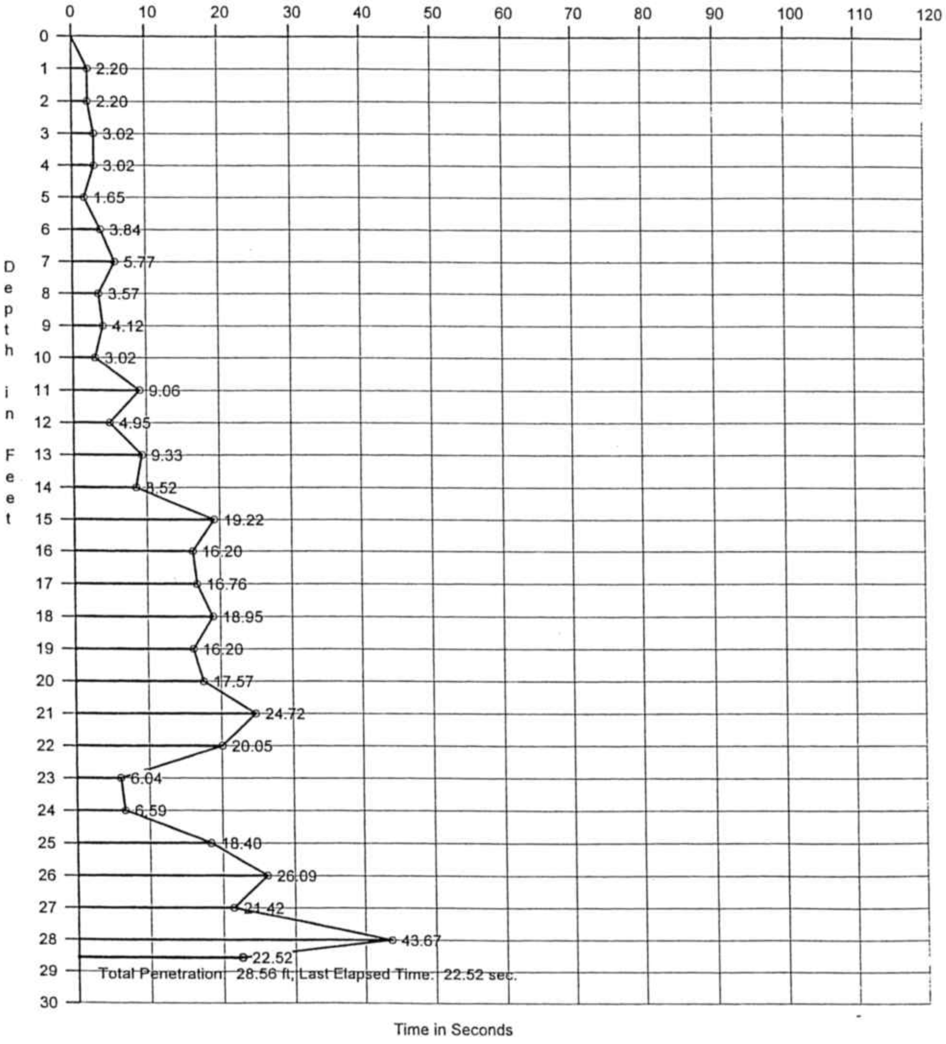
PROJECT Barrier Island Restoration (BA-35)

HOLE NO. VB-03-07

Penetration Graph for Core No. 15, Run 1

Date: 8/27/03	Penetration: 28.56 ft	Easting: 3756112.40	Lat: 2916.2608
Start Time: 1:54:00 PM	Recovery: 29.7	Northing: 283487.16	Long: 08950.5599
End Time: 1:59:59 PM	W. D. Corrected: 22.5 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 23.9 ft		

Comment:



Hole No. VB-03-15

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT
Barrier Island Restoration (BA-35)

2. LOCATION (Coordinates or Station)
N 280,032.6 E 3,758,201.9

3. DRILLING AGENCY
Alpine Ocean Seismic Survey

4. HOLE NO. (As shown on drawing title and file number) VB-03-15

5. NAME OF DRILLER
J. Cole

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.

7. PENETRATION (ft) 28.8

8. RECOVERY (ft) 29.7

9. TOTAL CORE RECOVERY (%) 107.0

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
MLLW

12. MANUFACTURER'S DESIGNATION OF DRILL
Vibracore

13. TOTAL NO. OF SAMPLES TAKEN — INTERVAL 5 — COMPOSITE 1

14. TOTAL NUMBER CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE — STARTED 8/27/03 — COMPLETED 8/27/03

17. ELEVATION TOP OF HOLE -22.5

18. TOTAL CORE RECOVERY FOR BORING 107 %

19. GEOLOGIST
W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	Sample No. Depth Interval, ft f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-22.5	0.0	▨	Dark gray firm CLAY			Composite Sample 1: 5'-30' 50.4% Sand 28.6% Silt 21.0% Clay Mean: 0.022 mm (See Notes 1 and 2)
					1 5.0 10.0	48.6% Sand 32.6% Silt 18.9% Clay Mean: 0.023 mm
-28.4	5.9	▦	Dark gray silty CLAY			
-28.7	6.2	░	Dark gray silty FINE SAND			
-29.4	6.9	▦	Dark gray silty CLAY			
-30.1	7.6	▨	Dark gray CLAY			
-30.9	8.4	░	Dark gray silty FINE SAND			
-32.1	9.6	▨	Dark gray CLAY			
					2 10.0 15.0	86.8% Sand 8.0% Silt 5.3% Clay Mean: 0.122 mm
-33.5	11.0	░	Dark gray fine to medium SAND			
-36.9	14.4	░	Dark gray silty FINE SAND			
-37.2	14.7	░	Dark gray fine to medium SAND			
					3 15.0 20.0	93.7% Sand 4.1% Silt 2.3% Clay Mean: 0.135 mm
-39.8	17.3	▨	Dark gray CLAY			
-40.1	17.6	░	Dark gray FINE SAND			
					4 20.0 25.0	87.7% Sand 7.8% Silt 5.2% Clay Mean: 0.114 mm
-44.6	22.1	▦	Dark gray to red CLAY with silt lenses			
-47.5	25.0	░	Dark gray fine to medium SAND		5 25.0 30.0	95.4% Sand 3.1% Silt 1.6% Clay Mean: 0.173 mm
-52.5	30.0					

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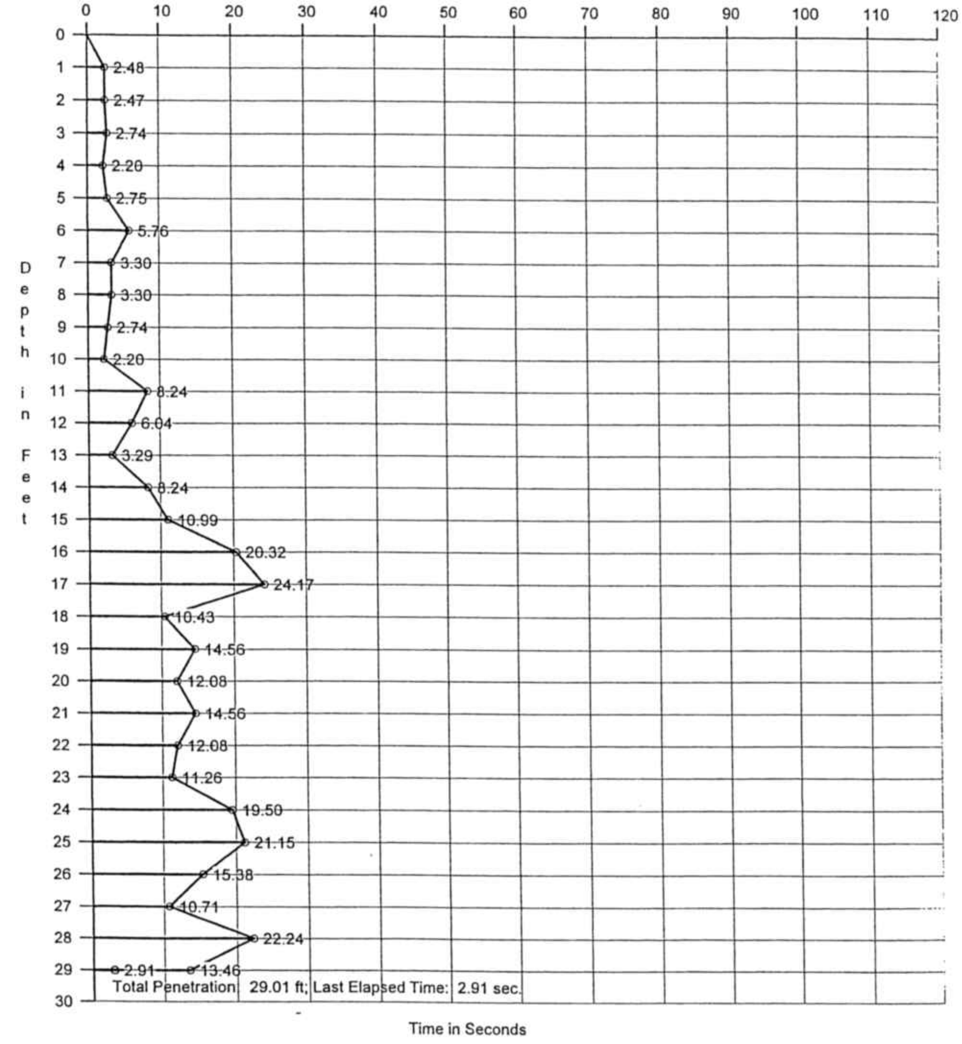
PROJECT
Barrier Island Restoration (BA-35)

HOLE NO.
VB-03-15

Penetration Graph for Core No. 16, Run 1

Date: 8/27/03	Penetration: 29.01 ft	Easting: 3757041.35	Lat: 2916.0964
Start Time: 2:55:41 PM	Recovery: 29.7	Northing: 282502.83	Long: 08950.3876
End Time: 3:00:35 PM	W. D. Corrected: 24.0 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 25.3 ft		

Comment:



Hole No. VB-03-16

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT
Barrier Island Restoration (BA-35)

2. LOCATION (Coordinates or Station)
N 282,502.8 E 3,757,041.4

3. DRILLING AGENCY
Alpine Ocean Seismic Survey

4. HOLE NO. (As shown on drawing title and file number) VB-03-16

5. NAME OF DRILLER
J. Cole

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.

7. PENETRATION (ft) 29.0

8. RECOVERY (ft) 29.7

9. TOTAL CORE RECOVERY (%) 102.0

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
MLLW

12. MANUFACTURER'S DESIGNATION OF DRILL
Vibracore

13. TOTAL NO. OF SAMPLES TAKEN INTERVAL 5 COMPOSITE 1

14. TOTAL NUMBER CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE STARTED 8/27/03 COMPLETED 8/27/03

17. ELEVATION TOP OF HOLE -24.0

18. TOTAL CORE RECOVERY FOR BORING 102 %

19. GEOLOGIST
W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No Depth Interval, ft f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-24.0 -28.3	0.0 4.3	▨	Dark gray CLAY with one shell at 1.7'			Composite Sample 1: 5'-30' 72.4% Sand 18.6% Silt 9.1% Clay Mean: 0.052 mm (See Notes 1 and 2)
-28.9	4.9	▦	Dark gray clayey SILT with fine Sand			
-30.5	6.5	▦	Dark gray silty CLAY with nodules of light gray clay and silt laminae		1 5.0 10.0	48.0% Sand 41.0% Silt 10.5% Clay Mean: 0.031 mm
-32.0	8.0	░	Dark gray sandy SILT			
-33.0	9.0	▨	Dark gray CLAY			
-34.2	10.2	░	Dark gray silty SAND			
-35.0	11.0	▨	Dark gray CLAY		2 10.0 15.0	39.8% Sand 39.6% Silt 20.7% Clay Mean: 0.018 mm
-35.5	11.5	░	Dark gray silty SAND			
-36.0	12.0	▨	Dark gray CLAY			
-39.8	15.8	░	Dark gray silty SAND			
-40.0	16.0	▨	Dark gray CLAY		3 15.0 20.0	84.6% Sand 10.0% Silt 5.5% Clay Mean: 0.111 mm
		░	Dark gray silty SAND with black organic silt streaks at 18.8', 19.6', and 26.2-30'			
					4 20.0 25.0	93.0% Sand 4.4% Silt 2.5% Clay Mean: 0.153 mm (See Notes 1 and 2)
-54.0	30.0				5 25.0 30.0	89.6% Sand 7.9% Silt 2.5% Clay Mean: 0.141 mm

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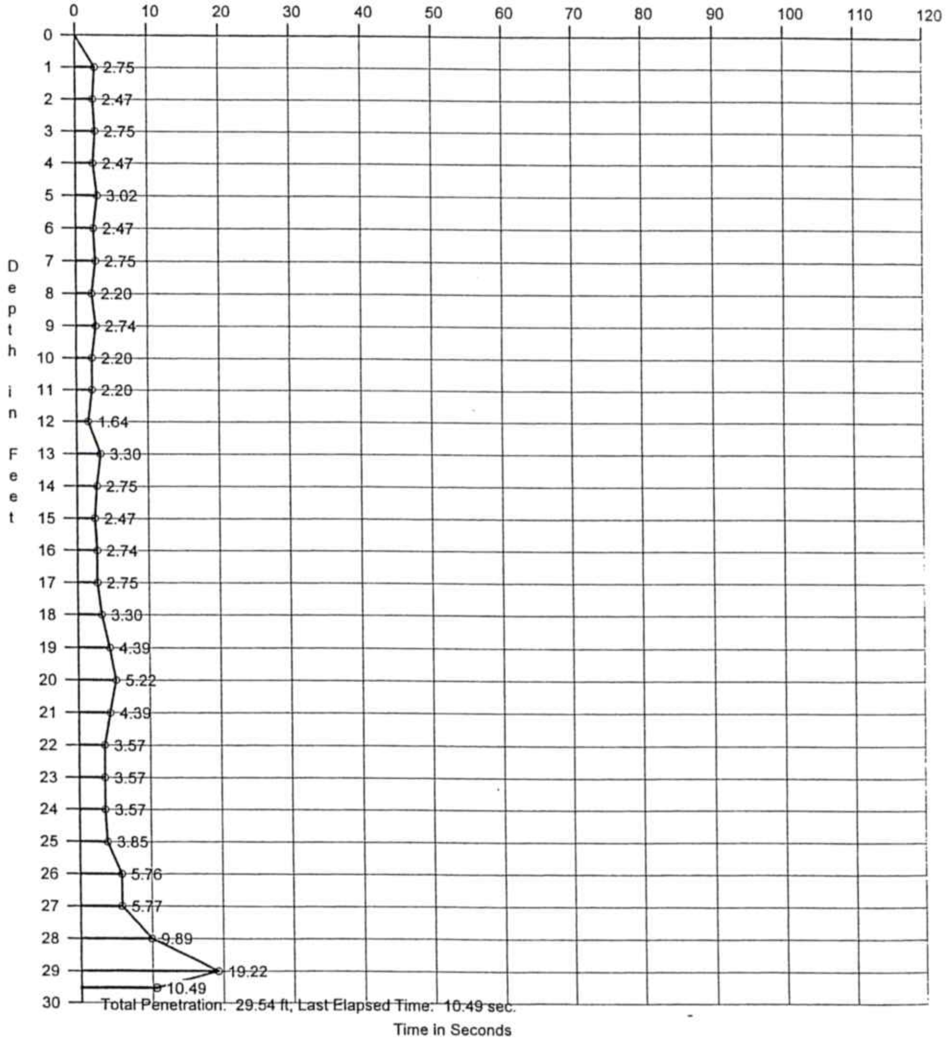
PROJECT
Barrier Island Restoration (BA-35)

HOLE NO.
VB-03-16

Penetration Graph for Core No. 18, Run 1

Date: 8/27/03	Penetration: 29.54 ft	Easting: 3757882.12	Lat: 2916.0095
Start Time: 4:16:35 PM	Recovery: 29.7	Northing: 281986.83	Long: 08950.2306
End Time: 4:18:42 PM	W. D. Corrected: 25.4 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 26.5 ft		

Comment:



Hole No. VB-03-18

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT
Barrier Island Restoration (BA-35)

2. LOCATION (Coordinates or Station)
N 281,986.8 E 3,757,882.1

3. DRILLING AGENCY
Alpine Ocean Seismic Survey

4. HOLE NO. (As shown on drawing title and file number) VB-03-18

5. NAME OF DRILLER
J. Cole

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.

7. PENETRATION (ft) 29.5

8. RECOVERY (ft) 29.7

9. TOTAL CORE RECOVERY (%) 100.0

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
MLLW

12. MANUFACTURER'S DESIGNATION OF DRILL
Vibracore

13. TOTAL NO. OF SAMPLES TAKEN INTERVAL 5 COMPOSITE 1

14. TOTAL NUMBER CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE STARTED 8/27/03 COMPLETED 8/27/03

17. ELEVATION TOP OF HOLE -25.4

18. TOTAL CORE RECOVERY FOR BORING 100 %

19. GEOLOGIST
W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	Sample No. Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-25.4	0.0	▨	Dark gray slightly silty CLAY			Composite Sample 1: 6'-30' 60.5% Sand 29.1% Silt 10.5% Clay Mean: 0.034 mm (See Notes 1 and 2)
-29.2	3.8	▦	Dark gray silty CLAY			
-31.4	6.0	░	Dark gray silty FINE SAND		1 6.0 10.0	61.1% Sand 27.5% Silt 11.4% Clay Mean: 0.045 mm
-32.8	7.4	▦	Dark gray silty CLAY			
-33.4	8.0	▨	Dark gray CLAY			
-34.7	9.3	▨	Dark gray slightly silty CLAY			
-35.2	9.8	░	Dark gray silty FINE SAND, trace clay; with brown organic streaks and clay laminae below 26'		2 10.0 15.0	54.8% Sand 34.9% Silt 10.4% Clay Mean: 0.033 mm
					3 15.0 20.0	69.9% Sand 21.5% Silt 8.5% Clay Mean: 0.056 mm (See Notes 1 and 2)
					4 20.0 25.0	74.7% Sand 19.1% Silt 6.2% Clay Mean: 0.085 mm (See Notes 1 and 2)
					5 25.0 30.0	91.2% Sand 7.3% Silt 1.5% Clay Mean: 0.123 mm
-55.4	30.0					

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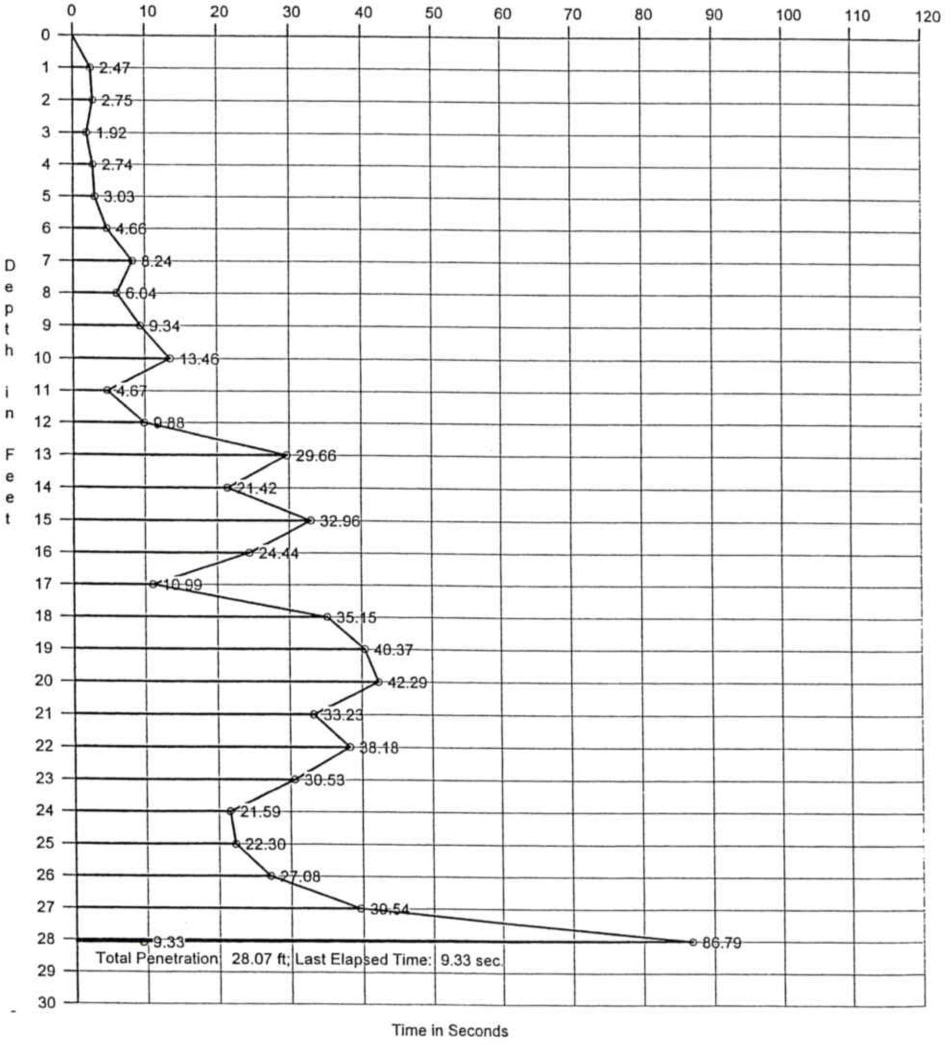
PROJECT
Barrier Island Restoration (BA-35)

HOLE NO.
VB-03-18

Penetration Graph for Core No. 17, Run 1

Date: 8/27/03	Penetration: 28.07 ft	Easting: 3758639.24	Lat: 2915.8385
Start Time: 3:33:25 PM	Recovery: 30.0	Northing: 280960.35	Long: 08950.0907
End Time: 3:43:40 PM	W. D. Corrected: 26.4 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 27.6 ft		

Comment:



Hole No. VB-03-17

DRILLING LOG

DIVISION		INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT Barrier Island Restoration (BA-35)		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) N 280,960.4 E 3,758,639.2		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW	
3. DRILLING AGENCY Alpine Ocean Seismic Survey		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore	
4. HOLE NO. (As shown on drawing title and file number)	VB-03-17	13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 5 COMPOSITE 1
5. NAME OF DRILLER J. Cole		14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED 8/27/03 COMPLETED 8/27/03
7. PENETRATION (ft)	28.1	17. ELEVATION TOP OF HOLE	-26.4
8. RECOVERY (ft)	30.0	18. TOTAL CORE RECOVERY FOR BORING	104 %
9. TOTAL CORE RECOVERY (%)	104.0	19. GEOLOGIST	W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	Sample No. Depth Interval, ft. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-26.4 -31.9	0.0 5.5	▨	Dark gray CLAY, with shells at 2.3-2.4'			Composite Sample 1: 7.6'-30' 51.2% Sand 26.9% Silt 22.0% Clay Mean: 0.020 mm (See Notes 1 and 2)
-32.4	6.0	▦	Dark gray silty CLAY			
-33.6	7.2	░	Dark gray silty FINE SAND			
-33.9	7.5	▨	Dark gray CLAY			
-36.1	9.7	░	Dark gray soft silty FINE SAND		1 7.6 10.5	63.2% Sand 23.9% Silt 12.9% Clay Mean: 0.032 mm
-37.2	10.8	▨	Dark gray stiff silty FINE SAND			
-39.6	13.2	▦	Dark gray CLAY with silt laminae and nodules below 12'			
-45.4	19.0	░	Dark gray FINE SAND with rare nodules or streaks of silt and clay		2 13.2 17.0 3 17.0 19.0	95% Sand 3.1% Silt 1.9% Clay Mean: 0.151 mm (See Notes 1 and 2) 92.1% Sand 5.0% Silt 2.8% Clay Mean: 0.149 mm
-45.9	19.5	▨	Dark gray CLAY			
-56.4	30.0	░	Dark gray FINE SAND with rare nodules or streaks of silt and clay		4 19.5 24.5 5 24.5 30.0	90.1% Sand 7.6% Silt 2.3% Clay Mean: 0.123 mm 83.6% Sand 12.1% Silt 4.3% Clay Mean: 0.117 mm

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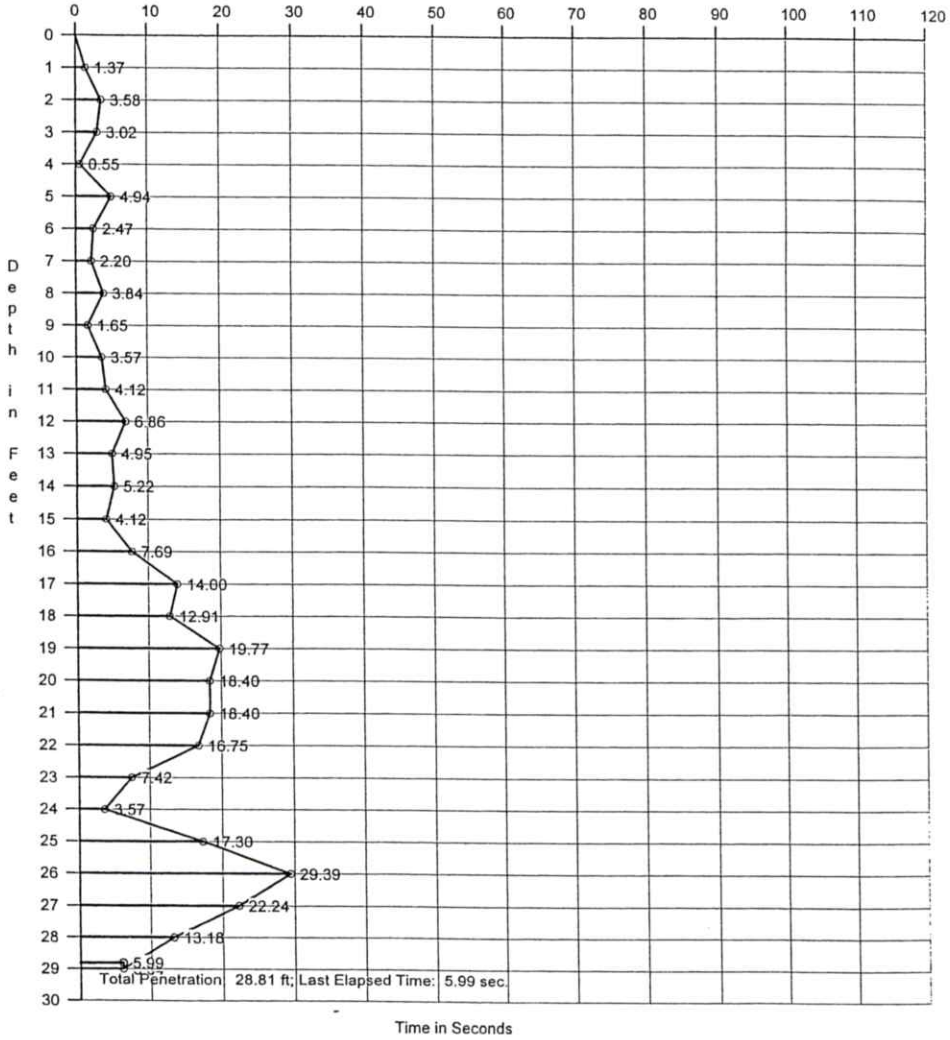
PROJECT Barrier Island Restoration (BA-35)

HOLE NO. VB-03-17

Penetration Graph for Core No. 30, Run 1

Date: 8/29/03	Penetration: 28.81 ft	Easting: 3758201.88	Lat: 2915.6864
Start Time: 1:35:00 PM	Recovery: 30.0	Northing: 280032.58	Long: 08950.1753
End Time: 1:39:26 PM	W. D. Corrected: 28.0 ft	Coord. System: LA SOUTH 83	Datum: WGS-84
	W. D. Raw: 29.6 ft		

Comment:



Hole No. VB-03-30

DRILLING LOG

DIVISION		INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT	Barrier Island Restoration (BA-35)	10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station)	N 280,032.6 E 3,758,201.9	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLLW
3. DRILLING AGENCY	Alpine Ocean Seismic Survey	12. MANUFACTURER'S DESIGNATION OF DRILL	Vibracore
4. HOLE NO. (As shown on drawing title and file number)	VB-03-30	13. TOTAL NO. OF SAMPLES TAKEN	INTERVAL 4 : COMPOSITE 1
5. NAME OF DRILLER	J. Cole	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.	15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED 8/23/03 : COMPLETED 8/23/03
7. PENETRATION (ft)	28.8	17. ELEVATION TOP OF HOLE	-29.6
8. RECOVERY (ft)	30.0	18. TOTAL CORE RECOVERY FOR BORING	107 %
9. TOTAL CORE RECOVERY (%)	107.0	19. GEOLOGIST	W. McGuinness

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	Sample No. Depth Interval, ft f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-29.6	0.0		Soft dark gray silty CLAY			Composite 13.4'-28.2' 67.4% Sand 25.2% Silt 17.7% Clay Mean: 0.070 mm (See Notes 1 and 2)
-43.0	13.4		Dark gray fine SAND		1 13.4 17.6	89.5% Sand 8.4% Silt 2.2% Clay Mean: 0.128 mm
-43.8	14.2		Dark gray sandy SILT			
-44.6	15.0		Dark gray fine SAND		2 17.6 22.0	94.3% Sand 3.8% Silt 1.8% Clay Mean: 0.156 mm
-52.7	23.1		Dark gray sandy SILT			
-54.7	25.1		Dark gray fine SAND		3 25.1 28.2	93.7% Sand 5.0% Silt 1.4% Clay Mean: 0.179 mm
-57.8	28.2		Dark gray silty SAND		4 28.2 30.0	85.3% Sand 11.3% Silt 3.4% Clay Mean: 0.123 mm
-59.6	30.0					

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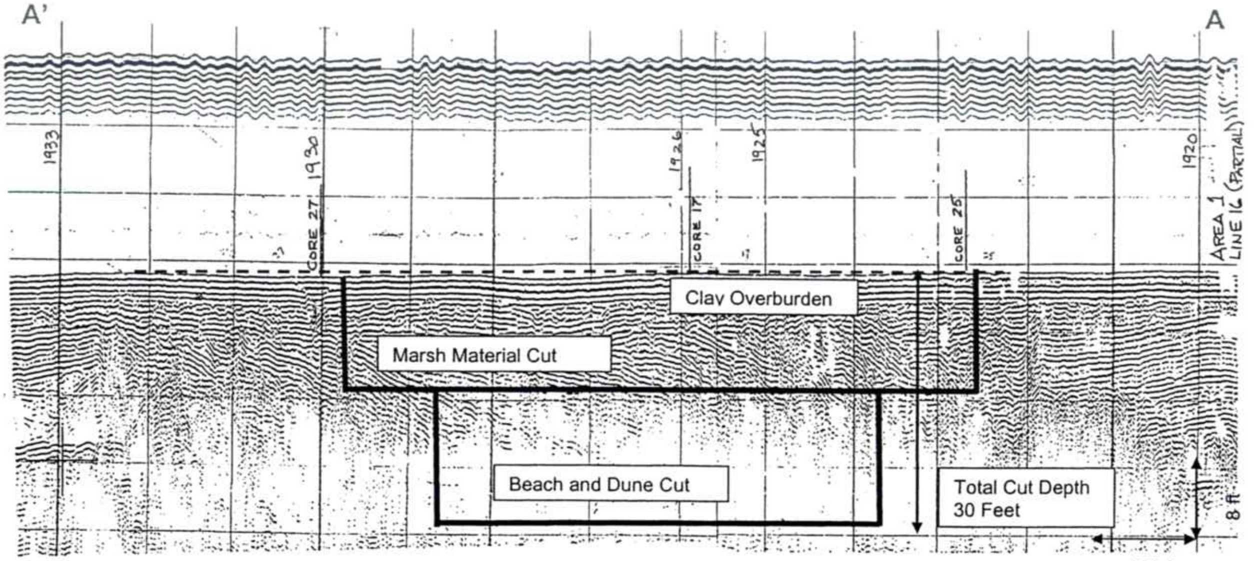
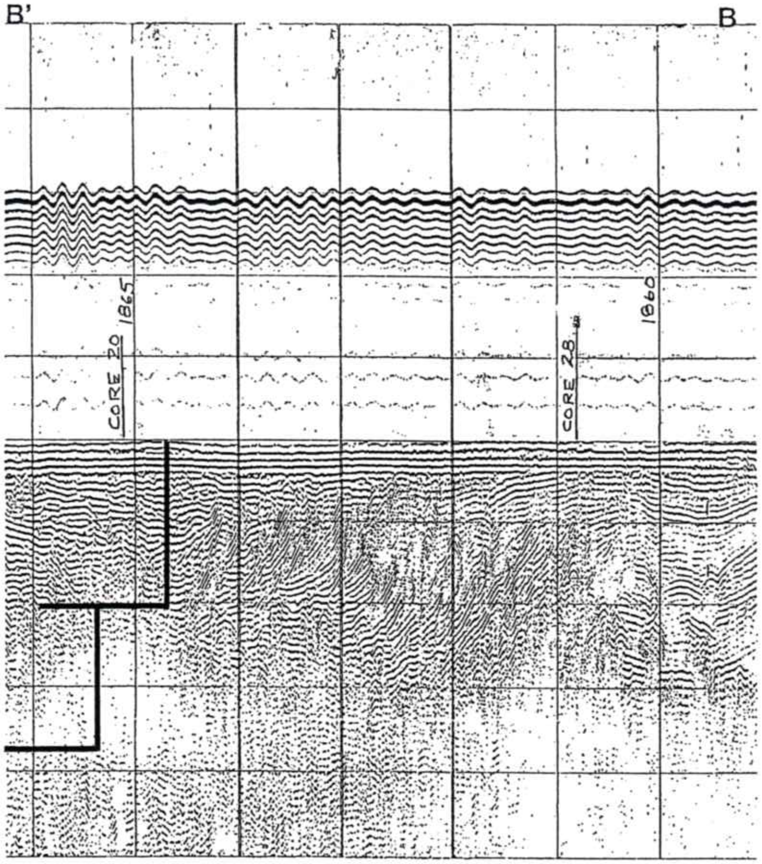
PROJECT Barrier Island Restoration (BA-35) HOLE NO. VB-03-30

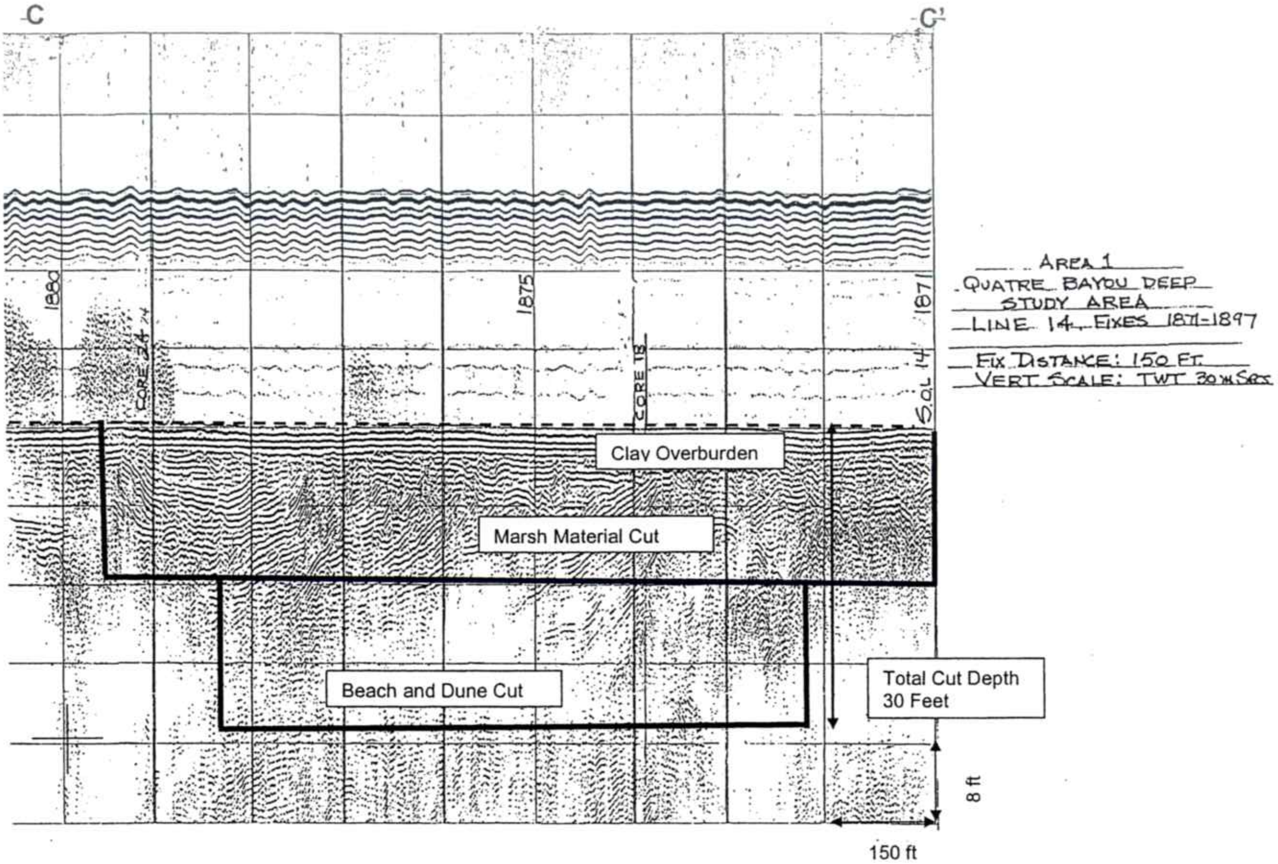


Seismic Profile, Area 1, Line 16
Buried Distributary Channel
See 2/24/04 Plan

RECTANGLE SCALE
8 ft high by 150 ft wide



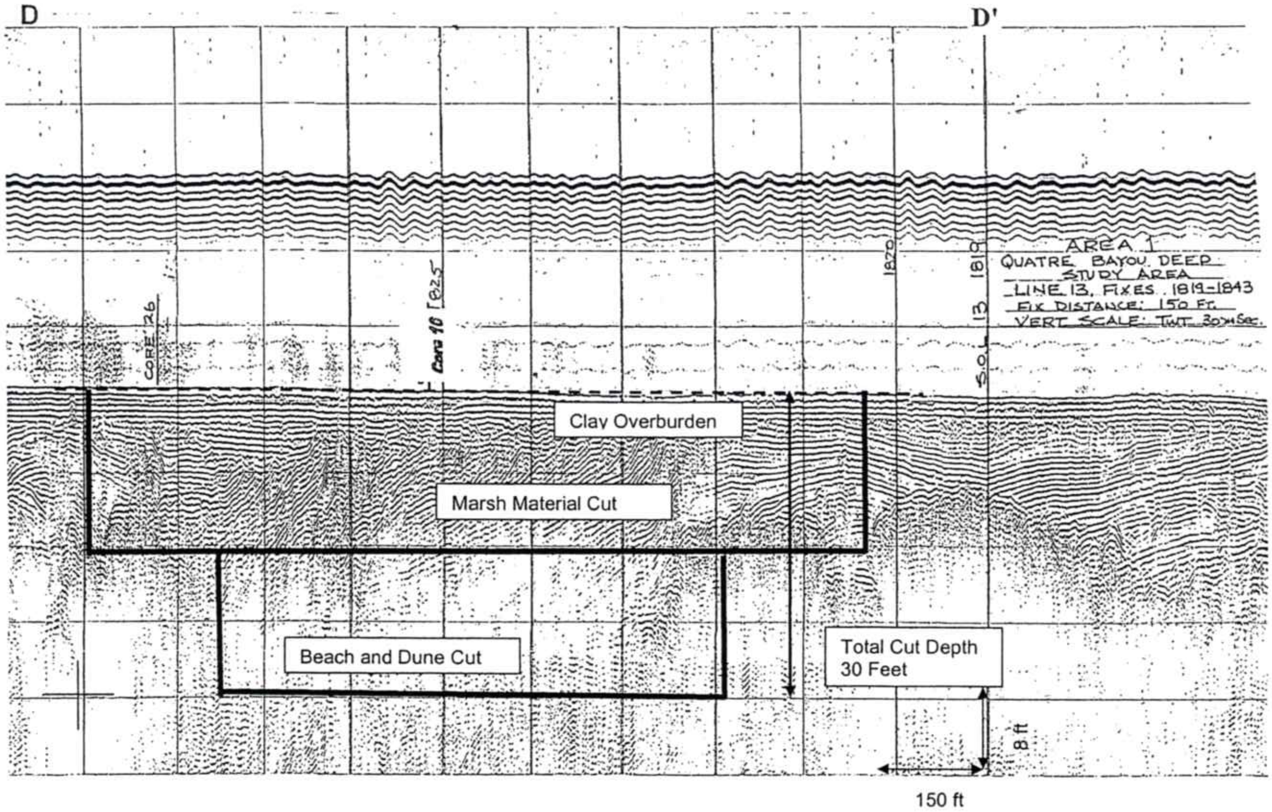
Seismic Profile, Area 1, Line 15
Buried Distributary Channel
See 2/24/04 Plan



Seismic Profile, Area 1, Line 14
Buried Distributary Channel

See 2/24/04 Plan

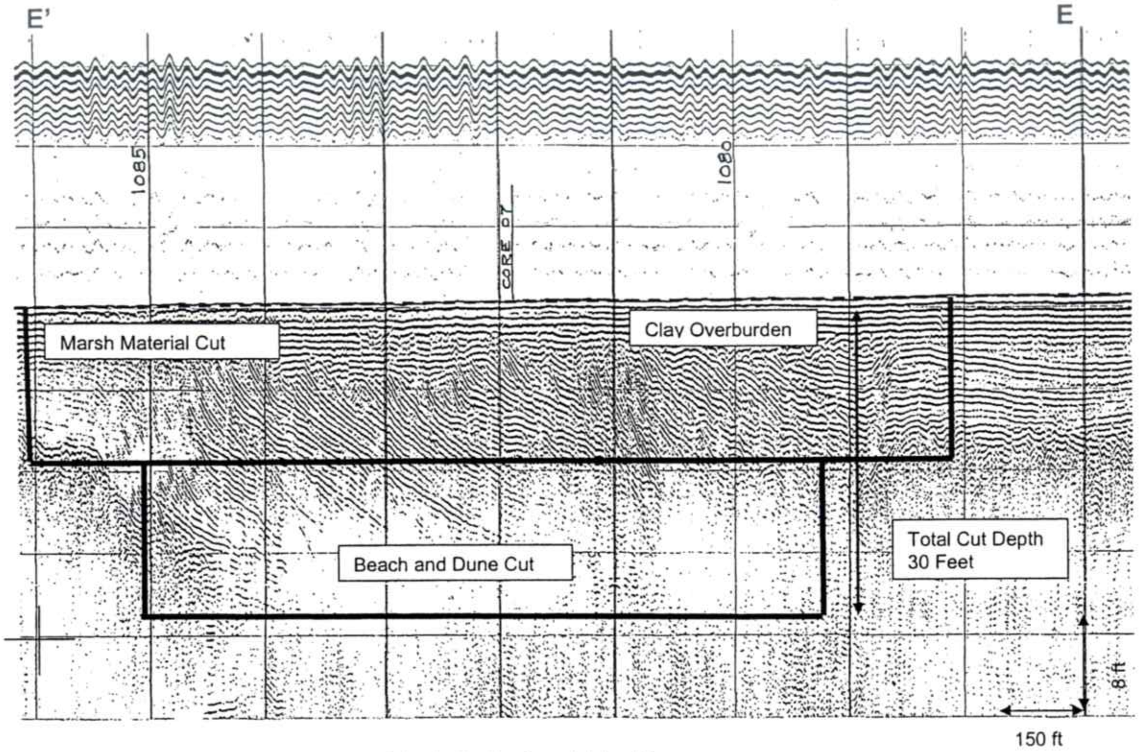
RECTANGLE SCALE
8 ft high by 150 ft wide



RECTANGLE SCALE
8 ft high by 150 ft wide

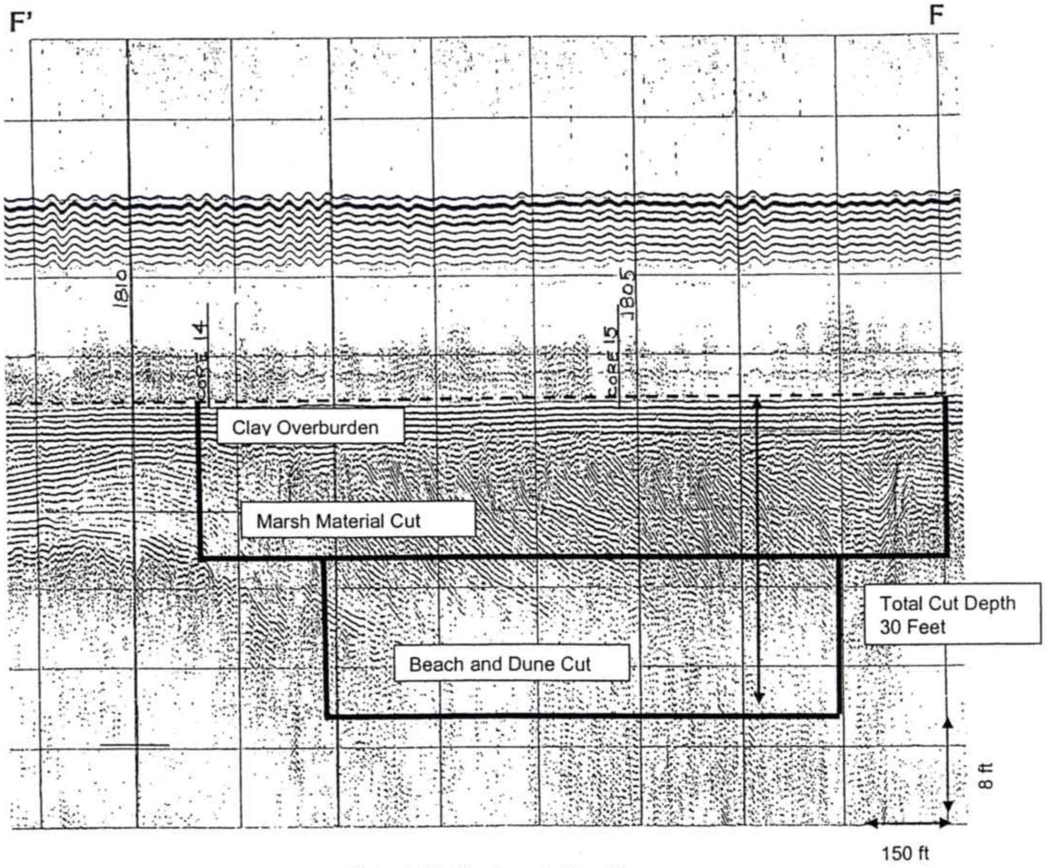
Seismic Profile, Area 1, Line 13
Buried Distributary Channel

See 2/24/04 Plan



Seismic Profile, Area 1, Line 10
Buried Distributary Channel
See 2/24/04 Plan

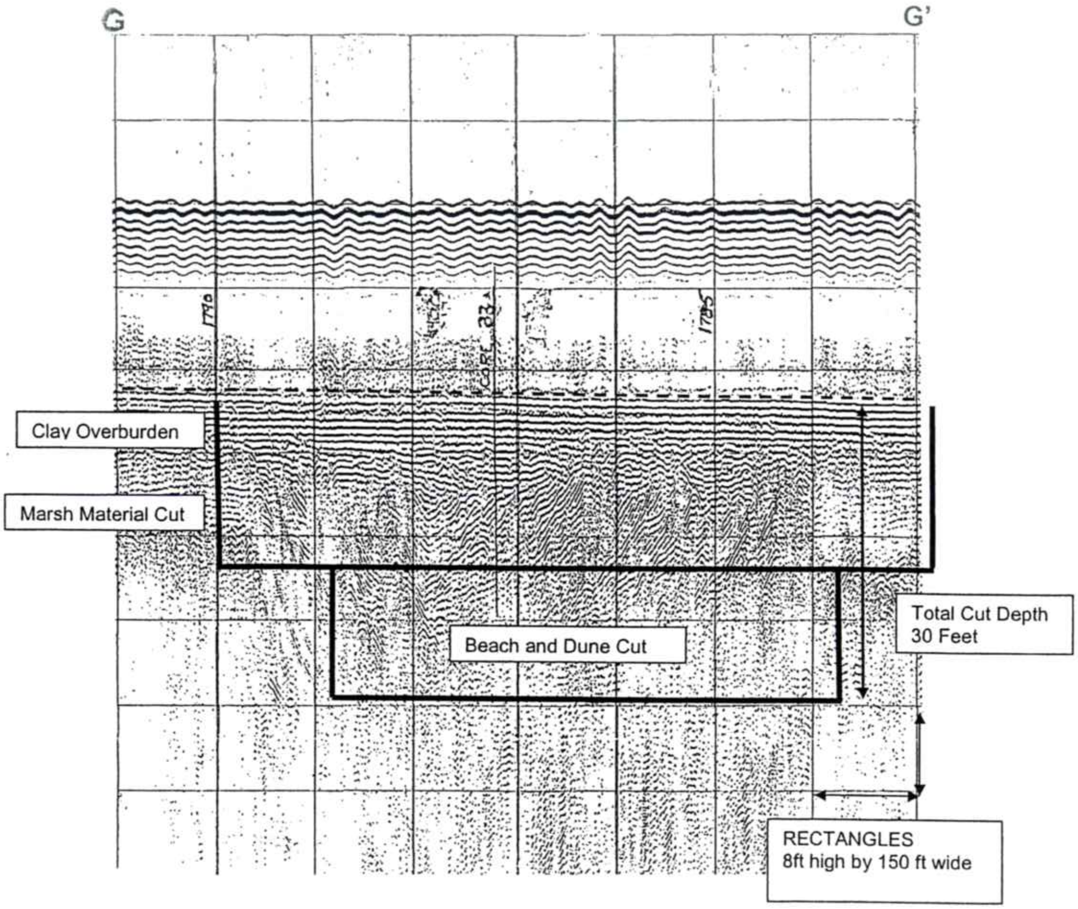
RECTANGLE SCALE
8 ft high by 150 ft wide



Seismic Profile, Area 1, Line 12
Buried Distributary Channel

See 2/24/04 Plan

RECTANGLE SCALE
8 ft high by 150 ft wide



Seismic Profile, Area 1, Line 11
Buried Distributary Channel
See 2/24/04 Plan

APPENDIX C

BORROW AREA WAVE REFRACTION MODELING FINAL DESIGN

1. BORROW AREA WAVE REFRACTION MODELING

1.1 Model Description

1.1.1 Software Description

The Steady-State Spectral Wave Model (STWAVE) was used to evaluate changes to wave refraction and sediment transport patterns resulting from the proposed borrow area excavation.

STWAVE, as its name implies, is a steady-state finite difference model (Smith, Sherlock, and Resio, 2001). It simulates depth-induced wave refraction and shoaling, current-induced refraction and shoaling, depth and steepness induced wave breaking, diffraction, wind driven wave growth, and wave-wave interaction and whitecapping that redistribute and dissipate energy in a growing wave field. The version of STWAVE chosen is part of a package developed by Veri-Tech, Inc., called the Coastal Engineering Design and Analysis System, or CEDAS. Version 3.06 of CEDAS was used for this evaluation.

1.1.2 Grid Design

The model grid was made up of 401 columns (east-west direction) and 500 rows (north-south direction) of grid cells. Each grid cell was 200 feet long by 200 feet wide. This gave a total width of 80,000 feet (east-west) and a total length of 99,800 feet (north-south). The origin of the model grid, located at the southeast corner, was located at an Easting of 3,815,100 and a Northing of 205,100. This grid design is identical to that used for evaluation of wave refraction conducted for the 30% design phase (SJB et al., 2004).

1.1.3 Model Parameters and Calibration

The same calibration parameters and bathymetric surface that were used for the 30% design phase analysis (SJB et al., 2004) were used for this analysis. The only exception to that is the bathymetric surface for the post-construction scenario. In that scenario, the deepest portion of the proposed Bay Joe Wise Borrow Area, denoted as the beach/dune cut, was increased by five (5) feet to account for the overdredge allowance, and an Overburden Disposal Area as thick as five (5) feet was added as an alternative disposal location for stripping off the top layer of the borrow area deemed undesirable for project construction.

A total of nine (9) different incident wave cases were investigated. The wave parameters are displayed in Table 1-1. Initial wave heights, wave periods, angles, and water stages were obtained from the 30% design analysis for all scenarios to allow for comparison of the two model results. In all cases, the initial wave height was applied in a water depth of 27.5 meters, which was the approximate average depth of water at the southernmost section of the model where the waves generally originated. The initial wave height and period in the table are the input heights and periods for the waves. The local angle is the angle used by STWAVE. With the local angle, a value of zero degrees is straight toward shore, which is due north in this case. A value of 180 degrees is due north in the real world angle. Gamma is the spectral peakedness parameter and is used in STWAVE to control the width of the peak in the frequency spectrum. The parameter nn is the directional spreading coefficient which helps control how the wave energy is distributed in the frequency spectrum. The STWAVE user manual provides representative values of both gamma and nn for user defined wave period values.

For each storm scenario previously run for the 30% design evaluation on the pre-excavation bathymetric surface, the same scenario and bathymetry were rerun to verify the model was functioning as it had in the previous modeling effort. In all nine (9) cases previously run, the output appeared to be identical when compared to the reported outputs. These comparisons served as the calibration of the model.

Table 1-1: Input Wave Parameters

Case Number	Initial Wave Height (ft)	Initial Wave Period (sec)	Local Angle (deg)	Real World Angle (deg)	Water Stage (ft NAVD)	Gamma	nn
1	2.5	5.0	57	123	1.0	3.3	4
2	2.6	4.6	49	131	1.0	3.3	4
3	2.5	5.0	23	157	1.0	3.3	4
4	2.6	4.6	15	165	1.0	3.3	4
5	2.5	5.0	-11	191	1.0	3.3	4
6	17.4	11.0	3	177	1.6	4.0	8
7	18.0	11.7	7	173	3.0	4.0	10
8	20.5	12.4	7	173	4.9	4.4	10
9	22.9	13.2	7	173	6.7	5.0	12

1.1.4 Borrow Area Incorporation

The proposed Bay Joe Wise Borrow Area, the proposed Chaland Borrow Area, and the proposed Overburden Disposal Area were all incorporated into the wave calculation models. Figure 1-1 displays the locations and orientations of both these areas. The -7 feet NAVD and -15 feet NAVD bathymetric contours are also displayed on the figure. For the normal wave scenarios (Case Numbers 1 through 5 in Table 1-1), the point at which waves were found to be depth limited was -7 feet NAVD (CP&E, 2003). For the storm scenarios (Case Numbers 6 through 9 in Table 1-1), -15 feet NAVD was found to be the cutoff at which the waves became depth limited. The results are presented at these respective contours for consistency.

The modeled pre- and post-construction bathymetry at the Borrow and Overburden Disposal Areas is shown in Figure 1-2 and Figure 1-3 respectively. The difference between the pre- and post-construction bathymetry, or the depth of the borrow area excavations and the height of the overburden placement, is shown in Figure 1-4. From these figures, it is observed that the proposed Bay Joe Wise Borrow Area is in deeper water, and has a deeper proposed excavation than the proposed Chaland Borrow Area.

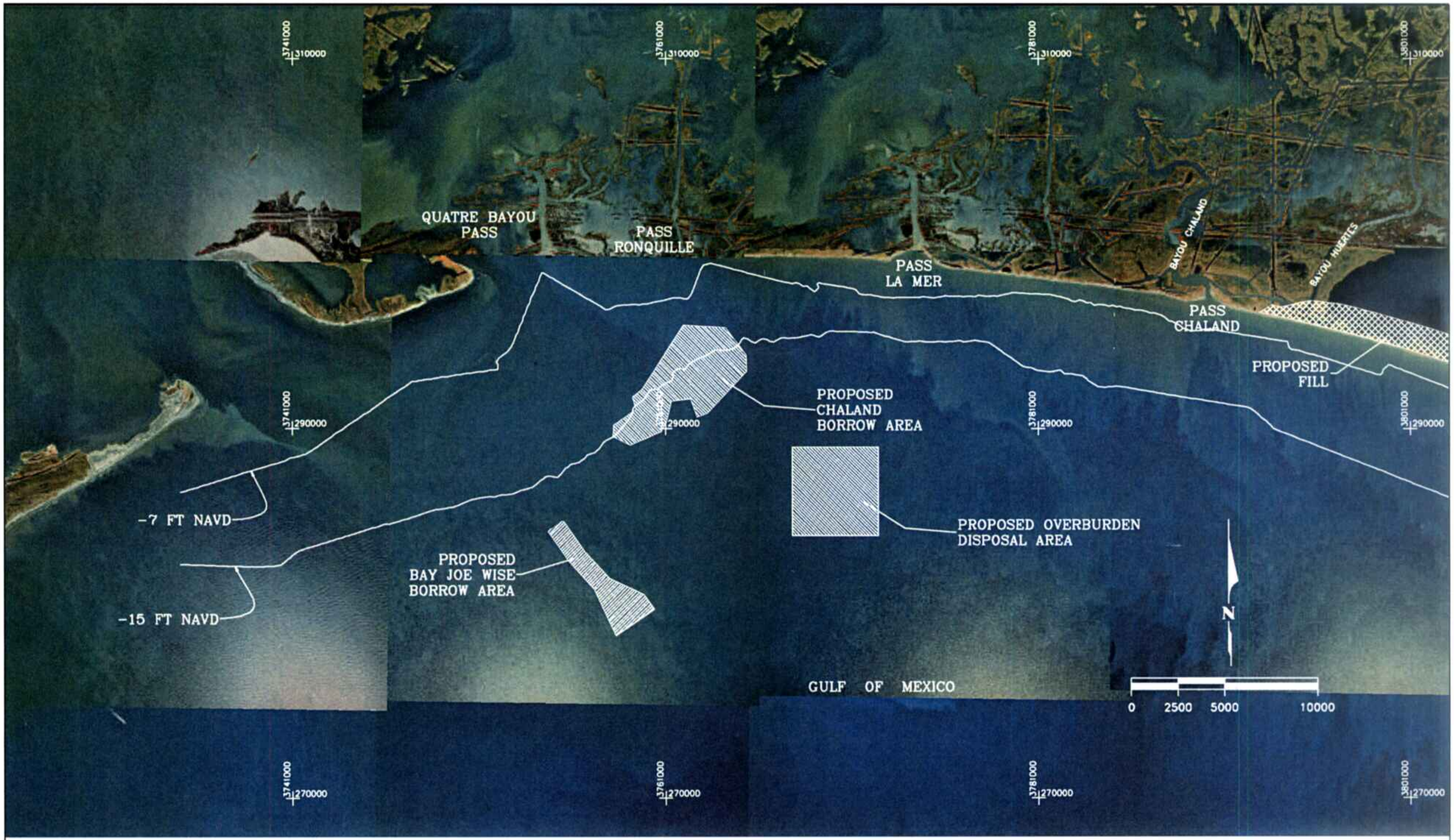


FIGURE 1-1: BORROW AND OVERBURDEN DISPOSAL AREA LOCATION MAP

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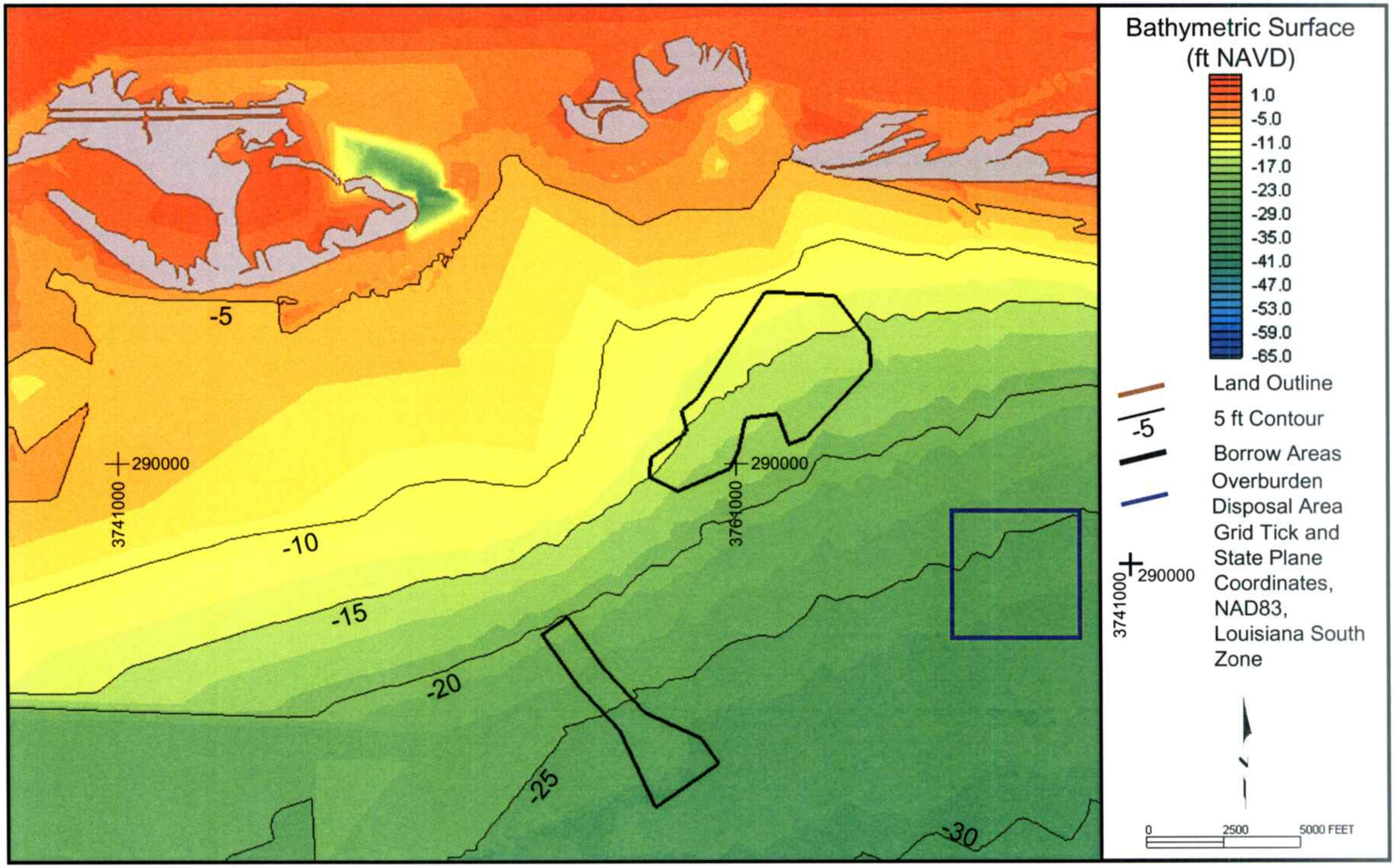

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Figure 1-2: Pre Construction Bathymetry

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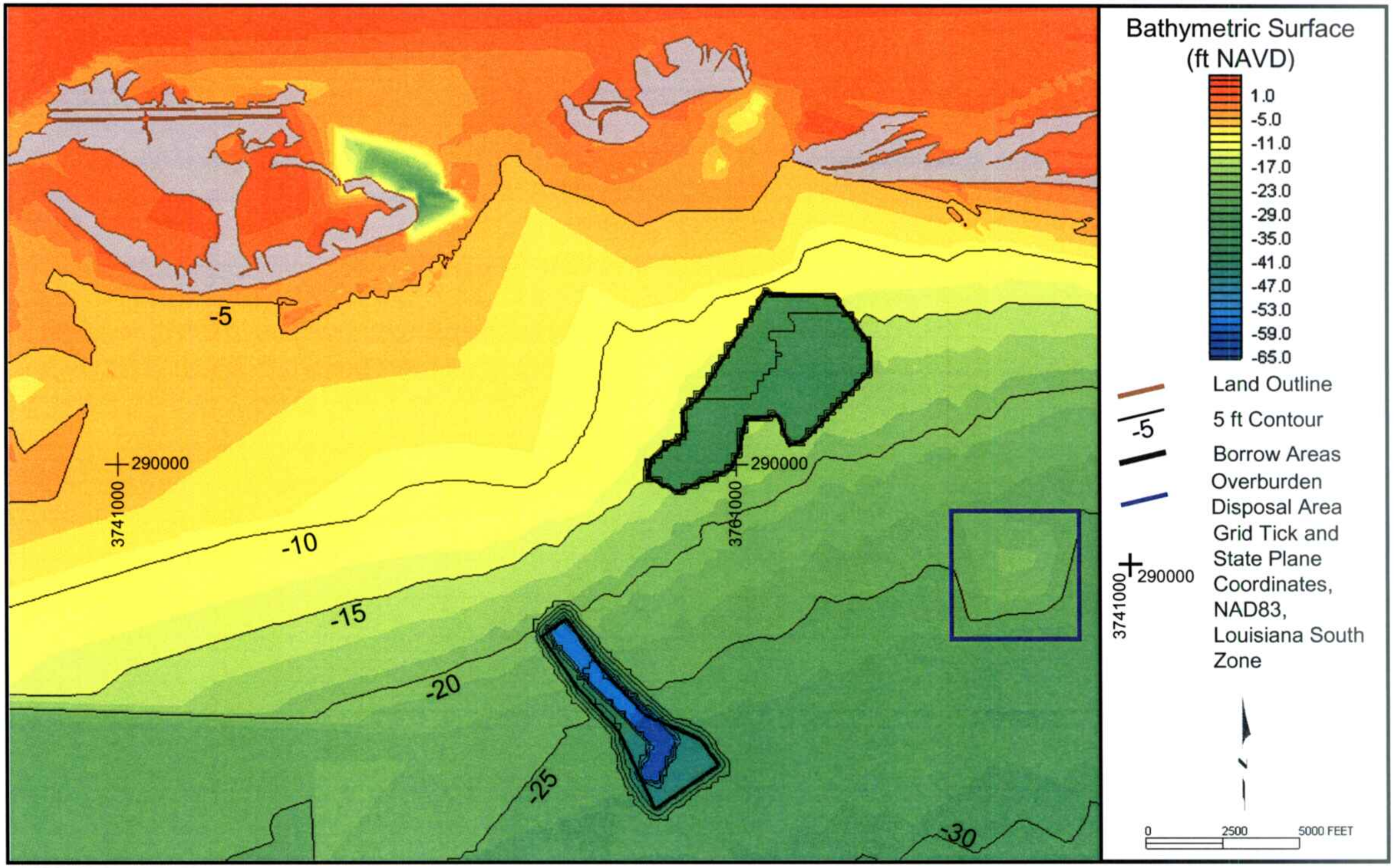

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Figure 1-3: Post Construction Bathymetry

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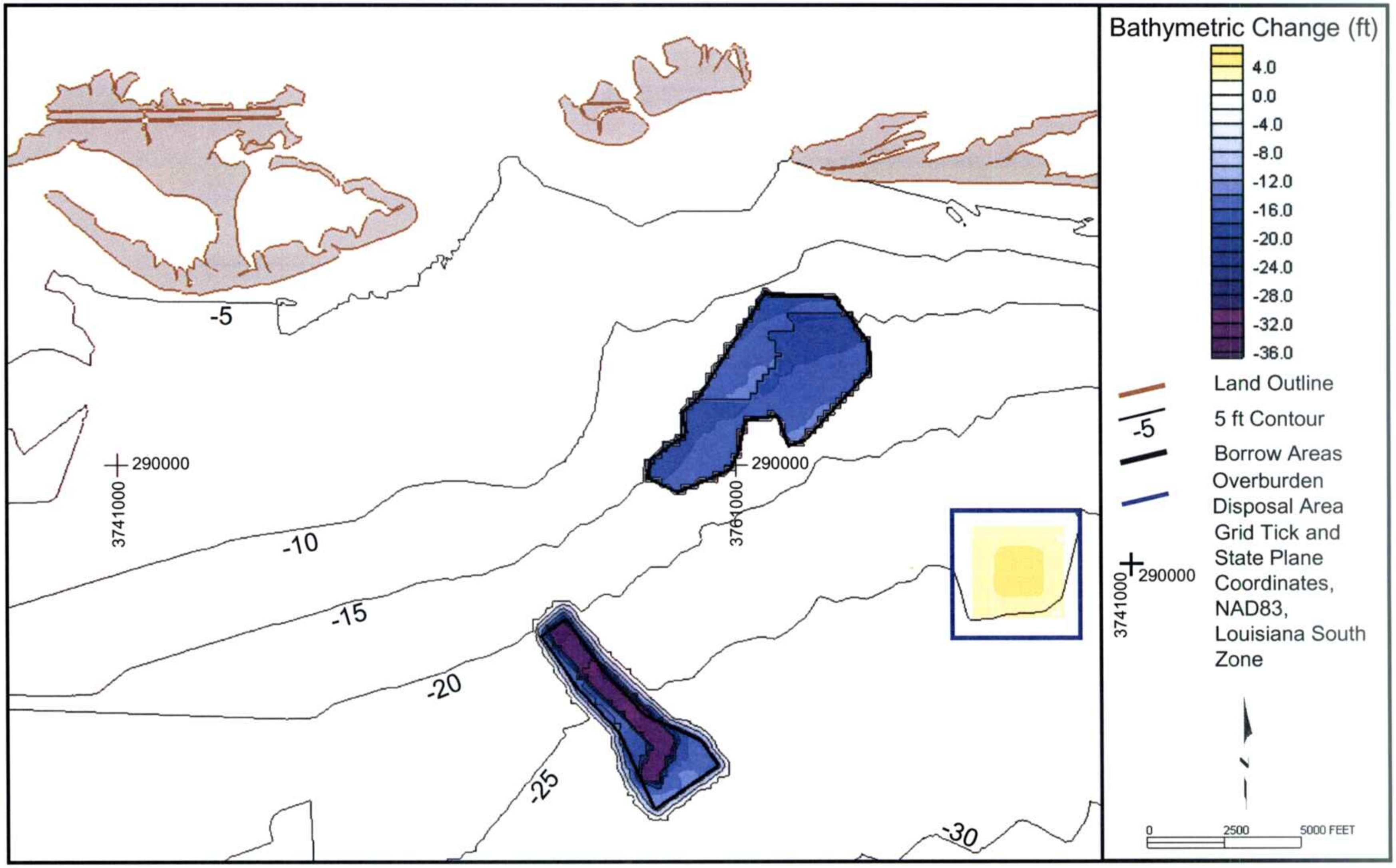

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Figure 1-4: Post – Pre Bathymetric Change

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1.2 Model Results

STWAVE simulations were run for all nine (9) cases listed in Table 1-1 for both the pre-construction bathymetry and the post-construction bathymetry giving a total of 18 simulations. The changes in modeled wave heights compared to the pre-construction conditions were calculated for each case, and the plan view maps displaying those changes, starting from Case 1, are displayed in Figures 1-5 through 1-13. Under the normal wave conditions (Figures 1-5 through 1-8), the proposed Bay Joe Wise Borrow Area had minor impacts on modeled wave heights, primarily reducing wave heights. These changes in height did not extend all the way to dry land.

The proposed Chaland Borrow Area showed minor changes in modeled wave heights at the landward boundary on the order of about 0.1 feet. Under normal wave conditions, these negligible changes in wave height from excavation of the borrow areas are not anticipated to adversely impact the adjacent shorelines. Figures 1-9 through 1-13 display the modeled wave height changes for the storm wave scenarios. In all wave conditions, the impacts on the magnitude of the wave heights at the landward boundaries did not exceed 0.5 feet. In all cases, the modeled wave height changes within the breaking point are reductions in wave heights.

The Bay Joe Wise Borrow Area generally caused the waves to separate under all scenarios. In the normal wave cases, waves on the west side of the Borrow Area were modeled to refract slightly further to the west, while waves on the east side of the Borrow Area were simulated to refract slightly to the east. These changes were on the order of five (5) degrees for the normal wave scenarios. Similar separation of the waves in the storm scenario were also simulated in the model, but the waves on the western side of the Borrow Area generally refracted approximately twenty (20) to thirty (30) degrees to the west while waves on the east side of the Borrow Area refracted approximately five (5) to ten (10) degrees to the east. These deflections of the wave directions are the likely source of the reduction in wave height north of the Borrow Area. The deflections in the wave direction were isolated to within approximately 3500 feet of the Borrow Area in all scenarios.

Figures 1-14 through 1-22 display changes in wave heights between this latest wave refraction analysis and the analysis performed as part of the 30% design. As stated above, the proposed Bay Joe Wise Borrow Area was deepened by five (5) feet to account for allowable overdredging, and an Overburden Disposal Area was added approximately 10,000 feet east of the proposed Borrow Area. As expected, the normal wave conditions were relatively unaffected by the additional depth in the proposed Borrow Area. The storm waves show a minor (0.5 to 1.0 foot) decrease in height north of the Borrow Area compared to the 30% design evaluation. Wave heights near the proposed Overburden Disposal Area were generally within 0.1 foot of the pre-construction wave heights under normal wave conditions. Under storm wave conditions, wave heights were decreased at the proposed Overburden Disposal Area by as much as 3 feet. This change in wave height was confined to the immediate Overburden Disposal Area, and is not expected to affect the adjacent shorelines.

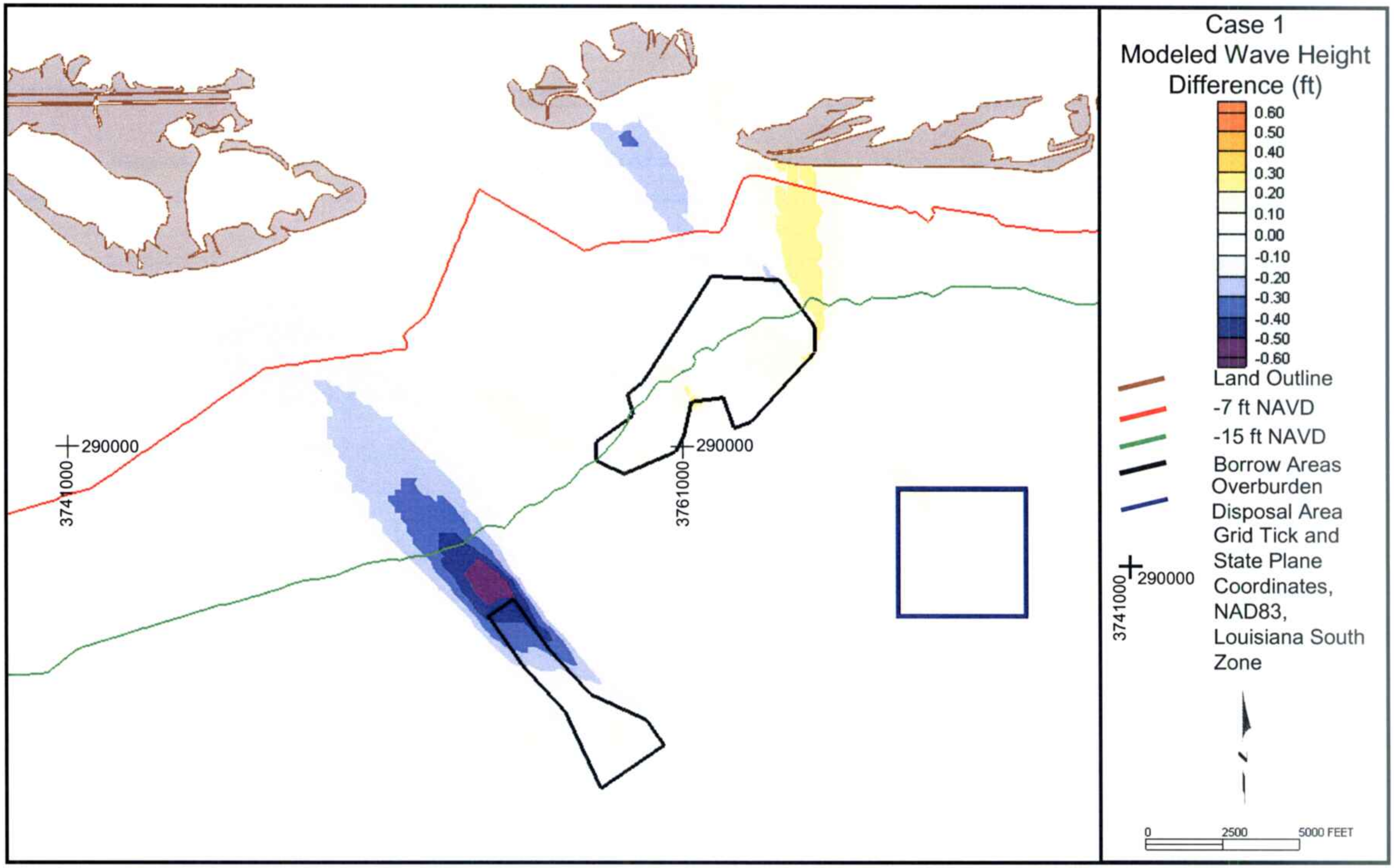

Figure 1-5: Wave Height Difference – Case 1

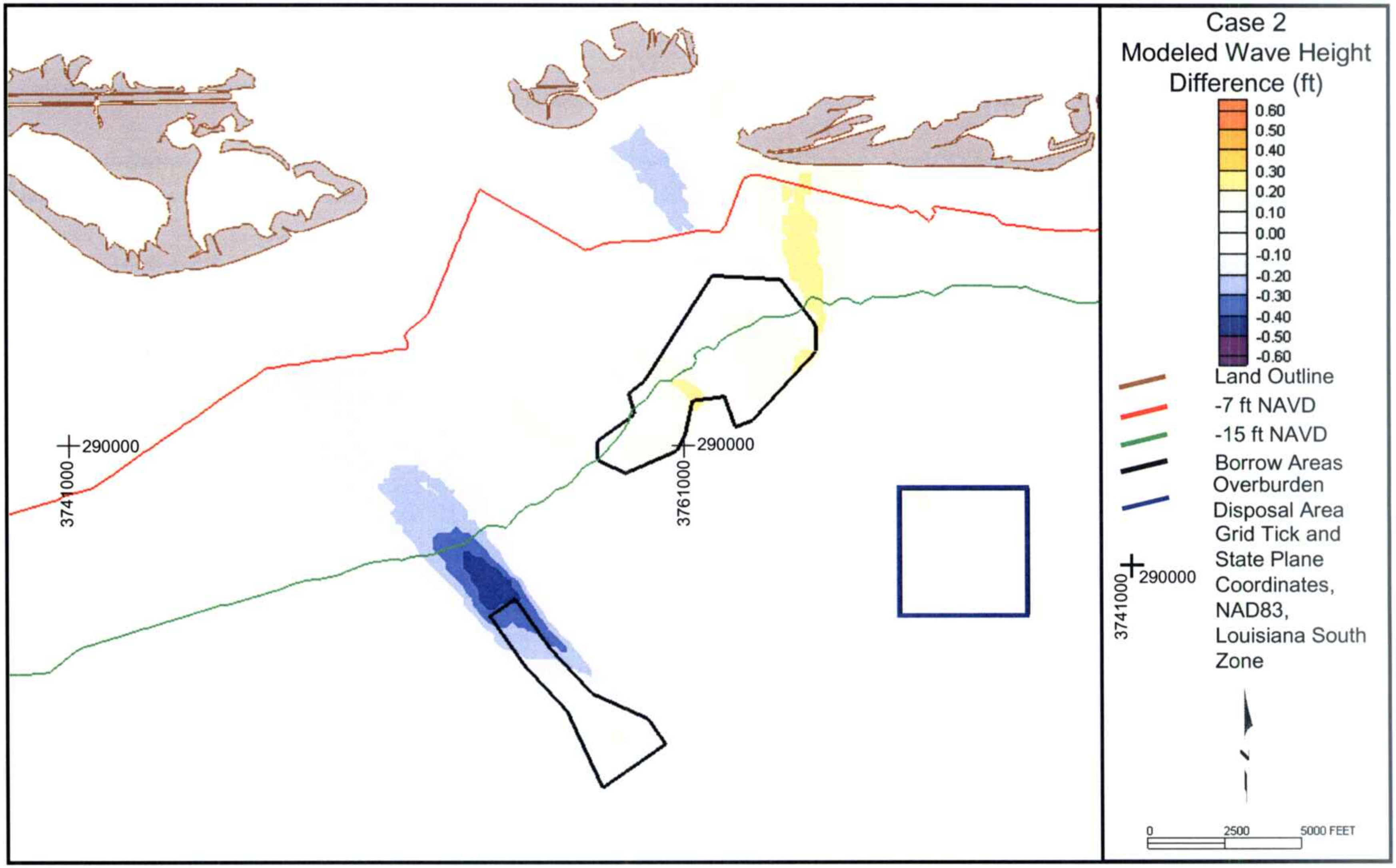

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Figure 1-6: Wave Height Difference – Case 2

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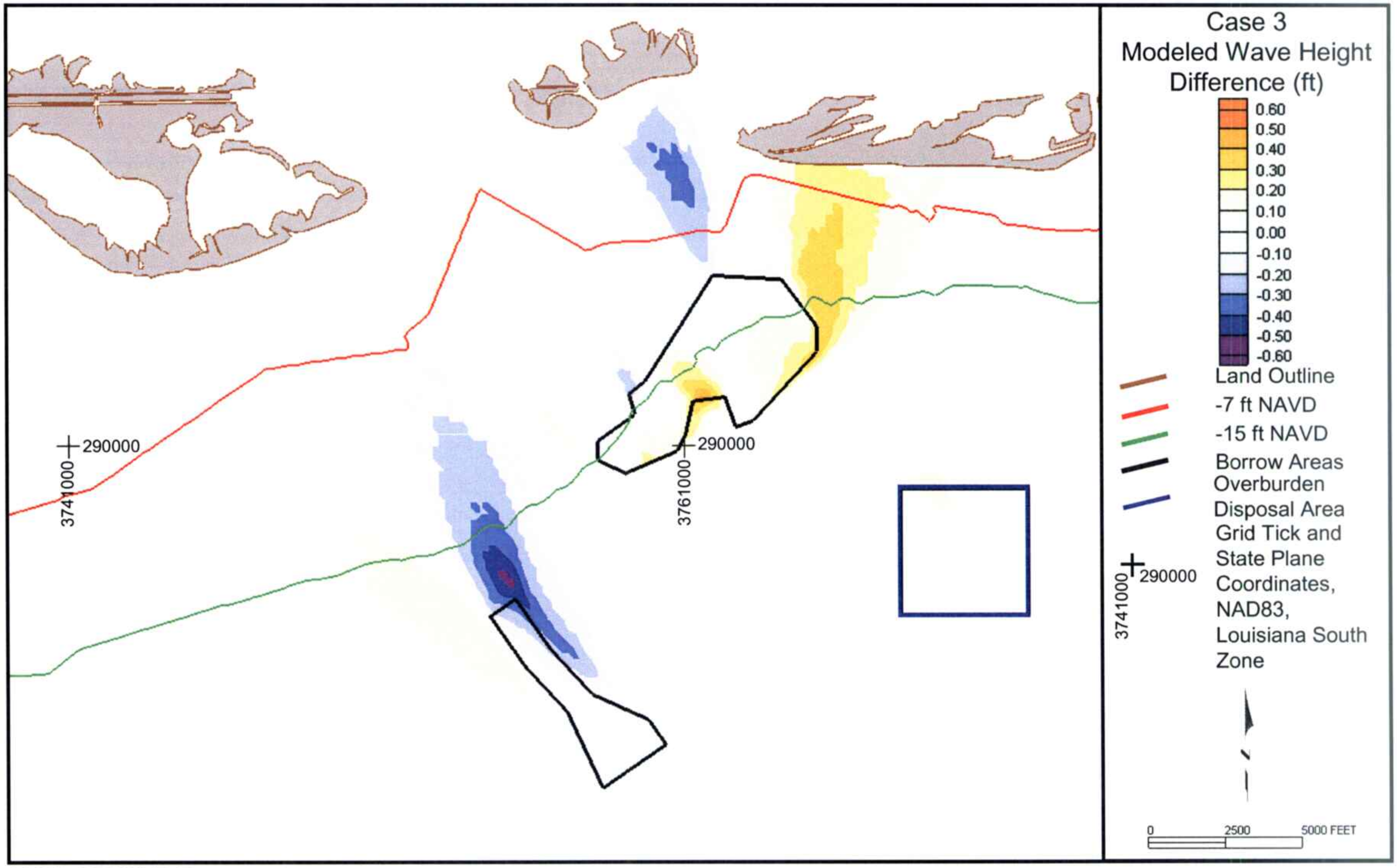

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Figure 1-7: Wave Height Difference – Case 3

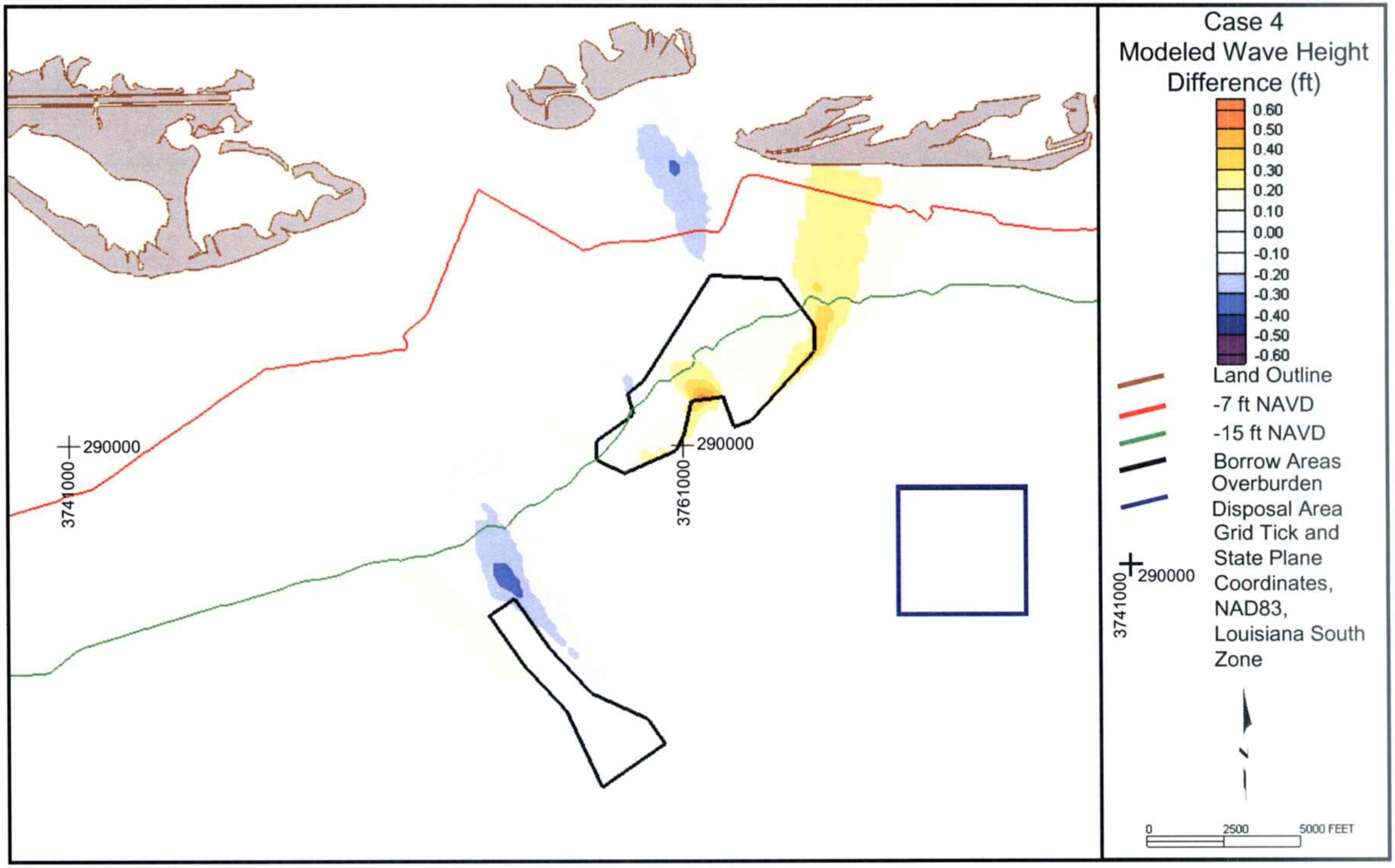

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Figure 1-8: Wave Height Difference – Case 4

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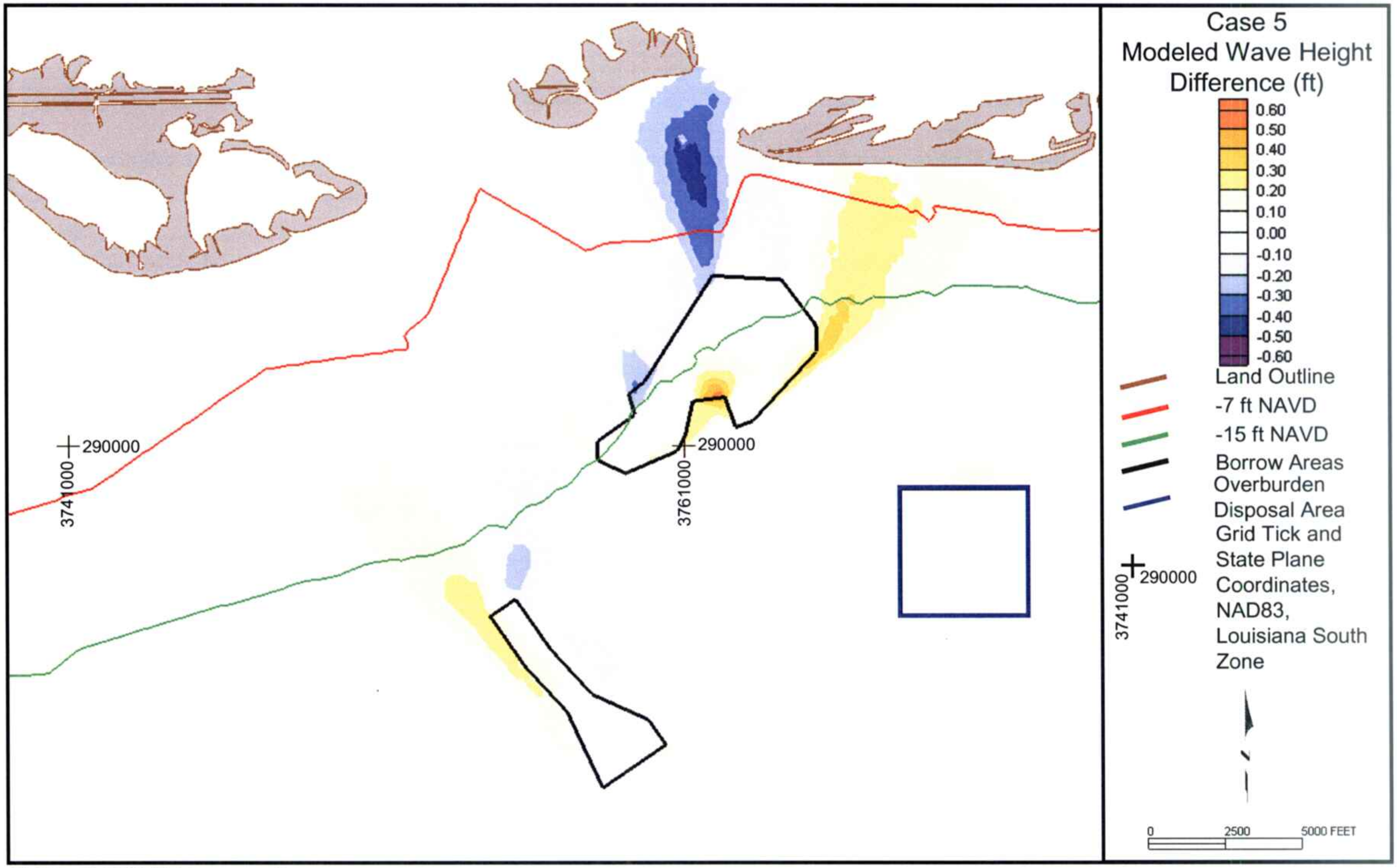

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Figure 1-9: Wave Height Difference – Case 5

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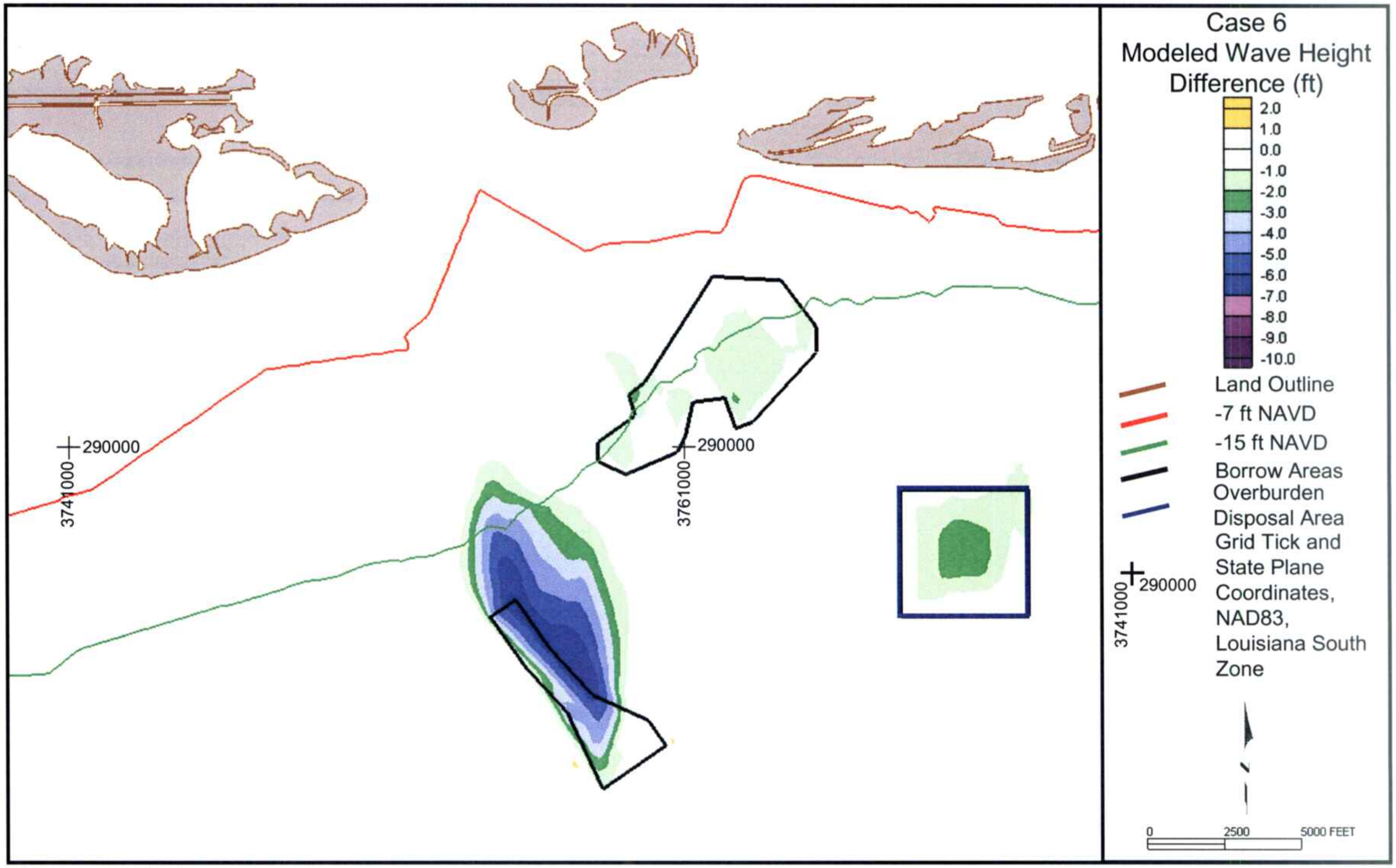

Figure 1-10: Wave Height Difference – Case 6

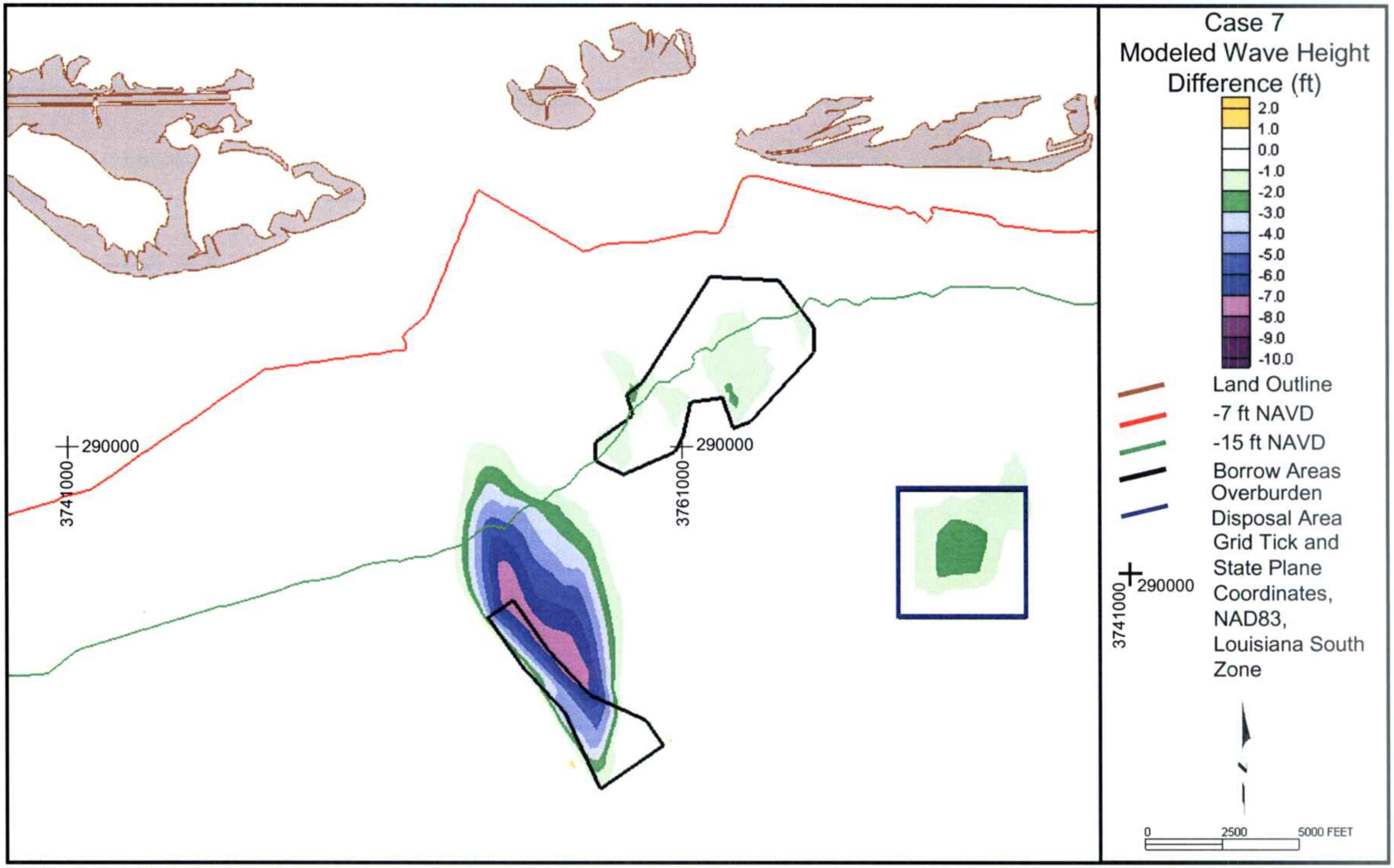

Figure 1-11: Wave Height Difference – Case 7

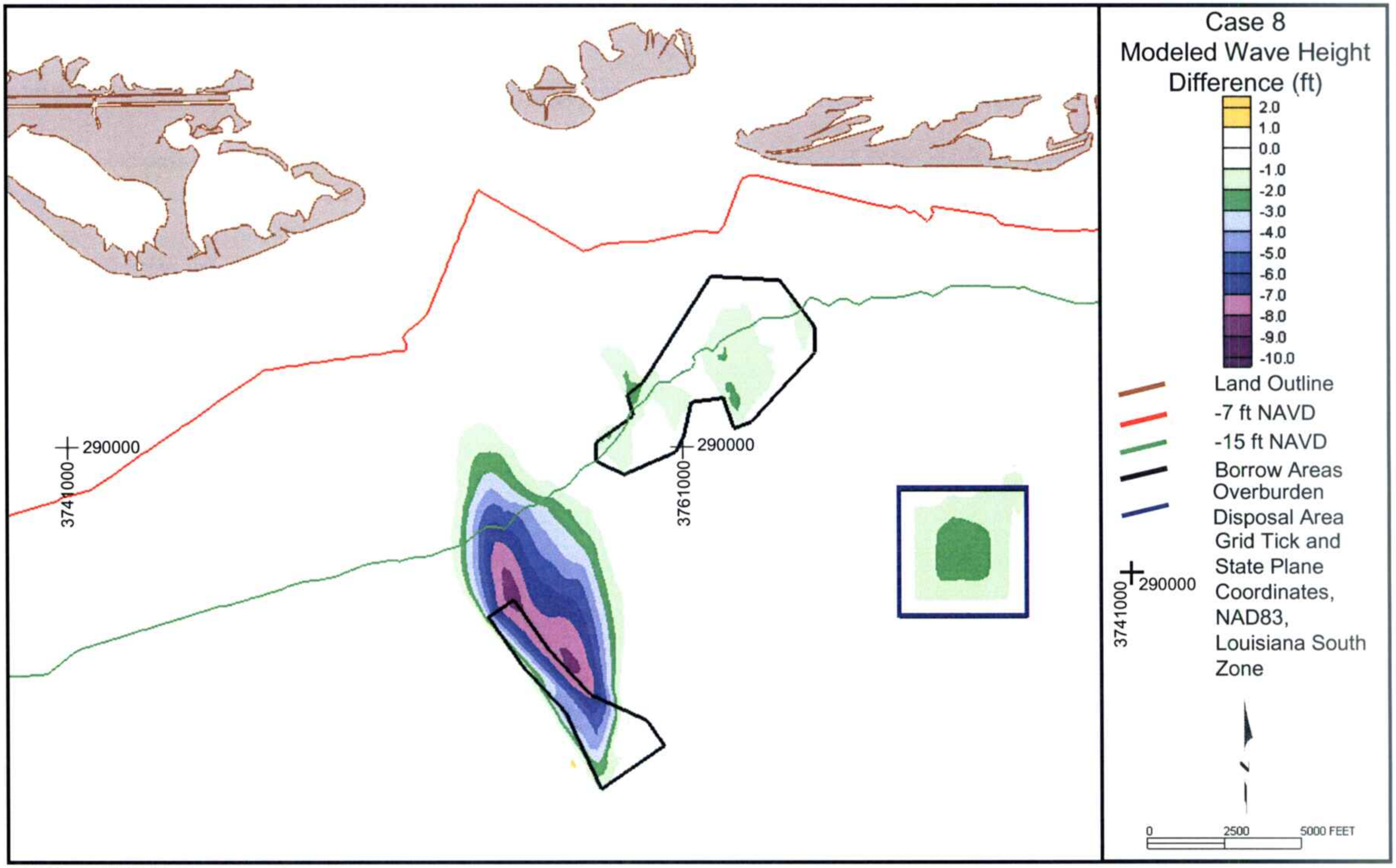

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Figure 1-12: Wave Height Difference – Case 8

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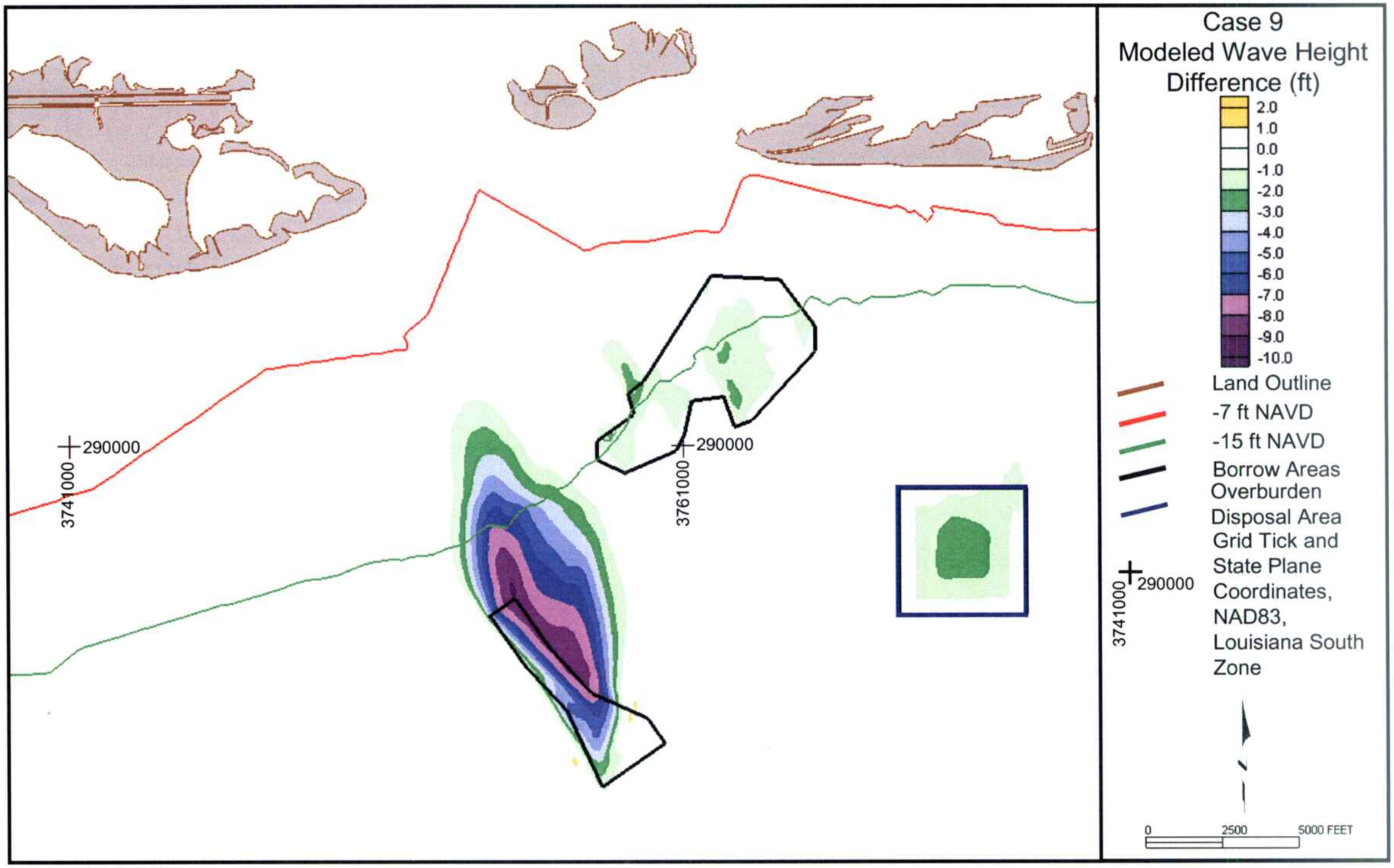

Figure 1-13: Wave Height Difference – Case 9

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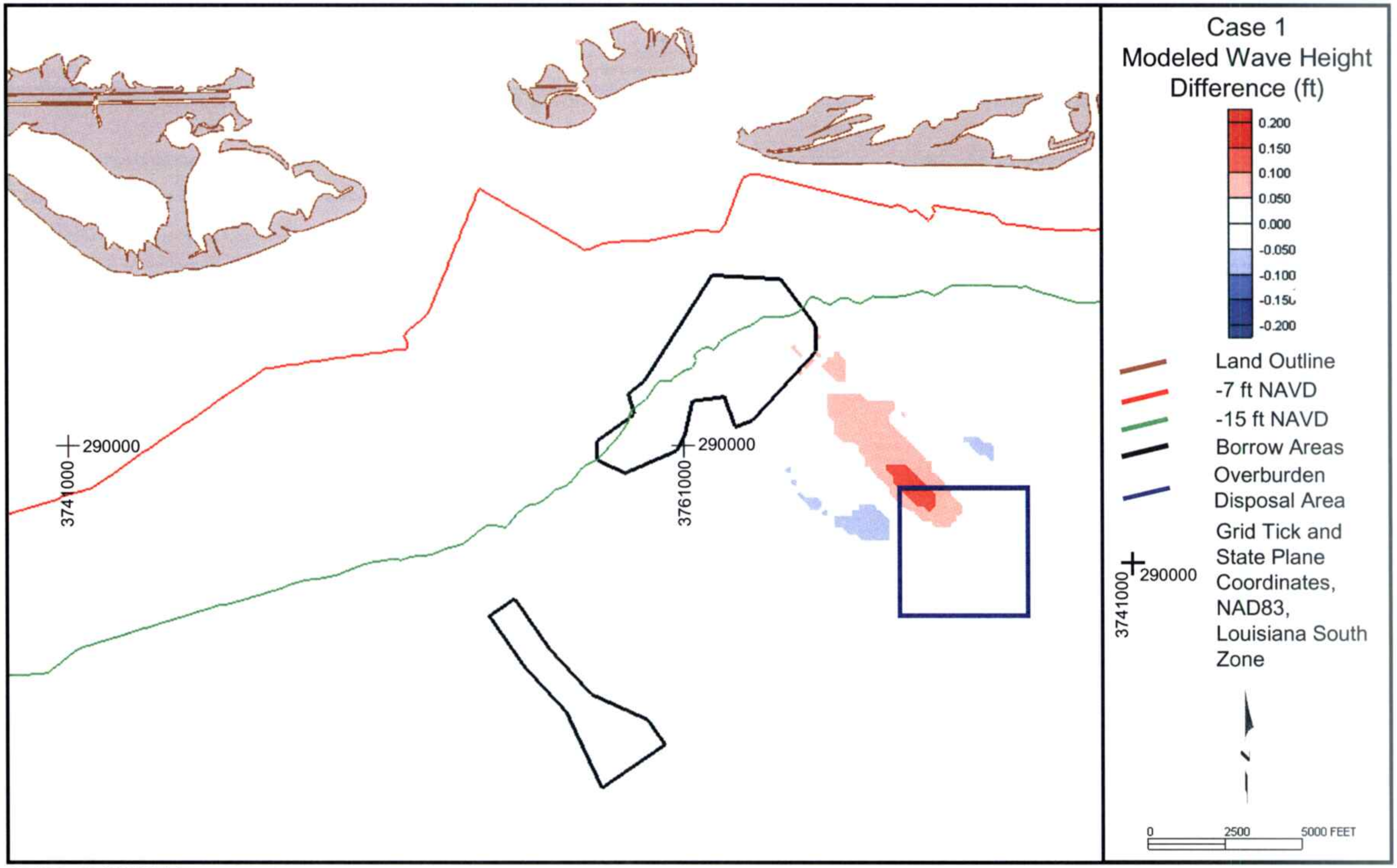

Figure 1-14: Wave Height Difference – Case 1

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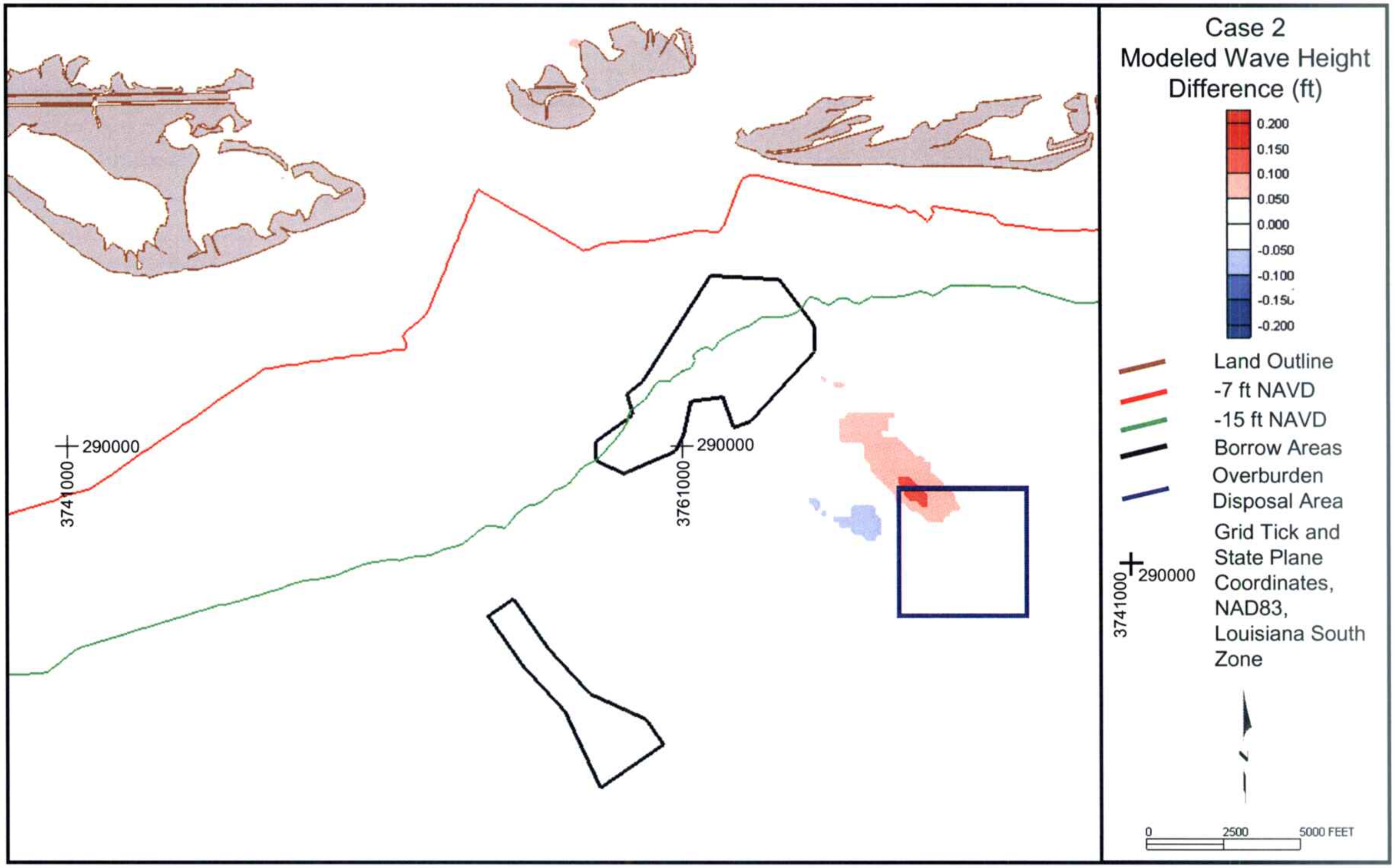

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Figure 1-15: Wave Height Difference – Case 2

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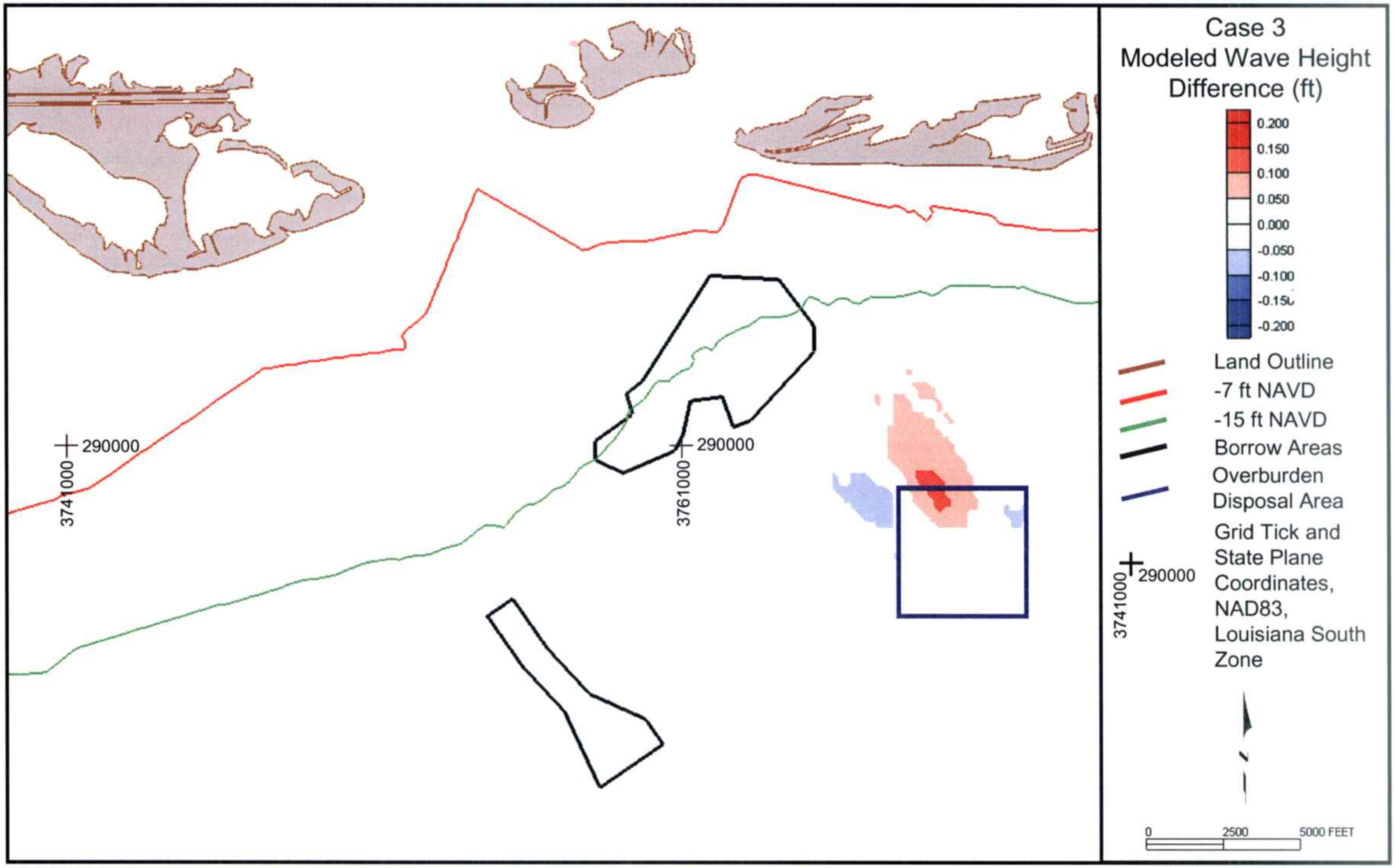

Figure 1-16: Wave Height Difference – Case 3

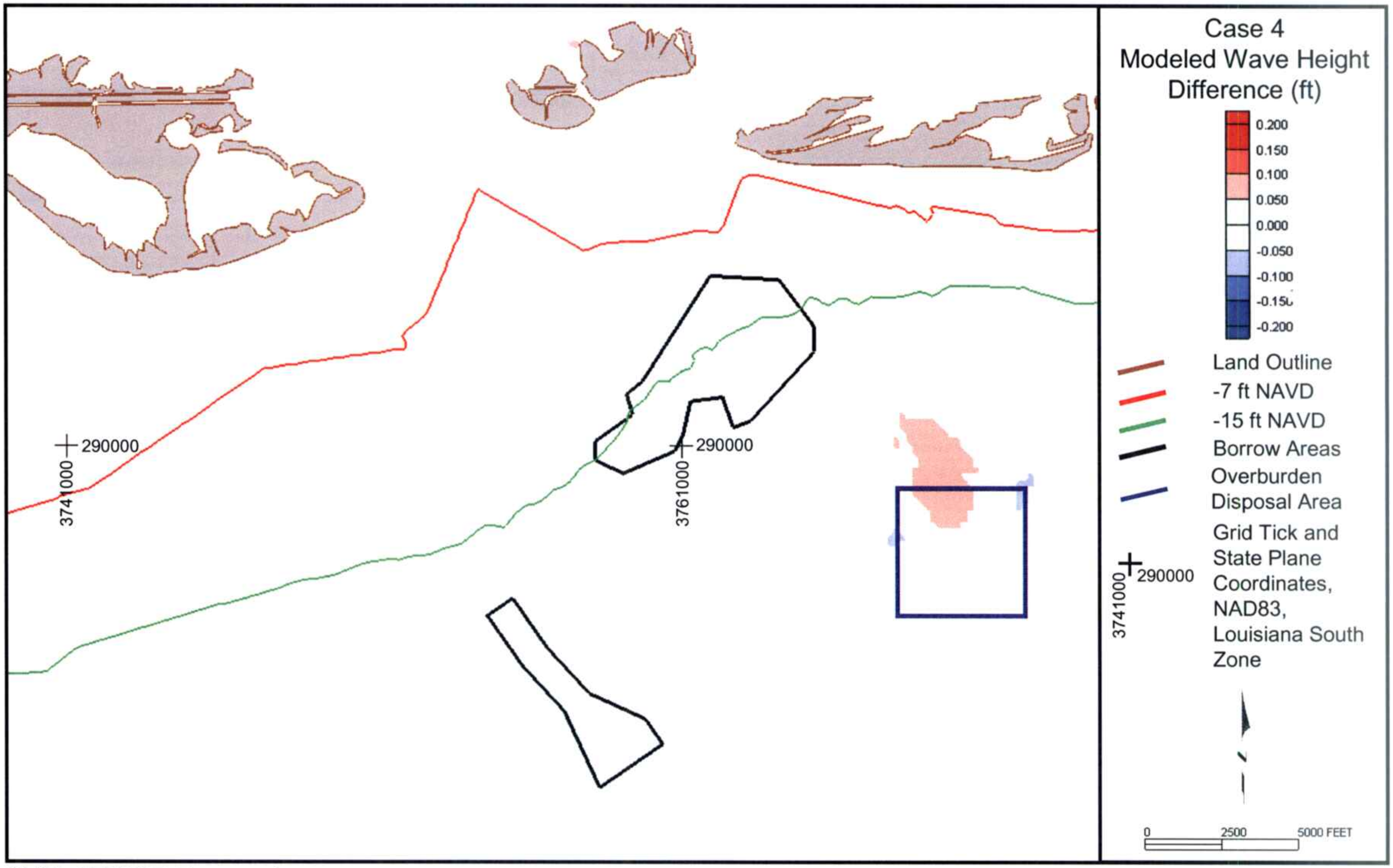

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Figure 1-17: Wave Height Difference – Case 4

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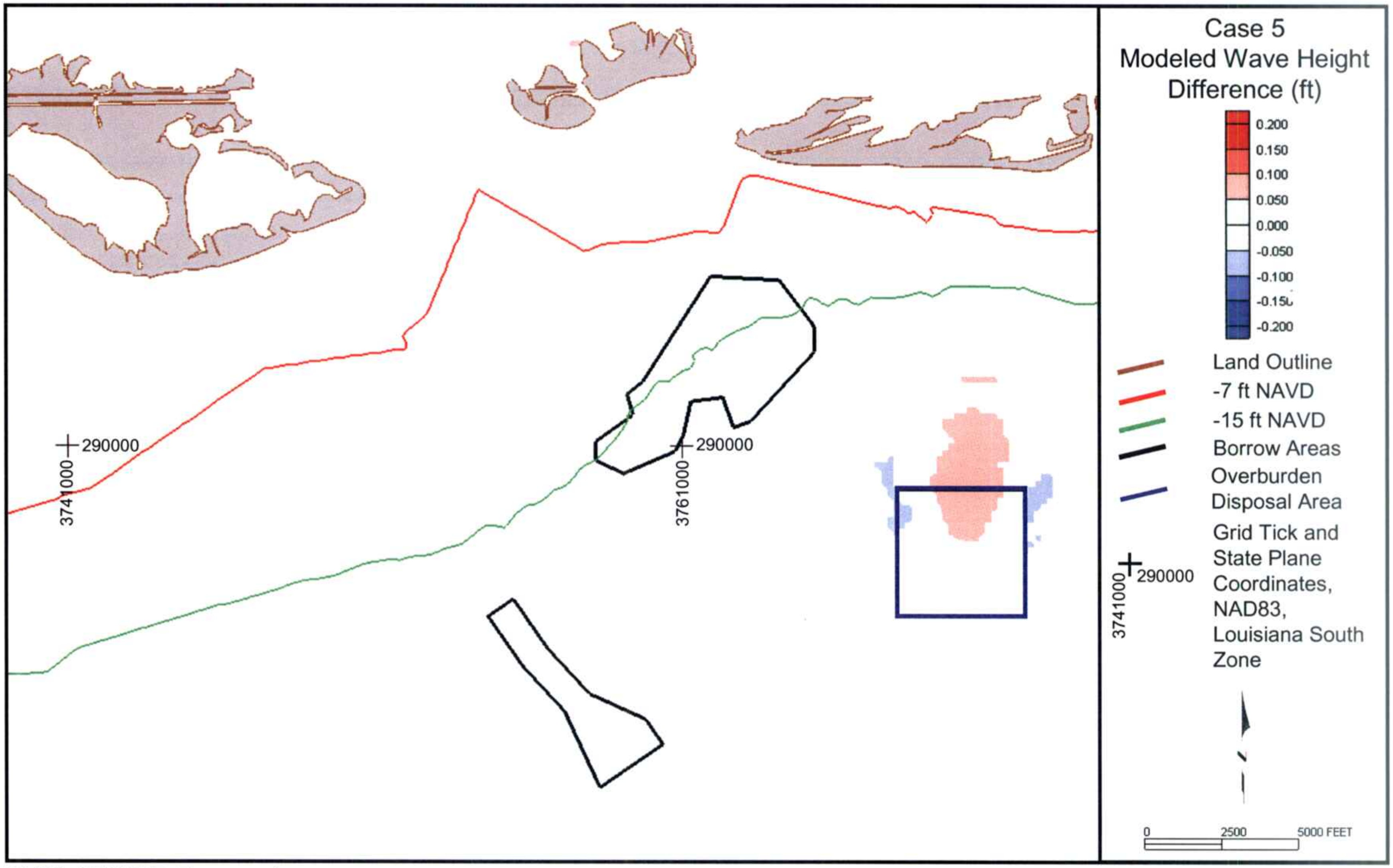

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Figure 1-18: Wave Height Difference – Case 5

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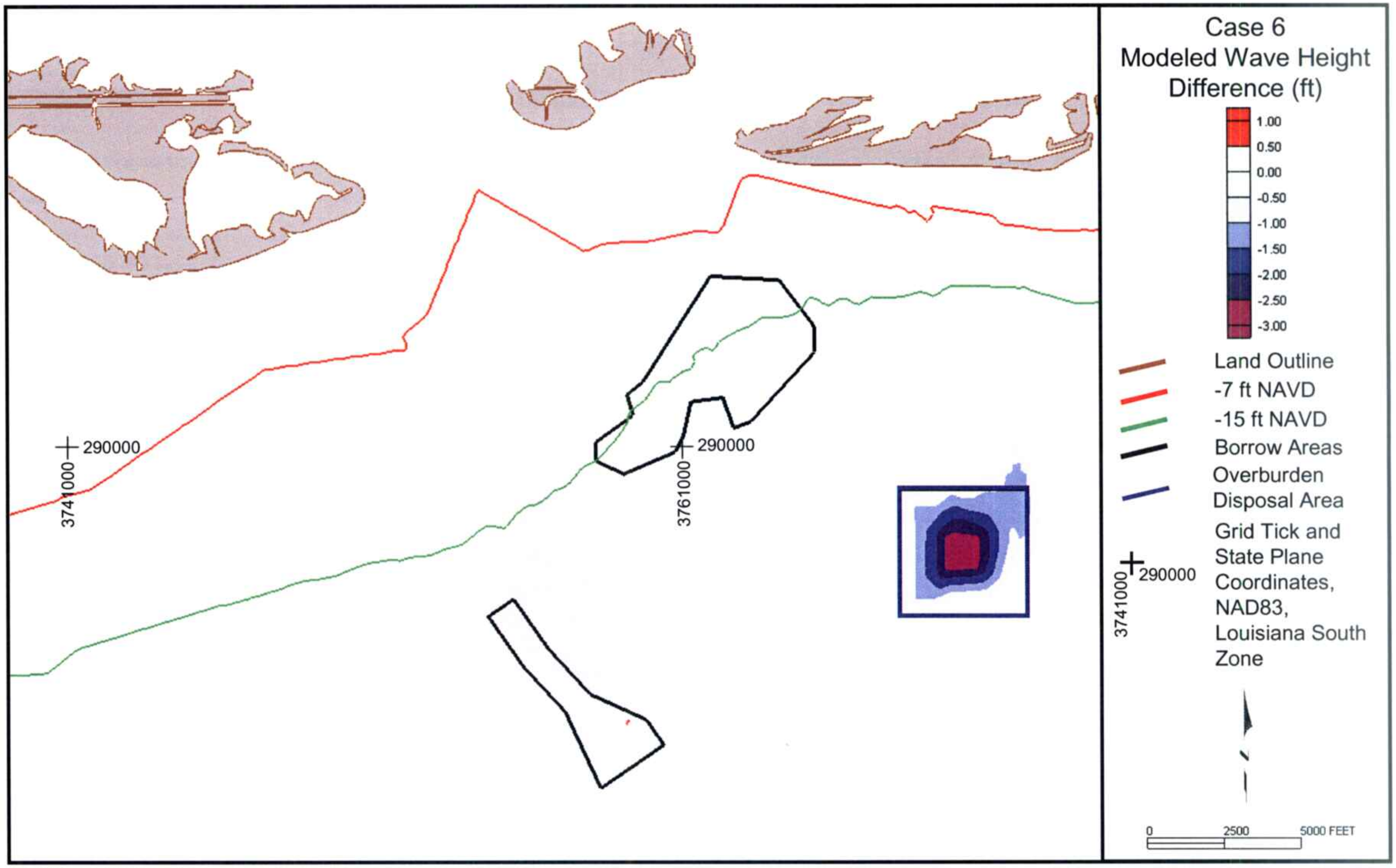

Figure 1-19: Wave Height Difference – Case 6

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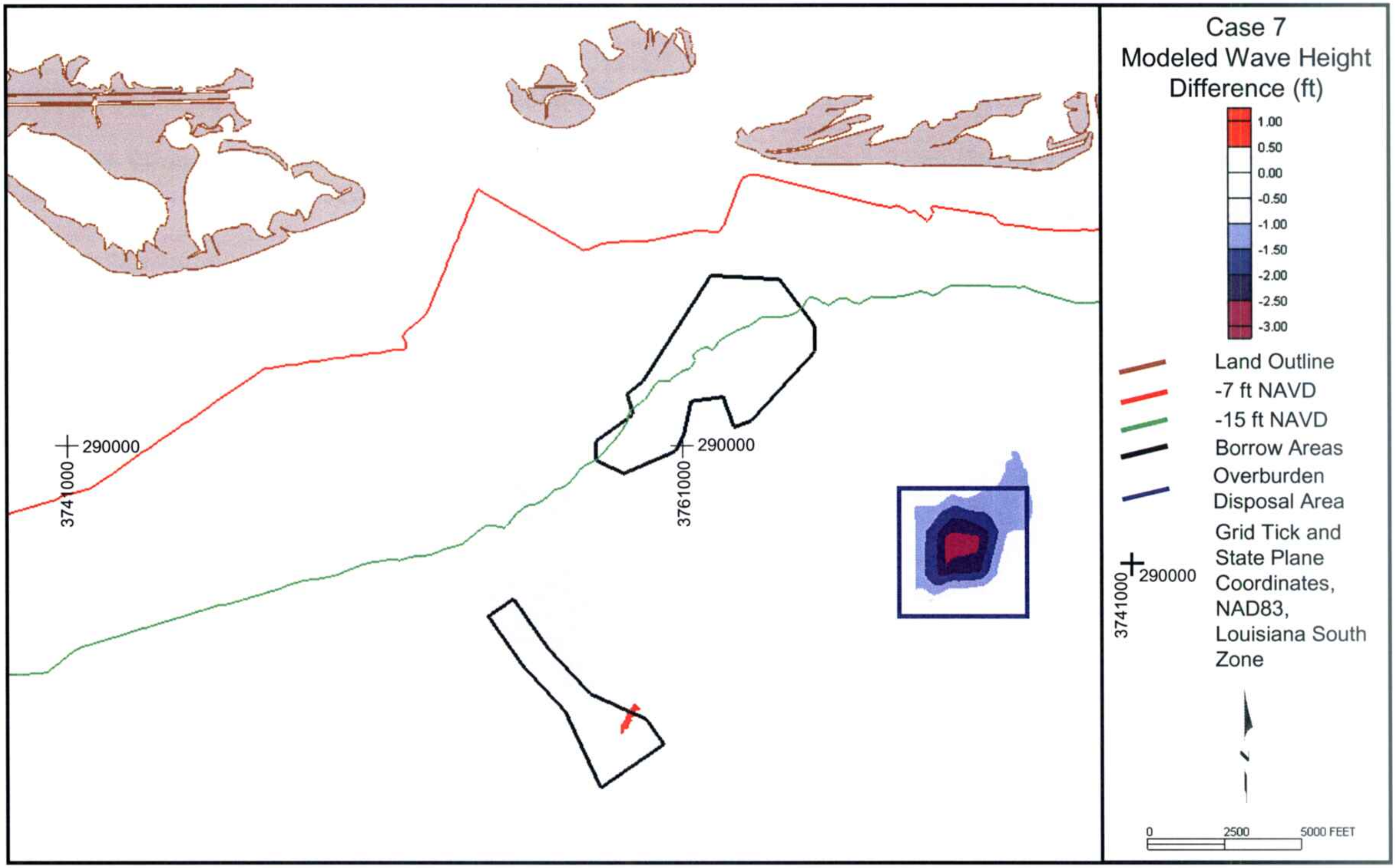

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Figure 1-20: Wave Height Difference – Case 7

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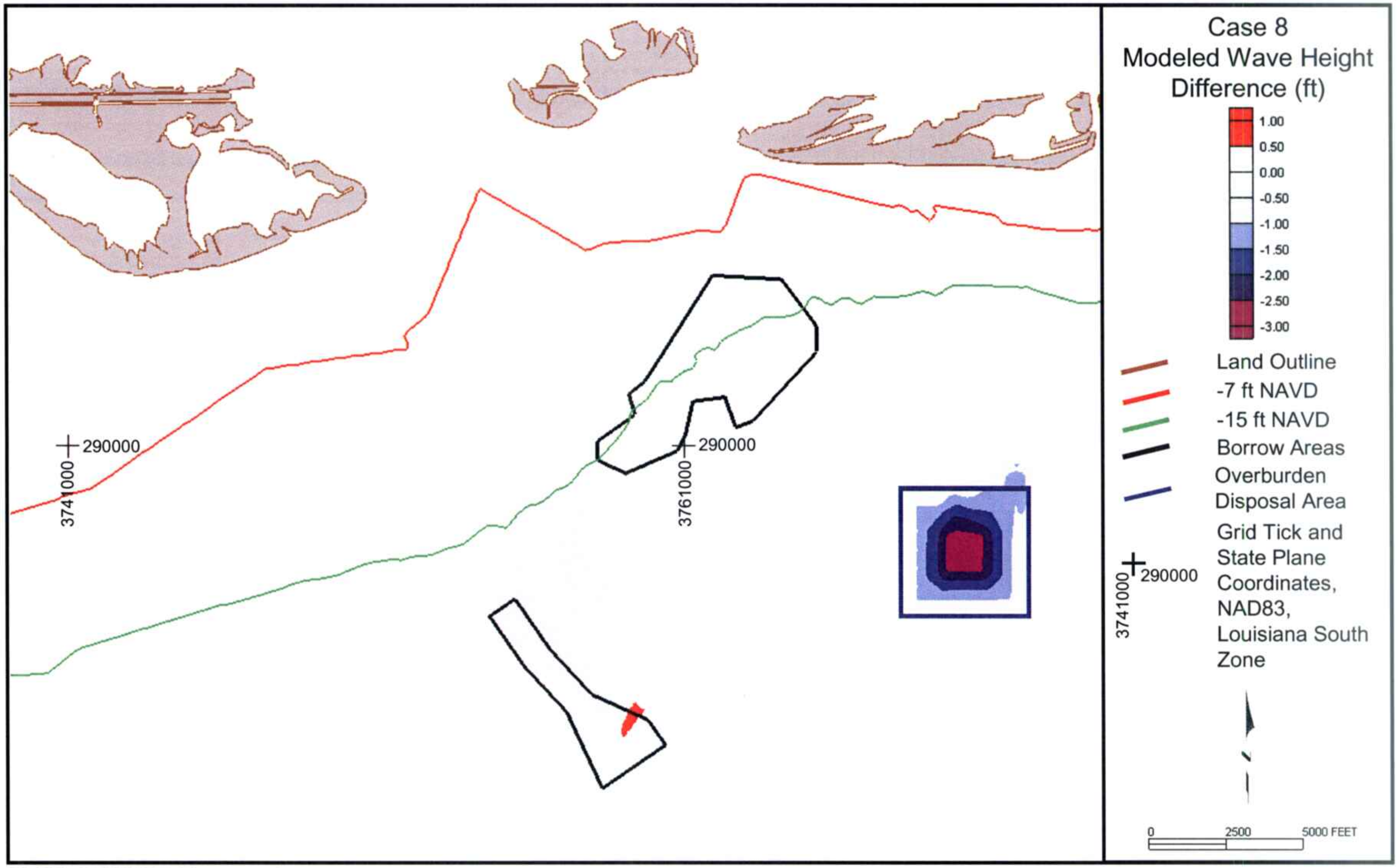

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Figure 1-21: Wave Height Difference – Case 8

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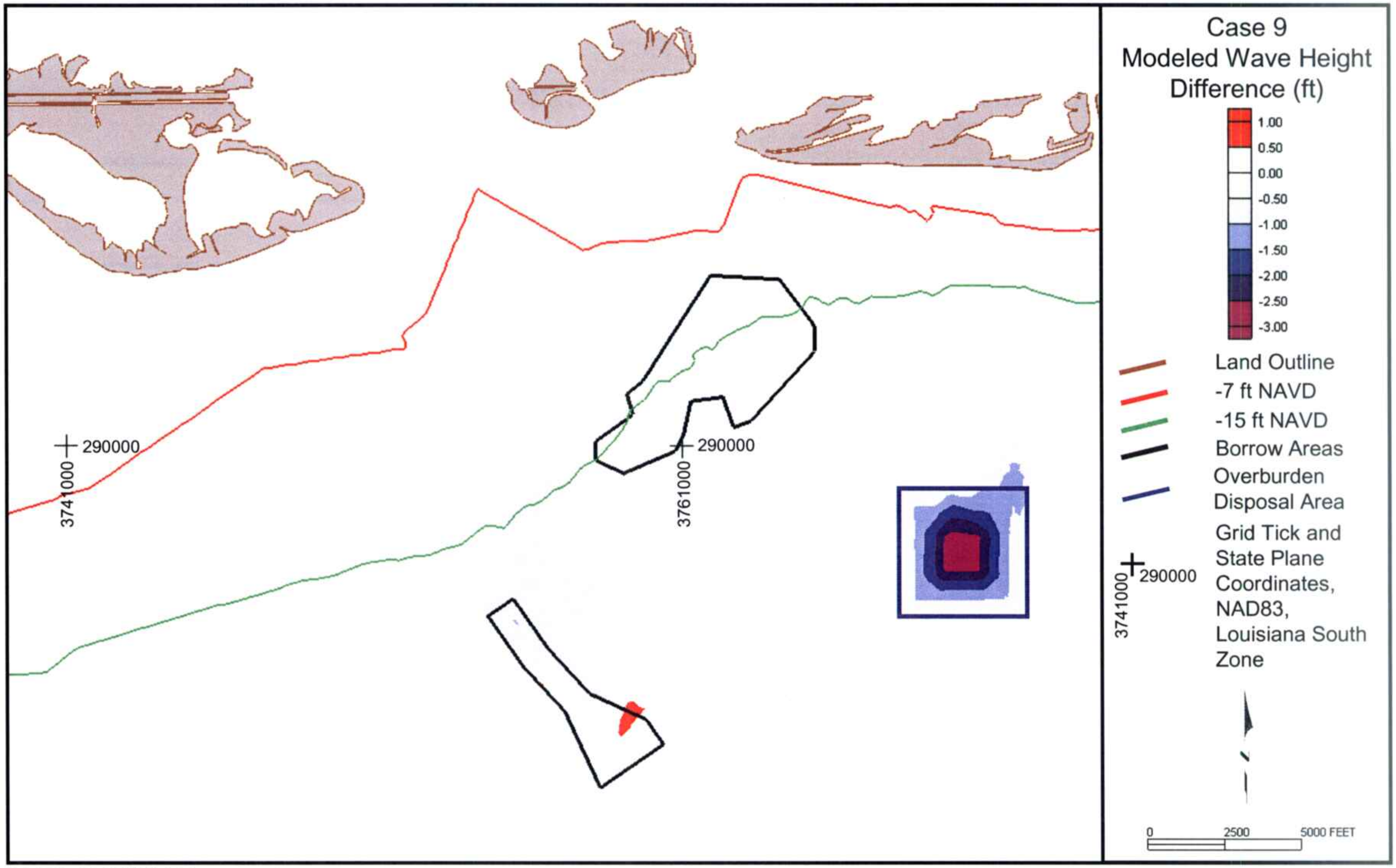
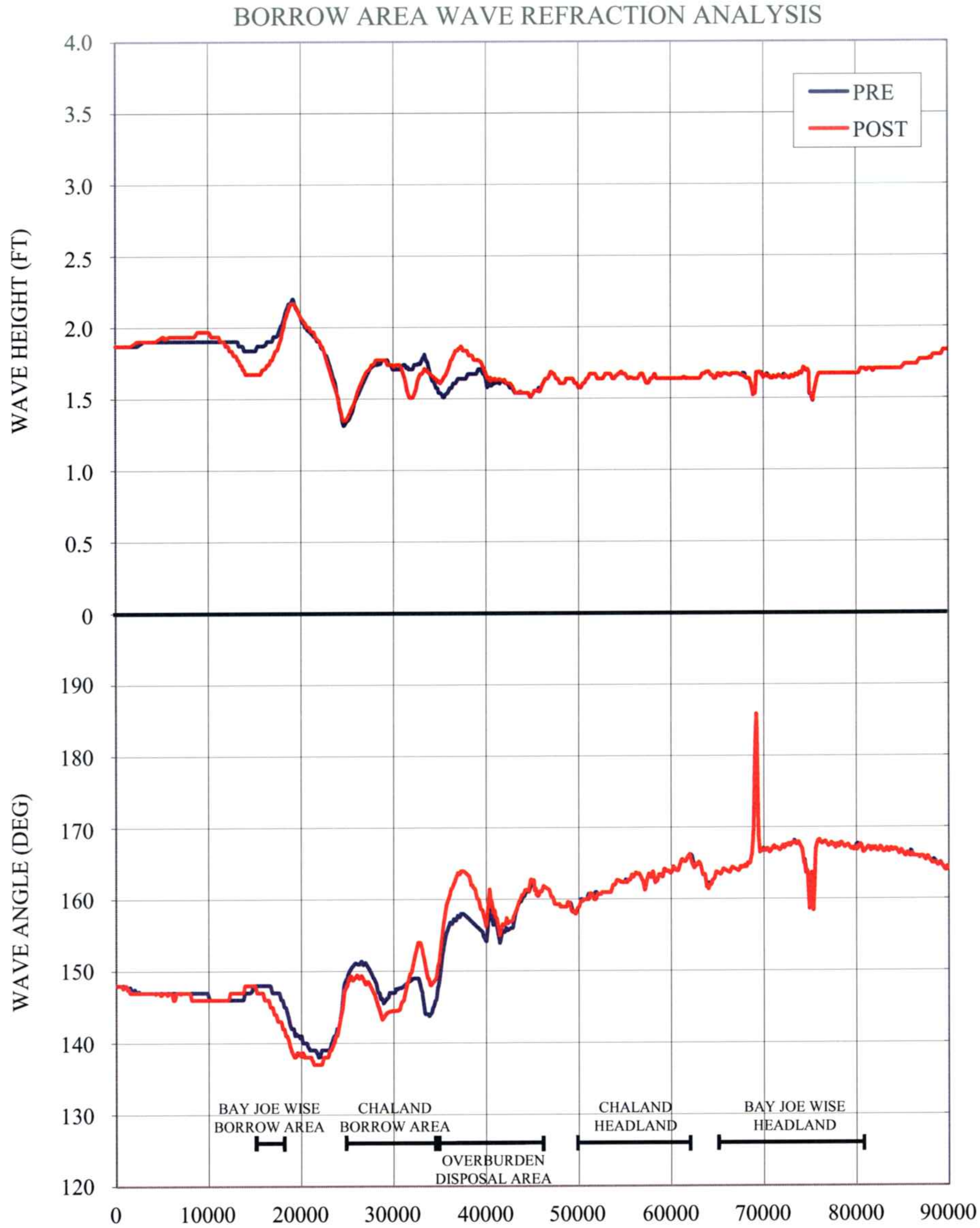


Figure 1-22: Wave Height Difference – Case 9

Comparisons of the modeled wave heights and modeled wave angles between the pre-construction bathymetry and post-construction bathymetry for all nine (9) cases are shown in Figures 1-23 through 1-31. For the normal wave scenarios (Figures 1-23 through 1-27), the data was extracted along the -7 feet NAVD bathymetric contour line and for the storm wave scenarios (Figures 1-28 through 1-31), the data was extracted along the -15 feet NAVD bathymetric contour line, corresponding to depth limited conditions as described in Section 1.1.4.

These figures show modeled wave heights decreasing slightly for most normal wave scenarios near the Bay Joe Wise Borrow Area, and slightly increasing in areas and decreasing in other areas near the Chaland Borrow Area. The magnitude of the wave height change along this bathymetric contour rarely exceeded 0.2 feet for the normal wave scenarios. The modeled wave heights decrease significantly under the storm wave scenarios at the proposed Bay Joe Wise Borrow Area. In general, at the -15 feet NAVD contour line, the wave heights are decreased by about 5 to 6 feet. The proposed Chaland Borrow Area generally decreased wave heights by about 2 feet in most of the storm scenarios. In both the storm and normal wave scenarios, the proposed Bay Joe Wise Borrow Area deflected waves more along a westerly path. The proposed Chaland Borrow Area deflected waves along a more northerly or easterly path. The potential zone of influence on wave refraction patterns from excavation of both borrow areas extends approximately 12,000 feet to the west and 20,000 feet to the east.



02132_Wave HtAndAngleAtDOCs.ppt

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FIGURE 1-23: STWAVE CASE 1 RESULTS

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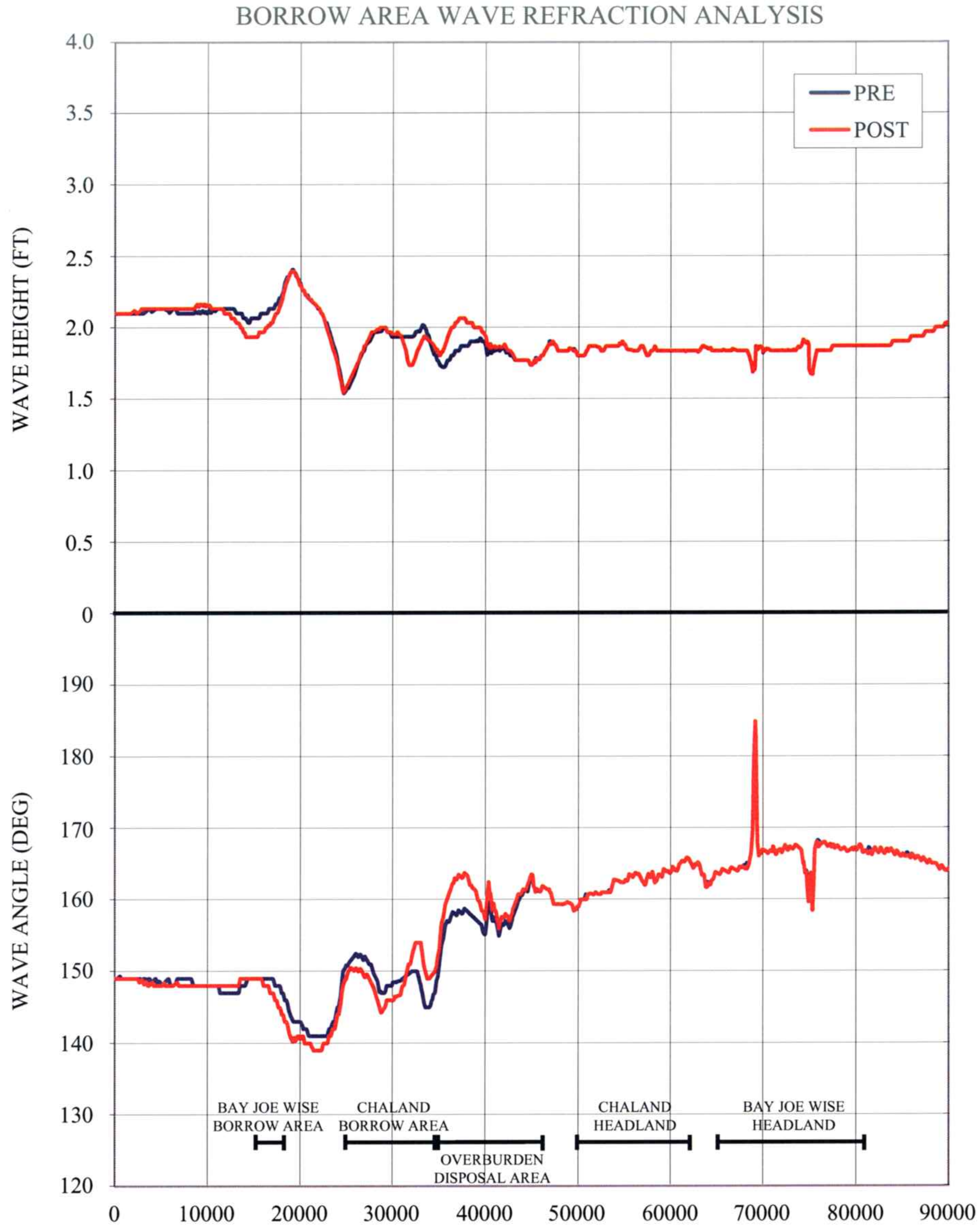

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FIGURE 1-24: STWAVE CASE 2 RESULTS

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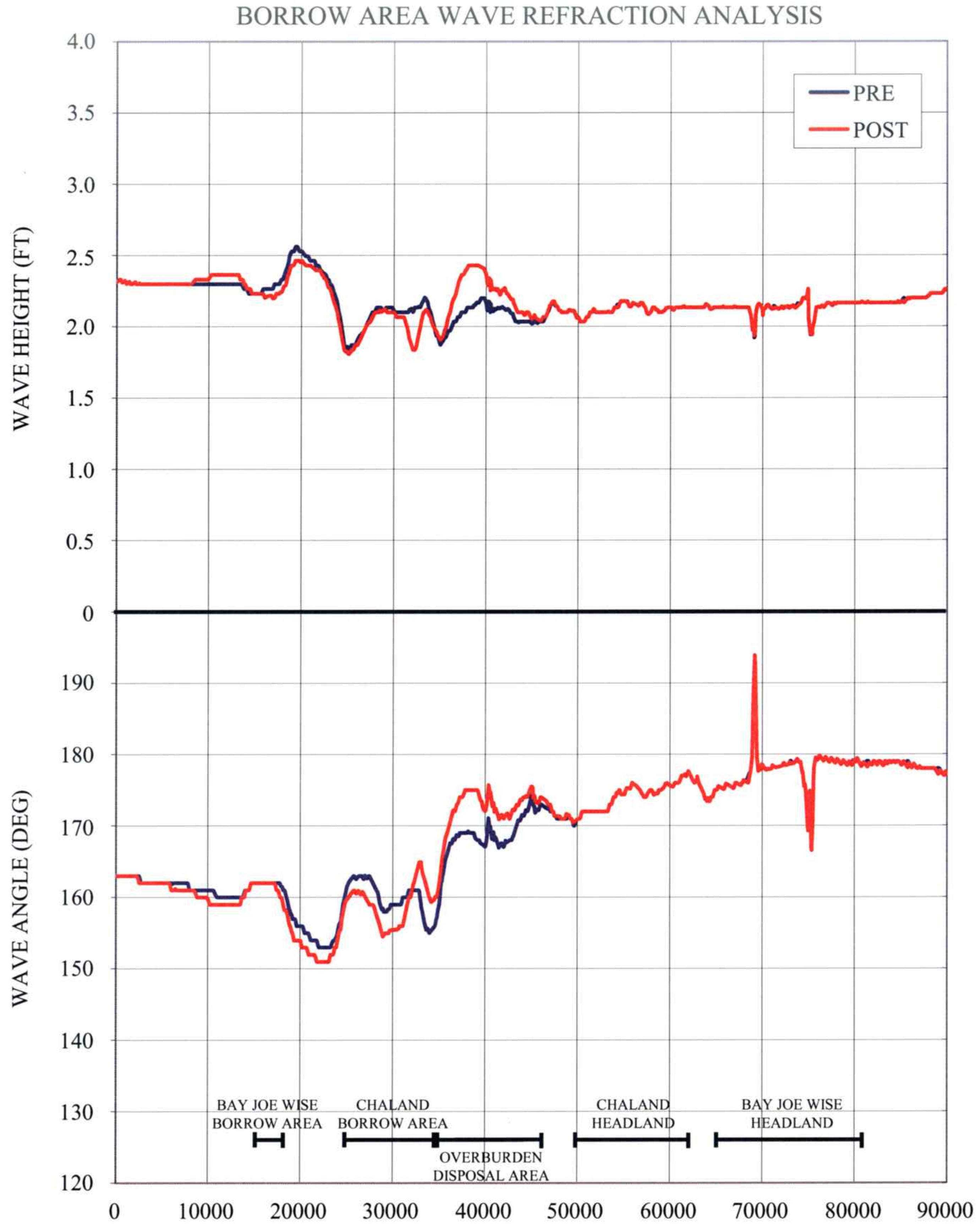

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FIGURE 1-25: STWAVE CASE 3 RESULTS

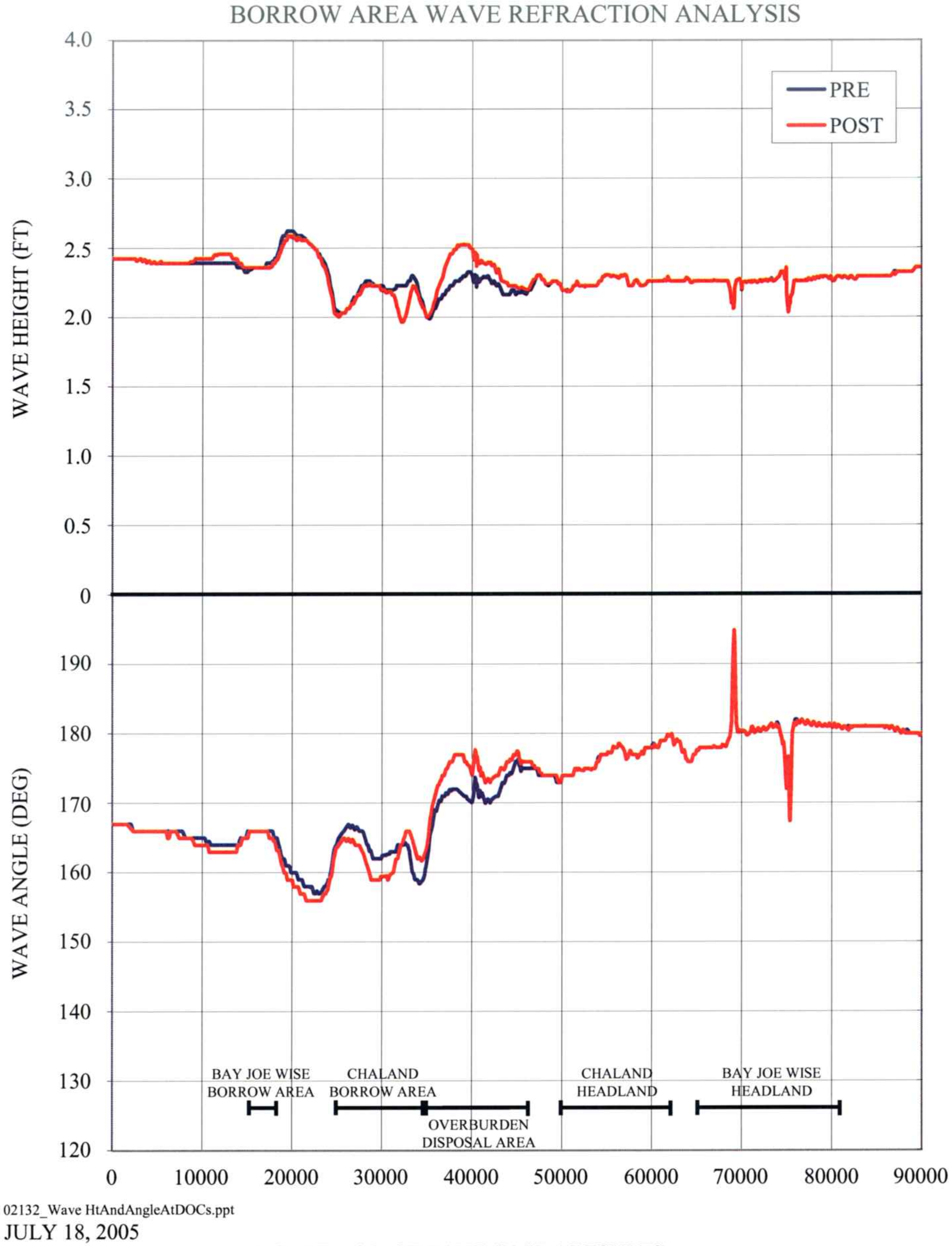

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FIGURE 1-26: STWAVE CASE 4 RESULTS

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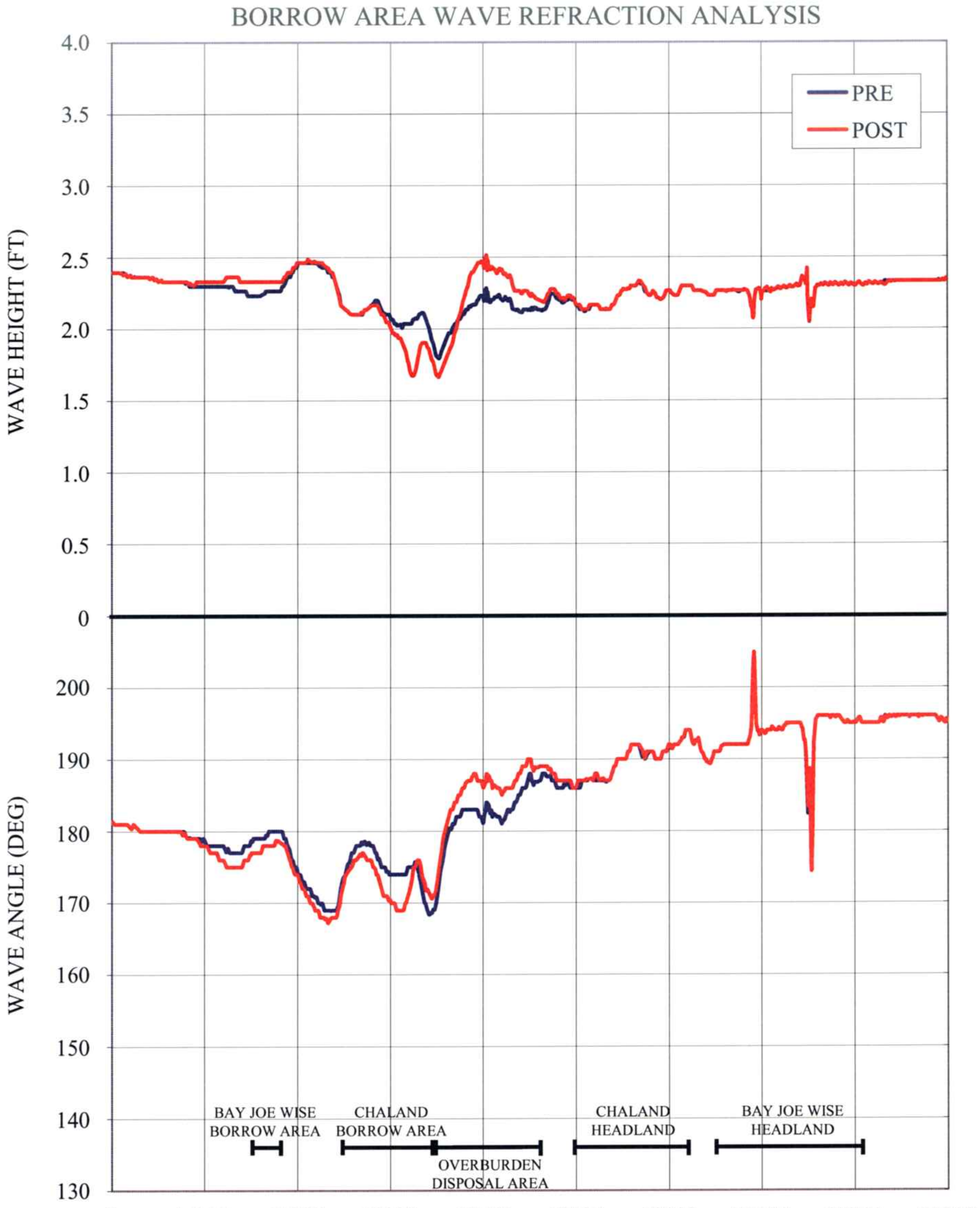

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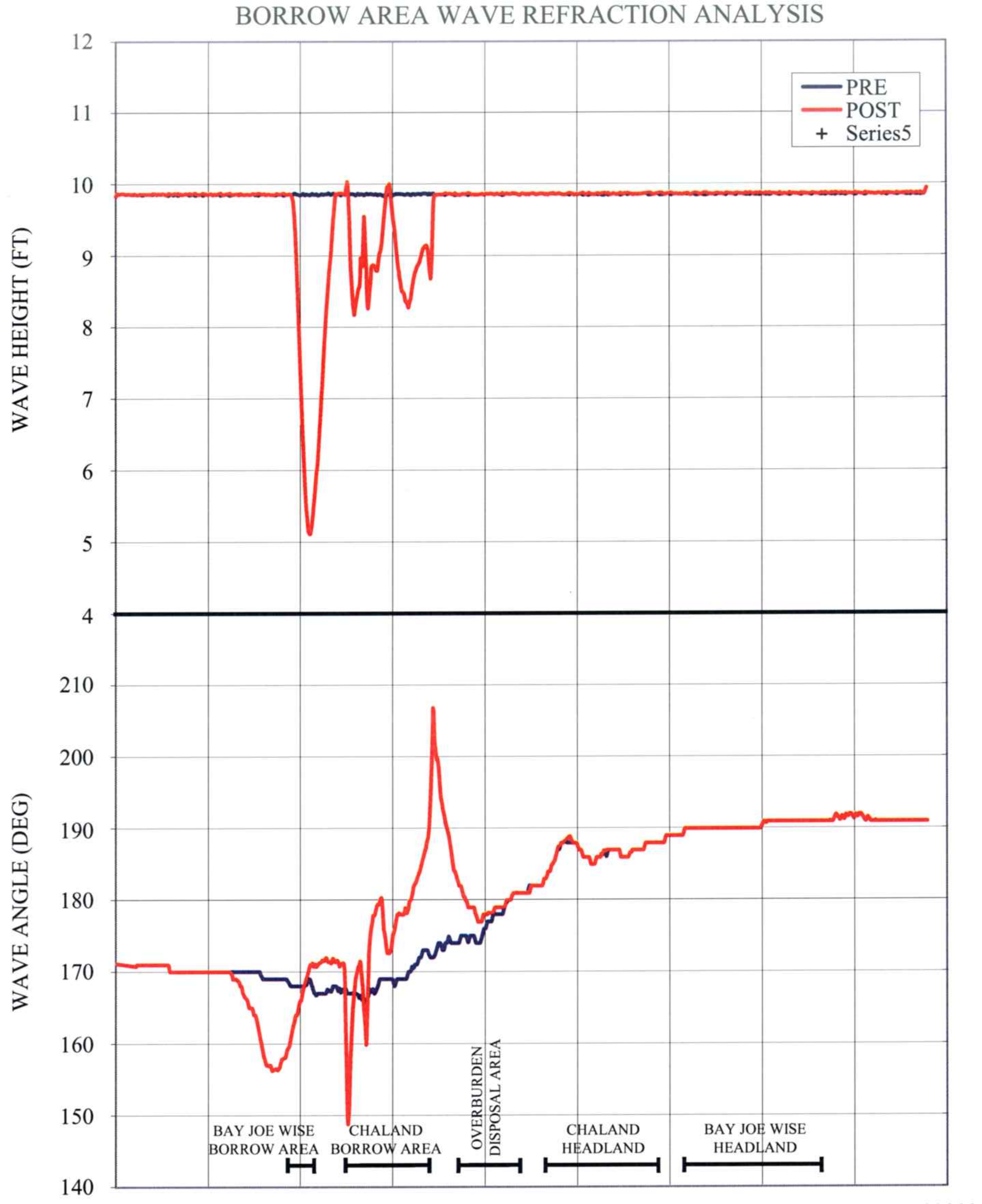
FIGURE 1-27: STWAVE CASE 5 RESULTS



02132_Wave HtAndAngleAtDOCs.ppt

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FIGURE 1-28: STWAVE CASE 6 RESULTS

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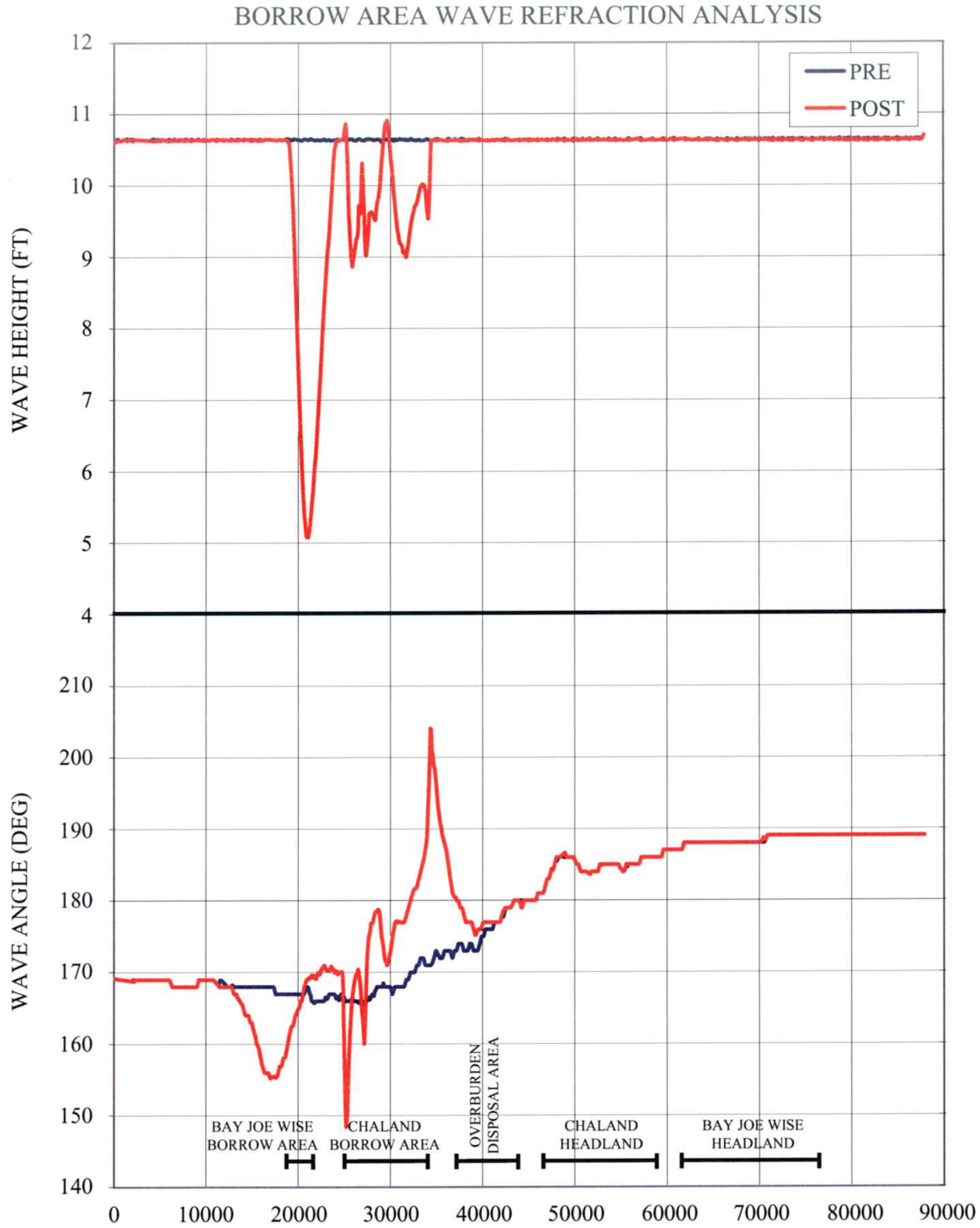

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FIGURE 1-29: STWAVE CASE 7 RESULTS

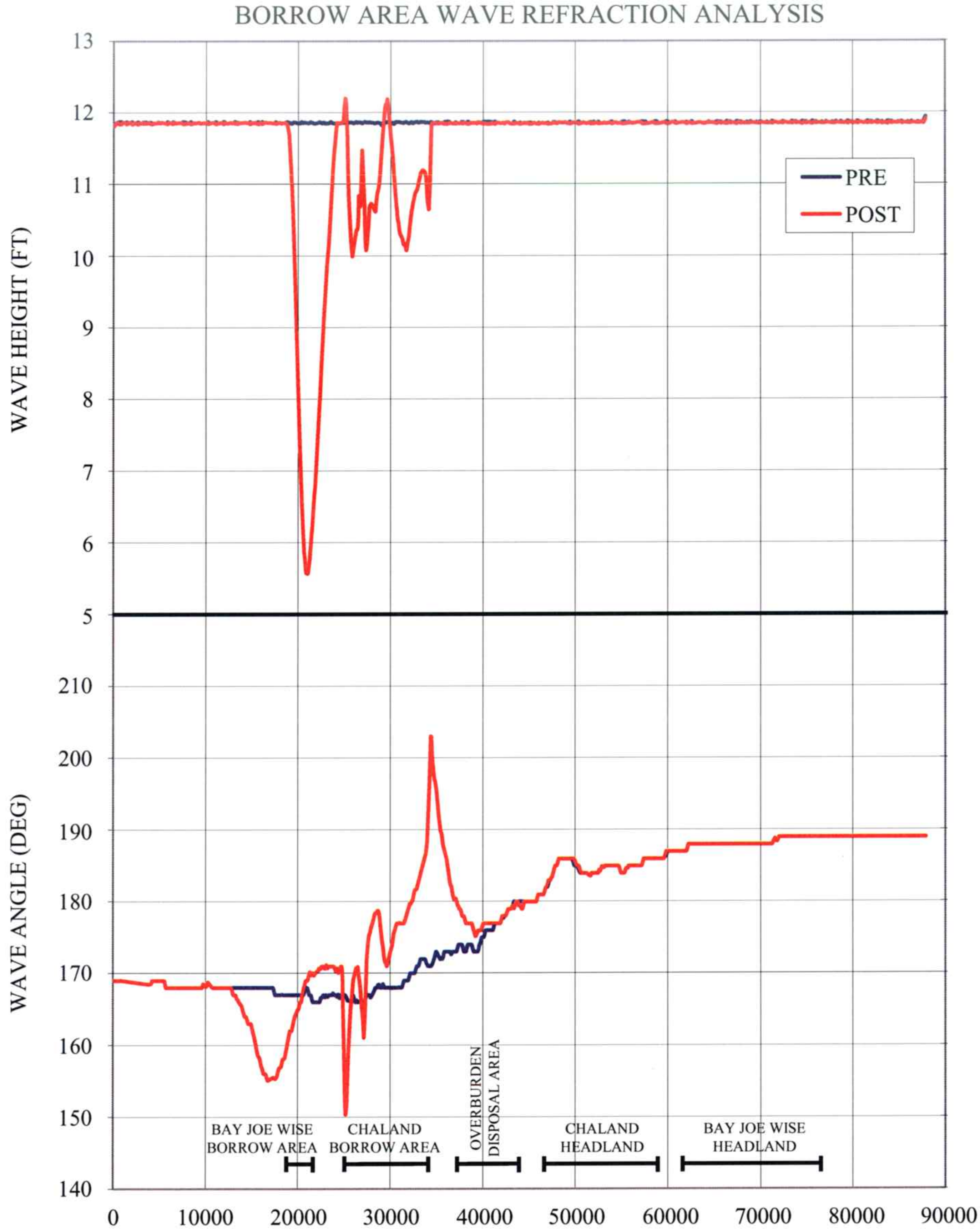

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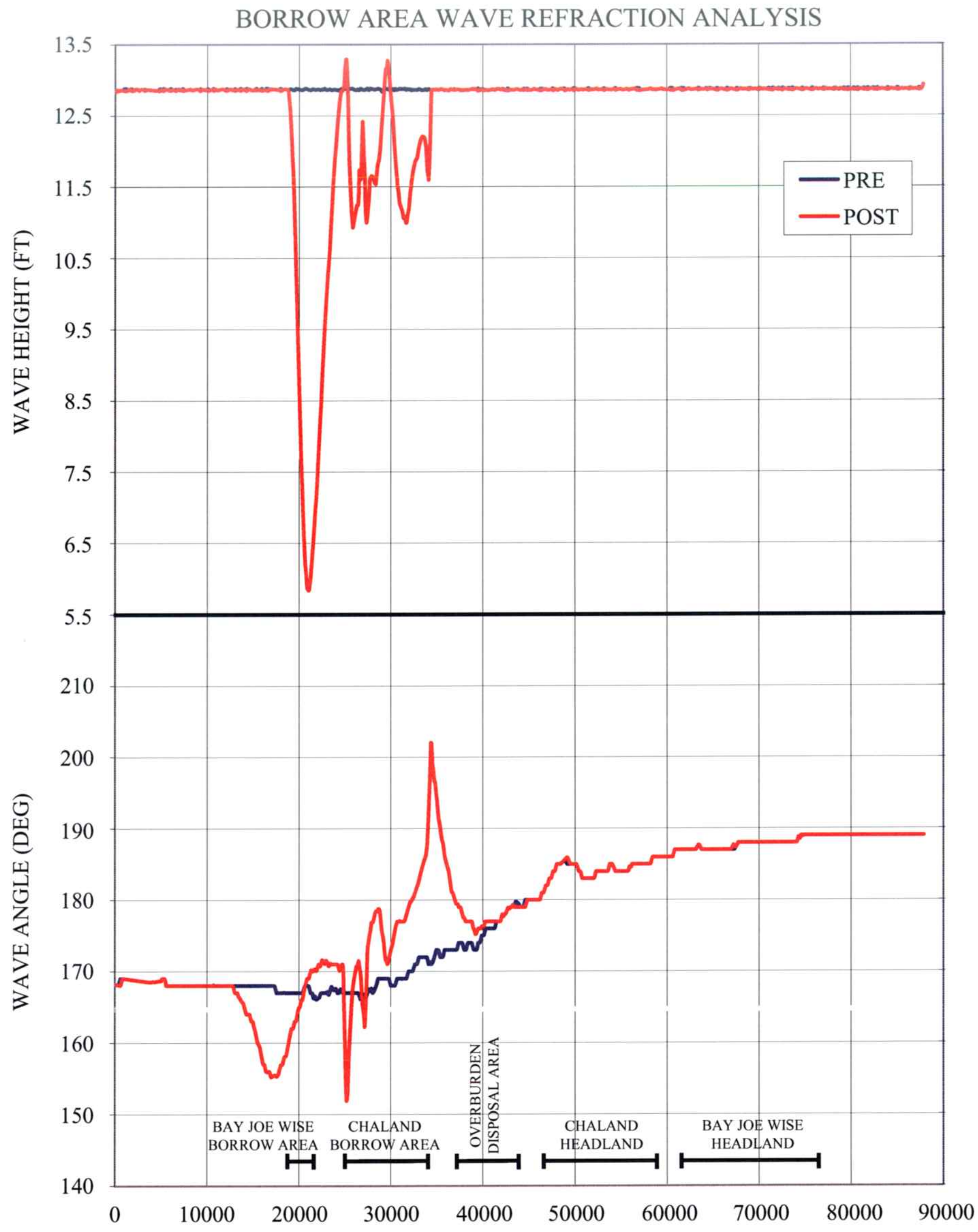
FIGURE 1-30: STWAVE CASE 8 RESULTS



02132_Wave HtAndAngleAtDOCs.ppt

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FIGURE 1-31: STWAVE CASE 9 RESULTS

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1.3 Conclusions

Wave height increases caused by the proposed Bay Joe Wise Borrow Area were immeasurable at the breaking points. The expected result of the modeled minor decreases in wave height will be minor reductions in sediment transport within the zone of influence of the borrow areas. Additionally, both the plan view images of the results and the cross-sectional comparisons at the breaking points show there is no interaction between the two borrow areas, thus wave height changes are not expected to occur at the proposed Chaland Borrow Area as a result of the excavation of the proposed Bay Joe Wise Borrow Area. The Overburden Disposal Area did not show any changes in wave height or wave angle at the breaking point under normal or storm wave scenarios. Thus, it is predicted that excavation of the proposed Bay Joe Wise Borrow Area and placement of material in the Overburden Disposal Area will have negligible effects on wave refraction and resultant sediment transport patterns, and no adverse impacts to the adjacent shorelines.