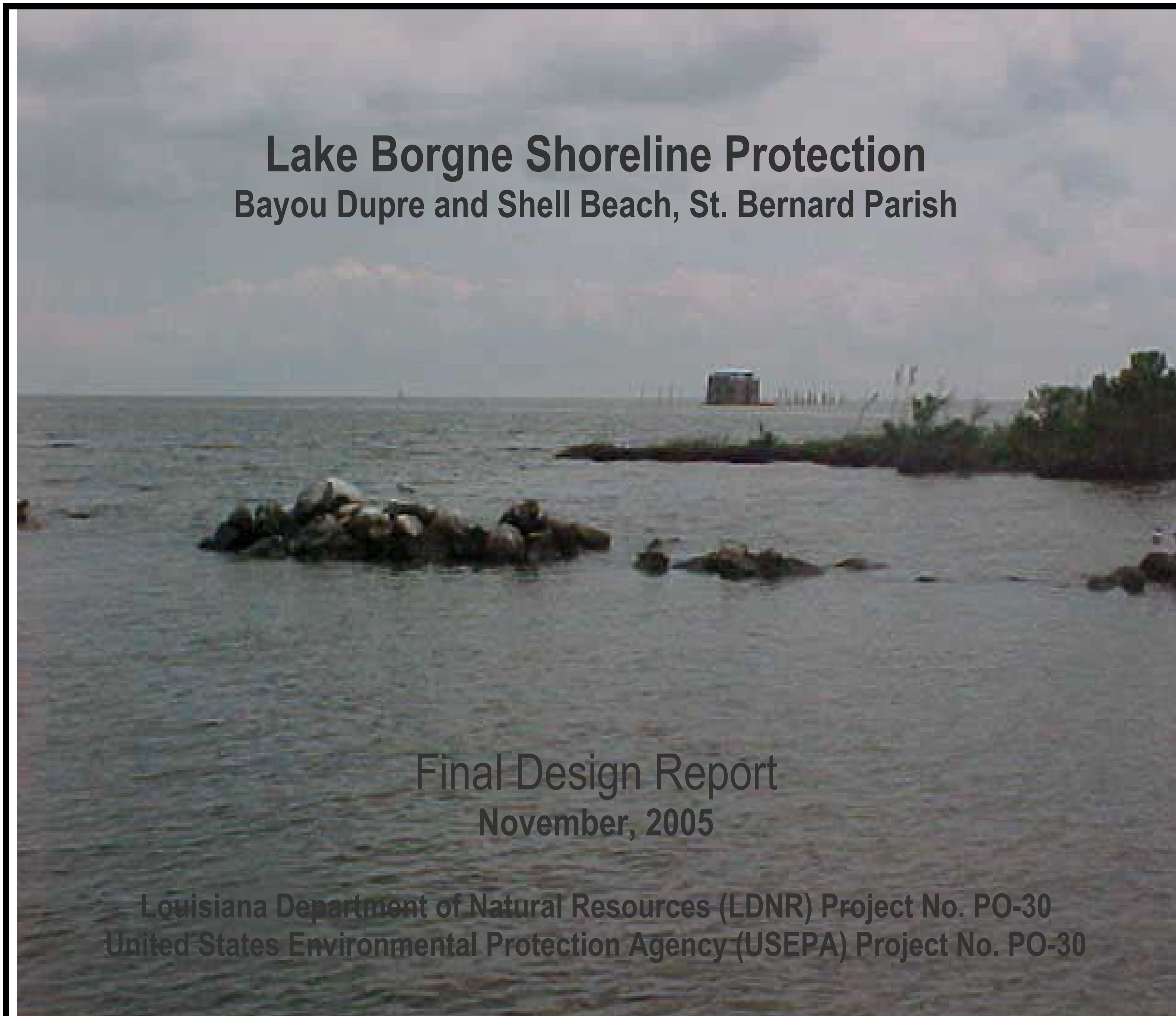

Lake Borgne Shoreline Protection

Bayou Dupre and Shell Beach, St. Bernard Parish

Final Design Report

November, 2005

Louisiana Department of Natural Resources (LDNR) Project No. PO-30
United States Environmental Protection Agency (USEPA) Project No. PO-30

Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA)

LOUISIANA DEPARTMENT OF NATURAL RESOURCES
COASTAL RESTORATION AND MANAGEMENT

COASTAL WETLANDS PLANNING, PROTECTION, AND RESTORATION ACT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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1. INTRODUCTION

The Lake Borgne Shoreline Protection Project (herein referred to as PO-30) is located in the Pontchartrain Basin on the southern shoreline of Lake Borgne. The Louisiana Coastal Wetlands Conservation and Restoration Task Force (Task Force) designated PO-30 as part of the 10th Priority Project List. The United States Environmental Protection Agency Region 6 (EPA) was designated as the lead federal sponsor. The Louisiana Department of Natural Resources, Coastal Engineering Division (LDNR-CED) was selected by EPA to perform engineering and design for the project. Approval to proceed with engineering and design was granted at the January 2001 Task Force meeting. Funds for the project are provided through the Federal Coastal Wetlands Planning, Protection and Restoration Act (Public Law 101-646) and the local cost share is provided by the State of Louisiana's Wetlands Conservation Trust Fund.

The initial project provided lakeside protection only to the Old Shell Beach area. In April 2002, the Task Force combined the original project and funding with the Lake Borgne Shoreline Protection at Bayou Dupre (PO-31) from Priority Project List 11. The combined project (PO-30) is divided into two authorized sections, Bayou Dupre and Shell Beach. The section at Shell Beach extends approximately 3.2 miles between Fort Bayou and Doulluts Canal, and the section at Bayou Dupre extends approximately 1.4 miles to the west and 0.9 miles to the east of Bayou Dupre (Figure 1).

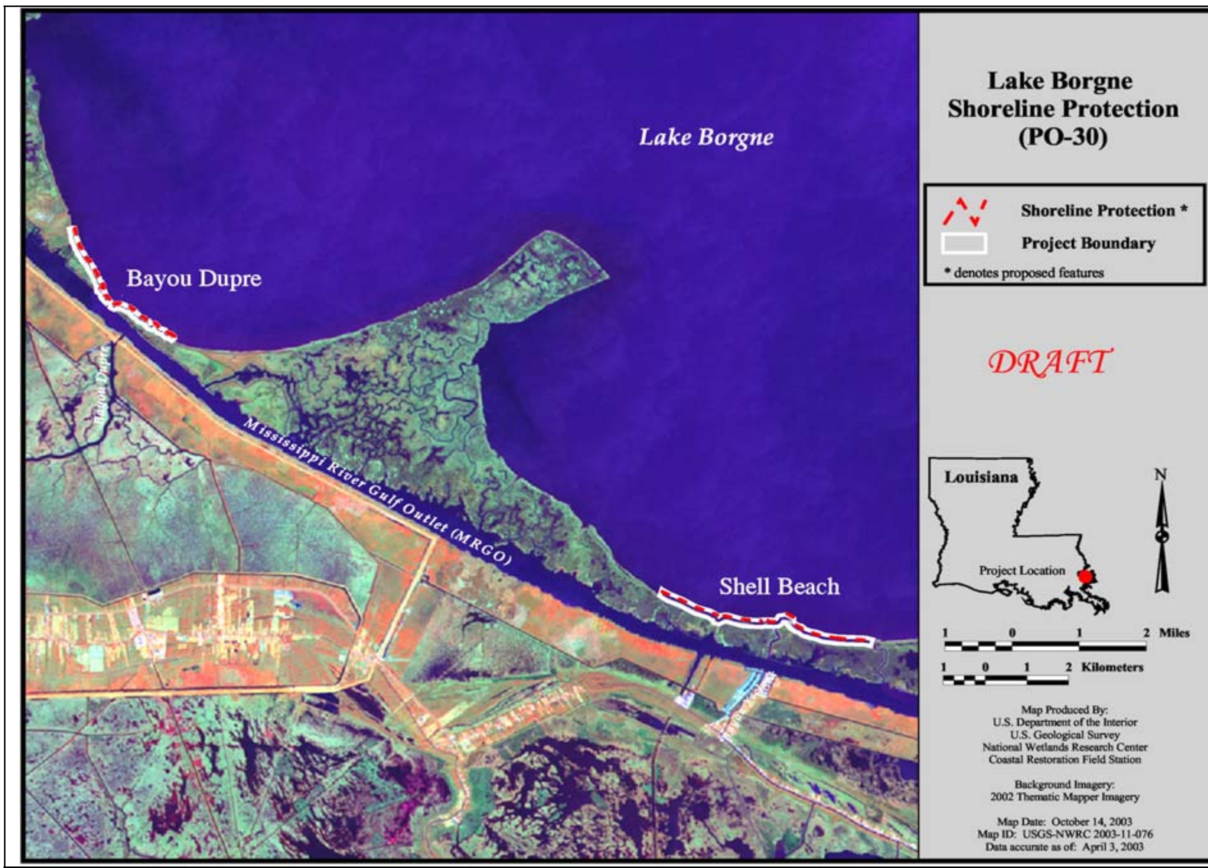

Figure 1 – PO30 Project Boundaries

The narrow strip of marsh which separates Lake Borgne from the Mississippi River Gulf Outlet (MRGO) is degrading at an estimated 7-9 feet per year at Shell Beach, and 6-7 feet per year at Bayou Dupre (USGS 2005). This narrow strip of marsh also protects the coastal communities of Shell Beach, Yscloskey, and Hopedale from wave energy and tidal surge generated in Lake Borgne. The objectives of this project are to halt shoreline retreat and direct marsh loss along Lake Borgne, prevent further coalescence of the lake and MRGO, re-establish a sustainable lake rim, restore saline marsh habitat, and enhance fish and wildlife habitat.

The proposed solution is to construct a nearly continuous rock breakwater along the designated shoreline sections of Lake Borgne at Bayou Dupre and Shell Beach. At the mouth of Bayou Dupre, maintenance dredging within the MRGO has created an unnatural water depth. Therefore, a sheet pile structure or equivalent will tie the proposed shoreline breakwater into the existing offshore USACE (United States Army Corps of Engineers) rock breakwater along the MRGO. At Shell Beach, the proposed rock breakwater will tie into the existing rock breakwater which surrounds the perimeter of Fort Beauregard and the only openings in the breakwater will occur along the mouth of Bayou Yscloskey and across the Tennessee Gas Pipeline right-of-way. The design life for the project is 20 years.

A temporary flotation channel will also be excavated along the shoreline in order to facilitate construction and maintenance of the rock breakwater. The spoil will be deposited on the lakeside of the flotation channel and degraded back into the flotation channel after construction or maintenance of the rock breakwater is complete.

The project team, consisting of members of EPA, LDNR-CED, the St. Bernard Parish Council, and Coastal Zone Monitoring committee, performed an on-site kick-off meeting on March 8, 2001. Based on that meeting, a plan was developed to identify and address all of the project requirements. The engineering and design, environmental compliance, real estate negotiations, oyster lease acquisitions, and cultural resources investigations have been carried through to the 95% level of completion as required by the CWPPRA standard operating procedures. A 30% review conference was held at LDNR on August 18, 2005. The meeting minutes are included in Section 12. A 95% review conference will be scheduled during November, 2005.

2. SURVEYS

2.1 Topographic, Bathymetric and Magnetometer Surveys

In order to facilitate the design of the shoreline protection structures and associated access and flotation channels, bathymetric, topographic and magnetometer surveys were performed for Shell Beach on February 25, 2002 by BFM Corporation, L.L.C., and on March 21, 2005 by Sigma Consulting Group, Inc. (Appendix A). For Bayou Dupre, bathymetric, topographic, and magnetometer surveys were performed on January 13, 2004 and on March 21, 2005 by Sigma Consulting Group, Inc., (Appendix B). A magnetometer survey was performed near the former naval base on Bayou Yscloskey at Lake Borgne by Earth Search, Inc., on March 17, 2005.

The survey baseline for Shell Beach was established along the shoreline extending from the east bank of Fort Bayou to the west bank of Doullut's Canal. The survey transects intersect the baseline at 1000 foot intervals and extend perpendicular into Lake Borgne from 25 feet onshore to the approximate -7.0 foot contour, except at the middle an outermost transects where they extend to the -8.0 foot contour. Upland and shallow water areas were shot using conventional level soundings. Deepwater areas were shot using a fathometer and RTK positioning.

In order to identify potentially live ordnance along the immediate shoreline of the former naval facility located east of Bayou Yscloskey at Lake Borgne, a separate magnetometer survey was performed. One hundred and twenty-one anomalies were detected by the survey. Individual ordnance, if present, was masked by the magnetic inflections of existing large-scale structures. According to the Formerly Used Defense Sites 2002 Properties list by the United States Corps of Engineers, no hazardous potential was found at the officially closed site. As well personal communications with the Fort Worth District confirmed the site has been closed.

The survey baseline for Bayou Dupre was established along the shoreline extending approximately 1.6 miles to the west and 1.2 miles to the east of the bayou. The survey transects intersect the baseline at 500 foot intervals within the bayou and 1000 foot intervals thereafter, and extend perpendicular into Lake Borgne from 25 feet onshore to the approximate -8.0 foot contour in Lake Borgne. An additional transect was added along an approximate 200 foot section extending between the existing rock breakwaters along the MRGO located immediately west of the bayou. Upland and shallow water areas were shot using conventional level soundings. Deepwater areas were shot using a fathometer and RTK positioning.

2.2 Secondary Monuments

Prior to performing the topographic and bathymetric survey of the project areas, permanent secondary monuments were installed at Shell Beach and Bayou Dupre. "PO-30-SM-01" was installed on the south bank of the MRGO at Bayou Yscloskey having coordinates of 29°56'10.33674"N, 89°50'08.86486"W. "SHELL BEACH 2002" was installed at the northwest end of Louisiana State Highway 46 having coordinates of 29°51'17.18441"N, 89°40'41.00787"W. These monuments were established primarily for this project but are also now part of the LDNR secondary GPS network. The data sheets for these monuments are provided in Appendices C and

D. The monuments were verified to still exist after Hurricanes Katrina and Rita based on a field trip on October 26, 2005.

3. WIND ANALYSIS

NOAA Station 42007 was selected to gather historical wind data due to availability and close proximity to the project area. It is located in the Gulf of Mexico (30°05'24"N; 88°46'12"W), approximately 22 miles south-southeast of Biloxi, Mississippi, and approximately 40 miles northeast of the project area.

Based on statistical analysis of the hourly wind data available from 1993 to 2002, the 90th percentile wind direction was determined to be 39.69˚ north-northeast as shown in Figure 2. The 90th percentile wind speed associated with the 90th percentile wind direction was calculated to be 23.3 miles per hour.

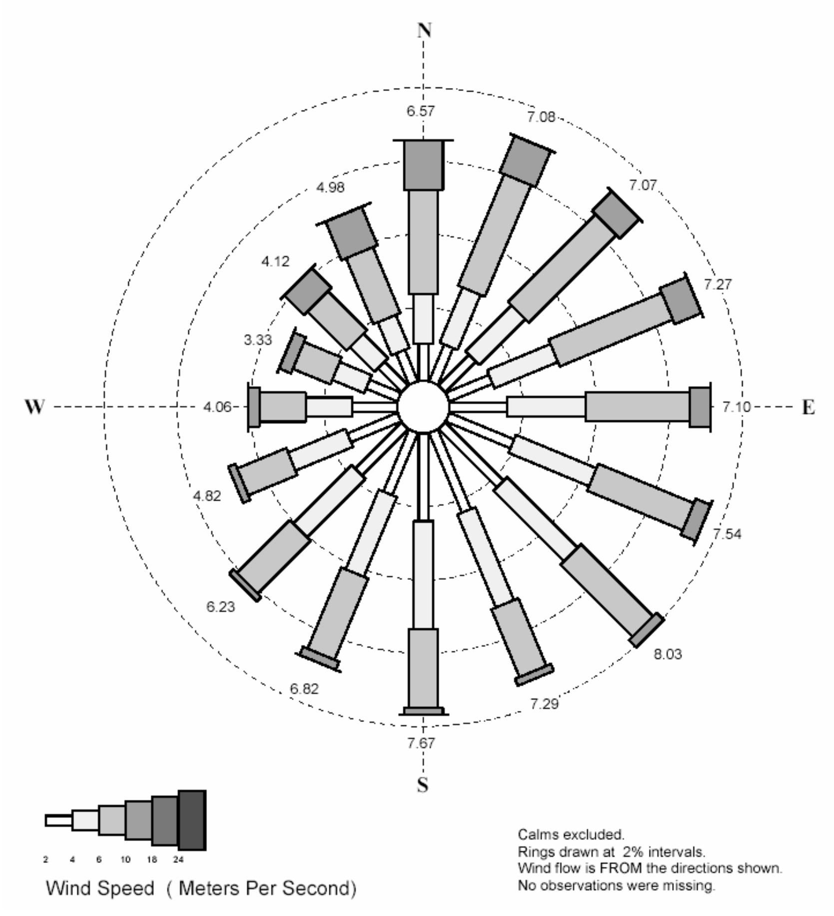

Figure 2 – Wind Rose for NOAA Station 42007, 1993-2002

4. HYDRAULICS

4.1 Historic Water Levels

USACE Gage Station 85800 was selected to gather historical water level records due to its close proximity to the project area and database availability. It is located on Bayou Yscloskey at 29°51'00"N; 89°41'00"W, approximately 200 feet southwest of the junction with the MRGO. Based upon historical water level records from 1993 to 2002 the mean high water (MHW), mean water level (MWL), and the mean low water level (MLW) were determined as shown in Table 1. The gage is referenced to NGVD29 but all values were corrected by -0.72 feet to the NAVD88 datum by the USACE.

DATUM	NORTHING	EASTING	NGVD 29	NAVD 88	CHANGE
	(U.S. FEET)	(U.S. FEET)	(U.S. FEET)	(U.S. FEET)	(U.S. FEET)
MHW	496,520.60	3,805,331.73	1.90	1.18	-0.72
MW	496,520.60	3,805,331.73	1.24	0.52	-0.72
MLW	496,520.60	3,805,331.73	0.57	-0.15	-0.72

Table 1 – Water Level Elevations at USACE Gage Station 85800, 1993-2002

4.2 Setup

The setup for Lake Borgne at Bayou Dupre and Shell Beach was determined using the 90th percentile water and wave conditions from the historical records. The average recorded water level associated with the 90th percentile wind speed and direction is 1.67 feet (0.5m) NAVD88. This value minus the mean high water level yields a setup of 0.49 feet (0.15 m).

4.3 Deep Water Wave Hind Casting

According to NOAA Nautical Chart #11371 (1989), the average depth of Lake Borgne is approximately 7 feet in the western lobe and 9 feet in the eastern lobe. For Shell Beach, the longest fetch associated with the 90th percentile wind direction and continuous 9 foot water depth is 22 miles as shown in Figure 3. For Bayou Dupre the longest fetch associated with the 90th percentile wind direction and continuous 7 foot water depth is 7.5 miles as shown in Figure 4.

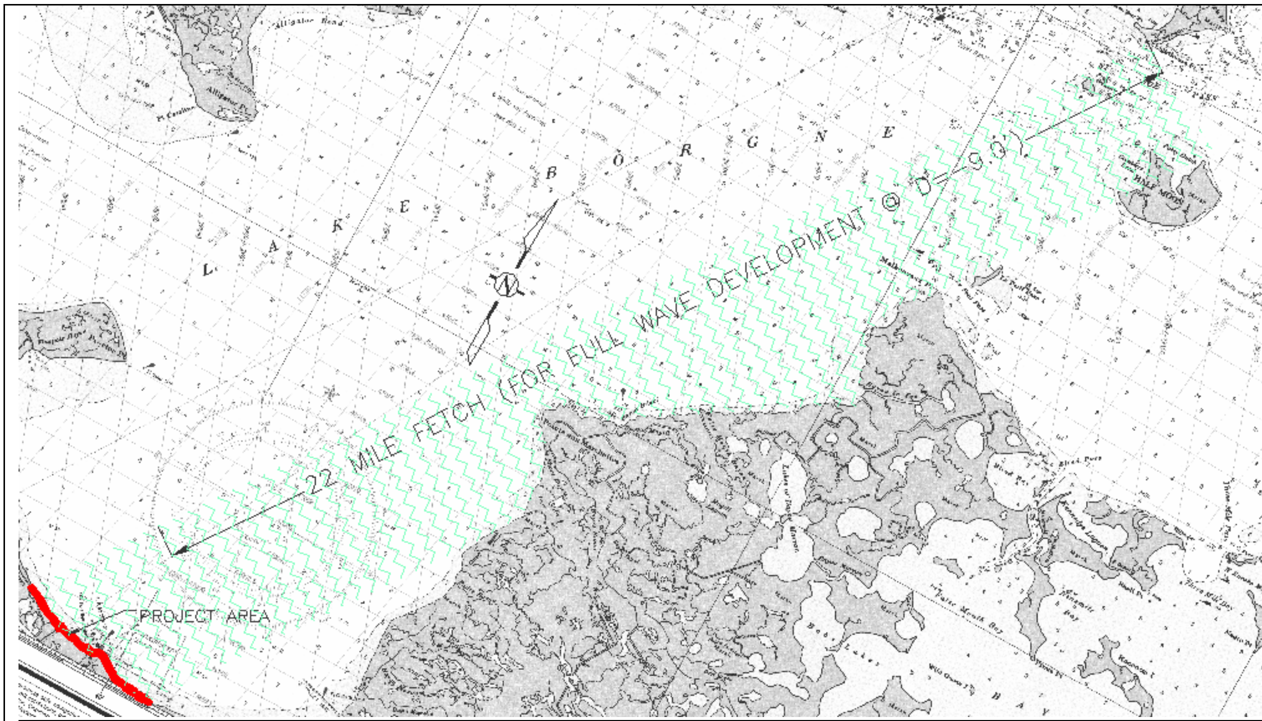

Figure 3 (NTS) – Maximum Reach for Wind Generated Wave at Shell Beach

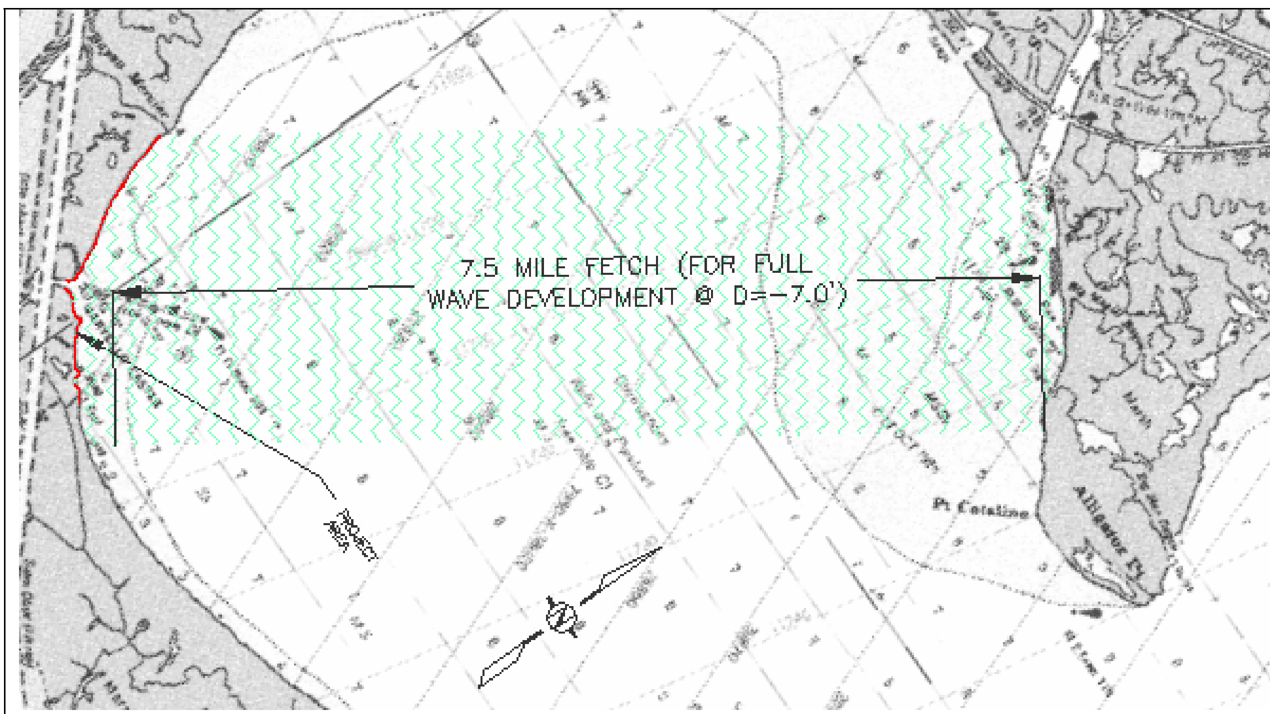

Figure 4 (NTS) – Maximum Reach for Wind Generated Wave at Bayou Dupre

Using the deep water nomograms in Figure II-2-23 of the U.S. Army Corps of Engineers Coastal Engineering Manual (USACE CEM), the deep water wave height and period for Shell Beach were determined to be 0.9 meters (2.9 feet) and 3.5 seconds, respectively (Figure 5). For Bayou Dupre, the relative deep water wave height and period were determined to be 0.5 meters (1.6 feet) and 2.4 seconds, respectively (Figure 6). The values for deep water wave height from the nomograms are relative to still water elevation and represent the wave profile from crest to trough. The deepwater waves generated for both areas were not fetch or shallow water limited.

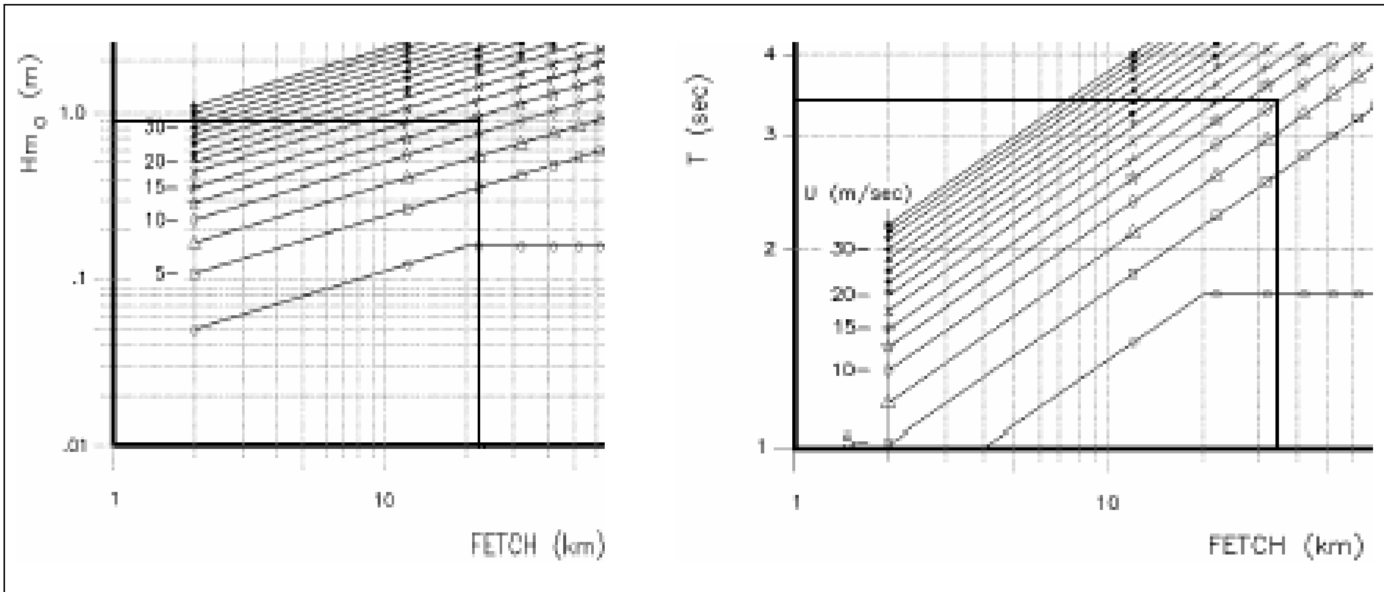

Figure 5 – Deep Water Wave Nomographs for Lake Borgne at Shell Beach

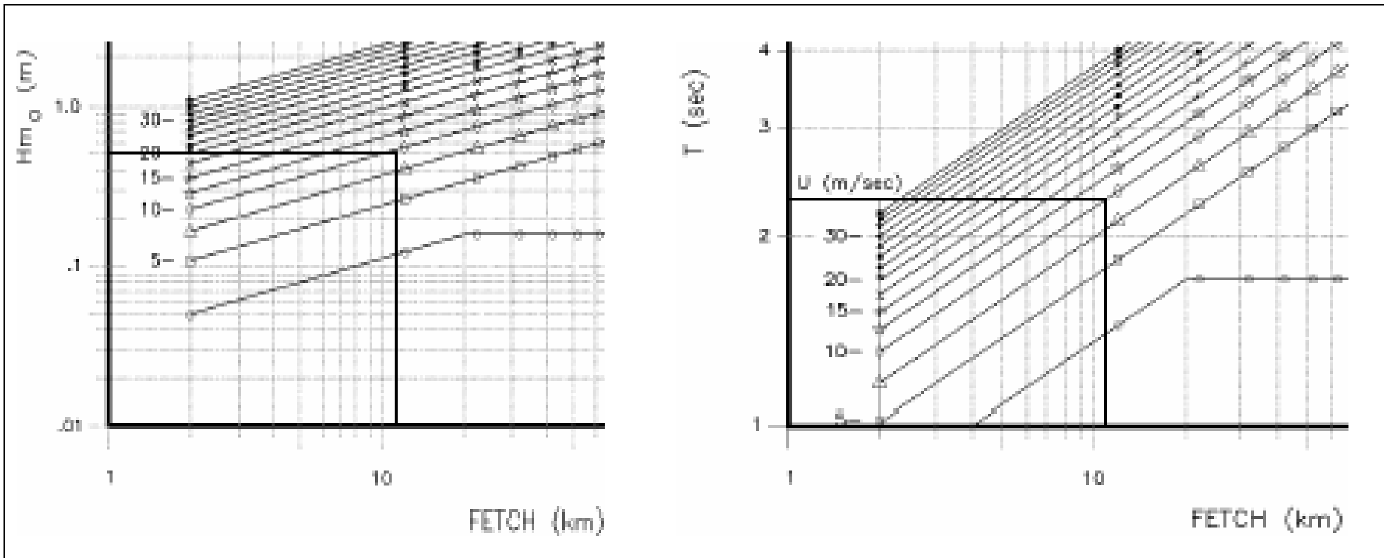

Figure 6 – Deep Water Wave Nomographs for Lake Borgne at Bayou Dupre

For this design, the components of the absolute deep water wave height include the setup, mean high water level, and half of the relative deep water wave height shown in the nomograms. Therefore, for Bayou Dupre, the absolute deep water wave height is 0.49 ft + 1.18 ft + 0.8 ft = 2.47 ft NAVD88. For Shell Beach, the absolute deep water wave height is 0.49 ft + 1.18 ft + 1.34 ft = 3.01 ft NAVD88.

4.4 Wave Transformation

As a deep water wave propagates shoreward along increasing bathymetry, it loses energy, and therefore height due to frictional forces. These frictional forces are caused by the reflection and refraction of the wave with the bottom surface. Calculations were performed based on the methodologies in Chapter II of the USACE CEM to determine the height of the 90th percentile wind generated wave in deep water as it is transformed onshore at Bayou Dupre and Shell Beach (Table 2). For Bayou Dupre, it was determined that the 90th percentile wind generated wave would break between the 0.0 and 1.0 foot NAVD88 contours assuming an initial wave reflectivity angle of 25 degrees. For Shell Beach, it was determined that the 90th percentile wind generated wave would break between the -1.0 and 0.0 foot NAVD88 contours assuming an initial wave reflectivity angle of 11 degrees.

Contour	**Wave Height @ Bayou Dupre**			**Wave Height @ Shell Beach**		
(ft NAVD88)	H/2 (ft)	Water Type	h_{mhw}+Setup+H/2 (ft NAVD88)	H/2 (ft)	Water Type	h_{mhw}+Setup+H/2 (ft NAVD88)
-7	0.77	Transition	2.45	1.35	Transition	3.01
-6	0.76	Transition	2.43	1.36	Transition	3.03
-5	0.75	Transition	2.42	1.37	Transition	3.05
-4	0.74	Transition	2.42	1.40	Transition	3.07
-3	0.74	Transition	2.41	1.43	Transition	3.10
-2	0.74	Transition	2.42	1.43	Transition	3.10
-1	0.76	Transition	2.43	1.04	Transition	2.72
0	0.50	Transition	2.17	0.50	Shallow	2.17
1	0.20	Shallow	1.87	0.20	Shallow	1.87

Table 2 – Deep Water Wave Transformation

4.5 Wave Run-up

The maximum height to which a breaking wave will run up onto the rock breakwater cannot be calculated using current methodologies. Instead, in order remain conservative, the minimum breakwater height required to provide protection against the 90th percentile wind generated and breaking wave is taken as the sum of the setup, mean high water level and the wave height corresponding to the design contour. For example, at Bayou Dupre and Shell Beach, approaching waves will break prior to reaching the rock breakwater if it is placed at edge of the shoreline (Approximate +0.5 ft NAVD88 contour) at mean water level (+0.52 ft NAVD88). For this case the highest 90th percentile breaking wave height along both of the reaches is calculated to be approximately 2.0 ft NAVD88. The crown height of the chosen shoreline protection feature must maintain this elevation in order to provide optimum performance throughout the 20 year design life of the project.

5. GEOTECHNICAL INVESTIGATION

5.1 Soils Investigation

A total of twenty-four subsurface borings were drilled along the shoreline of the project area beginning on February 17, 2002 by Louis J. Capozzoli & Associates, Inc (LJCA). Fourteen borings were drilled near Shell Beach (Figure 7) and ten borings were drilled near Bayou Dupre (Figure 8). The borings ranged in depth from 15 to 50 feet, and were sampled continuously to the 10 foot depth, and on 5 foot centers thereafter.

Figure 7 – Geotechnical Borings Near Shell Beach

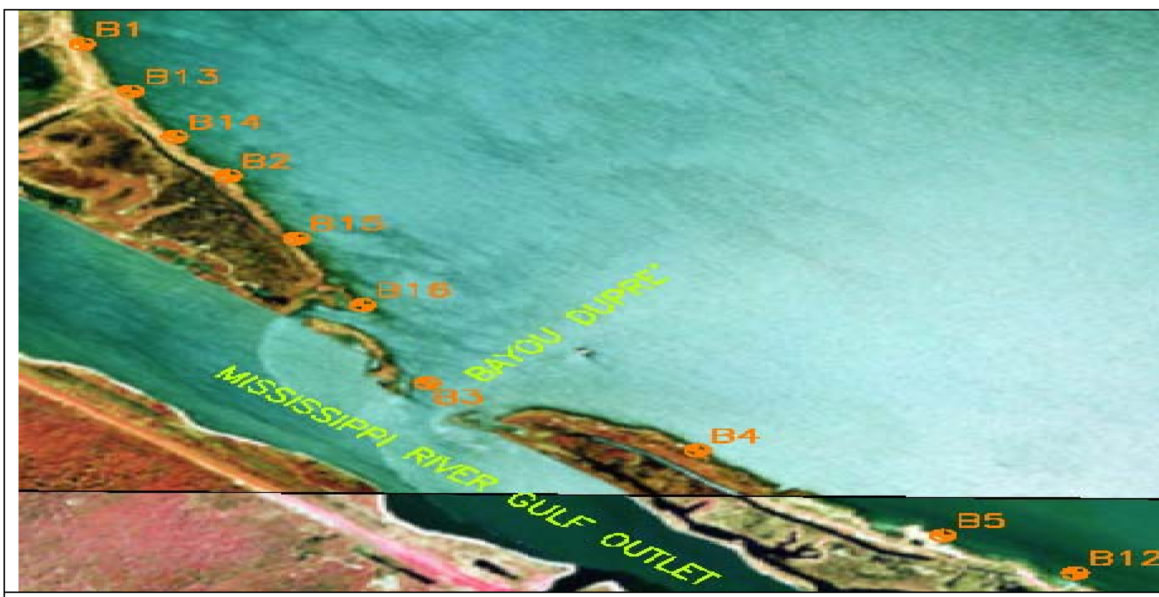

Figure 8 – Geotechnical Borings Near Bayou Dupre

The soils along the southern shoreline of Lake Borgne are generally very soft organic clays, peats and clays near the surface followed by several feet of very soft clays and silts. The shear strength and bearing capacity generally increases from the west to east along the project boundary.

Selected soil samples were tested in the laboratory for classification, strength, and compressibility. Analyses for settlement, bearing capacity and slope stability were performed for eight different rock breakwater sections (Table 3). The sections varied by type of material (250 lb. rock or lightweight aggregate), cross section, and depth of placement. The design elevation for the crown of all of the sections was set at +2.0 ft NAVD88 based on preliminary hydraulics information. The alignment for seven of the sections was based on offshore conditions in 2 feet of water. Only Section #8 was aligned with the lakeward toe located onshore at mean water elevation. All of the sections included nonwoven geotextile fabric and geogrid composite as support for the base. A detailed summary of the investigation is presented in the geotechnical report.

Section #	Contour (Ft NAVD88)	Crown Height (Ft NAVD88)	Crown Width (Ft)	Side Slopes H:V	Vertical Composition
1	-2	+2	4	2:1	4 ft stone
2	-2	+2	4	2:1	4 ft aggregate and stone
3	-5	+2	4	2:1	7 ft stone
4	-6	+2	4	2:1	8 ft stone
5	-2	+2	Multiple Furrow	2:1	4 ft aggregate and stone
6	-15	+2	4	2:1	17 ft aggregate and stone
7	-6	+2	Multiple Furrow	2:1	8 ft aggregate and stone
8	0	+2	4	2:1	4 ft stone

Table 3 – Design Sections from Geotechnical Report

5.2 Subsidence and Sea Level Rise

The combined subsidence and eustatic sea level rise rate for Lake Borgne is predicted to be 18 in/century, or a total of 3.6 inches over the 20 year design life of the project (EPA 1995). This rate was used to calculate the overall long term settlement rates of the rock breakwater sections.

5.3 Consolidation and Immediate Settlement

The LGCA geotechnical report evaluated the immediate (undrained) and consolidation (long-term) settlement rates for the eight alternative rock breakwater sections in order to determine the optimum breakwater section for the given soil conditions. The consolidation settlement rates varied between 0.5 to 53 inches within the 20 year design life of the project, but all of the alternatives were expected to reach a 95% degree of consolidation within this time period. The immediate settlement was estimated to be approximately 20% of the consolidation settlement.

The section in alternative #8 produced the smallest settlement rate among all of the eight alternatives considered. This section was aligned onshore at the 0 ft NAVD88 contour and consisted of class 250 lb rock, a 2 foot crown height, and 2:1 side slopes. The final settlement for this alternative varied based on subsurface conditions between 7 to 23 inches over the 20 year design life of the project.

Additional alternatives were evaluated at the +0.5 ft NAVD88 contour by LDNR/CED in order to optimize the design of the rock breakwaters. In order to evaluate the variability in settlement across the project area, the borings were separated into two sections, "Weak" and "Strong" soils according to shear strength profiles. Borings 8 and 9 represent the median of the "Strong" sections while borings B2 and B7 were selected to represent the "Weak" sections. The locations of these sections relative to the project area are shown in Figures 9 and 10.

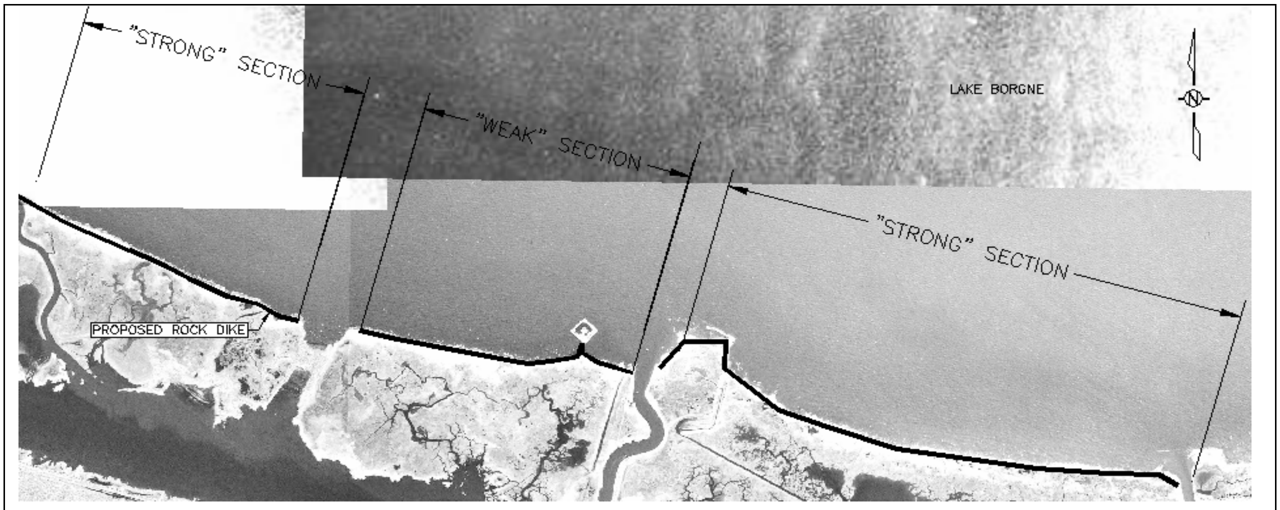

Figure 9 (NTS) – "Weak" and "Strong" Soil Settlement Sections at Shell Beach Section

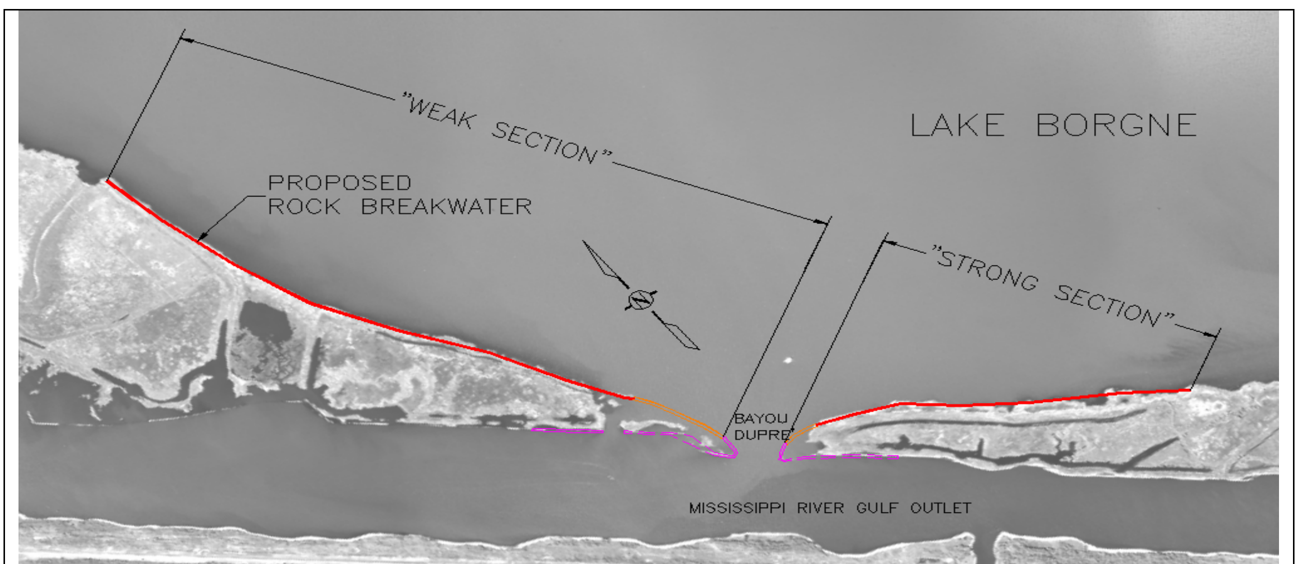

Figure 10 (NTS) – "Weak" and "Strong" Soil Settlement Sections at Bayou Dupre Section

Analysis of the "Weak" soil profile assumed the recent soils above the Pleistocene soils are normally consolidated. The "Strong" soil profile assumed the recent soils have experienced a minor amount of overconsolidation and generally contain better engineering properties.

The time rates of consolidation for both the "Weak" and "Strong" profiles were estimated using coefficients of consolidation (c_v). The "low" c_v values were determined from laboratory testing. The "High" c_v values are 10 times greater than the "Low" c_v values in order to assess the possibility that the field c_v values are greater than the laboratory ("Low") values. Laboratory tests often do not reflect existing macro-level features that facilitate the dissipation of excess pore water pressures in the field.

Three lift cycles will be required to maintain the crown height of the rock breakwater at the optimum design height of +2.0 ft NAVD88 for the "Weak" sections over the 20 year design life of the project. The results of the "High" coefficient of consolidation were selected in order to be more conservative in the design approach. Geogrid composite will be placed beneath the footprint (plus 3 feet on either side) of the breakwater in order to improve constructability, maintain the load more uniformly, and increase the factor of safety for shear strength to 1.38. The breakwater will be constructed to an initial crown elevation of +3.0 ft NAVD88 and experience an estimated 1.5 feet of immediate settlement. At day 30, the breakwater will be re-constructed to elevation +3.25 ft NAVD88. At year 1, a final maintenance lift will be placed to elevation +4.0 ft NAVD88. The estimated construction and maintenance lift cycles are shown graphically in Figure 11.

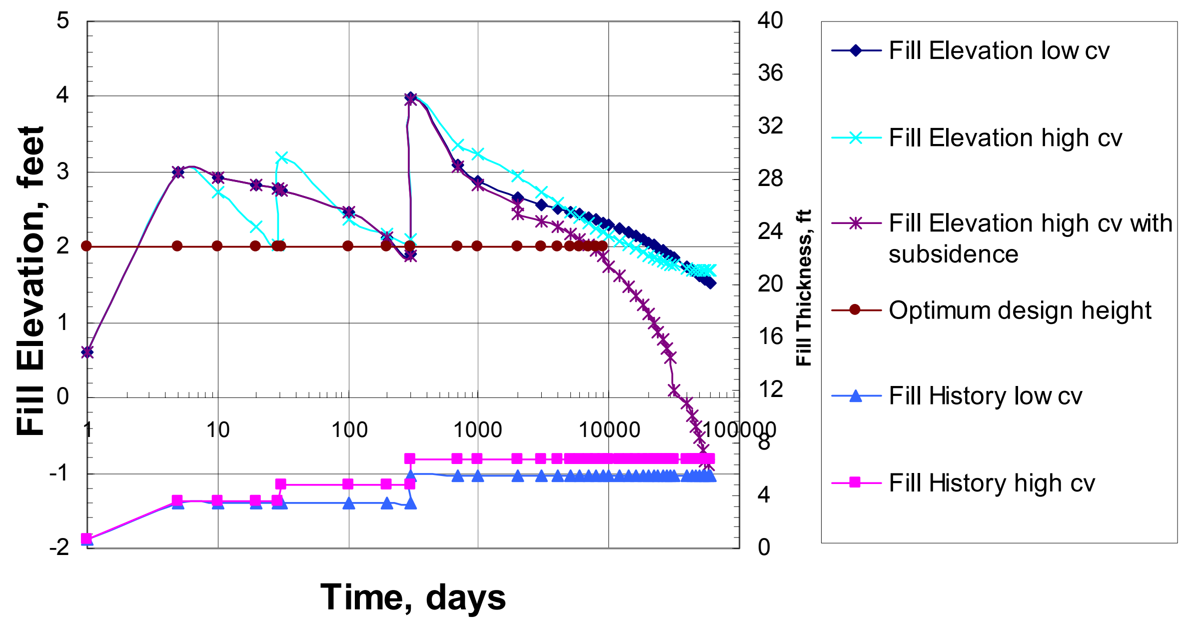

Figure 11 – Predicted Settlement for the "Weak" Breakwater Sections

For the "Strong" sections, one lift may be adequate to maintain the crown height of the rock breakwater at the optimum design height of +2.0 ft NAVD88 over the 20 year design life. Both the "Low" and "High" c_v cases are estimated to remain above this elevation over the 20 year design life of the project. Geogrid composite will be placed beneath the footprint (plus 3 feet on either side) of the breakwater in order to improve constructability, maintain the load more uniformly, and increase the factor of safety to 1.4 with respect to slope stability. The breakwater will be constructed to an initial crown elevation of +4.0 ft NAVD88 and may experience an estimated 2 inches of immediate settlement (Figure 12).

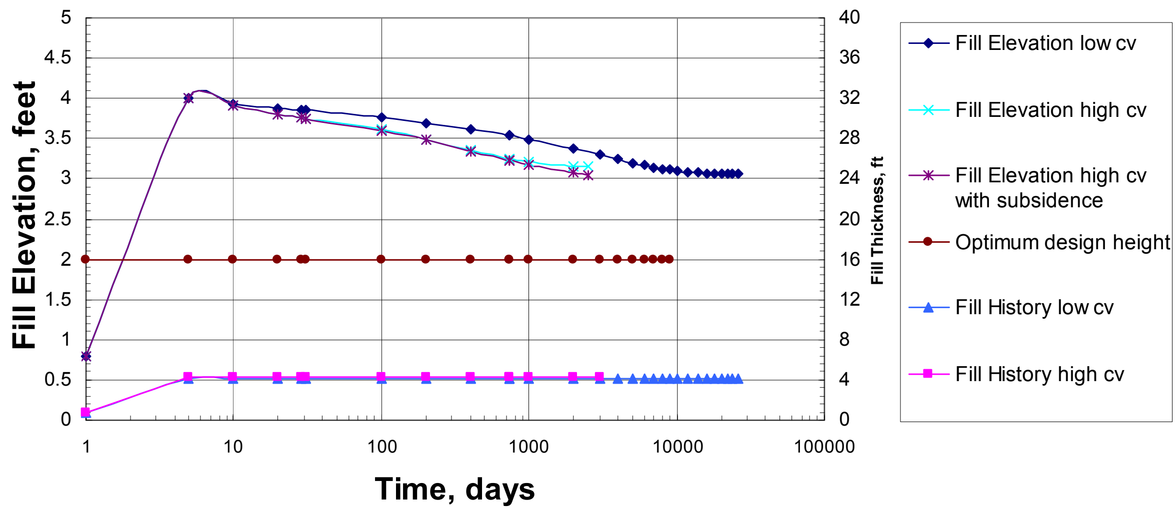

Figure 12 – Predicted Settlement for the "Strong" Breakwater Sections

5.4 Slope Stability and Bearing Capacity

The slope stability and ultimate bearing capacity of several alternative rock breakwater sections were originally analyzed in the geotechnical report with the alignment along at the 0 ft NAVD88 contour. Minimum factors of safety of 1.3 and 1.2 were used for calculating the slope stability and ultimate bearing capacity, respectively. The results of the analysis show a large variability across the entire project reach. Only the rock breakwater in alternative #8 (Crown Elevation +2.0 ft NAVD88) maintained the acceptable factors of safety across the entire project reach at the 0 ft NAVD88 contour.

Further analysis of additional alternatives was performed at the +0.5 ft NAVD88 contour subsequent to the geotechnical report. Assuming a stone density of 155 lb/ft^3 and porosity of 19%, the in-place unit weight of stone was estimated as follows:

$$\gamma_{STONE} = 155 \text{ lb/ft}^3 \times (1 - 0.19) = 125 \text{ lb/ft}^3$$

The maximum net allowable bearing pressure was estimated to be approximately 400 psf. The addition of geogrid composite beneath the stone will load the soil more uniformly and increase the factor of safety relative to bearing capacity. With a geogrid composite, the crown elevation of the "Weak" and "Strong" profiles can be set as high as +3.5 ft NAVD88 and +4.0 ft NAVD88, respectively.

The factor of safety with respect to slope stability was estimated for both the "Weak" and "Strong" profiles. The base elevation of the rock breakwater was set at +0.5 ft NAVD88 with H2:1V side slopes. The maximum crown elevations that can be achieved for the "Weak" and

"Strong" profiles using geogrid composite are +3.0 ft NAVD88 and +4.0 ft NAVD88, respectively. The factors of safety for both profiles are greater than 1.35. Critical circular failures occur approximately 20 to 25 feet from the base of the "Weak" and "Strong" rock breakwater sections (Figures 13 and 14). Taking into account the maximum available reach for a barge mounted track hoe, the distance from the lake ward toe of the rock breakwater to the flotation channel is therefore set at 50 feet in order to remain conservative.

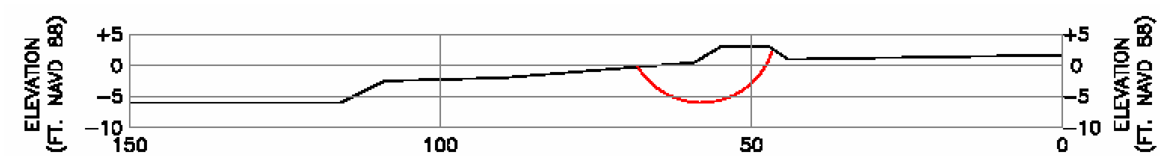

Figure 13 – Slope Stability Analysis of "Weak" Rock Breakwater (Crown +3.0' NAVD 88, Base +0.5' NAVD88)

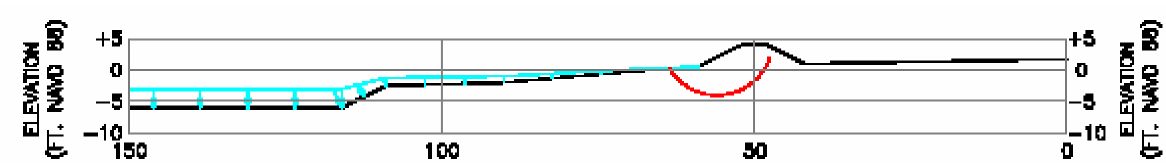

Figure 14 – Slope Stability Analysis of "Strong" Rock Breakwater (Crown +4.0' NAVD 88, Base +0.5' NAVD88)

6. DESIGN ALTERNATIVES

Four design alternatives were evaluated for use as protection along the shoreline of Lake Borgne at Shell Beach and Bayou Dupre; rock breakwaters, segmented concrete panels, steel sheet piles, and a combination of rock breakwaters and a back-to-back fiberglass sheet pile structure. A preliminary design was formulated for each of the design alternatives based on the minimum requirements of the project including the design wave height, existing bathymetry and topography, and consolidation settlement. A construction cost estimate was then calculated for each of the alternatives as shown in Attachment E.

Similar criteria were utilized in the preliminary design of the alternatives in order to maintain a consistent comparison of the cost estimates. All of the design alternatives used the same alignment along the approximate +0.5 ft NAVD88 contour except at the mouth of Bayou Dupre where it traverses along the shallowest route and connects to the existing USACE breakwaters on either side. The top elevations of the design alternative features were all set at the optimum design height of +2.0 ft NAVD88 at a minimum. At the mouth of Bayou Dupre, the top elevation was set at the deep water wave height of +2.5 ft NAVD88 due to the fact that the bathymetry actually deepens as it approaches the MRGO. For those design alternatives which included rock breakwaters, the crown elevations for the initial and maintenance lifts were adjusted for the bearing load of the rock profile, allowable bearing capacity of the existing soil, and preliminary settlement predictions.

For the segmented concrete panel alternative, 16 in by 16 in by 30 ft piles and 21 ft. long panels with varying lengths based on the existing topography and bathymetry were utilized in the design. The total construction cost for segmented concrete panels is estimated to be approximately $17.3 million with a 15% contingency. This estimate includes flotation, geotextile, scour berm, and maintenance costs.

For the steel sheet pile alternative, a standard PZ-27 pile with varying lengths based on the existing topography and bathymetry were utilized in the design. The total construction cost for steel sheeting is estimated to be approximately $32 million with a 15% contingency. This estimate includes 35 foot soldier piles, scour protection, flotation, and maintenance costs.

For the rock breakwater alternative, two lifts (three at the mouth of Bayou Dupre) were set at a crown elevation of +4.0 ft NAVD88 and crown width of 4 feet with 2H to 1V side slopes in order to maintain adequate protection against the deep water wave and consolidation settlement. The volume of rock required to construct the two lifts was nearly 300,000 tons. The total construction cost for the rock breakwater is estimated to be approximately $14.3 million with a 15% contingency. This estimate includes flotation, geotextile fabric and maintenance lifts.

For the combination rock breakwaters and back-to-back fiberglass sheet pile structure alternative, the crown elevation of the breakwater was set at the optimum design elevation of +2.0 ft NAVD88. The structure consisted of a back-to-back fiberglass sheet pile structure set at a crown elevation of +2.5 ft NAVD88, interconnected by tie rods, backfilled with sand to mean water level, and capped with geogrid composite and 250 lb class stone. Fiberglass was initially chosen for the sheet pile material because it is stronger than vinyl and more economical than steel, rock or concrete. However, as will be discussed in detail in Section 9, the structural limitations for fiberglass sheet pile may have become exceeded due to changes in bathymetry from Hurricane Katrina on August 29, 2005. Therefore, in order to increase the stability of the structure, steel sheet pile was substituted in place of fiberglass sheet pile as presented at the 30% Design Review Meeting. The total construction cost for the rock breakwaters and steel sheeting is estimated to be approximately $11.6 million which includes a 15% contingency. This estimate includes scour protection, flotation, geogrid composite, settlement plates, warning signs, walers, tie rods, and sand backfill. Due to the expected longevity and relatively lower construction costs for this alternative, the combination rock breakwaters and back-to-back steel sheet pile structure was judged to be the preferred option as shown in Attachment E.

7. BREAKWATER DESIGN

As discussed in Section 6, the most cost effective shoreline protection feature is a semi-continuous rock breakwater along the +0.5 ft NAVD88 contour. Gaps will be provided at the mouth of Bayou Dupre, Bayou Yscloskey, and the pipeline crossing located west of Fort Beauregard. The breakwater will be designed to maintain its integrity against the design wave based on the 20 year design life of the project. Flotation and access channels will be provided in order to facilitate construction of the breakwater. The estimated materials quantities are provided in Attachment E. The final analysis and design of the breakwater will now be discussed.

7.1 Riprap Gradation

The size of the minimum stone class required by the breakwater to protect against the design wave was determined using the Hudson's Equation in Chapter VI of the USACE CEM as shown below:

W_{50} = Weight of Medium Stone (lb)

$$= \frac{(H^3)\hat{Y}s}{K_D(\hat{Y}s/\hat{Y}w-1)^3 \cot\alpha} \quad \textit{(Eq. VI-5-67)}$$

Where:

H = 2.5 (Design wave height)
K_D = 3.5 (Stability Coefficient, *Table VI-5-22*)
$\hat{Y}s$ = 155 PCF (Weight of Stone)
$\hat{Y}w$ = 62.4 PCF (Density of Water)
α = 0.4 (2:1 Slope)

Using the deep water wave height of 2.5 ft as a conservative estimate at Bayou Dupre yields W_{50}=67 lbs. Using the deep water wave height of 3.2 ft as a conservative estimate at Shell Beach yields a W_{50}=140 lbs. Due to economy of scale, a class 250 lb stone was chosen for design and construction.

7.2 Minimum Crest Width

In order for the 250 lb class rock breakwater to withstand the force of the design wave, the minimum crest width was calculated from the guidelines in Chapter VI of the USACE CEM as shown below:

B = Minimum crest width (ft)

$$= n * k_\Delta * (W/w_a)^{1/3} \quad \textit{(Eq. VI-5-116)}$$

Where:

n = 3.0 (Number of stones, typical)
k_Δ = 1.0 (Layer coefficient, *Table VI-5-51*)
W = 250 lb (Unit Weight of Primary Armor Unit)
w_a = 155 PCF (Specific Weight of Rock)

The minimum crest width is calculated to be 3.5 ft. Adding a factor of safety of 0.5 foot to the design yields a crest width of 4 ft.

7.3 Minimum Layer Thickness

In order for the rock breakwater to withstand the force of the design wave, the minimum layer thickness was determined from the guidelines in Chapter VI of the USACE CEM as shown below:

r	= Minimum layer thickness (ft)		Where:		
1)	$\geq$ 0.3m (0.98 Ft.)	= 0.9 ft	W_{50} =	Weight of 50% grade size	= 250 lb
2)	$= 2*(W_{50}/w_a)^{1/3}$ *(Eq. VI-5-119)*	= 2.4 ft	w_a =	Specific weight of rock	= 155 PCF
3)	$= 1.25*(W_{max}/w_a)^{1/3}$ *(Eq. VI-5-120)*	= 2.5 ft	W_{max} =	Max weight in gradation	= 250 lb
r	= greatest of 1, 2 and 3	= 2.5 ft			

The minimum layer thickness of the rock is calculated to be 2.5 ft. Based upon the proposed geometry of a 4 ft. crest width, 3 or 4 ft NAVD88 crest height, +0.5 ft toe elevation, and 2:1 side slopes, this requirement is satisfied.

7.4 Typical Cross Section

The parameters used to set the typical cross sections for construction and maintenance lifts of the rock breakwaters include the crest height, crest width, side slope, and minimum layer thickness. As discussed in the previous sections, the toe of the breakwater is set at +0.5 ft NAVD 88. The side slopes are set at 2H:1V in conjunction with geogrid composite underneath the foot print (+3 feet on either side) in order to maintain an adequate factor of safety for slope stability.

The crest height for the "Strong" condition is set at +4 ft NAVD88 for all of Reaches 2 and 4, and between Stations 10+00 to 55+52 of Reach 3. The typical cross section for the construction lift of the "Strong" rock breakwater is shown in Figure 15.

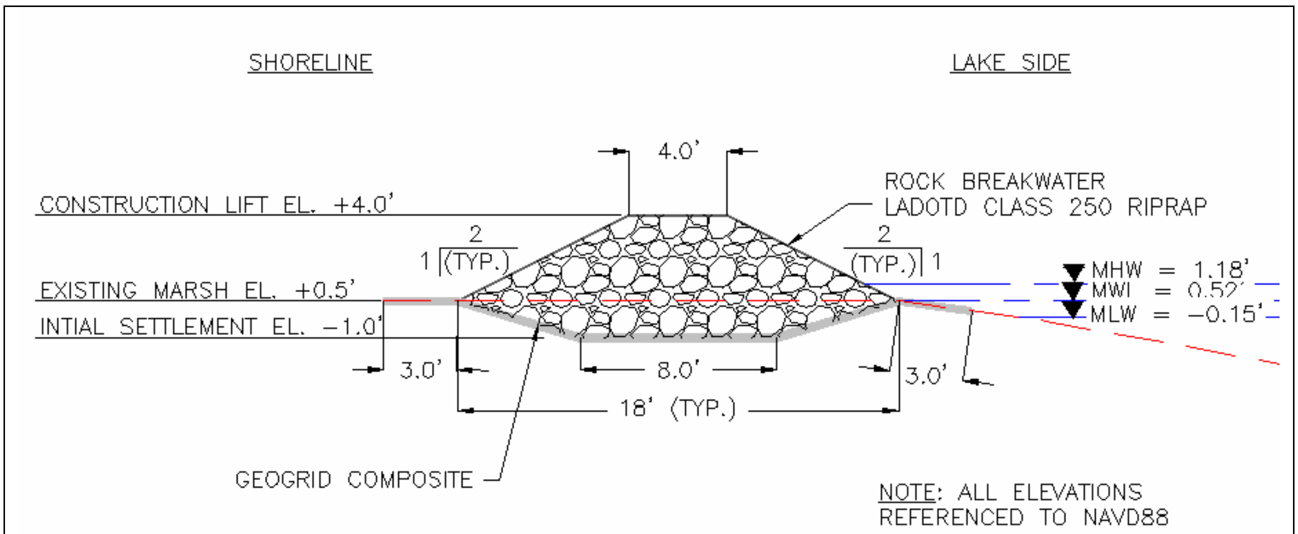

Figure 15 – Typical "Strong" Breakwater Section

The crest height for the "Weak" condition is set at +3 ft NAVD88 for the construction lift, +3.25 ft NAVD88 for the second (30 day) construction lift, and +4.0 ft NAVD88 for the maintenance lift (Year 1) along Reach #1 and between Stations 63+33 to 105+79 of Reach 3. The typical cross section for the construction and maintenance lifts of the "Weak" rock breakwater is shown in Figure 16.

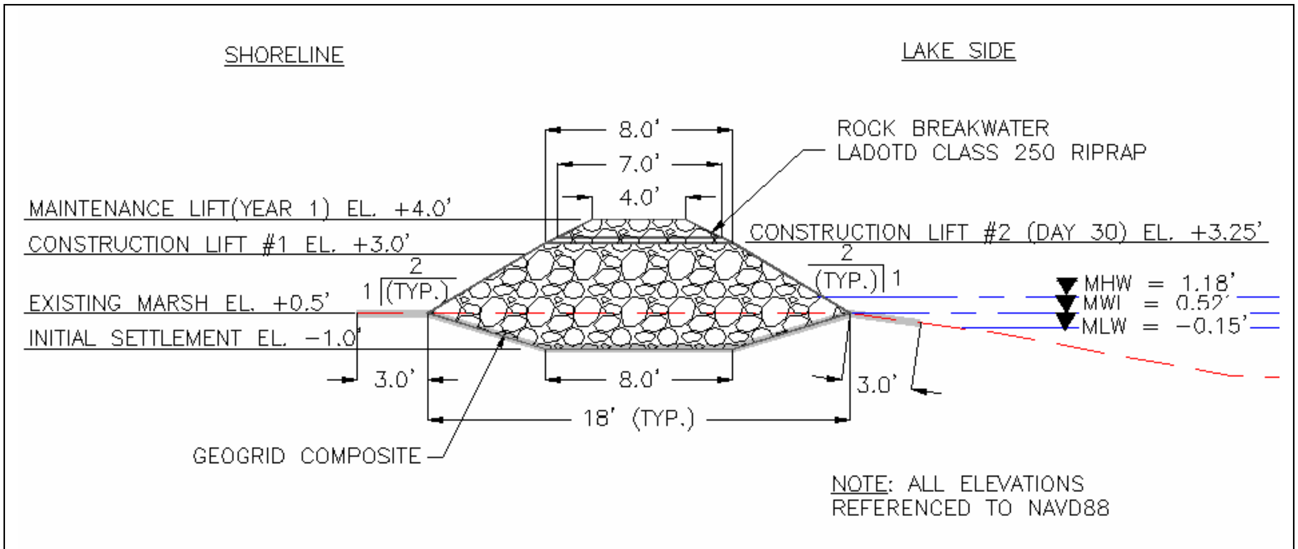

Figure 16 – Typical "Weak" Breakwater Section

7.5 Breakwater Alignment

The alignment of the rock breakwater is placed along the +0.5 ft NAVD88 contour using 1000-foot straight line segments. These straight line segments will create a more natural alignment for the rock breakwater to protect against wave energies. Construction surveying and stake out will also be more uniformly facilitated using straight line segments. The plan view for the alignment of the proposed breakwater is provided in the plans.

7.6 Flotation and Access Channels

Two barges will be aligned side by side but parallel to the shoreline during construction of the rock breakwater. One barge will support a long reach track-hoe and the other will supply the rock riprap. The minimum width for the flotation channel is therefore set at 80 feet based upon the width of two standard barges. For flotation access channels, the minimum width is set at 120 feet in order to allow an adequate turning radius for the barges.

The depth of the access and flotation channels is set at -6.0 ft NAVD88 which yields a total draft of approximately 7.0 ft after adding the mean water elevation. At this depth, the barges may be limited to partial loading because the typical draft for fully loaded barges is -8.0 ft below the water line. Partial loading of the barges will incur a small increase in cost due to a increase in handling of the material. However, this cost will be offset due to a corresponding decrease in the volume of dredged and backfilled spoil.

A 25 foot buffer between the flotation channel and the spoil stockpile was set to maintain slope stability for the temporary spoil stockpile. As discussed in Section 3.4, the minimum distance required to maintain adequate slope stability of the breakwater is set at 50 feet from the flotation channel. The alignment of the flotation channel is therefore set at 50 feet from the outside toe of the rock breakwater. The slope of the flotation channel is set at 2H:1V in order to match the slope of the breakwater. A typical section of the breakwater, flotation channel, and spoil stockpile is shown in Figure 17.

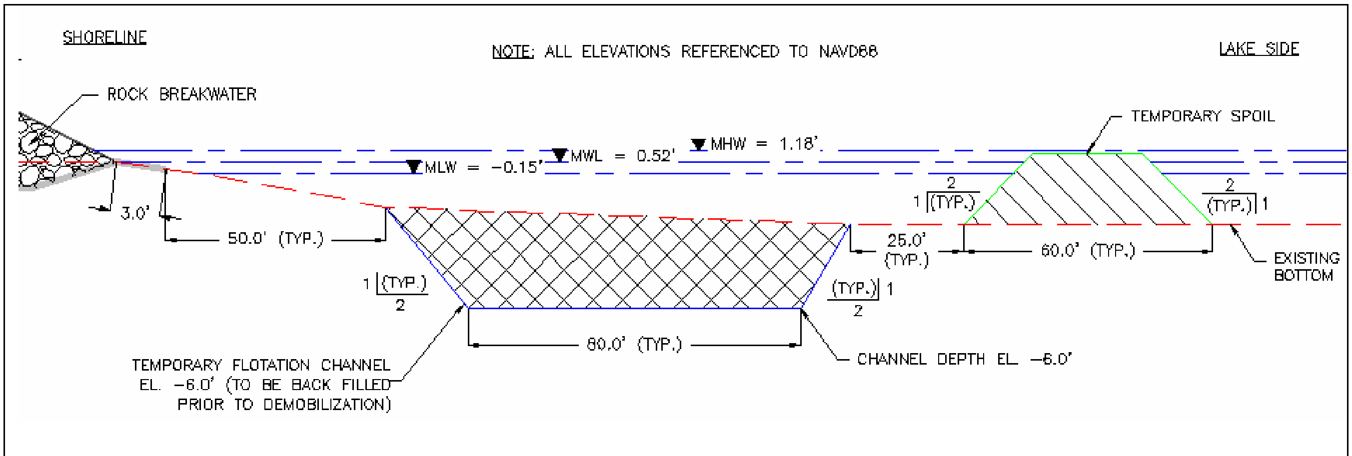

Figure 17 (NTS) – Typical Section of Flotation Channel

A total of four access routes will be strategically aligned from the lake in order to facilitate barge access to the flotation channels at the center of the corresponding reach. A typical section of the flotation channel and spoil stockpile is shown in Figure 18.

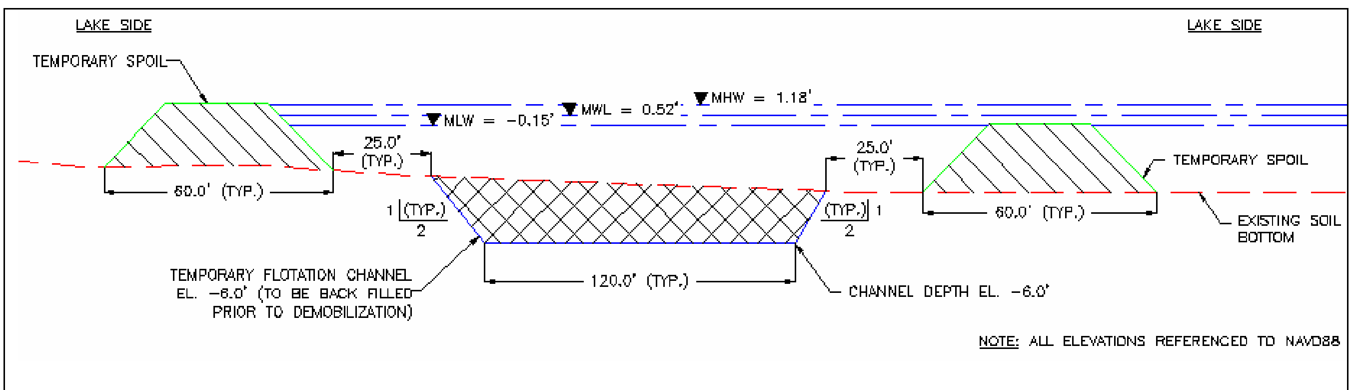

Figure 18 (NTS) – Typical Section of Access Channel

Flotation channels will not be provided along the former naval station. Instead, construction of the rock breakwaters along these two areas will be accomplished onshore using end-on-construction techniques as discussed in Section 8. The locations of the alignments of the access and flotation channels are shown in the Plans.

8. END-ON-CONSTRUCTION

End-on-construction does not require flotation access because all activities will be performed within the footprint of the breakwater. Equipment and materials access will be provided to the shore from flotation channels on adjacent construction reaches. Costs for construction using this technique, however, are more expensive due to the need for additional equipment and required expansion of the footprint for equipment travel. A typical section of the rock breakwater created through end-on-construction is shown in Figure 19.

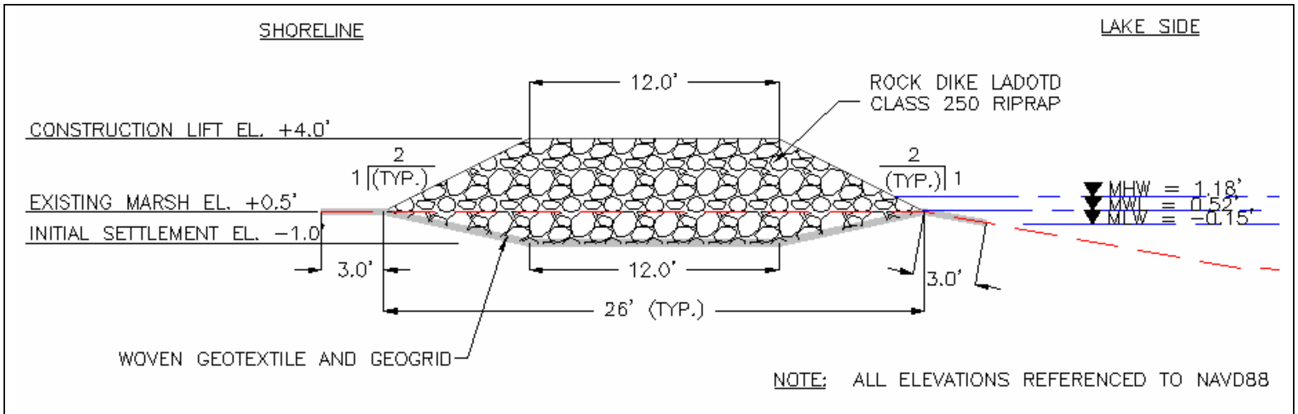

Figure 19 – Typical Section of Rock Breakwater Using End-On-Construction

Approximately 1,534 ft of rock breakwater along the former naval base will be constructed using end-on-construction in order to avoid the vast debris which exists in the area. The estimated materials quantities are provided in Attachment E.

9. SHORELINE PROTECTION STRUCTURE AT BAYOU DUPRE

As discussed in Section 6, the preferred shoreline protection feature at the mouth of Bayou Dupre was determined to be a back-to-back fiberglass sheet pile structure backfilled with coarse grained (sandy) material. This determination was based upon preliminary analyses and existing survey, geotechnical, and hydraulic data. Using the design methodology in this Section, a final design for the structure was developed using the fiberglass sheet pile. However, due to a direct impact by Hurricane Katrina on August 29, 2005, the bathymetry near the proposed structure may have become deeper in localized areas. Because there is a potential increase in exposure height, or distance from the top of the sheet pile to the mud line, the amount of deflection may supercede the allowable strength of the fiberglass. Therefore, steel sheet pile has now been substituted in place of fiberglass sheet pile.

The structure is designed to resist the overturning and sliding moment developed from the deep water wave. The structure will also be topped with a layer of stone separated by geogrid composite in order to limit erosion of the sand layer due to overtopping waves. An isometric view of the structure is shown in Figure 22. The estimated materials quantities are provided in Attachment E. The final analysis and design of the structure will now be discussed.

9.1 Wave Load Determination

The deep water wave condition was utilized in the design of the structure due to the fact that the bathymetry does not incur shoaling at the mouth of Bayou Dupre. The elevation of the existing mud line along the alignment ranges from -2 to -8 ft NAVD88. The pressure distribution of the deep water wave was developed using the Miche-Rundgren formula for non-breaking waves against vertical walls as shown in Attachment G. Impulsive forces from breaking waves were not incorporated into the design due to the low probability of an entire wave assaulting the entire structure simultaneously.

The structure will be designed to remain fully saturated by providing weep holes at elevation -2.0 ft NAVD88. Due to full saturation, the overall force acting against the structure will be reduced by an amount equal to the force caused by the hydrostatic pressure. The resultant force and overturning moment for the deep water wave minus the hydrostatic portion of the pressure distribution are calculated to be 1,109 lb/ft and 5,461 ft-lbs, respectively.

9.2 External Stability Analysis of Soil Mass

The design criteria used to evaluate the soil mass contained within the proposed back-to-back steel sheet pile wall is based on methodologies developed for designing Mechanically Stabilized Earth Walls (MSEW), which are used to retain soil. MSE Walls generally consist of a granular backfill material, reinforcing elements within the backfill, and a facing. These systems are usually constructed in fill applications by placing alternating layers of soil and reinforcing elements. The weight of the reinforced soil structure is then used to resist overturning and sliding forces developed from the retained soil (Figure 20).

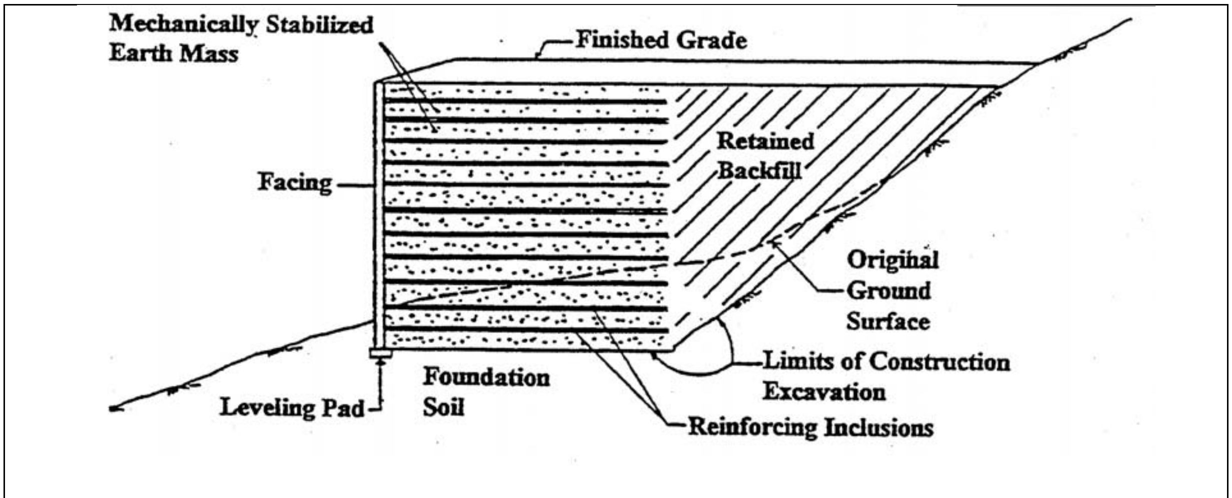

Figure 20 - Mechanically Stabilized Earth Wall System (Figure 6-1, NHI Course 13236)

The proposed back-to-back sheet pile structure will be backfilled with a granular material to elevation 0.00 ft NAVD88. A geogrid composite will be specified to cover the granular backfill. A rock layer will then be placed from elevation 0.0 ft NAVD88 to elevation 2.5 ft NAVD88. Therefore, the granular material and rock will be contained within the back-to-back sheet pile structure. The buoyant unit weight and soil friction angle, phi (ø) parameters of both materials were used to determine the resisting soil mass weight at a lake bottom elevation of -5.0 ft NAVD88 and -8.0 ft NAVD88. A silty sand backfill material with a unit weight of 115 PCF and a phi angle, ø, of 20 degrees were used for design. A top of wall elevation of +2.5 ft NAVD88 was also used for design. The geotechnical parameters from Boring #3 were used to determine the foundation soil parameters. Figure 21 shown below indicates the design parameters specified above. The soil mass area consists of the rock and sand layers.

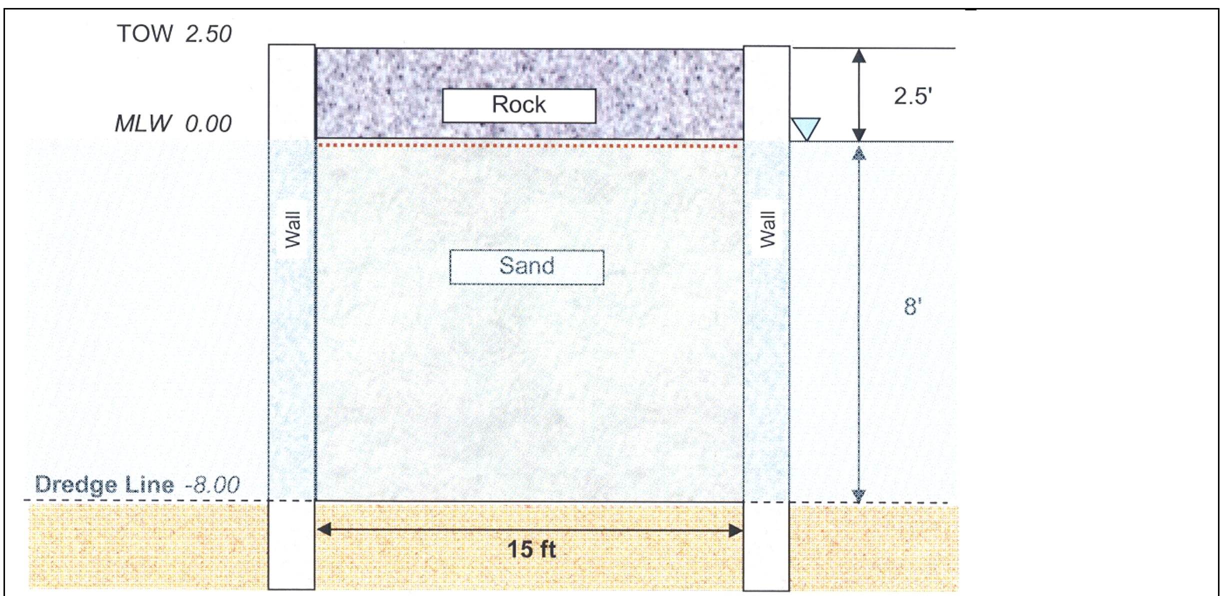

Figure 21 - Back-to-Back Steel Sheeting and Soil Mass

In an effort to simplify the design, the shear resistance of the sheeting was neglected in the overturning and sliding analyses. Several variations on the width of the soil mass were analyzed in order to determine the most optimum width of the structure. A wall width of 15 feet resulted in a $F.S._{overturning} = 7.7$, and a $F.S._{sliding} = 1.3$ for a lake bottom elevation of -8.0 NAVD88. A $F.S._{overturning} = 10.0$ and a $F.S._{sliding} = 1.9$ were determined for a lake bottom depth of -5.0 ft NAVD88. The hydrostatic force on the lake side was conservatively used in the analyses for evaluating the overturning and sliding safety factors. However, the Wave Resultant Force used in the sheet pile calculations was determined neglecting the hydrostatic force.

Based on these analyses, the soil mass weight will resist the overturning and sliding moments produced from the design wave force. The external stability analyses for each bayou bottom elevation are shown in Appendix F.

9.3 Steel Sheet Pile Wall

The external stability of the proposed back-to-back sheet pile structure was discussed in section 9.2. However, the sheet pile section used to contain the soil mass should be designed to resist the internal soil pressures placed behind the sheeting. The Rankine lateral earth pressure theory was used to determine the active and passive earth pressures acting on the proposed steel sheeting.

A fiberglass composite back to back sheet piling system was considered as the preferred alternative for the 30% design review. However, due to recent storm events and maintenance concerns, a steel sheet pile system was also evaluated as a viable alternative.

The bathymetry data taken in 2005 revealed a maximum water depth of 8.0 feet at the location of the proposed structure near the relic bayou. However, it is anticipated that the depth in this area may have increased due to the recent storm events, Hurricanes Katrina (August 2005) and Rita (September 2005). Using the sheet pile analyses software Pile Buck SPW911 version 2.00, several water depths and maximum deflections were evaluated using properties from the Composite Z – PZ26 sheeting and the PZ-27 steel sheeting. For example, a water depth of 10 feet could result in approximately 18 inches of maximum deflection using the Composite Z-PZ26 section. Correspondingly, a PZ-27 steel sheeting section would result in a 1.5 inch maximum deflection at the same water depth. A maximum deflection value of 4.0 inches was used for final design. A comparison graph of the maximum deflection values versus the water depth is shown in Appendix H.

Due to the soft material in this area and the possibility of an increase in depth, the use of a sand fill layer was evaluated to increase the passive resistance in the anticipated deeper areas. Based on the sheet pile analyses results, the sand fill or rock layer would provide an additional passive resistance and reduce the maximum deflection.

In order to maintain a continuous span of sheet piles along the alignment, a combination of steel tube walers and stainless steel tie rods were selected based on allowable loading, flexure and shear as shown in Appendix H. The optimum vertical location for placement of the waler and tie rods on the sheet pile span occurs at elevation 0 ft NAVD88. The optimum spacing for the tie rods occurs along 8 foot intervals.

Weep holes will be drilled into the sheeting in order for the back-to-back sheet pile structure to remain in hydrostatic pressure equilibrium with Bayou Dupre and Lake Borgne. The weep holes shall be 2 inches in diameter, spaced on approximate 5 foot centers, and located on the center of the outside web of the sheet piles at elevation +0.5 ft NAVD88.

The back-to-back steel sheet pile structure will tie the existing USACE rock breakwaters to the rock breakwaters proposed for this project. The existing USACE rock breakwaters will be extended to the structure by the addition of stone using the original geometry of the breakwaters. The proposed breakwaters will simply be tied in along the alignment during construction.

9.4 Scour Protection

The toe of the back-to-back steel sheet pile structure will be protected against wave scour by the use of a rock berm. The dimensions of the typical cross section for the rock berm were determined from the Markle Equation (1989) in Table VI-5-45 of the USACE CEM. The design wave height and maximum mud line depth of -8.0 ft NAVD88 were utilized in the calculations. The results of these calculations showed that no scour protection is warranted for the given design conditions. In order to remain conservative, a rock berm is proposed to be constructed along the outside toe of the structure with the following dimensions; crest height 2 ft above the mud line, 5 ft crest width, and a 2:1 side slope. A typical isometric view of the proposed back-to-back steel sheet pile structure is shown in Figure 22.

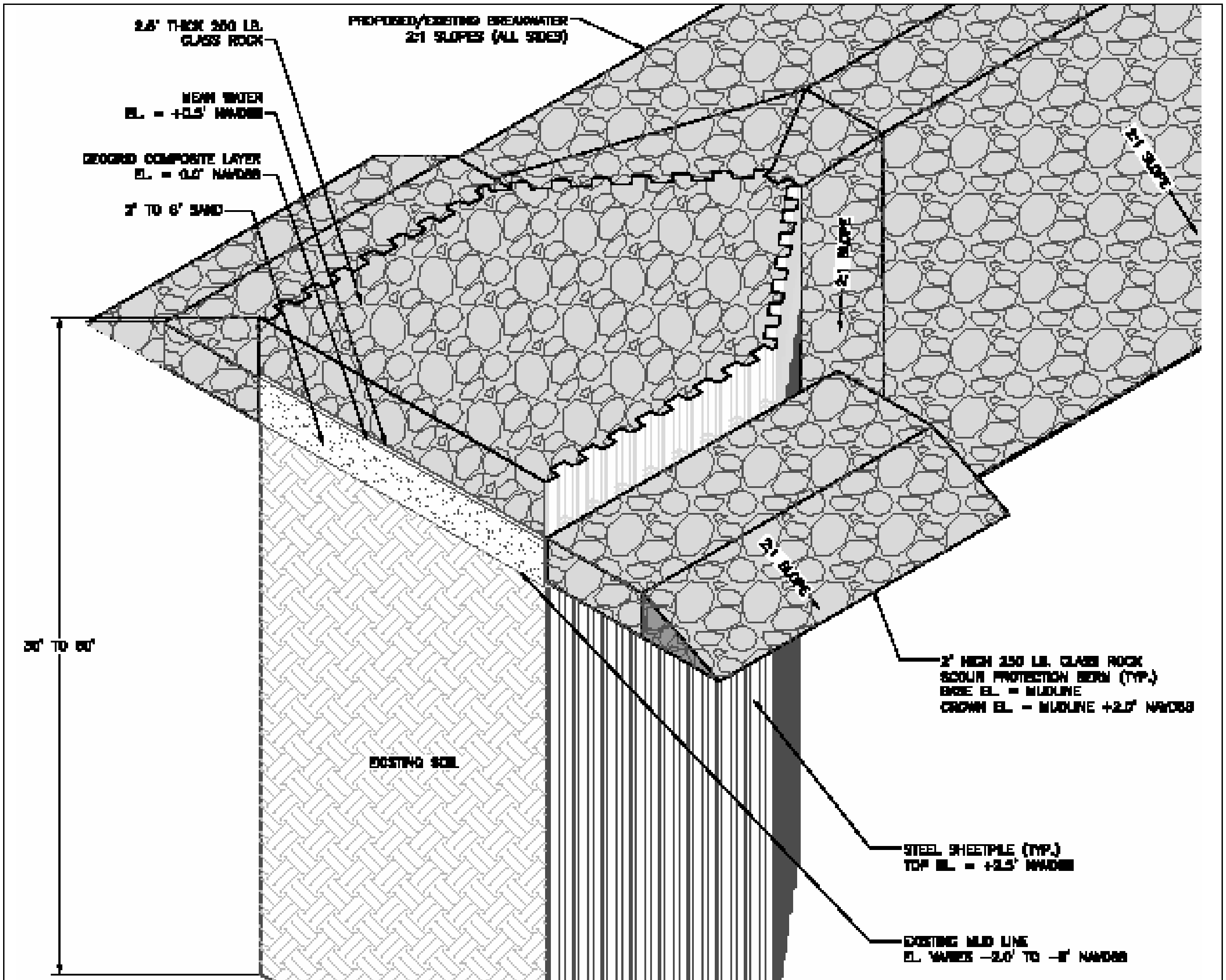

Figure 22 – Isometric View of Back-to-Back Steel Sheet Pile Structure

10. CULTURAL RESOURCES

A June 19, 2002, letter from the State of Louisiana, Division of Archaeology (SHPO), identified a total of six recorded archeological sites in the project's "Area of Potential Effects". During a site visit on April 23, 2003, representatives from the Chitimacha and Choctaw tribes, DNR, EPA Region 6, and SHPO located human remains in and/or around the project area. As a result, a Phase I cultural resources investigation was conducted by C&C Technologies under contract with DNR. Development of the archeology work plan, and field activities and processes performed by C&C, were extensively coordinated with the tribes and SHPO. The Phase I report revealed that only two sites in the project footprint (SB-39 and SB-154) were determined to be eligible for listing under the National Register of Historic Properties (NRHP). A meeting was held June 10, 2004 to discuss the draft Phase I report. Attendees at this meeting included representatives from the Chitimacha Tribe, SHPO, C&C Technologies, EPA Region 6, and DNR. EPA advised at this meeting that if letters of concurrence were not received from all three concerned parties (SHPO, Chitimacha and Choctaw) EPA would recommend the project be shortened in length to avoid impacting the two eligible sites. EPA Region 6 sent an e-mail to the Choctaw tribe on June 14, 2004, advising them of the possibility of shortening the project if letters are not received from all three parties. The final Phase I report was provided to the tribes. Another meeting was held on March 18, 2005, with the Chitimacha and SHPO to discuss the DNR preliminary design plans that called for placing rock on the shoreline due to geotechnical issues. EPA again advised if three letters were not received concurring that the benefits of the project would outweigh any adverse impacts, the length of the project would be shortened to avoid any impacts to the two eligible sites. A letter was received from the Chitimacha Tribe in April 2005 stating that no adverse effects determination could be rendered if "end-on" construction was utilized, the rock dike was moved as far from the exposed human remains as possible, and a post-construction site visit be conducted. DNR continued the design of the project and identified the rock dike length in the vicinity of the two eligible sites as an additive alternate, pending resolution of cultural resources issues. The additive alternate proposed to place rock along the shoreline using "end-on" construction methods in the vicinity of two cultural resources sites (SB-39 and SB-154) known to contain human remains of the Mississippi Band of Choctaw and/or Chitimacha Tribe of Louisiana.

A 30% Design Review meeting was held on August 18, 2005. After the meeting, the Chitimacha advised that placing the stone onshore at these two sites was an adverse impact and mitigation in addition to the end-on construction method would be required. The Chitimacha Tribe recommended a Memorandum of Agreement and formal consultation be initiated to outline all of the mitigation details. In order to finalize the plans and specifications to be in a position to request construction funding for this project from the CWPPRA Task Force in January 2006, EPA recommended DNR delete the additive alternate from the plans and proceed to the 95% design level. DNR advised the Chitimacha that EPA recommended eliminating the additive alternate section. The Chitimacha Tribe (Kimberly Walden, Cultural Resources Director) telephoned EPA Region 6 on August 22, 2005 to voice the tribe's displeasure over shortening the project. Ms. Walden stated placing stone at the sites is an adverse impact and "end on" construction is not sufficient mitigation. Ms. Walden further stated by eliminating the additive alternate, an adverse impact to the sites will occur.

Ongoing coordination with tribes and SHPO for the last two years has failed to resolve this issue. The first alternative to any impact to cultural resources is avoidance. Further delays or considering different design features will jeopardize completion of the plans and specifications for this project and the ability to request CWPPRA phase II construction funding in January 2006. The entire project will be delayed another year resulting in further re-design costs, additional erosion, and ecological degradation. Therefore, the additive alternate section (easternmost end of the Bayou Dupre segment) has been eliminated from the final design in the vicinity of the two NRHP eligible sites. A sufficient separation distance will be incorporated in the design to ensure no adverse impacts to the two sites occur. A Corps of Engineers' project design in a nearby area is maintaining a 100-foot buffer from known sites, DNR's current design calls for a 500-foot buffer. A copy of the letter from EPA to the tribe is included in Appendix I.

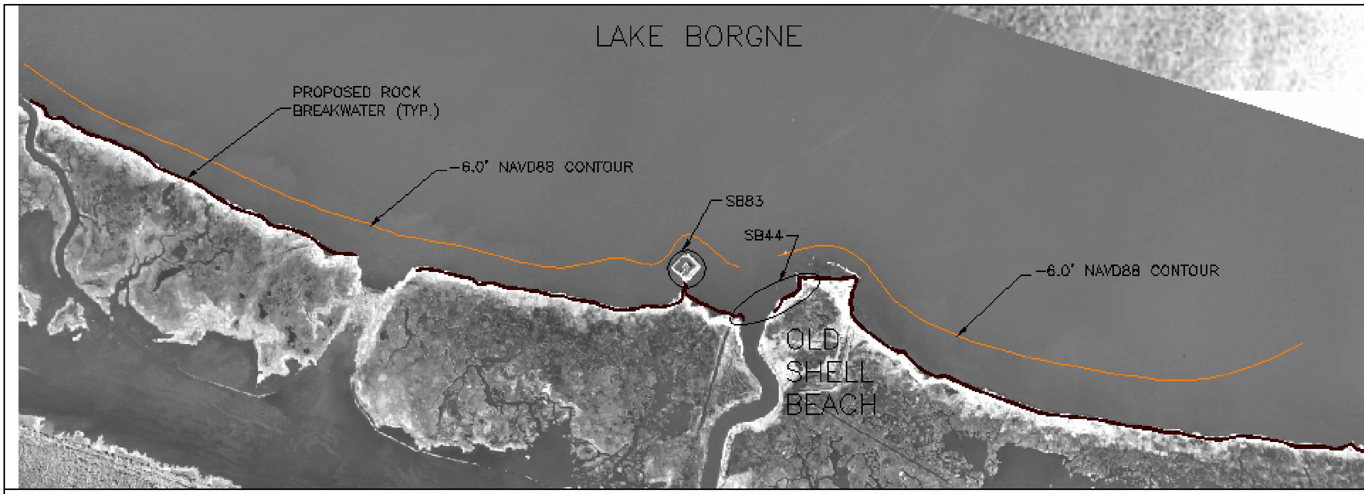

Figure 23 – Cultural Resource Sites at Shell Beach, within area of potential effect

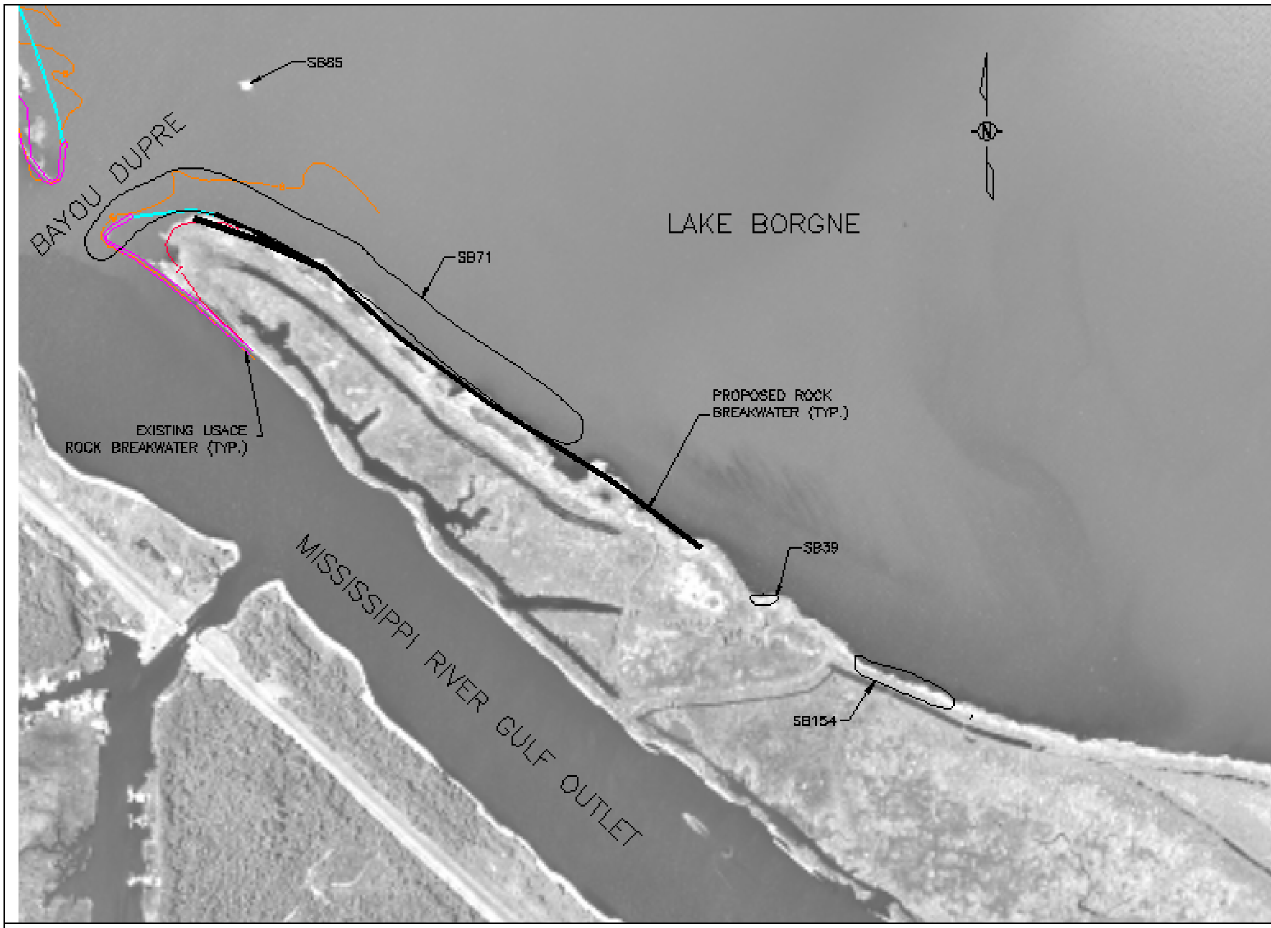

Figure 24 – Cultural Resource Sites at Bayou Dupre

11. REAL ESTATE AND OYSTER LEASES

The Louisiana Department of Natural Resources, Office of Coastal Restoration Land Rights Section (LDNR LR) coordinated the land rights. The LDNR LR Section identified 26 landowners within 14 tracts. LDNR has signed contracts with 25 of the 26 landowners. Attempts to contact the remaining landowner have not been successful. LDNR has determined that Due Diligence has been obtained with regard to the outstanding tract.

There are 6 oyster leases in the project area which encompasses 338 acres (Figures 25 and 26). The leases have a lease value of $91,200 and a standing crop value of $147,959 for a total value of $239,159. The state is currently evaluating its oyster lease policy in light of the recent Louisiana and U.S. Supreme Court rulings in the Avenal case.

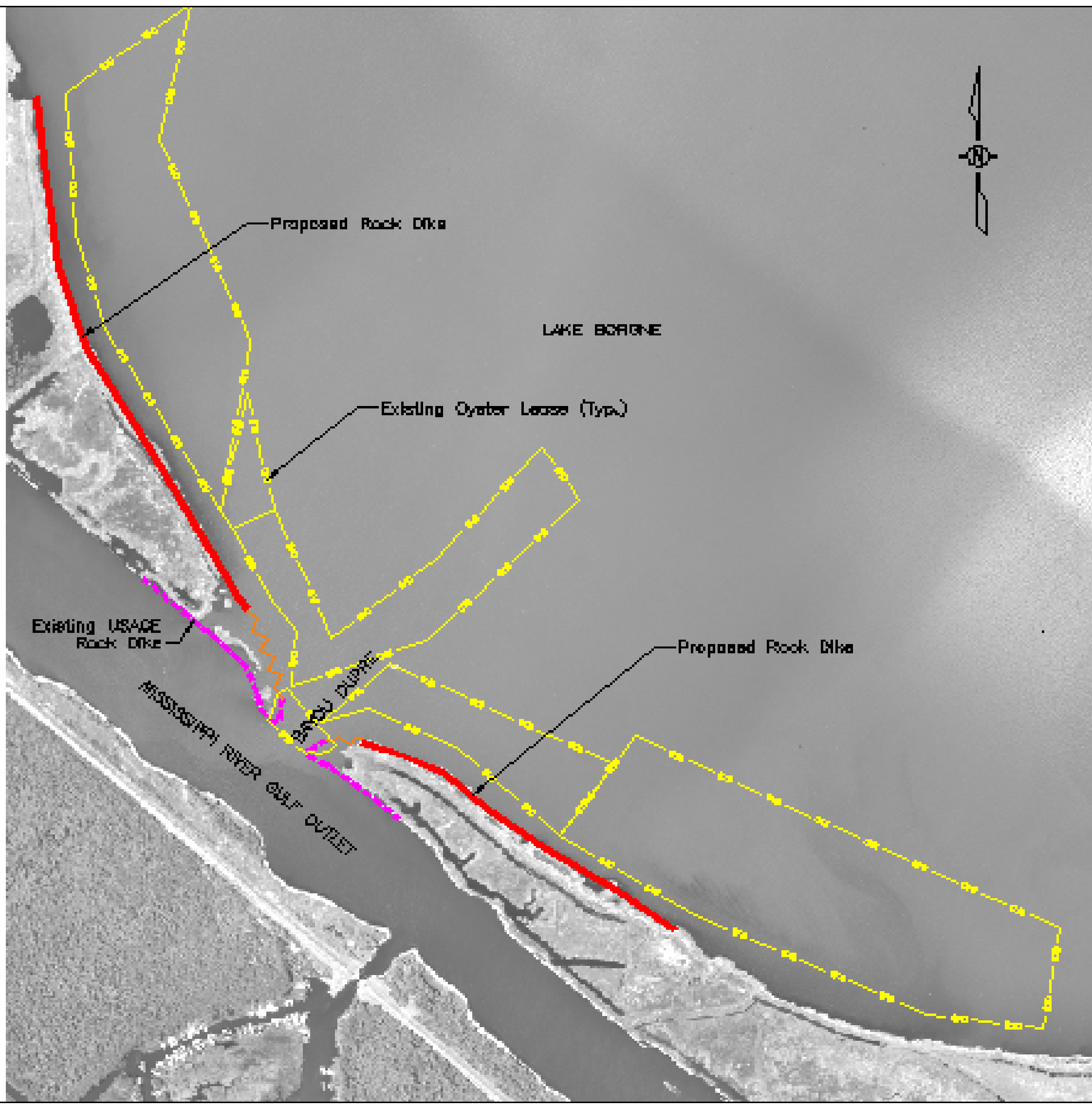

Figure 25 – Oyster Leases at Bayou Dupre

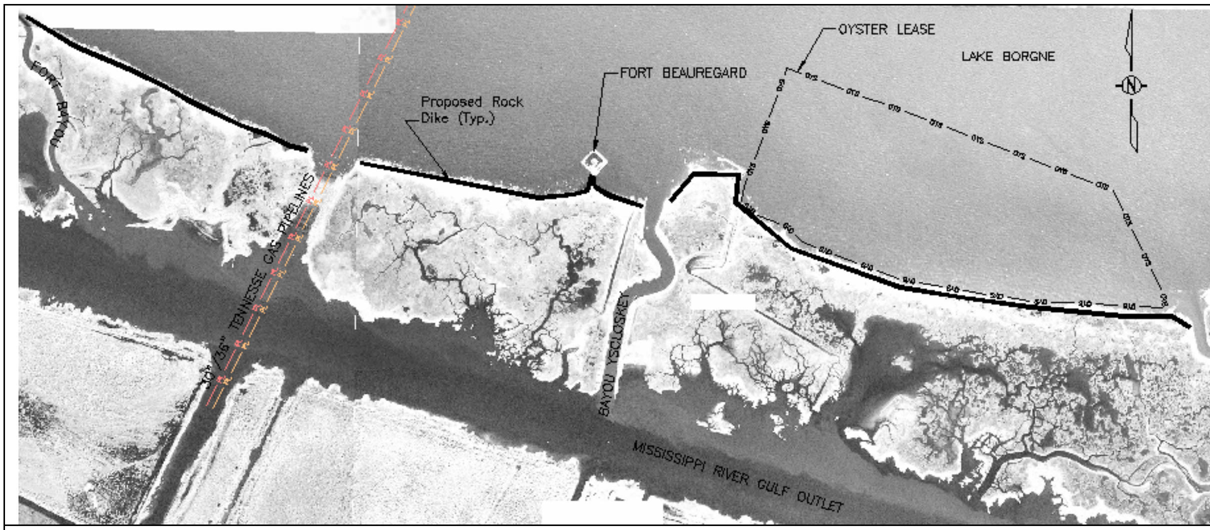

Figure 26 – Oyster Lease at Shell Beach

12. 30% Conference Meeting Minutes

The 30% design level review meeting for the Lake Borgne Shoreline Protection Project (PO-30) was held on Thursday, August 18, 2005 at the State of Louisiana, Department of Natural Resources (DNR) first floor conference room. The Lake Borgne project is being accomplished under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). EPA Region 6 is the federal sponsor for this project and DNR is the local sponsor. DNR designed the project using in-house engineering resources. The CWPPRA Technical Committee was advised of this meeting via e-mail on July 21, 2005, four weeks prior to the meeting date and information was posted on DNR's FTP server on August 4, 2005, two weeks prior to the meeting date in accordance with CWPPRA Standard Operating Procedures. An agenda and attendee listing is incorporated herein.

Patty Taylor, EPA Region 6 Project Manager, opened the meeting by welcoming the group and requesting everyone sign in. Ms. Taylor introduced Pam Mintz, also from EPA Region 6, who is coordinating the activities associated with the National Environmental Policy Act of 1969 and writing the Environmental Assessment for the project. Ken Teague, EPA Region 6, was unable to attend however Ms. Taylor explained Mr. Teague is preparing a revised Wetlands Value Assessment for the project. Ms. Taylor then introduced Chris Williams, DNR Project Manager who conducted the rest of the meeting.

Mr. Williams provided a brief history of the project including how the Shell Beach segment and Bayou Dupre segments were originally authorized on PPL 10 and PPL 11 and later combined by the Task Force into one project.

A timeline of the major project activities was given:

April 2002 – Project area survey;
December 2002 – Geotechnical investigation;
May 2003 – Additional geotechnical investigation;
July 2003 – Site visit, cultural resources areas present, Phase I investigation conducted, two sites identified as eligible for listing on the National Register for Historic Places, ongoing coordination with the Mississippi Band of Choctaws and Chitimacha Tribe of Louisiana;
July 2004 – Final Phase I report; and
January 2005 – Resurvey of Bayou Dupre inlet.

Mr. Williams introduced Shannon Haynes, DNR design engineer to discuss the project design features. Mr. Haynes described the design as challenging with some erosion estimates as high as 15 feet per year. He gave three reasons for erosion, 1) climate, 2) hydraulics, and 3) geology of the area. The prevailing winds are from northeast to southwest, and the resulting fetch is shorter in the Bayou Dupre area than in the Shell Beach segment. The soils in the area are "poor" and 24 borings were used to determine the physical characteristics for design purposes. An analysis of the results resulted in two design conditions to be used in the project areas, "strong" and "weak" areas. Mr. Haynes explained three structural alternatives were considered for shoreline protection:

1) steel sheetpiles
2) rock on shore
3) segmented concrete panels

Options 1 and 3 were considered too expensive in an effort to keep the project in a competitive posture for Phase II funding by the CWPPRA Task Force. The second alternative, placing rock on shore was selected. By dividing the project segments into the "strong" and "weak" categories, DNR was able to optimize the design of the stone structure, minimizing maintenance lifts. The breakwaters will rest on a geogrid and geotextile. Two construction lifts and one maintenance lift will be required for the "weak" segments. After the initial placement, another construction lift is planned at day 30, plus a maintenance lift during the 20-year project life. For the "strong" soil segments, after the initial placement, only one maintenance lift should be required during the 20 year project design life.

The Bayou Dupre segment is a special case due to the water depths and swift current. Three design alternatives were considered:

1) steel sheetpile;
2) rock breakwater; and
3) fiberglass sheetpile.

The selected alternative was the fiberglass sheetpile, which will be backfilled with sand. A 2.5 foot layer of stone will be placed on top to protect the sand from overwash. The sand will easily compact and will allow drainage. The design height of 2.5 feet matches the surrounding land elevation. Scour protection will also be placed on either side of the fiberglass structure. The length of the sheetpile will be 30 feet except in the area of the old Bayou where the length is 40 feet.

Mr. Williams described another unique feature within the project area, the old Naval facility at Shell Beach. Construction material remnants of the World War II facility are near the shoreline and present a hazard to dredging therefore end-on construction techniques will be used in this area. This facility is a Formerly Used Defense Site and according to the USACE the site status is complete with no hazards found. Cultural resources were found on the eastern end of the Bayou Dupre segment. A Phase I archeology site investigation was conducted and two sites within the project footprint were considered eligible for listing on the National Register for Historic Places. This area is designated as an additive alternative pending concurrences with the tribes and State of Louisiana Division of Archeology. End-on construction is provided in this area to avoid dredging. There are six oyster leases within the project area and the State is currently working on an oyster policy. The landrights are completed with agreements signed.

Agaha Bass advised the an Ecological Review was completed and six recommendations were provided. Recommendations include to consider articulated concrete mats as a project feature and use flotation dredge material for marsh creation in the Bayou Dupre area. Overall, the Ecological Review group concurs with the design of the project.

Mr. Williams advised total project costs are currently estimated at $10.9 M including Operations and Maintenance funds and asked for questions from the audience.

Cathy Grouchy, USFWS, asked about the maintenance lifts. Mr. Haynes confirmed that the "strong" soils sections will be constructed to a +4 elevation initially and have one maintenance lift. The "weak" soils areas will be constructed to +3 elevation initially, followed by another construction lift at 30 days, with one maintenance lift. Mr. Haynes stated there could be some areas where differential settlement takes place.

Sid Falk, USACE New Orleans, asked what the two lower lines were on the consolidation curve. Mr. Rickey Brouillette (LDNR) advised they were the fill heights (thickness) over time.

Pat Forbes, Governor's Office of Coastal Activities, asked what the total life cycle budget for the project currently is compared to the original $19 million estimate. Mr. Williams responded that the $10.8M is the total budget including estimated maintenance over the 20 year project life. Mr. Haynes advised that some sections may fail and require maintenance however based upon their analyses, the current budget should be sufficient to address maintenance issues.

Sid Falk, USACE New Orleans, recommended dredged material be placed in the old bayou area near Bayou Dupre in order to facilitate construction.

Rachel Sweeney, NOAA/NMFS, asked about the gap shown in figure 9. Mr. Williams responded the gap is for two large Tennessee gas pipelines. Helen Hoffpauir confirmed the presence of the pipelines at that location and no stone to be placed upon the pipelines.

No further questions from the audience, Mr. Williams advised the next steps are to address the concerns raised by the Ecological Restoration group.

Ms. Taylor and Mr. Williams thanked everyone for coming and requested any additional comments be provided by e-mail within one-week.

The sign-in sheet for this meeting is provided on the following page.

Lake Borgne Shoreline Protection, PO-30
Preliminary Design (30%) Meeting
Thursday August 18, 2005, 1:00 PM

Name	Organization	Phone
Dan Arceneaux	CZM St Bernard	504 271 5448
Christopher Andry	" "	(504) 278-4309
Beth McCasland	COE	504-862-2021
Sin Falk	USACE	504 862-1834
Tom Bernard	NOFO	504 240-4071
Cathy Grouchy	USFWS	504 862-2689
Brad Miller	DNR	225 342-4127
Chris Knotts	DNR	225-342-6871
Rachel Sweeney	NOAA	
Pat Forbes	LOCA	342-3968
Rickey Brouillette	LDNR	342-5330
Matt Campbell	LDNR	219-0379
Whitney Cash	LDNR	342-9419
Jason A. Emery	Chitimacha Tribe of LA	(337) 923-9923
Kimberly S. Walden	Chitimacha Tribe of LA	337-923-9923
Duke Rivet	LA SHPO	225-342-8170
Norwyn Johnson	DNR	225-342-0326
Agaha Brass	LDNR	225-342-9429
Luke LeBas	DNR	342-4102
Bob Roberts	DNR	342-9423
John Hodnett	DNR	342-7305
Kurt Johnson	CED	342-6850
Helen Hoffpauir	CRP/LAND	342-9420

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Environmental Protection Agency. 1995. The Probability of Sea Level Rise. James G. Titus and Vijay Naraya nan. Washington, D.C. 186 pp EPA Report 230-R95-008.

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United States Army Engineer Research Center. 2001. Coastal Engineering Manual. Part VI. Joan Pope and John Lockhart. Vicksburg, MS. EM 1110-2-1100

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B.F.M Corp., LLC. 2002. Hydrographic Survey of Lake Borgne at Shell Beach. Stanley Turner, PLS. Kenner, LA. 6 pp

Sigma Consulting Group, Inc. 2005. Topographic, Bathymetric and Magnetometer Survey – Lake Borgne at Bayou Dupre. Baton Rouge, LA. 4 pp

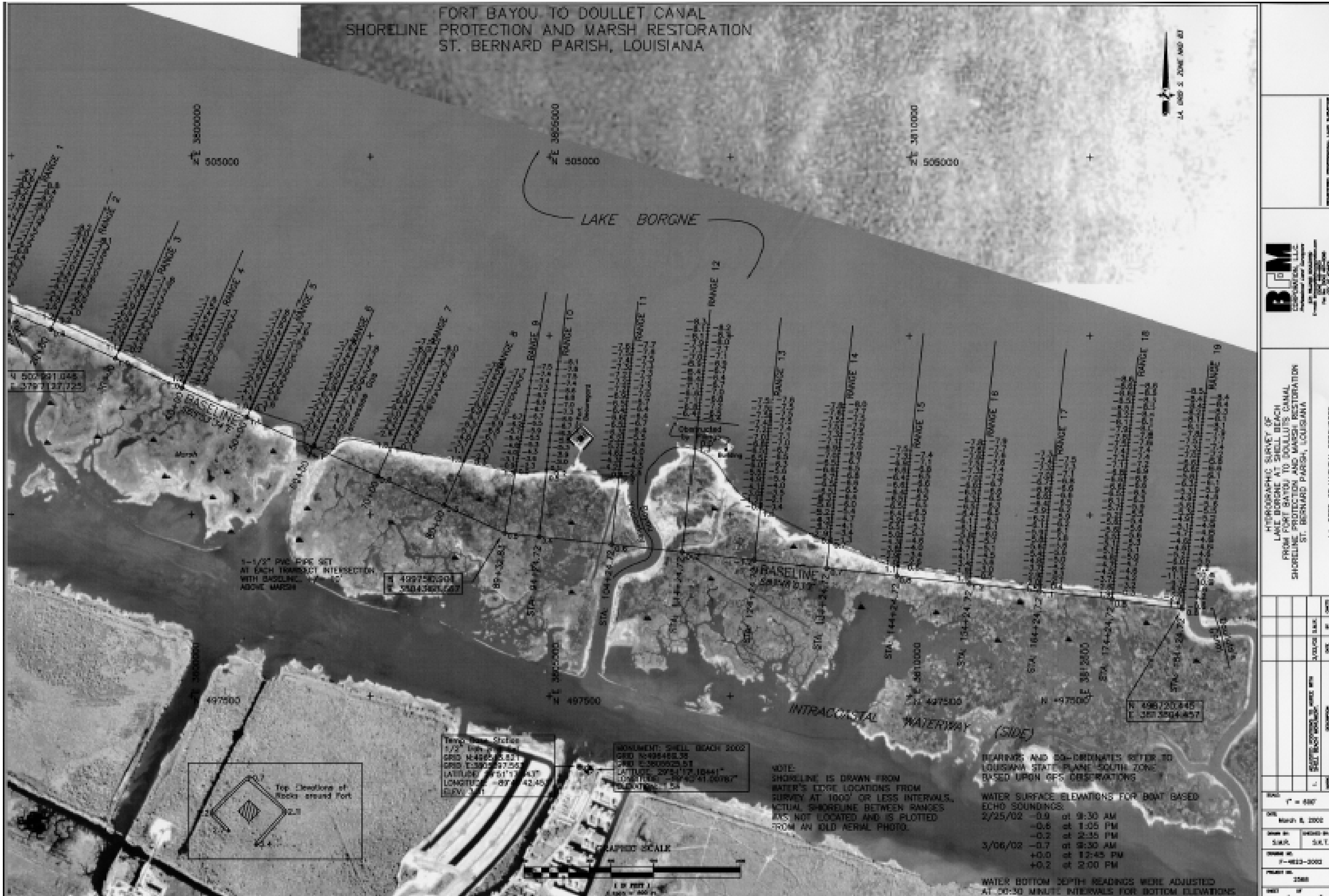
Earth Search, Inc. 2005. Magnetometer Survey of Fort Beauregard, Lake Borgne Shoreline Project, CWPPRA Project PO-30, St. Bernard Parish, Louisiana. New Orleans, LA 12pp

C & C Technologies. 2004. Phase I Terrestrial and Submerged Cultural Resources Survey Report of the Proposed Lake Borgne Bank Stabilization Project at Bayou Dupre and Shell Beach, St. Bernard Parish, Louisiana. Lafayette, LA.

NHI Course No. 13236 – Module 6, Earth Retaining Structures, May 1998, U. S. Department of Transportation; Federal Highway Administration, National Highway Institute.

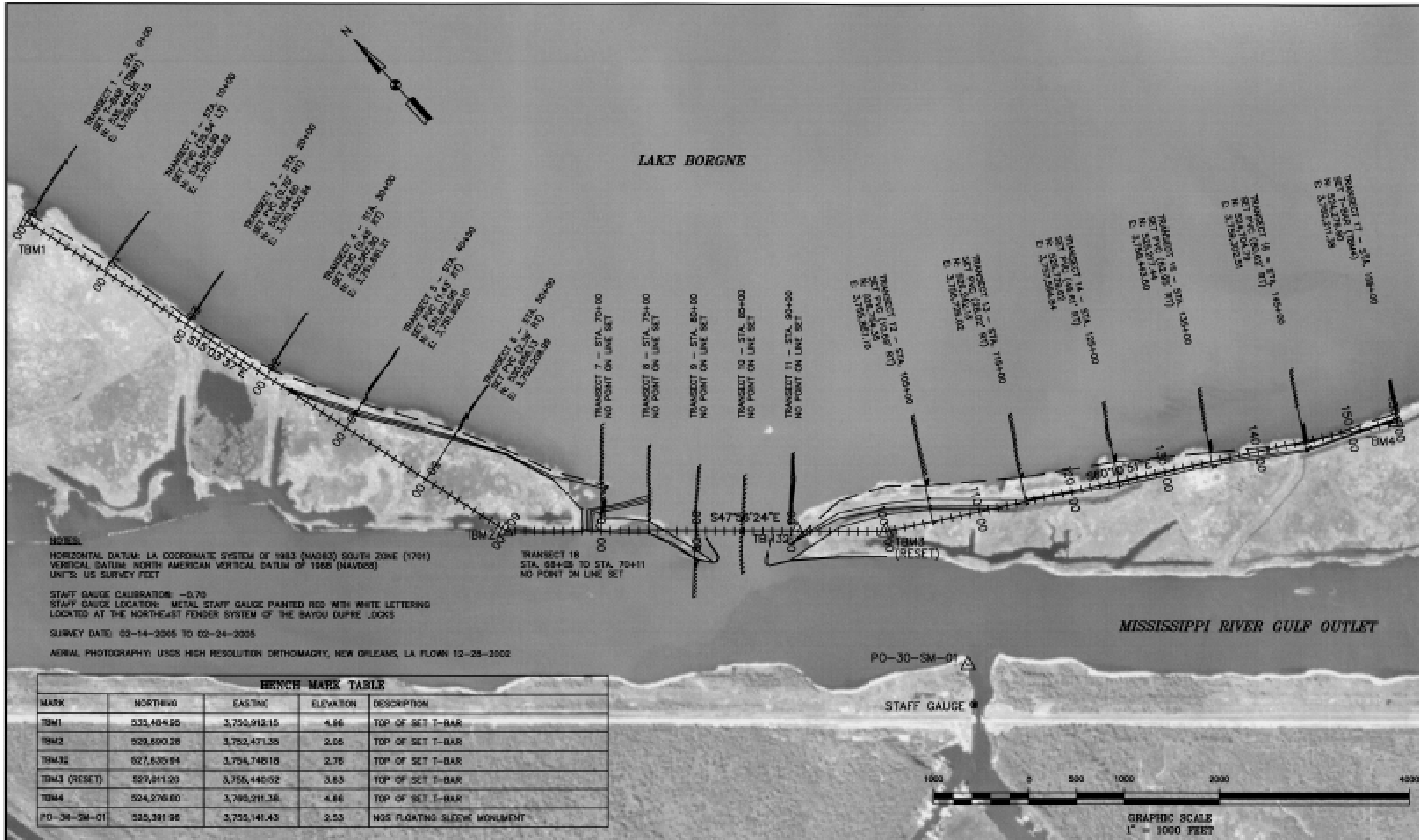
Appendix A

Topographic, Bathymetric and Magnetometer Survey – Lake Borgne at Shell Beach


FORT BAYOU TO DOULLET CANAL
SHORELINE PROTECTION AND MARSH RESTORATION
ST. BERNARD PARISH, LOUISIANA
LAKE BORGNE
INTRACOASTAL WATERWAY (SIDE)
BASELINE
N 505000
N 497500
E 3800000
E 3805000
E 3810000
E 3815000
RANGE 1
RANGE 2
RANGE 3
RANGE 4
RANGE 5
RANGE 6
RANGE 7
RANGE 8
RANGE 9
RANGE 10
RANGE 11
RANGE 12
RANGE 13
RANGE 14
RANGE 15
RANGE 16
RANGE 17
RANGE 18
RANGE 19
1-1/2" PVC PIPE SET AT EACH TRANSECT INTERSECTION WITH BASELINE
Top Elevations of Rocks around Fort
GRAPHIC SCALE
NOTE:
SHORELINE IS DRAWN FROM WATER'S EDGE LOCATIONS FROM SURVEY AT 1000' OR LESS INTERVALS. ACTUAL SHORELINE BETWEEN RANGES WAS NOT LOCATED AND IS PLOTTED FROM AN OLD AERIAL PHOTO.
BEARINGS AND CO-ORDINATES REFER TO LOUISIANA STATE PLANE SOUTH ZONE BASED UPON GPS OBSERVATIONS.
WATER SURFACE ELEVATIONS FOR BOAT BASED ECHO SOUNDINGS:
2/25/02 -0.9 at 9:30 AM
-0.6 at 1:05 PM
-0.2 at 2:35 PM
3/06/02 -0.7 at 9:30 AM
+0.0 at 12:45 PM
+0.2 at 2:00 PM
WATER BOTTOM DEPTH READINGS WERE ADJUSTED AT 30:30 MINUTE INTERVALS FOR BOTTOM ELEVATIONS.
HYDROGRAPHIC SURVEY OF LAKE BORGNE AT SHELL BEACH FROM FORT BAYOU TO DOULLUTS CANAL SHORELINE PROTECTION AND MARSH RESTORATION ST. BERNARD PARISH, LOUISIANA
LA. DEPT. OF NATURAL RESOURCES
March 8, 2002

Appendix B

Topographic and Bathymetric Survey – Lake Borgne at Bayou Dupre



NOTES:

HORIZONTAL DATUM: LA COORDINATE SYSTEM OF 1983 (NAD83) SOUTH ZONE (1701)
VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
UNITS: US SURVEY FEET

STAFF GAUGE CALIBRATION: -0.70
STAFF GAUGE LOCATION: METAL STAFF GAUGE PAINTED RED WITH WHITE LETTERING LOCATED AT THE NORTHEAST FENDER SYSTEM OF THE BAYOU DUPRE LOCKS

SURVEY DATE: 02-14-2005 TO 02-24-2005

AERIAL PHOTOGRAPHY: USGS HIGH RESOLUTION ORTHOIMAGRY, NEW ORLEANS, LA FLOWN 12-28-2002

BENCH MARK TABLE

MARK	NORTHING	EASTING	ELEVATION	DESCRIPTION
TBM1	535,464.95	3,750,912.15	4.66	TOP OF SET T-BAR
TBM2	529,690.28	3,752,471.35	2.05	TOP OF SET T-BAR
TBM3S	527,635.64	3,754,748.18	2.76	TOP OF SET T-BAR
TBM3 (RESET)	527,811.20	3,755,440.52	3.63	TOP OF SET T-BAR
TBM4	524,276.60	3,760,211.36	4.66	TOP OF SET T-BAR
PO-30-SM-01	535,391.96	3,755,141.43	2.53	NGS FLOATING SLEEVE MONUMENT

PRELIMINARY

LOUISIANA DEPARTMENT OF NATURAL RESOURCES
COASTAL RESTORATION DIVISION
617 NORTH 3RD STREET
BATON ROUGE, LOUISIANA 70802

LAKE BORGNE SHORELINE PROTECTION
CWPPRA PROJECT PO-30
ST. BERNARD PARISH, LA
TOPOGRAPHIC & BATHYMETRIC SURVEY

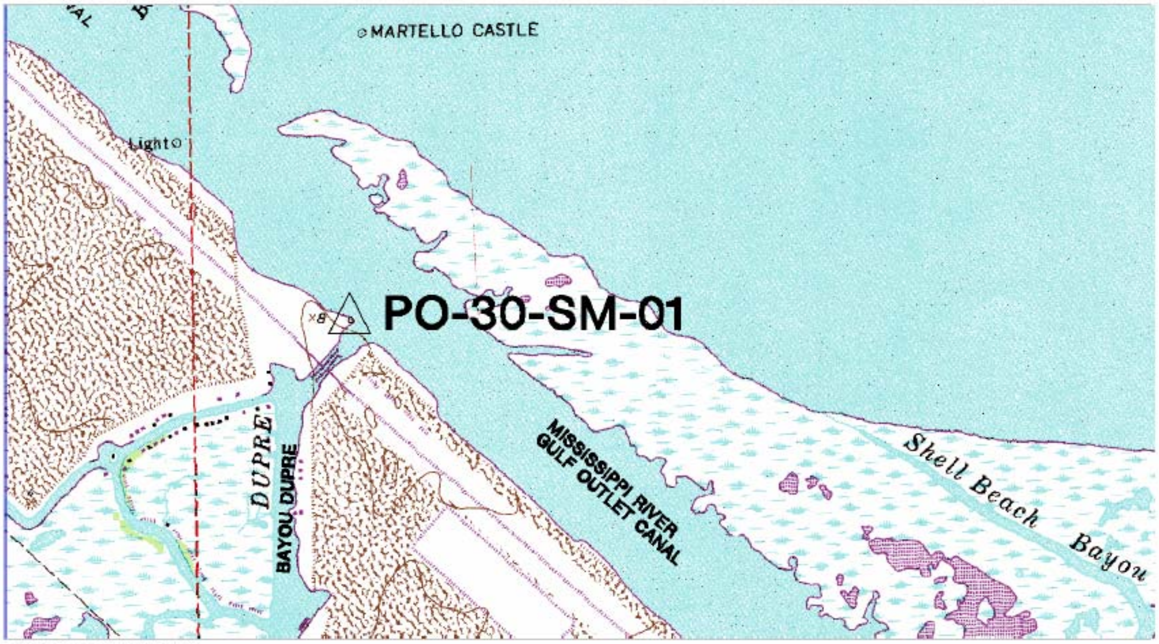
SURVEY PLAN VIEW

STATE PROJECT	PO-30	DESIGNED	R.J.
FEDERAL PROJECT		DRAWN	R.J.
SCALE	1"=1000'	CHECKED	
SHEET NUMBER	1	APPROVED	
		DATE	03-21-2005

SIGMA CONSULTING GROUP, INC.
10305 AIRLINE HWY.
BATON ROUGE, LA 70816
(225) 298-0800

Appendix C

LDNR Secondary Monument “PO-30-SM-01” Data Sheet



VICINITY MAP Scale: 1" = 2000' Reproduced from USC&GS "Martello Castle" Quadrangle

Station Name: "PO-30-SM-01"

Location: The monument stamped "PO-30-SM-01" is located near Shell Beach, Louisiana. From the intersection of Paris Road and LA Hwy. 39 (Judge Perez Road) in Chalmette proceed east on LA Hwy. 39 for 8.1 miles to the intersection of LA Hwy. 39 and LA Hwy. 46 near St. Bernard High School. Proceed east on LA Hwy. 46 for 6.3 miles to a levee on the left. Follow the levee for approximately 7.7 miles to the Bayou Dupre Floodgates. The monument is located at the intersection of the west bank of Bayou Dupre and southern bank of the Mississippi River Gulf Outlet Canal. It is approximately 800 ft. northeast of the northern wing wall of the Bayou Dupre flood control structure behind the rip-rap lined bank. Access across the flood control structure should be coordinated with the St. Bernard Parish Levee District.

Monument Description: NGS style floating sleeve monument; datum point set on 9/16" stainless steel sectional rods driven 28 feet to refusal, set in sand filled 6" PVC pipe with access cover set in concrete, flush with ground.

Stamping: PO-30-SM-01

Installation Date: 2003 **Date of Survey:** Nov. 19-21, 2003

Monument Established By: Sigma Consulting Group, Inc.

For: *Louisiana Department of Natural Resources, CRD*

Adjusted NAD 83 Geodetic Position
Lat. 29°56' 10.33674" N
Long. 89°50' 08.86486" W

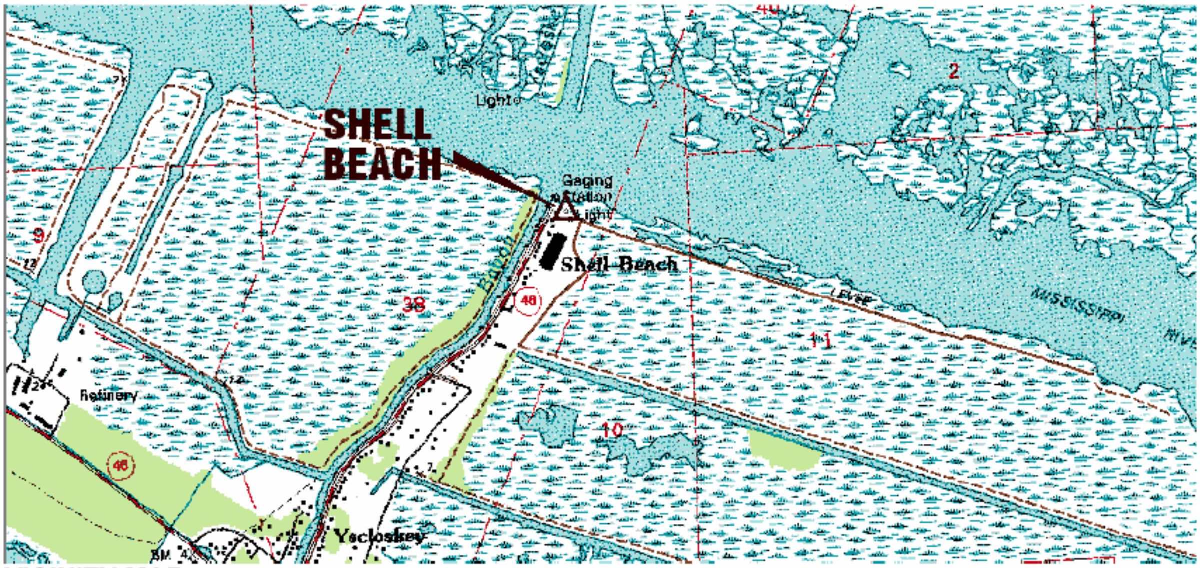
Adjusted NAD 83 Datum LSZ (1702) Feet
N= 525,391.96
E= 3,755,141.43

Adjusted NAVD88 Height
Elevation = 2.53 feet (0.772 mtrs)
Geoid99 Height = -26.109 mtrs.
Ellipsoid Height = -25.338 mtrs.

Adjusted Position Established for Louisiana Department of Natural Resources, Coastal Restoration Division

Appendix D

LDNR Secondary Monument "SHELL BEACH-2002" Data Sheet



VICINITY MAP Scale 1" = 2000' Reproduced from USC&G "Ysclosky" Quadrangle

Station Name: **"SHELL BEACH 2002"**

Monument Location: From the intersection of LA Hwy 46 & LA Hwy 300 in Reggio at the flashing signal light at the "The Junction Store", proceed east on LA Hwy 46 approximately 4.6 miles to a drawbridge. Proceed north across drawbridge over Bayou La Loutre to the intersection of LA Hwy 46 & LA Hwy 624, then head west 0.2 miles to a road that turns north along Bayou Ysclosky. Proceed north along winding road on the east side of Bayou Ysclosky for 1.2 miles to the end of the road at the Intracoastal Waterway. Mark is on the right (east side) of the road on the south edge of a shell parking area. 175 feet east of centerline of road; 75 feet Southeast of wood pole with meter; located at south edge of shell parking area.

Monument Description: Stainless steel rod driven to point of refusal (72' deep) within a sleeve and protective cover set in concrete and stamped "Shell Beach 2002".

Date: March 2002

Monument Established by: BFM Corporation

NAD 83 Geodetic Position

Lat. 29°51'17.18441"
Long. 89°40'41.00787"

La. State Plane South Zone(NAD 83)
N= 496,469.38
E= 3,805,525.51

NAVD 88(Feet)/Geoid 99
Elevation= 1.54feet/0.469meters

Ellipsoid Height = -25.400 meters
Geoid99 Height = -25.868 meters

Appendix E

Cost Estimates

PO30 (Lake Borgne) Cost Estimate for Steel Sheet Pile - Top Elevation +2.5 ft NAVD88

					Steel Sheet Piles				Battered Timber Piles		Rock Scour Berm			Geogrid Composite		Flotation		Maintenance
Location	Reach	Lift	Year	Linear Length (ft)	Crown Elevation NAVD88	# of Sheet Pile Rows	CADD Area (Ft^2)	Cost $34/$Yd^2$ ($)	# of 35' Long Piles (Each)	Cost $455/Pile ($)	Total Volume (Yd^3)	Total Weight (Tons)	Cost $25/ton ($)	Total Area (Yd^2)	Cost $7/yd2 ($)	Total Volume (Yd^3)	Cost $2/$Yd^3$ ($)	15% of Material Cost ($)
Bayou Dupre	1	1	1	6,643	2.5	1	132860	$4,517,240										
	West	1	1	1,163	2.5	1	31,413	1,068,042	194	88,194								
	East	1	1	439	2.5	1	10,975	373,150	73	33,291								
	2	1	1	6,418			128,360	4,364,240										
Shell Beach	3	1	1	7,864	2.5	1	157,280	5,347,520										
	4	1	1	9217	2.5	1	184,340	6,267,560										
All Areas			5															
							645,228	21,937,752	267	121,485	8726	18250	456479	4363	30540	384,262	768,524	3,290,663

	Total Cost
Mob/Demob	1,000,000
Total Cost	27,605,443
Total Cost +15%	31,746,259

PO30 (Lake Borgne) Cost Estimate Segmented Concrete Panels - Crown Elevation +2.5 ft NAVD88

Location	Reach	Lift	Year	Linear Length (ft)	Concrete Panels Crown Elevation NAVD88	Concrete Panels Cost $350/LF ($)	Rock Scour Berm Total Volume (yd^3)	Rock Scour Berm Total Weight (Tons)	Rock Scour Berm Cost $25/ton ($)	Geogrid Composite Total Area (yd^2)	Geogrid Composite Cost $7/yd2 ($)	Flotation Total Volume (Yd^3)	Flotation Cost $2/$Yd^3$ ($)	Maintenance 15% of Material Cost ($)
Bayou Dupre	1	1	1	6,643	2.5	2,325,050								
	West	1	1	1,163	2.5	407,050								
	East	1	1	439	2.5	153,650								
	2	1	1	6,418	2.5	2,246,300								
Shell Beach	3	1	1	7,864	2.5	2,752,400								
	4	1	1	9217	2.5	3,225,950								
All Areas			5											
						11,110,400	8726	18250	456479	4363	30540	384,262	768,524	1,666,560

	Total Cost
Mob/Demob	1,000,000
Cost	15,032,503
+15%	17,287,378

PO30 (Lake Borgne) Cost Estimate for Rock Breakwater - Outside Toe Elevation +0.5 ft NAVD88 - Construction Lift at +4 ft NAVD88 and 1 Maintenance Lift at +4 ft NAVD88

Location	Reach	Lift	Year	Linear Length (ft)	Rock Dike & Scour Protection: Crown Elevation NAVD88	Crown Width (ft)	Side Slopes (ft/ft)	CADD Volume (Yd^3)	Elastic Settlement Multiplier	Waste Added (%)	Total Volume (Yd^3)	Total Weight (Tons)	Cost $25/Ton ($)	Flotation: Bottom Elevation NAVD88	Bottom Width (ft)	Side Slopes (ft/ft)	CADD Volume (Yd^3)	Cost $2/$Yd^3$ ($)	Geotextile/grid: CADD Area (Yd^2)	Cost $7/$Yd^2$ ($)
Bayou Dupre	1	1	1	6,643	4	4	2:1	10,349	1.5	10	17,076	35,731	893,280	-6	80	2:1	64,335	128,670	20,081	140,567
			5		1	4	2:1													
		2			4	4	2:1	7,343	1.0	10	8,077	16,902	422,544	-6	80	2:1	64,335	128,670		
	West	1	1	1,163	4	4	2:1	10,169	1.5	10	16,779	35,110	877,744	-6	80	2:1	908	1,816	15,253	106,771
			5		1	4	2:1													
		2			4	4	2:1	6,101	1.0	10	6,711	14,043	351,074	-6	80	2:1	908	1,816		
			10		1	4	2:1													
		3			4	4	2:1	6,101	1.0	10	6,711	14,043	351,074	-6	80	2:1	908	1,816		
	East	1	1	439	4	4	2:1	2,685	1.5	10	4,430	9,270	231,757	-6	80	2:1	1,209	2,418	5,236	36,652
			5		1	4	2:1													
		2			4	4	2:1	1,611	1.0	10	1,772	3,708	92,703	-6	80	2:1	1,209	2,418		
			10		1	4	2:1													
		3			4	4	2:1	1,611	1.0	10	1,772	3,708	92,703	-6	80	2:1	1,209	2,418		
	2	1	1	6,418	4	4	2:1	8,695	1.5	10	14,347	30,021	750,514	-6	80	2:1	62,156	124,312	13,763	96,343
			5		1	4	2:1													
		2			4	4	2:1	5,250	1.0	10	5,775	12,084	302,105	-6	80	2:1	62,156	124,312		
Shell Beach	3	1	1	7,864	4	4	2:1	11,088	1.5	10	18,295	38,283	957,068	-6	80	2:1	92,350	184,700	22,529	157,703
			5		1	4	2:1													
		2			4	4	2:1	9,777	1.0	10	10,755	22,504	562,605	-6	80	2:1	92,350	184,700		
	4	1	1	9217	4	4	2:1	12,318	1.5	10	20,325	42,529	1,063,236	-6	80	2:1	83,979	167,958	24,254	169,776
			5		1	4	2:1													
		2			4	4	2:1	8,622	1.0	10	9,484	19,846	496,142	-6	80	2:1	121,896	243,792		
								101,720			142,309	297,782	7,444,550				649,908	1,299,816	101,116	707,811

Task	Initial Construction	Maintenance Lift 1st	Maintenance Lift 2nd	Total Cost
Mob/Demob	1,000,000	1,000,000	1,000,000	2,000,000
Total Cost	7,091,285	3,912,881	1,448,011	11,004,166
Total Cost +15%	8,154,977	4,499,813	1,665,213	14,320,004

PO30 (Lake Borgne) Cost Estimate for Rock Breakwater and Steel Sheetpile - Outside Toe Elevation +0.5 ft NAVD88 - Construction Lift at +3, +3.25 and +4 ft NAVD88 and 1 Maintenance Lift at +4 ft NAVD88

					Rock Dike & Scour Protection									Flotation				
Location	Reach	Lift	Year	Linear Length (ft)	Crown Elevation NAVD88	Crown Width (ft)	Side Slopes (ft/ft)	CADD Volume (Yd^3)	Elastic Settlement Multiplier	Waste Added (%)	Total Volume (Yd^3)	Total Weight (Tons)	Cost $25/Ton ($)	Bottom Elevation NAVD88	Bottom Width (ft)	Side Slopes (ft/ft)	CADD Volume (Yd^3)	Cost $2/$Yd^3$ ($)
Bayou Dupre	1	1	0	6,643	3	8	2:1	8,873	1.5	10	14,640	30,635	765,879	-6	80	2:1	64,335	128,670
			0.1		2	8	2:1											
		2			3.25	7	2:1	2,905	1.0	10	3,196	6,687	167,165					
			1		1.7	7	2:1											
		3			4	4	2:1	4,841	1.0	10	5,325	11,143	278,569	-6	80	2:1	58,391	116,782
	1 Scour	1	0	1,154	2 AML	0	2:1	4,860	1.5	10	8,019	16,780	419,494					
	1 Fill	1	0	1,154	2.5	15	0	1,592	1.5	10	2,627	5,497	137,414					
	2 Scour	1	0	439	2 AML	0	2:1	1,890	1.5	10	3,119	6,525	163,137					
	2 Fill	1	0	439	2.5	15	0	615	1.5	10	1,015	2,123	53,084					
	2	1	0	4,418	4	4	2:1	5,003	1.5	10	8,255	17,273	431,837	-6	80	2:1	45,224	90,448
			20		3	4	2:1											
Shell Beach	3	1	0	7,864	3 or 4	8	2:1	9,947	1.5	10	16,413	34,343	858,582	-6	80	2:1	87,923	175,846
			0.1		2 or N/A	8	2:1											
		2			3.25 or N/A	7	2:1	1,867	1.0	10	2,054	4,297	107,434					
			1		1.7 or N/A	7	2:1											
		3			4 or N/A	4	2:1	3,113	1.0	10	3,424	7,165	179,134	-6	80	2:1	44,410	88,820
	4	1	0	9217	4	4	2:1	13,981	1.5	10	23,069	48,271	1,206,779	-6	80	2:1	83,979	167,958
			20		3	4	2:1											
								59,487			91,154	190,740	4,768,507				384,262	768,524

PO30 (Lake Borgne) Cost Estimate for Rock Breakwater and Steel Sheetpile - Outside Toe Elevation +0.5 ft NAVD88 - Construction Lift at +3, +3.25 and +4 ft NAVD88 and 1 Maintenance Lift at +4 ft NAVD88

Geogrid Composite		Settlement Plate		Warning Sign		PZ27 Steel Sheet Pile		6"x6"x16' Galv. Tube		16'x1.25" SS Tie Rod		3/8"x4.75"x9.5" Splice		Sand Fill	
CADD Area (Yd^2)	Cost $\$7/Yd^2$ ($)	# Plates @ 1000' Intervals	Cost @ $1K/Plate ($)	# Signs @ 1000' Intervals	Cost $2000 Ea. ($)	Total Area (Ft^2)	Cost $\$34/Ft^2$ ($)	Length of Alignment (Ft)	Cost $25/LF ($)	Length @8' Spacing (Ft)	Cost $2/LF ($)	# @16' Spacing (Each)	Cost $30/Each ($)	CADD Volume (Yd^3)	Cost $\$8/Yd^3$ ($)
17,462	122,235	7	7,000	7	14,000										
1044	7,310			1	2,000	85,538	2,908,292	2342	58,550	2402	4,804	146	4,391	3,664	29,312
1907	13,351														
447	3,128			1	2,000	27,008	918,272	900	22,500	960	1,920	56	1,688	986	7,888
739	5,173														
11,879	83,151	4	4,000	5	10,000										
22,529	157,700	10	10,000	8	16,000										
24,254	169,776	9	9,000	9	18,000										
80,261	561,824	30	30,000	31	62,000	112,546	3,826,564	3,242	81,050	3,362	6,724	203	6,079	4,650	37,200

Task	Initial Construction 1st	Initial Construction 2nd	Initial Construction Cost	Maintenance Lift	Total Final Cost
Mob/Demob	1,000,000	0	1,000,000	1,000,000	2,000,000
Total Cost	10,210,568	274,599	10,485,166	1,663,305	12,148,471
Total Cost +15%	11,742,153	315,789	12,057,941	1,912,801	13,970,742

PREFERRED ALTERNATIVE

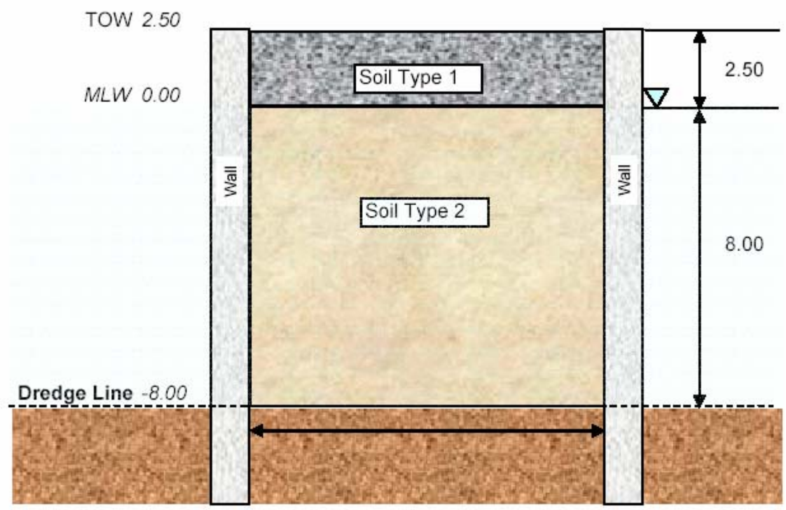
Appendix F

Stability Analysis of Soil Mass

EXTERNAL STABILITY ANALYSES OF SOIL MASS

Back-to-Back Fiberglass Sheetpile Walls- Initial Static Condition

Case @ -8.00



Soil Data Input

Soil Type 1- Unit Weight	135	lb/cu.ft.
ST1- cohesion, C	0	psf
ST1- phi angle	40	degrees
Soil Type 2- Unit Weight	115	lb/cu.ft.
Soil Type 2- Bouyant Unit Wt.	51	lb/cu.ft.
ST2- cohesion, C	0	psf
ST2- phi angle	20	degrees
Tan (phi)	0.36397	

Wall Geometry

Top of Wall (TOW)	2.50	
MLW	0.00	
Dredge Line	-8.00	
Wall Width, W	15.00	ft.

Volumes per unit length (1 foot)

ST1- Volume	37.5	cu. Yds.
ST2- Volume	120.0	cu. Yds.

Resisting Soil Mass Weight (water level at MLW)

ST1- Weight	5062.5	lbs./ft
ST2- Weight	6120	lbs./ft
Total Soil Mass Weight	***11182.5***	lbs./ft

Resisting Soil Mass Weight (water level at TOW)

Total Soil Mass Weight	***8782.5***	lbs./ft

Assumptions:

The soil mass is confined by the back-to-back walls and the woven geosynthetic fabric. The external stability analyses is determined from the NHI Couse No. 13236- Module 6, Earth Retaining Strucrures, May 1998, Figure 6-13, excluding the shear resistance of the fiberglass sheeting.

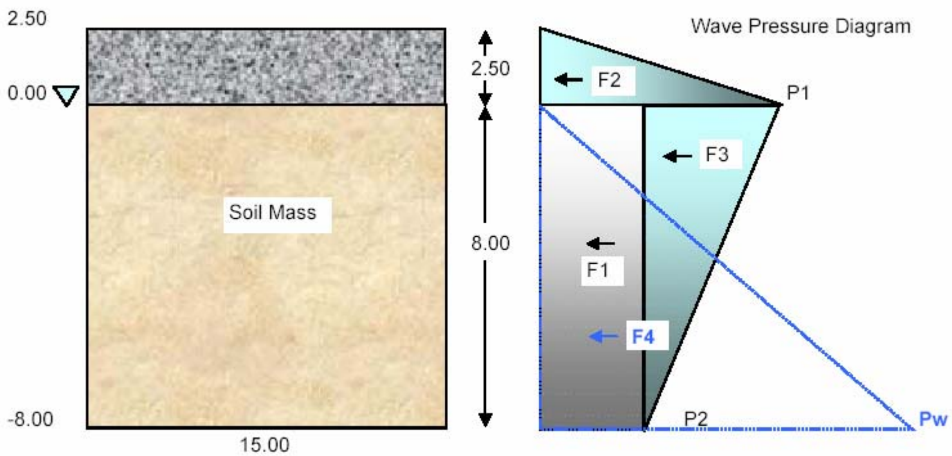
LDNR/CED (PO-30) Bayou Dupre 1 5/23/2005

EXTERNAL STABILITY ANALYSES OF SOIL MASS

Nonbreaking wave force on vertical walls (ACES- Miche-Rundgren) at crest

water unit weight 64.0 lb/cu ft

Case @ -8.00



Wave Force Data @ Crest		
Wave Pressures		
P1	135	psf
P2	100	psf
Pw (hydrostatic)	512	psf
Wave Forces		
Force 1	800.0	lbs./ft.
Force 2	168.8	lbs./ft.
Force 3	140.0	lbs./ft.
Force 4 (hydrostatic)	2048	lbs./ft.
Ft, Total Force	***3156.8***	*lbs./ft.*
Ft, w/o hydrostatic	1108.8	lbs./ft.

"Soil Mass" Resisting Moments (per ft. of wall)		
MR1	83868.8	ft.-lbs.
Wave Force Overturning Moments (per ft. of wall)		
Mo1	3200.0	ft.-lbs.
Mo2	1490.6	ft.-lbs.
Mo3	746.7	ft.-lbs.
**Mo4*	5461.3	ft.-lbs.
Wave Resultant Force Location w/o Pw		
***FR*	4.90	lbs./ft.

"Soil Mass" External Stability

Factor of Safety Against Overturning

F.S.overturning = ***7.7***

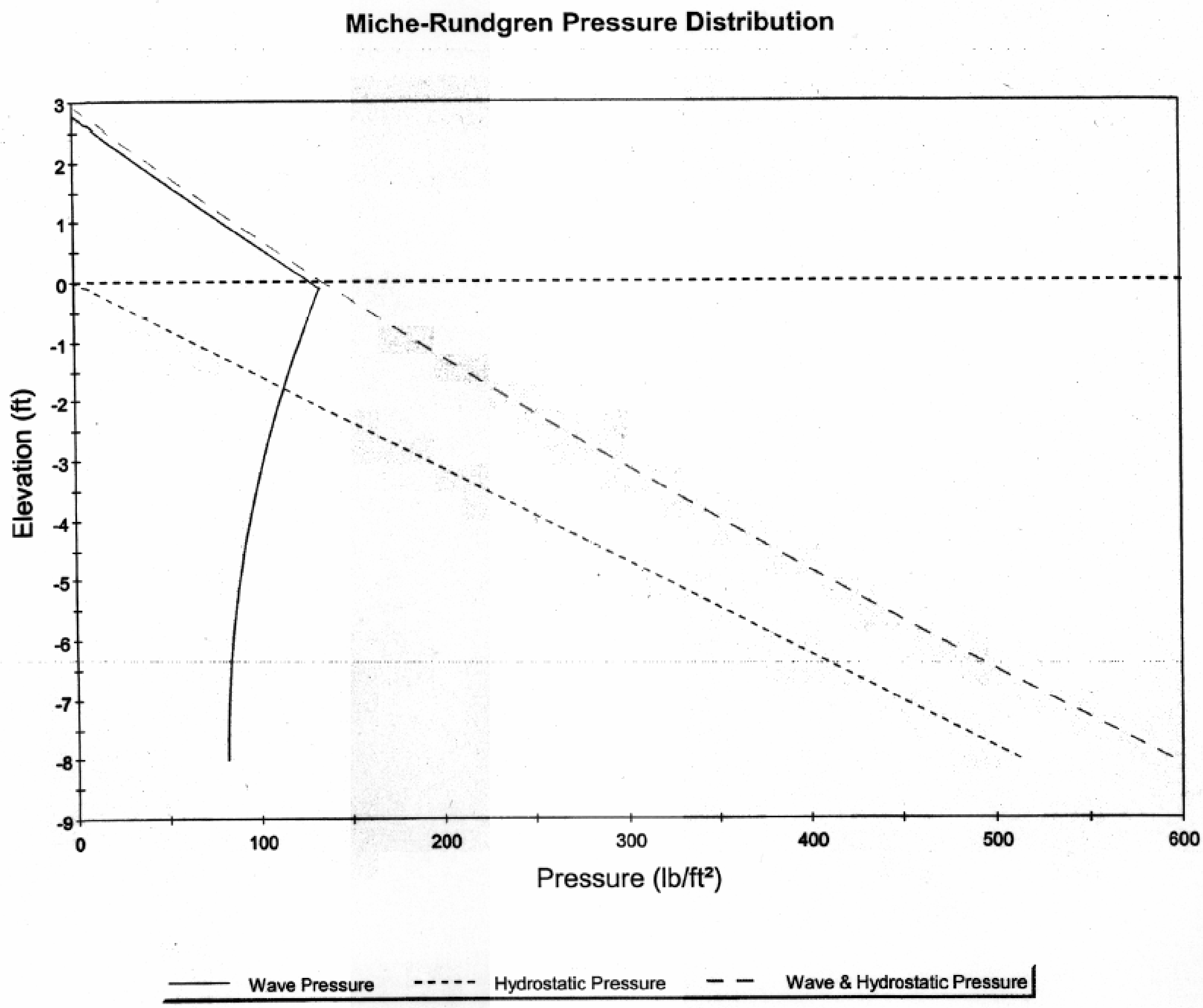
Factor of Safety Against Sliding

F.S. sliding = ***1.3***

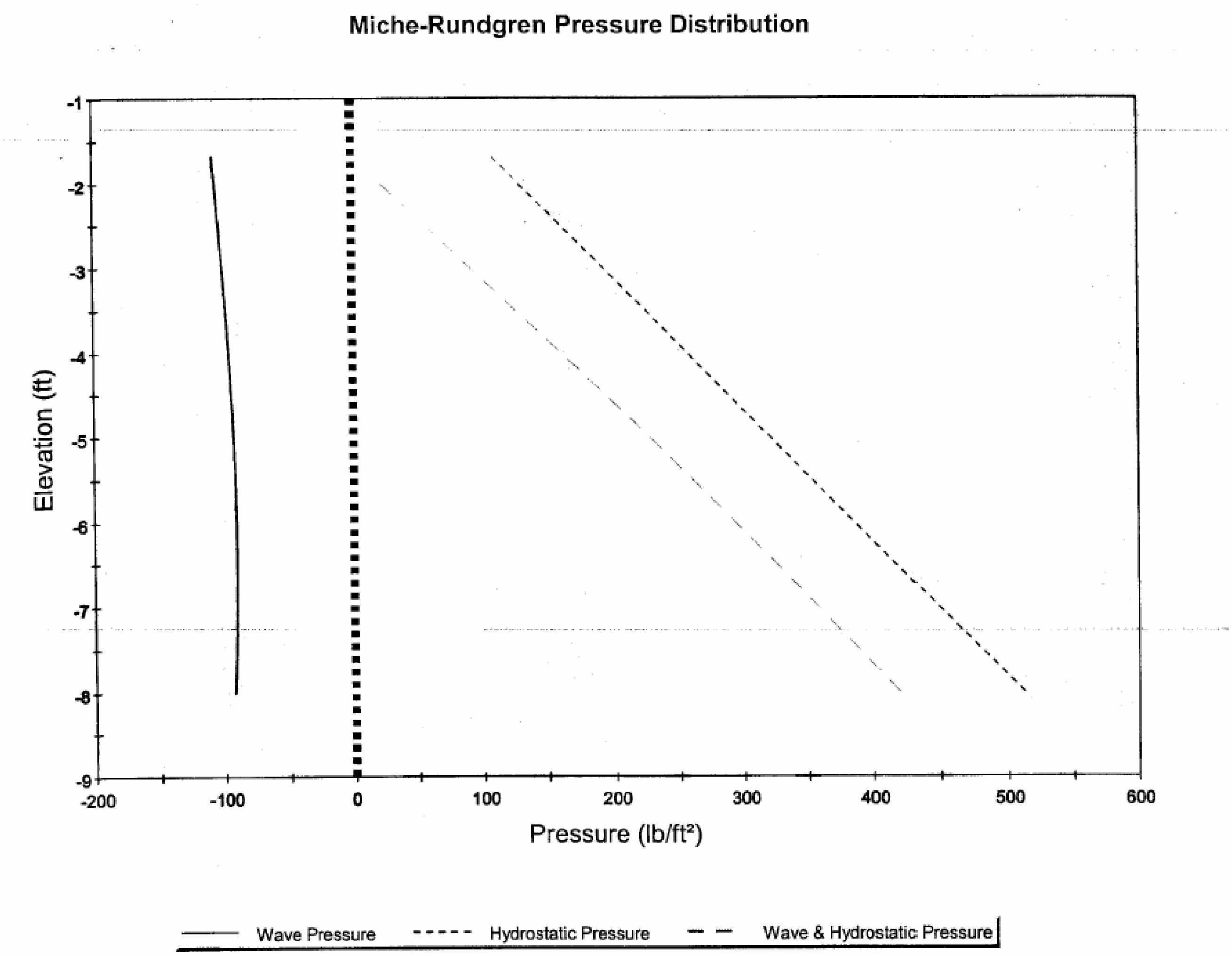
* The hydrostatic pressure, Pw, was used to determine F.S. for Overturning and Sliding.
** The Wave Resultant Force, FR, location was determined neglecting the hydrostatic force.

Appendix G

Wave Force/Pressure Distribution on Sheet pile Wall



Crest at Wall



Trough at Wall

Appendix H

Sheet Pile Wall Calculations

PO-30 LAKE BORGNE

Double Fiberglass Sheetpile Wall Design

I. Loads:

1. The wave loads are developed from the Miche-Rundgren formulation in the USACE "Shore Protection Manual" page 7-161.

II. External Stability Analyses of Soil Mass:

1. Calculation performed by RJJ. Checked Overturning and Sliding of the structure. Also, see "Assumptions" on the same page.

III. Fiberglass Sheetpile Wall Design:

1. Design calculated with the Pilebuck SPW911 v2.0 model

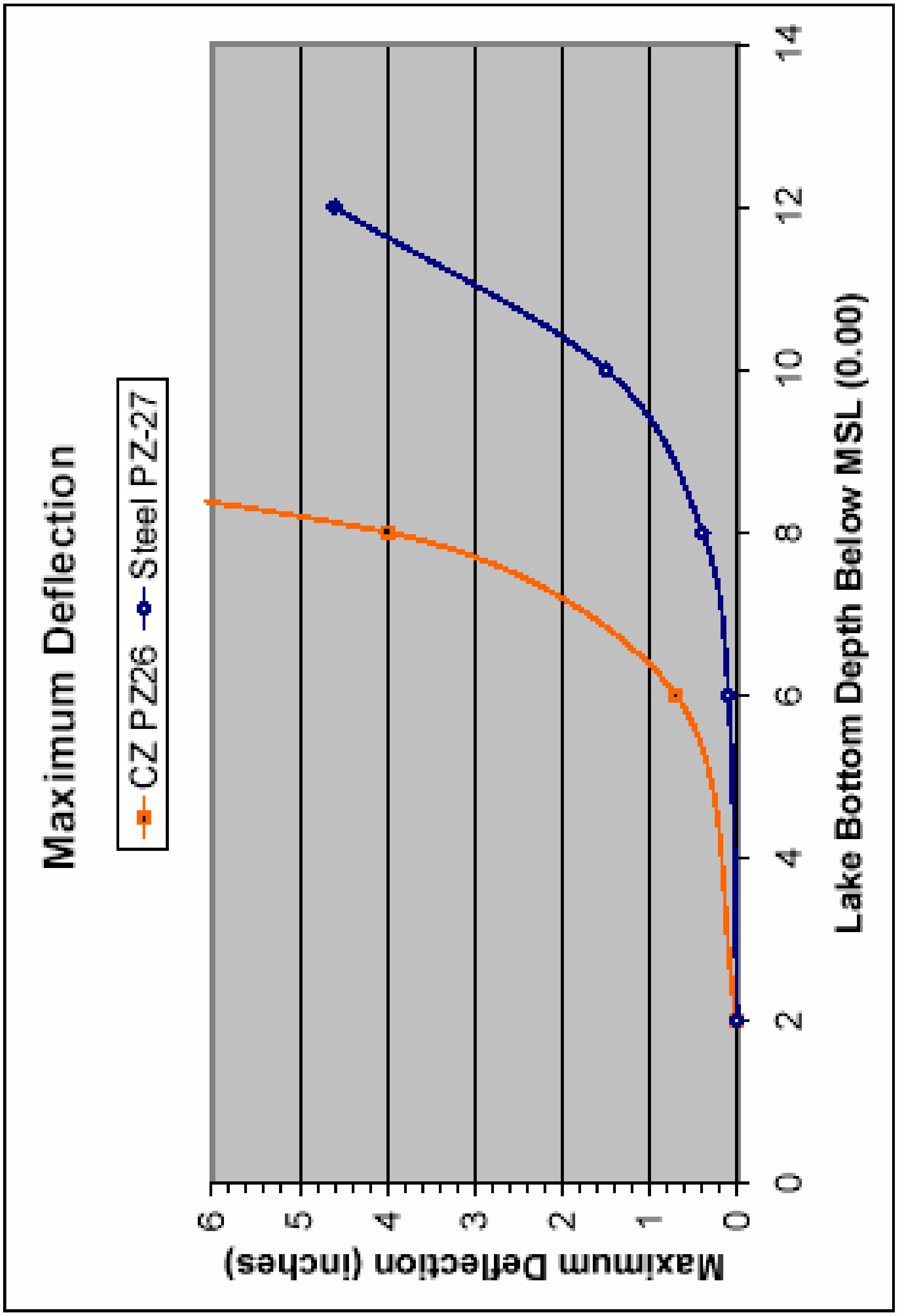
2. Assumptions:

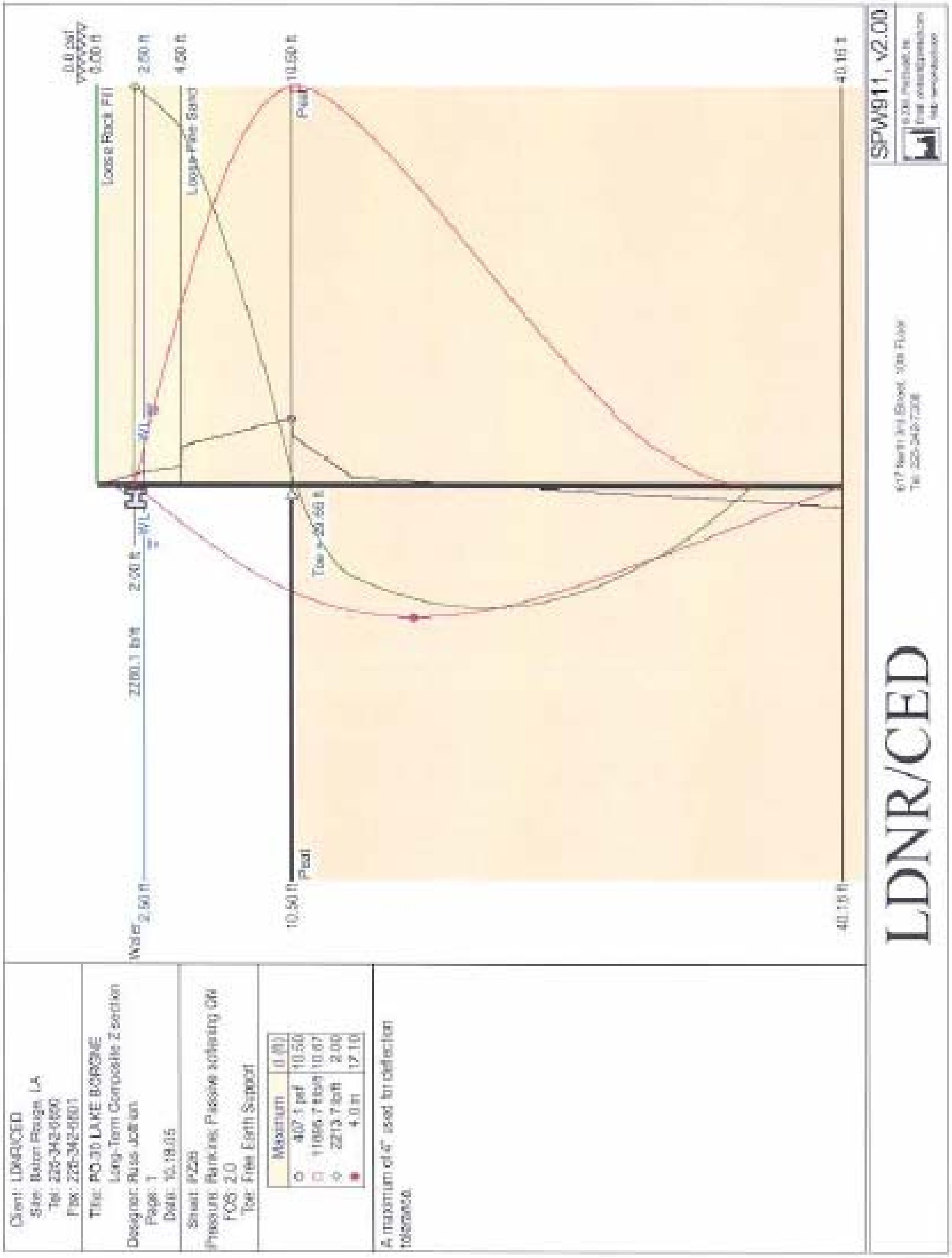
   a. Conservatively, designed the sheetpile wall structure as a single cantilever wall. Therefore, the design is not dependent on the load transfer through the soil to the second sheetpile wall.
   b. Drainage/Weep holes will be provided in the wall system. Therefore, the hydrostatic pressure, P_w, was neglected.

3. Load Cases:
   a. Soil Load with Wave Force
   b. Soil Load without Wave force
   c. Soil Load (post primary consolidation with additional rock lift) without wave force.

IV. Waler and Tie-Rod Design:

1. Use Creative Pultrusions SuperLoc Composite Sheet Pile System – Design Manual pages 20 and 21.


Maximum Deflection
CZ PZ26
Steel PZ-27
Maximum Deflection (inches)
Lake Bottom Depth Below MSL (0.00)
0
1
2
3
4
5
6
0
2
4
6
8
10
12
14


LDNR/CED
SPW911, v2.00
Loose Rock Fill
Loose Fine Sand
Peat
Water
2.50 ft
4.50 ft
10.50 ft
40.16 ft
Client: LDNR/CED
Site: Baton Rouge, LA
Title: PO-30 LAKE BORGNE
Designer: Russ Joffrion
Page: 1
Date: 10.18.05
FOS: 2.0
Toe: Free Earth Support
Maximum
A maximum of 4" used for deflection tolerance.

Client: LDNR/CED
Site: Baton Rouge, LA
Tel: 225-342-6850
Fax: 225-342-6801

Title: PO-30 LAKE BORGNE
Long-Term Composite Z section
Designer: Russ Joffrion
Page: 2
Date: 10.18.05

Sheet: PZ26
Pressure: Rankine; Passive softening On
FOS: 2.0
Toe: Free Earth Support

A maximum of 4" used for deflection tolerance.

Input Data

Depth Of Excavation = 10.50 ft
Surcharge = 0.0 psf
Depth Of Active Water = 2.50 ft
Depth Of Passive Water = 2.50 ft
Water Density = 64.00 pcf
Minimum Fluid Density = 31.82 pcf

Soil Profile

Passive Softening Depth = 3.28ft

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	φ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.50	Loose Rock Fill	135.00	62.37	0-0	0.0	35.0	14.0	0.24	0.00	5.27	0.00
4.50	Loose Fine Sand	130.00	58.00	0-0	0.0	17.0	11.0	0.51	0.00	2.49	0.00
10.50	Peat	81.46	19.09	105-0	540.0	5.0	0.0	0.84	1.83	1.19	2.18

Solution

Sheet

Sheet Name	I (in⁴/ft)	E (psi)	Z (in³/ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)
PZ26	182.40	2.9E+06	28.08	12500.0	27113.5	0.00	39.66	40.16

Load Model: Area Distribution

Supports

Depth (ft)	Type	Linear Load (lb/ft)
2.00	Water	2280.1

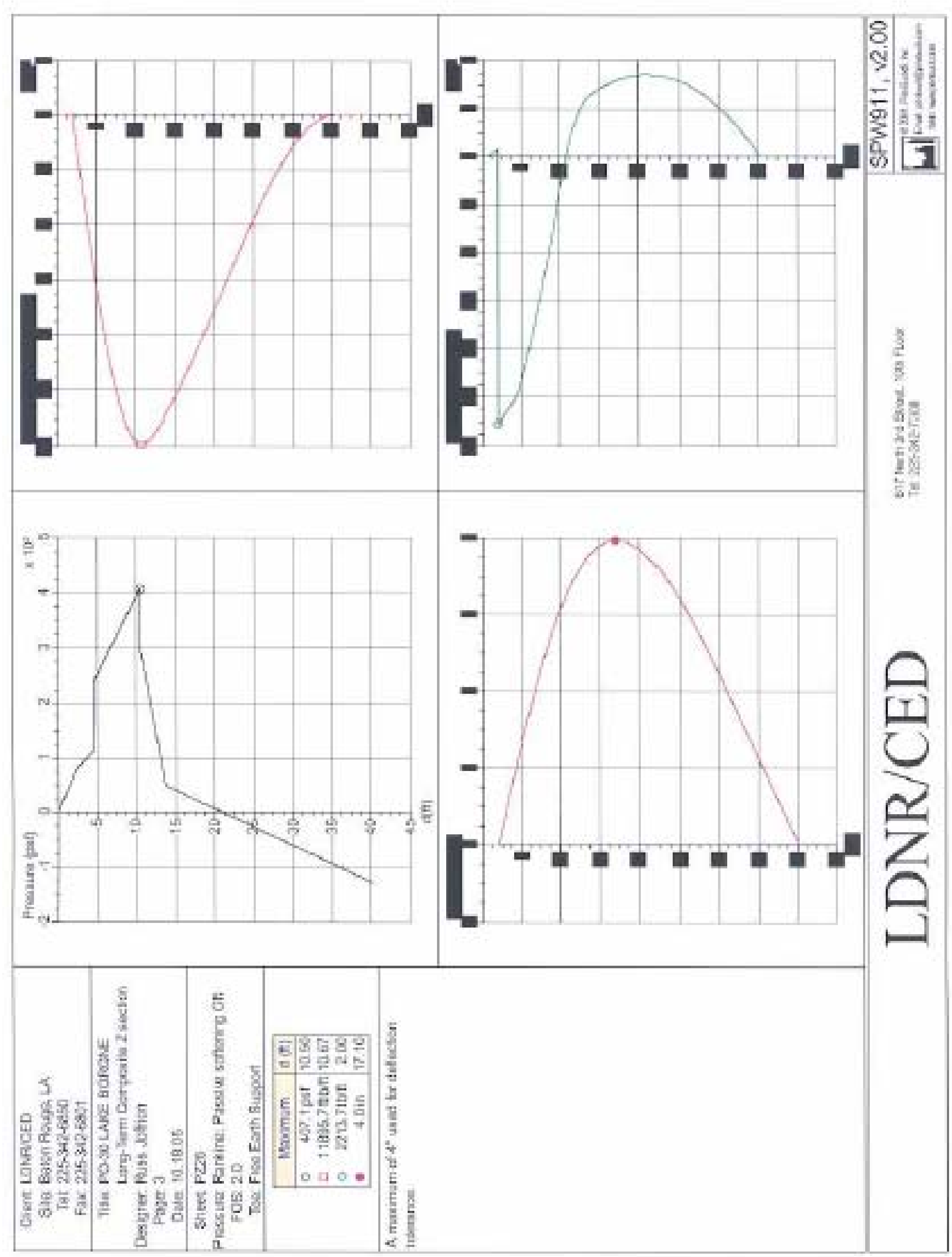
Maxima

	Maximum	Depth
Bending Moment	11806.7 ftlb/ft	10.67 ft
Deflection	4.0 in	17.10 ft
Pressure	407.1 psf	10.50 ft
Shear Force	2213.7 lb/ft	2.00 ft

LDNR/CED

617 North 3rd Street, 10th Floor
Tel: 225-342-7308

SPW911, v2.00


LDNR/CED
SPW911, v2.00

Client: LDNR/CED
Site: Baton Rouge, LA
Tel: 225-342-6850
Fax: 225-342-6801

Title: PO-30 LAKE BORGNE
Long-Term Composite Z section
Designer: Russ Joffrion
Page: 4
Date: 10.18.05

Sheet: PZ26
Pressure: Rankine; Passive softening ON
FOS: 2.0
Toe: Free Earth Support

A maximum of 4" used for deflection tolerance.

depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
0.00	0.0	0.0	0.0	0.0	13.50	68.4	-11051.5	3.8	495.9	27.01	-40.2	-2606.6	2.8	563.2
0.36	11.9	0.3	0.0	2.4	13.86	47.6	-10867.4	3.8	515.9	27.36	-42.5	-2423.1	2.8	549.4
0.71	23.9	2.4	0.0	9.1	14.21	45.4	-10694.0	3.8	531.5	27.72	-44.9	-2226.6	2.7	533.2
1.07	34.7	7.2	0.0	19.1	14.57	42.5	-10497.5	3.9	547.7	28.07	-47.2	-2053.1	2.6	517.6
1.42	46.6	17.2	0.0	34.3	14.93	40.5	-10295.3	3.9	563.0	28.43	-49.6	-1868.4	2.5	499.9
1.78	58.5	33.6	0.0	53.8	15.28	38.3	-10106.6	3.9	576.1	28.78	-52.1	-1690.3	2.5	481.2
2.13	69.4	-326.0	0.1	-2204.8	15.64	35.8	-9894.6	3.9	589.7	29.14	-54.3	-1534.5	2.4	463.3
2.49	81.0	-1132.0	0.2	-2176.7	15.99	33.6	-9697.6	3.9	601.3	29.49	-56.8	-1376.1	2.3	442.9
2.84	86.2	-1855.3	0.4	-2146.6	16.35	31.1	-9476.6	4.0	613.1	29.85	-59.2	-1213.3	2.2	421.5
3.20	91.7	-2626.7	0.5	-2115.8	16.70	28.8	-9251.5	4.0	624.1	30.21	-61.5	-1077.6	2.2	401.2
3.55	97.2	-3411.5	0.7	-2081.0	17.06	26.4	-9043.5	4.0	633.3	30.56	-63.9	-936.3	2.1	378.1
3.91	102.2	-4101.8	0.9	-2047.5	17.41	23.9	-8811.4	4.0	642.5	30.92	-66.2	-815.3	2.0	355.3
4.26	107.7	-4847.7	1.0	-2008.8	17.77	21.7	-8587.6	4.0	650.1	31.27	-68.6	-690.6	1.9	331.5
4.62	240.1	-5577.5	1.2	-1951.2	18.12	19.2	-8359.6	3.9	657.6	31.63	-71.1	-575.2	1.9	305.7
4.98	249.6	-6215.5	1.3	-1869.1	18.48	16.8	-8116.4	3.9	664.2	31.98	-73.3	-478.5	1.8	281.5
5.33	260.1	-6884.8	1.5	-1775.1	18.83	14.6	-7898.5	3.9	669.4	32.34	-75.6	-381.6	1.7	254.0
5.69	269.7	-7462.5	1.6	-1686.3	19.19	12.1	-7654.5	3.9	674.2	32.69	-78.0	-302.3	1.6	228.3
6.04	280.2	-8060.0	1.8	-1584.9	19.54	9.6	-7408.0	3.9	678.2	33.05	-80.5	-228.1	1.5	199.1
6.40	290.7	-8625.4	1.9	-1476.7	19.90	7.4	-7183.6	3.9	681.0	33.40	-82.9	-158.6	1.5	168.9
6.75	300.3	-9102.4	2.0	-1380.6	20.26	4.9	-6935.6	3.8	683.2	33.76	-85.2	-107.9	1.4	140.8
7.11	310.8	-9588.1	2.2	-1298.0	20.61	2.7	-6709.7	3.8	684.6	34.11	-87.6	-63.0	1.3	108.9
7.46	321.3	-10031.6	2.3	-1151.5	20.97	0.2	-6460.7	3.8	685.0	34.47	-90.1	-29.9	1.2	75.2
7.82	330.9	-10306.0	2.4	-1042.2	21.32	-2.2	-6211.7	3.7	684.6	34.83	-92.3	-10.2	1.2	45.6
8.17	341.4	-10756.8	2.6	-918.3	21.68	-4.5	-5985.6	3.7	683.4	35.18	-94.8	-0.4	1.1	11.2
8.53	350.9	-11041.8	2.7	-802.3	22.03	-6.9	-5737.6	3.6	681.3	35.54	-97.0	0.0	1.0	0.0
8.88	361.4	-11310.9	2.8	-671.1	22.39	-9.4	-5490.4	3.6	678.3	35.89	-99.5	0.0	0.9	0.0
9.24	372.0	-11530.9	2.9	-535.9	22.74	-11.6	-5266.6	3.5	674.7	36.25	-101.9	0.0	0.8	0.0
9.59	381.5	-11687.1	3.0	-400.7	23.10	-14.1	-5022.6	3.5	669.6	36.60	-104.2	0.0	0.8	0.0
9.95	392.0	-11808.4	3.1	-267.1	23.45	-16.3	-4801.6	3.4	664.8	36.96	-106.6	0.0	0.7	0.0
10.31	401.6	-11874.4	3.2	-134.2	23.81	-18.8	-4561.5	3.4	658.3	37.31	-109.1	0.0	0.6	0.0
10.66	385.6	-11898.7	3.2	-4.1	24.16	-21.2	-4323.6	3.3	650.9	37.67	-111.3	0.0	0.5	0.0
11.02	257.7	-11877.2	3.3	95.4	24.52	-23.5	-4109.6	3.3	643.4	38.02	-113.8	0.0	0.5	0.0
11.37	232.1	-11830.6	3.4	176.9	24.88	-25.9	-3877.6	3.2	634.3	38.38	-116.0	0.0	0.4	0.0
11.73	203.9	-11750.1	3.5	256.7	25.23	-28.2	-3669.6	3.2	625.2	38.73	-118.5	0.0	0.3	0.0
12.08	175.6	-11642.7	3.5	326.1	25.59	-30.6	-3444.4	3.1	614.3	39.09	-120.9	0.0	0.2	0.0
12.44	150.2	-11524.8	3.6	380.2	25.94	-33.1	-3223.4	3.0	603.6	39.44	-123.2	0.0	0.1	0.0
12.79	122.1	-11376.4	3.7	429.9	26.30	-35.3	-3026.3	3.0	591.1	39.80	-125.6	0.0	0.1	0.0
13.15	96.5	-11227.6	3.7	466.0	26.65	-37.8	-2814.0	2.9	577.6	40.16	-127.9	0.0	0.0	0.0

LDNR/CED

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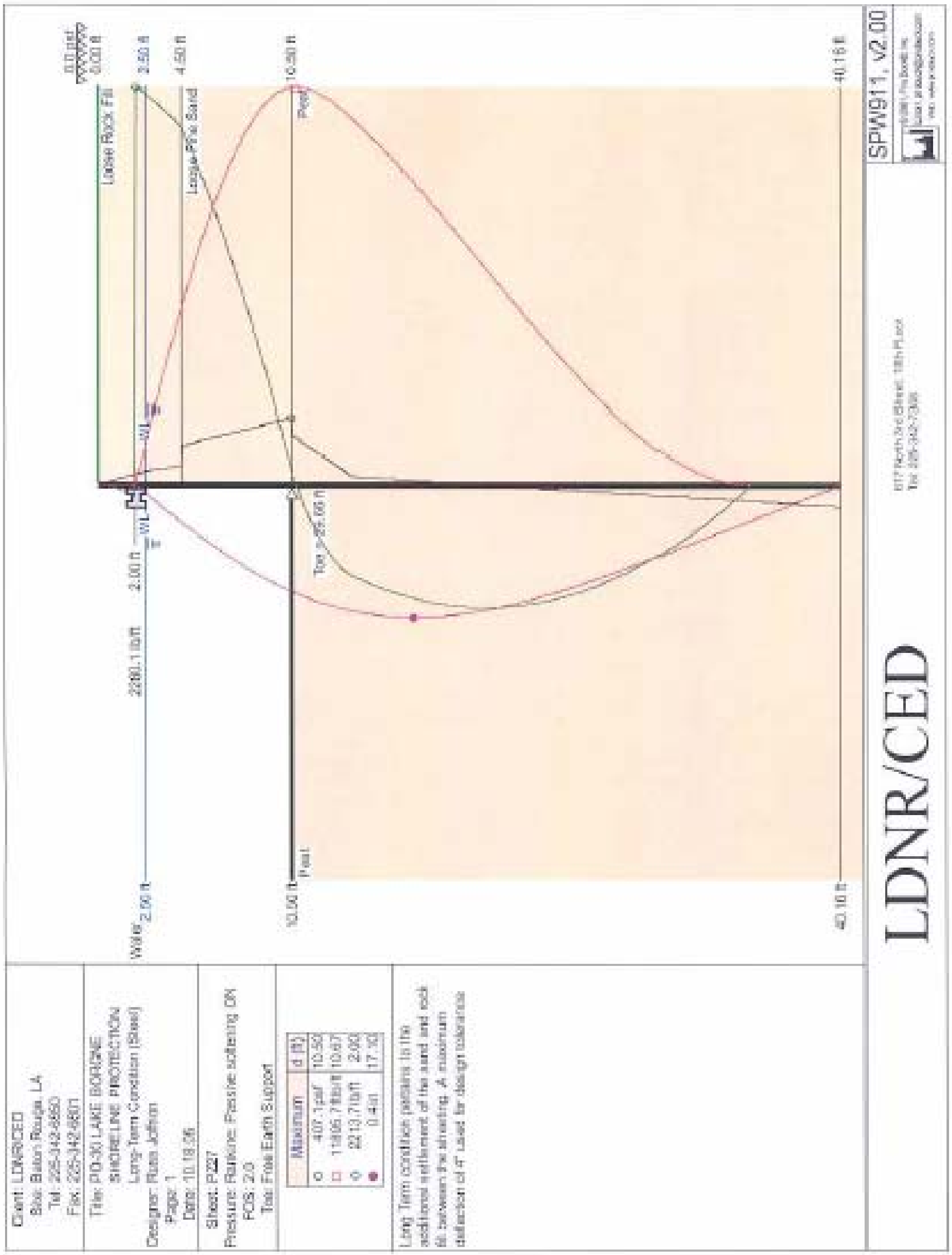
SPW911, v2.00


LDNR/CED
SPW911, v2.00

Client: LDNR/CED
Site: Baton Rouge, LA
Tel: 225-342-6850
Fax: 225-342-6801

Title: PO-30 LAKE BORGNE SHORELINE PROTECTION
Long-Term Condition (Steel)
Designer: Russ Joffrion
Page: 2
Date: 10.18.05

Sheet: PZ27
Pressure: Rankine: Passive softening On
FOS: 2.0
Toe: Free Earth Support

Long Term condition pertains to the additional settlement of the sand and rock fill between the sheeting. A maximum deflection of 4" used for design tolerance.

Input Data

Depth Of Excavation = 10.50 ft
Surcharge = 0.0 psf
Depth Of Active Water = 2.50 ft
Depth Of Passive Water = 2.50 ft
Water Density = 64.00 pcf
Minimum Fluid Density = 31.82 pcf

Soil Profile

Passive Softening Depth = 3.28ft

Depth (ft)	Soil Name	γ(pcf)	γ'(pcf)	C (psf)	C_a (psf)	φ(°)	δ(°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Loose Rock Fill	135.00	62.37	0.0	0.0	36.0	14.0	0.24	0.00	5.27	0.00
4.50	Loose Fine Sand	120.00	56.00	0.0	0.0	17.0	11.0	0.61	0.00	2.49	0.00
10.50	Peat	81.46	19.05	105.0	50.0	5.0	0.0	0.84	1.83	1.19	2.18

Solution

Sheet

Sheet Name	I (in⁴/ft)	E (psi)	Z (in³/ft)	f (psi)	Maximum Bending Moment (lb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)
PZ27	184.20	3.04E+07	30.20	25000.0	62841.7	0.00	29.66	40.16

Load Model: Axis Distribution

Supports

Depth (ft)	Type	Linear Load (lb/ft)
2.00	Water	2260.1

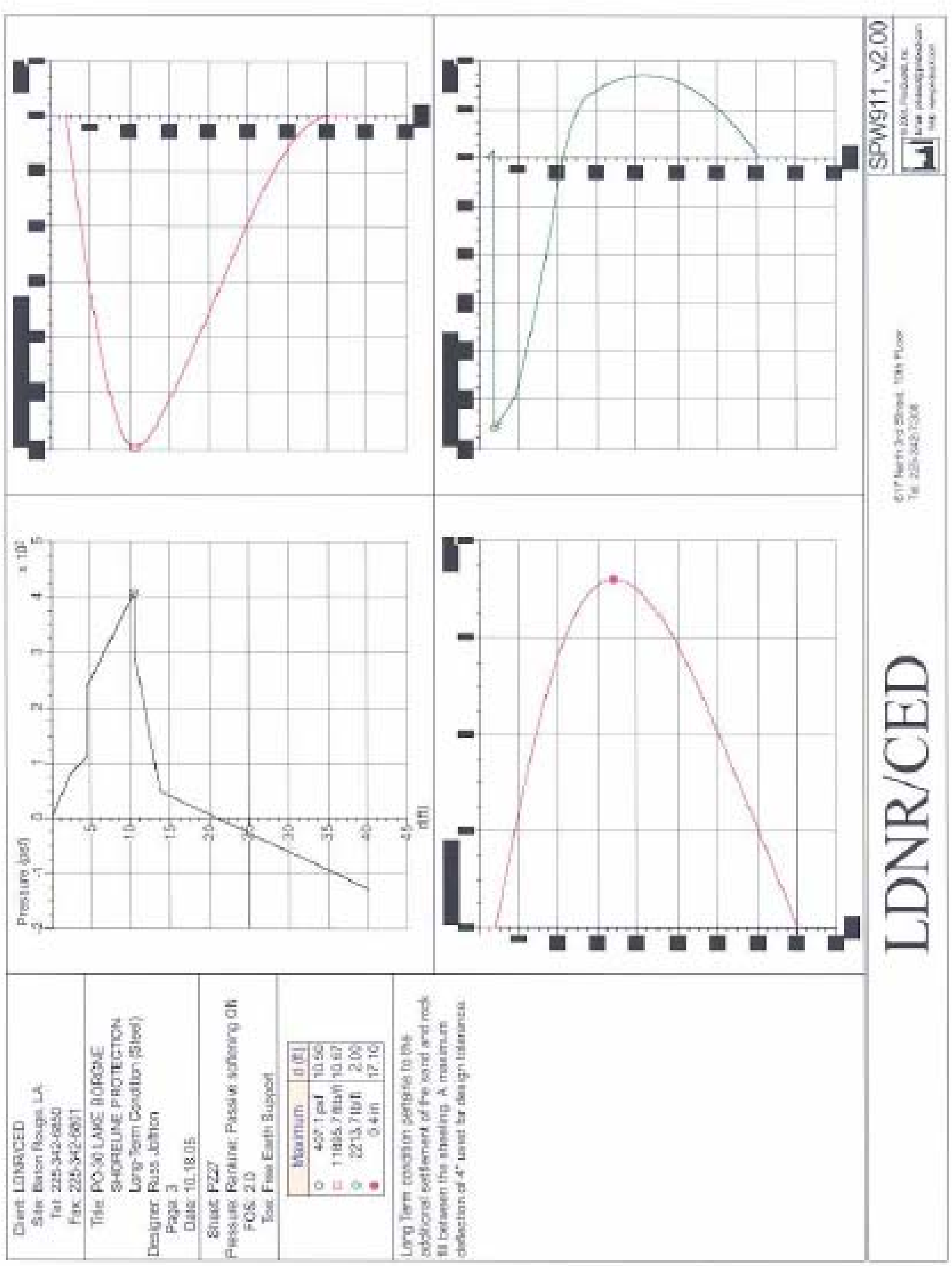
Maxima

	Maximum	Depth
Bending Moment	11806.7 ftlb/ft	10.67 ft
Deflection	0.4in	17.10 ft
Pressure	407.1 psf	10.50 ft
Shear Force	2213.7 lb/ft	2.00 ft

LDNR/CED

617 North 3rd Street, 10th Floor
Tel: 225-342-7308

SPW911, v2.00


LDNR/CED
SPW911, v2.00

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Title: PO-30 LAKE BORGNE SHORELINE PROTECTION
Long-Term Condition (Steel)
Designer: Russ Joffrion
Page: 4
Date: 10.18.05

Sheet: PZ27
Pressure: Rankine: Passive softening ON
FOS: 2.0
Toe: Free Earth Support

Long Term condition pertains to the additional settlement of the sand and rock fill between the sheeting. A maximum deflection of 4" used for design tolerance.

depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
0.00	0.0	0.0	0.0	0.0	13.50	98.4	-11051.0	0.3	495.9	27.01	-40.2	-2606.8	0.3	563.2
0.36	11.9	0.3	0.0	2.4	13.86	47.6	-10867.4	0.3	515.9	27.36	-42.6	-2423.1	0.3	549.4
0.71	23.9	2.4	0.0	9.1	14.21	45.4	-10684.0	0.3	531.5	27.72	-44.9	-2226.6	0.2	533.2
1.07	34.7	7.2	0.0	19.1	14.57	42.9	-10497.5	0.4	547.7	28.07	-47.2	-2053.1	0.2	517.8
1.42	46.6	17.2	0.0	34.3	14.93	40.6	-10295.3	0.4	563.0	28.43	-49.6	-1868.4	0.2	499.9
1.78	58.5	33.6	0.0	53.8	15.28	38.3	-10106.6	0.4	576.1	28.78	-52.1	-1690.3	0.2	481.2
2.13	69.4	-326.0	0.0	-2204.6	15.64	35.8	-9894.6	0.4	589.7	29.14	-54.3	-1534.5	0.2	463.3
2.49	81.0	-1132.0	0.0	-2176.7	15.99	33.6	-9697.6	0.4	601.3	29.49	-56.6	-1370.1	0.2	442.9
2.84	86.2	-1865.3	0.0	-2148.6	16.35	31.1	-9476.0	0.4	613.1	29.85	-59.2	-1213.3	0.2	421.5
3.20	91.7	-2639.7	0.0	-2115.8	16.70	28.6	-9251.0	0.4	624.1	30.21	-61.5	-1077.6	0.2	401.2
3.55	97.2	-3411.5	0.1	-2081.0	17.06	26.4	-9043.0	0.4	633.3	30.56	-63.9	-936.3	0.2	378.1
3.91	102.2	-4101.8	0.1	-2047.5	17.41	23.9	-8811.4	0.4	642.5	30.92	-66.2	-816.3	0.2	356.3
4.26	107.7	-4847.7	0.1	-2008.8	17.77	21.7	-8597.6	0.4	650.1	31.27	-68.6	-690.6	0.2	331.5
4.62	240.1	-5577.6	0.1	-1951.2	18.12	19.2	-8369.6	-0.4	657.6	31.63	-71.1	-576.2	0.2	305.7
4.98	249.6	-6215.5	0.1	-1889.1	18.48	16.8	-8110.4	-0.4	664.2	31.98	-73.3	-478.5	0.2	281.5
5.33	260.1	-6884.8	0.1	-1776.1	18.83	14.6	-7888.0	-0.4	668.4	32.34	-75.8	-381.6	0.2	254.0
5.69	269.7	-7462.5	0.1	-1686.3	19.19	12.1	-7654.5	-0.4	674.2	32.69	-78.0	-302.3	0.1	228.3
6.04	280.2	-8063.0	0.2	-1584.9	19.54	9.6	-7408.6	-0.4	678.2	33.05	-80.5	-226.1	0.1	199.1
6.40	290.7	-8626.4	0.2	-1479.7	19.90	7.4	-7183.6	-0.4	681.0	33.40	-82.9	-158.6	0.1	168.9
6.75	300.3	-9102.4	0.2	-1380.6	20.26	4.9	-6935.6	-0.3	683.2	33.76	-85.2	-107.5	0.1	140.8
7.11	310.8	-9588.1	0.2	-1268.0	20.61	2.7	-6709.7	-0.3	684.5	34.11	-87.6	-63.0	0.1	108.9
7.46	321.3	-10051.6	0.2	-1151.5	20.97	0.2	-6460.7	-0.3	685.0	34.47	-90.1	-29.9	0.1	76.2
7.82	330.9	-10396.9	0.2	-1042.2	21.32	-2.2	-6211.7	-0.3	684.6	34.83	-92.3	-10.2	0.1	45.6
8.17	341.4	-10756.8	0.2	-918.3	21.68	-4.5	-5985.6	-0.3	683.4	35.18	-94.8	-0.4	0.1	11.2
8.53	350.9	-11041.8	0.2	-802.3	22.03	-6.9	-5737.6	-0.3	681.3	35.54	-97.0	0.0	0.1	0.0
8.88	361.4	-11310.9	0.3	-671.1	22.39	-9.4	-5490.4	-0.3	678.3	35.89	-99.5	0.0	0.1	0.0
9.24	372.0	-11530.9	0.3	-535.9	22.74	-11.8	-5268.0	-0.3	674.7	36.25	-101.9	0.0	0.1	0.0
9.59	381.5	-11687.1	0.3	-409.7	23.10	-14.1	-5022.6	-0.3	669.9	36.60	-104.2	0.0	0.1	0.0
9.95	392.0	-11808.4	0.3	-267.1	23.45	-16.3	-4801.6	-0.3	664.8	36.96	-106.6	0.0	0.1	0.0
10.31	401.6	-11874.4	0.3	-134.2	23.81	-18.8	-4561.5	-0.3	658.3	37.31	-109.1	0.0	0.1	0.0
10.66	286.8	-11896.7	0.3	-4.1	24.16	-21.2	-4323.6	-0.3	650.9	37.67	-111.3	0.0	0.0	0.0
11.02	257.7	-11877.2	0.3	85.4	24.52	-23.5	-4109.6	-0.3	643.4	38.02	-113.8	0.0	0.0	0.0
11.37	232.1	-11830.6	0.3	176.9	24.88	-25.9	-3877.6	-0.3	634.3	38.38	-116.0	0.0	0.0	0.0
11.73	203.8	-11750.1	0.3	256.7	25.23	-28.2	-3669.6	-0.3	625.2	38.73	-118.5	0.0	0.0	0.0
12.08	175.8	-11642.7	0.3	326.1	25.59	-30.6	-3444.4	-0.3	614.3	39.09	-120.9	0.0	0.0	0.0
12.44	150.2	-11524.8	0.3	380.2	25.94	-33.1	-3223.4	-0.3	602.6	39.44	-123.2	0.0	0.0	0.0
12.79	122.1	-11376.4	0.3	429.9	26.30	-35.3	-3026.3	-0.3	591.1	39.80	-125.6	0.0	0.0	0.0
13.15	96.5	-11227.0	0.3	465.0	26.65	-37.8	-2814.0	-0.3	577.6	40.16	-127.9	0.0	0.0	0.0

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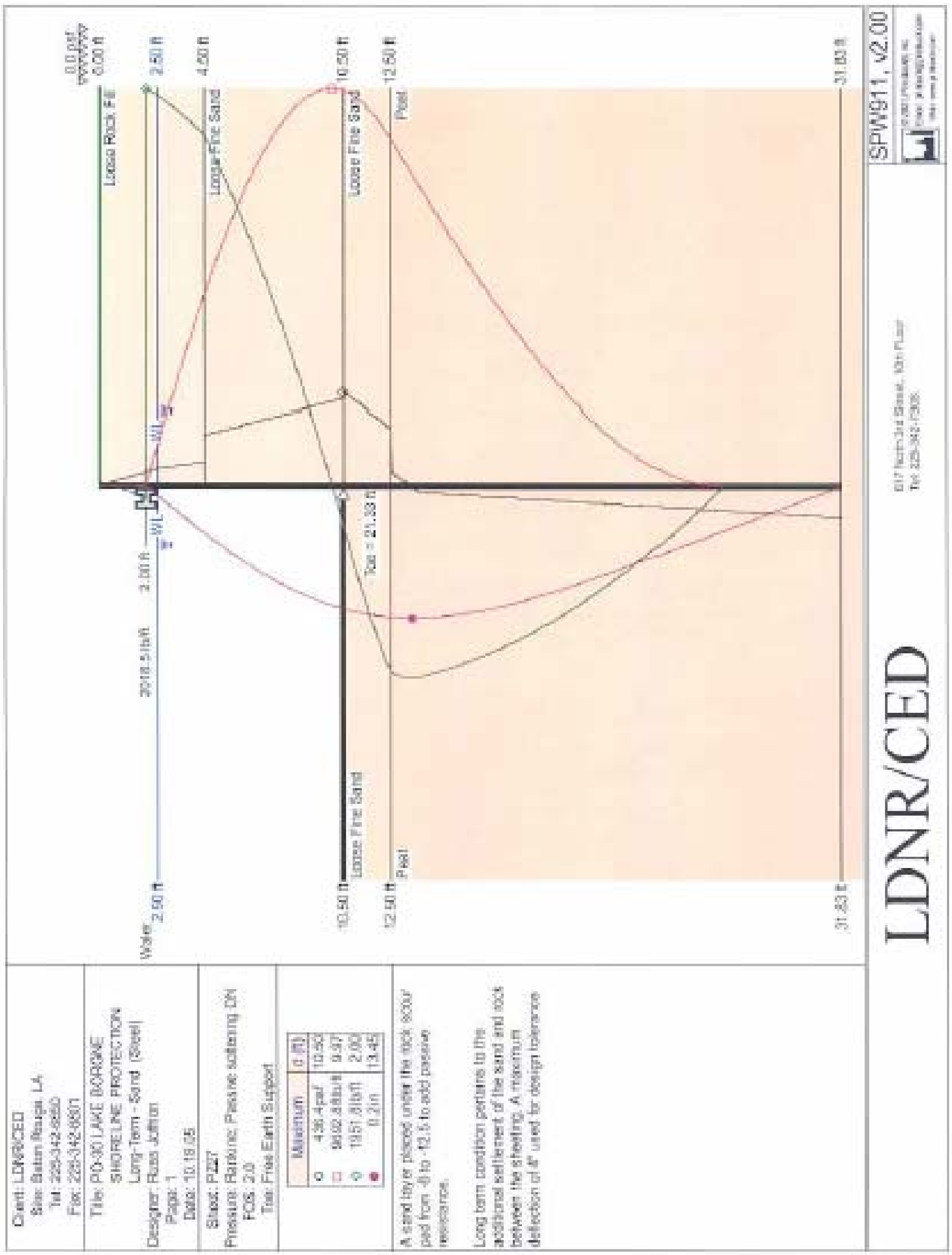
SPW911, v2.00


Loose Rock Fill
Loose Fine Sand
Loose Fine Sand
Peat
Loose Fine Sand
Peat
0.0 psf
0.00 ft
2.50 ft
4.50 ft
10.50 ft
12.50 ft
31.83 ft
Water
2.50 ft
10.50 ft
12.50 ft
31.83 ft
Toe = 21.33 ft
SPW911, v2.00
LDNR/CED
Client: LDNR/CED
Site: Baton Rouge, LA
Title: PO-30 LAKE BORGNE
SHORELINE PROTECTION
Long-Term - Sand (Steel)
Designer: Ross Jolfton
Page: 1
Date: 10.18.05
Sheet: PZ27
FOS: 2.0
Toe: Free Earth Support
Maximum
10.50
9.97
2.00
13.45
A sand layer placed under the rock scour pad from -8 to -12.5 to add passive resistance.
Long term condition pertains to the additional settlement of the sand and rock between the sheeting. A maximum deflection of 4" used for design tolerance.

Client: LDNR/CED
Site: Baton Rouge, LA
Tel: 225-342-6850
Fax: 225-342-6801

Title: PO-30 LAKE BORGNE SHORELINE PROTECTION Long-Term - Sand (Steel)
Designer: Russ Joffrion
Page: 2
Date: 10.18.05

Sheet: PZ27
Pressure: Rankine; Passive softening ON
FOS: 2.0
Toe: Free Earth Support

A sand layer placed under the rock scour pad from -8 to -12.5 to add passive resistance.

Long term condition pertains to the additional settlement of the sand and rock between the sheeting. A maximum deflection of 4" used for design tolerance.

Input Data

Depth Of Excavation = 10.50 ft
Surcharge = 0.0 psf
Depth Of Active Water = 2.50 ft
Depth Of Passive Water = 2.50 ft
Water Density = 64.00 pcf
Minimum Fluid Density = 31.82 pcf

Soil Profile

Passive Softening Depth = 3.28ft

Depth (ft)	Soil Name	γ(pcf)	γ'(pcf)	C (psf)	C_a (psf)	φ(°)	δ(°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Loose Rock Fill	135.00	62.37	0.0	0.0	35.0	14.0	0.24	0.00	5.27	0.00
4.50	Loose Fine Sand	120.00	58.00	0.0	0.0	17.0	11.0	0.51	0.00	2.48	0.00
10.50	Loose Fine Sand	109.20	65.55	0.0	0.0	17.0	0.0	0.55	0.00	1.83	0.00
12.50	Peat	81.46	19.06	105.0	50.0	5.0	0.0	0.84	1.83	1.19	2.18

Solution

Sheet

Sheet Name	I (in^4/ft)	E (psi)	Z (in^3/ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)
PZ27	184.20	3.04E+07	30.20	25000.0	62841.7	0.00	21.33	31.83

Load Model: Area Distribution

Supports

Depth (ft)	Type	Linear Load (lb/ft)
2.00	Water	2015.5

Maxima

	Maximum	Depth
Bending Moment	9692.6ftlb/ft	9.97 ft
Deflection	0.2 in	13.45 ft
Pressure	436.4 psf	10.50 ft
Shear Force	1951.6lb/ft	2.00 ft

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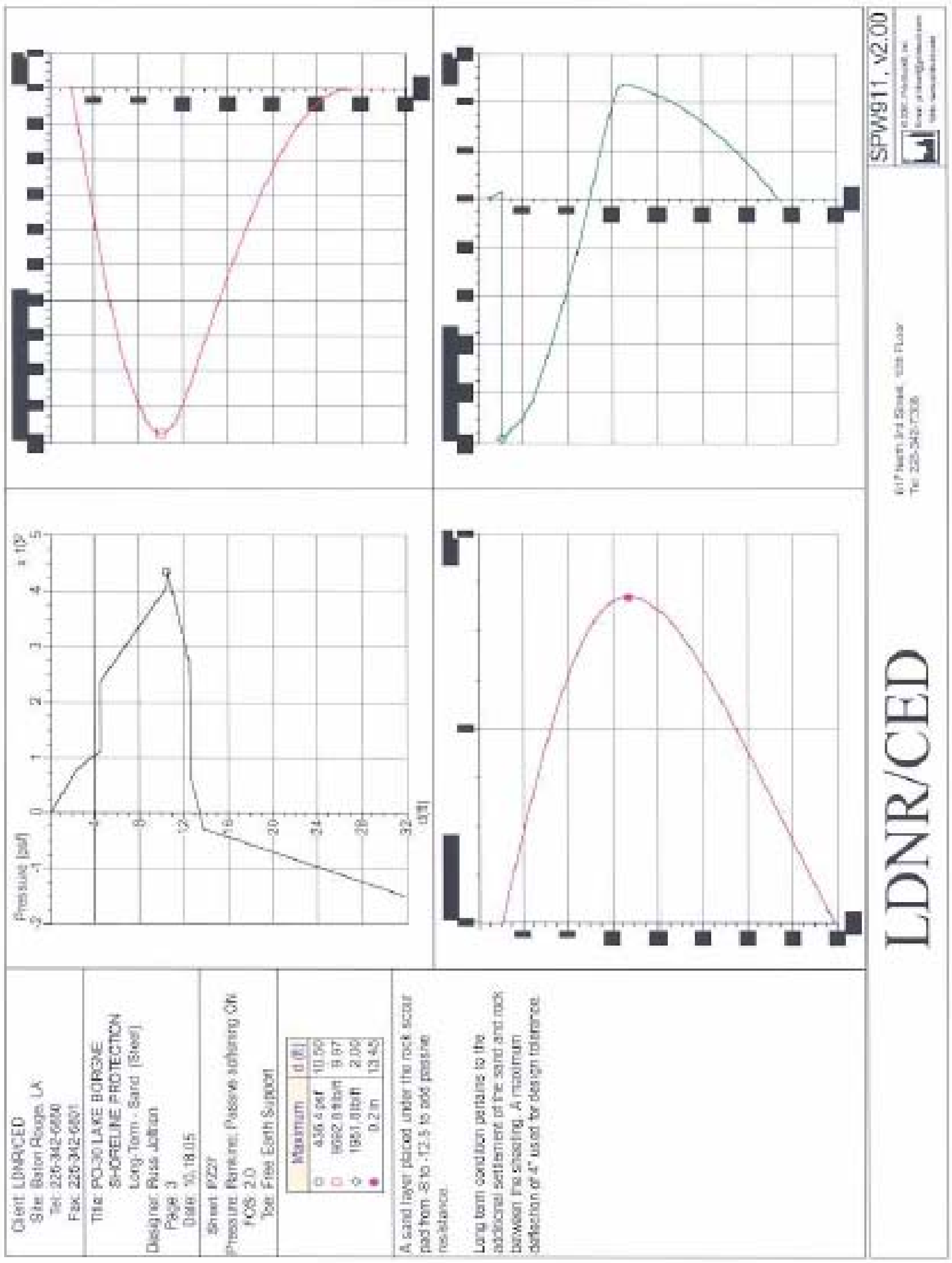
SPW911, v2.00


Client: LDNR/CED
Site: Baton Rouge, LA
Tel: 225-342-6880
Fax: 225-342-6801
Title: PO-30 LAKE BORGNE SHORELINE PROTECTION
Long-Term - Sand (Steel)
Designer: Russ Joffrion
Page: 3
Date: 10.18.05
Pressure: Rankine; Passive softening ON
FOS: 2.0
Toe: Free Earth Support
A sand layer placed under the rock scour pad from -8 to -12.5 to add passive resistance.
Long term condition pertains to the additional settlement of the sand and rock between the sheeting. A maximum deflection of 4" used for design tolerance.
Pressure (psf)
LDNR/CED
SPW911, v2.00

Client: LDNR/CED
Site: Baton Rouge, LA
Tel: 225-342-6850
Fax: 225-342-6801

Title: PO-30 LAKE BORGNE SHORELINE PROTECTION
Long-Term - Sand (Steel)
Designer: Russ Joffrion
Page: 4
Date: 10.18.05

Sheet: PZ27
Pressure: Rankine; Passive softening Off
FOS: 2.0
Toe: Free Earth Support

A sand layer placed under the rock scour pad from -8 to -12.5 to add passive resistance.

Long term condition pertains to the additional settlement of the sand and rock between the sheeting. A maximum deflection of 4" used for design tolerance.

depth (ft)	P (psf)	M (ft-lb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ft-lb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ft-lb/ft)	D (in)	F (lb/ft)
0.00	0.0	0.0	0.0	0.0	10.71	420.8	-9582.2	0.2	296.8	21.41	-80.1	-1465.8	0.1	524.2
0.28	9.5	0.2	0.0	1.5	10.99	396.3	-9477.0	0.2	417.7	21.69	-81.9	-1331.1	0.1	502.6
0.56	18.9	1.2	0.0	6.7	11.27	374.0	-9352.3	0.2	519.6	21.97	-83.8	-1189.5	0.1	478.4
0.85	27.5	3.6	0.0	12.0	11.55	345.6	-9185.2	0.2	624.8	22.26	-85.6	-1067.0	0.1	455.9
1.13	37.0	8.6	0.0	21.5	11.83	325.1	-8988.0	0.2	722.9	22.54	-87.6	-939.1	0.1	430.7
1.41	46.4	16.7	0.0	33.8	12.11	302.8	-8786.7	0.2	805.9	22.82	-89.5	-818.6	0.1	404.8
1.69	56.0	27.6	0.0	47.4	12.40	278.3	-8640.2	0.2	880.4	23.10	-91.3	-716.6	0.1	380.8
1.97	64.5	44.2	0.0	65.0	12.68	55.1	-8298.7	0.2	929.0	23.38	-93.2	-609.7	0.1	353.8
2.25	73.1	-471.4	0.0	-1935.2	12.96	32.8	-8027.5	0.2	941.5	23.66	-95.2	-511.7	0.1	326.3
2.54	81.7	-1032.6	0.0	-1912.4	13.24	10.5	-7754.6	0.2	947.6	23.95	-97.0	-429.5	0.1	300.8
2.82	86.1	-1586.7	0.0	-1887.9	13.52	-9.8	-7505.2	0.2	947.4	24.23	-98.9	-347.1	0.1	272.2
3.10	90.0	-2064.2	0.0	-1864.4	13.80	-29.2	-7232.1	0.2	941.1	24.51	-100.7	-279.4	0.1	245.7
3.38	94.4	-2524.0	0.0	-1837.5	14.08	-31.0	-6985.6	0.2	933.1	24.79	-102.6	-213.0	0.1	216.0
3.66	98.8	-3156.7	0.0	-1809.2	14.37	-33.0	-6717.4	0.2	923.7	25.07	-104.6	-155.2	0.1	185.8
3.94	102.7	-3631.8	0.0	-1782.5	14.65	-34.9	-6451.6	0.2	913.8	25.36	-106.3	-110.4	0.1	157.8
4.23	107.1	-4147.1	0.1	-1751.8	14.93	-36.7	-6212.6	0.2	904.3	25.64	-108.3	-69.7	0.1	126.4
4.51	110.5	-4607.6	0.1	-1722.8	15.21	-38.6	-5953.1	0.2	893.3	25.92	-110.1	-40.7	0.1	97.5
4.79	244.4	-6099.2	0.1	-1652.6	15.49	-40.6	-5696.6	0.2	881.7	26.20	-112.0	-17.6	0.1	65.0
5.07	252.7	-6569.9	0.1	-1580.9	15.78	-42.4	-5466.4	0.2	870.7	26.48	-114.0	-4.0	0.1	32.0
5.36	260.3	-5979.2	0.1	-1511.8	16.06	-44.3	-5216.5	0.2	858.0	26.76	-115.7	0.0	0.1	0.0
5.63	268.6	-6408.1	0.1	-1434.6	16.34	-46.1	-4992.7	0.2	846.0	27.04	-117.7	0.0	0.1	0.0
5.92	276.5	-6814.1	0.1	-1364.9	16.62	-48.0	-4750.2	0.2	832.2	27.33	-119.6	0.0	0.1	0.0
6.20	284.5	-7162.7	0.1	-1280.3	16.90	-50.0	-4511.7	0.2	817.9	27.61	-121.4	0.0	0.0	0.0
6.48	292.5	-7522.9	0.1	-1195.9	17.18	-51.8	-4298.7	0.2	804.4	27.89	-123.4	0.0	0.0	0.0
6.76	300.4	-7828.7	0.1	-1117.1	17.47	-53.7	-4066.4	0.2	789.0	28.17	-125.1	0.0	0.0	0.0
7.04	308.8	-8140.6	0.1	-1028.1	17.75	-55.7	-3842.6	0.2	773.0	28.45	-127.1	0.0	0.0	0.0
7.32	317.1	-8426.1	0.1	-936.7	18.03	-57.4	-3641.7	0.1	758.0	28.74	-129.0	0.0	0.0	0.0
7.61	324.7	-8682.2	0.1	-861.5	18.31	-59.4	-3425.2	0.1	740.9	29.02	-130.8	0.0	0.0	0.0
7.89	333.0	-8896.5	0.1	-755.4	18.59	-61.1	-3232.7	0.1	724.9	29.30	-132.6	0.0	0.0	0.0
8.17	340.6	-9082.9	0.1	-666.0	18.87	-63.1	-3025.6	0.1	706.7	29.58	-134.7	0.0	0.0	0.0
8.46	348.9	-9261.2	0.1	-565.3	19.16	-65.0	-2824.4	0.1	688.0	29.86	-136.5	0.0	0.0	0.0
8.73	357.3	-9408.8	0.1	-462.1	19.44	-66.8	-2645.1	0.1	670.5	30.14	-138.4	0.0	0.0	0.0
9.01	364.8	-9518.5	0.1	-366.3	19.72	-68.8	-2455.2	0.1	650.7	30.43	-140.2	0.0	0.0	0.0
9.30	373.2	-9608.3	0.1	-258.5	20.00	-70.5	-2285.6	0.1	632.2	30.71	-142.1	0.0	0.0	0.0
9.58	381.5	-9666.2	0.1	-148.3	20.28	-72.5	-2107.2	0.1	611.3	30.99	-144.1	0.0	0.0	0.0
9.86	389.1	-9690.7	0.2	-45.9	20.57	-74.4	-1933.6	0.1	589.8	31.27	-145.9	0.0	0.0	0.0
10.14	397.4	-9686.0	0.2	68.9	20.85	-76.2	-1781.7	0.1	569.8	31.55	-147.8	0.0	0.0	0.0
10.42	406.0	-9652.4	0.2	175.4	21.13	-78.2	-1620.4	0.1	547.3	31.83	-149.6	0.0	0.0	0.0

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SPW911, v2.00

10/18/05 PO-30 Lake Borgne RAR 1/4

Waler Design

$W_f = 2280.1$ lbs/ft (per pileback SPW911, V2.0)

Use 8' spacing, conservatively assume pin connected

$M_f = wl^2/8 = \frac{(2280.1)(8)^2}{8} = 18,240$ ft·lbs

(ASTM 500, B) $F_b = 0.66 F_y = 0.66(46) = 30.4$ ksi (B 1-92)

$S_x = M_f/F_b = \frac{(18.24\ ft \cdot k)(12''/ft)}{30.4\ ksi} = 7.21\ in^3$

Since continually braced, use Tube 6x6x1/4, $S_x = 10.1\ in^3$

Tie-Rod Design

$P_T = (2280.1\ lbs/ft)(8\ ft) = 18,240$ lbs

$F_T = 0.33 F_u$ (per ASD 9th, connections, table J-3)

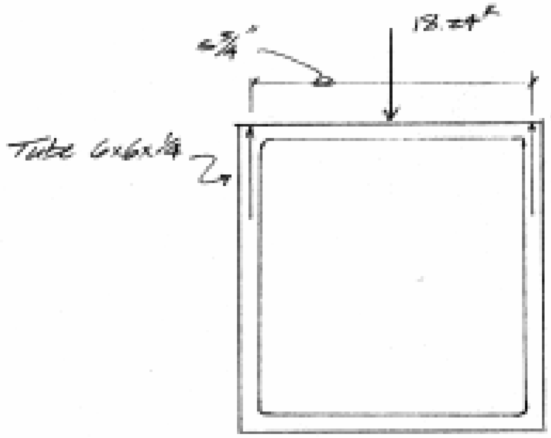
$F_T = 0.33(58) = 19.1$ ksi

$A_{req} = P/F_T = \frac{18.24^k}{19.1\ ksi} = 0.95\ in^2$

Use 1 1/4" φ A36 Tie-rod, $A = 1.227\ in^2$, @ 8' spacing

10/18/05 PO-30 Lake Borgne RAR 2/4

Bearing Plate Design:



$M = PL/8 = \frac{18.24^k (5\frac{3}{4})}{8}$

$M = 13.11''^k$

$F_b = \frac{M}{S}$, $S = \frac{M}{F_b}$

$S = \frac{13.11''^k}{27\ ksi} = 0.49\ in^3$

$S = \frac{1}{6} b t^2$

$t = \left(\frac{6(0.49\ in^3)}{5.25\ in}\right)^{1/2}$

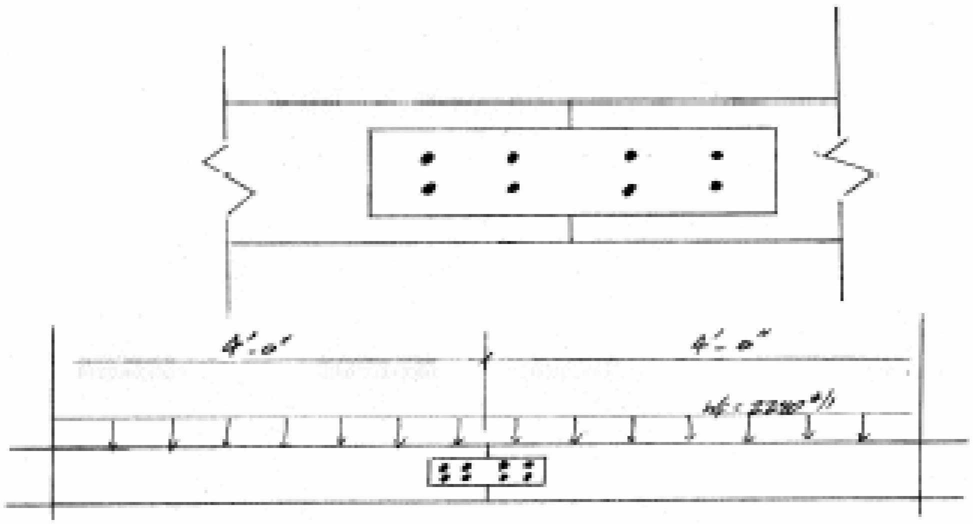
$t = 0.748\ in$

Use PL 3/4 x 5 1/4 x 0'-5 1/4" Bearing Plate w/ 1/4" Fillet

/ /

10/18/05 PO-30 Lake Borgne RAR 3/4

Splice Design



Bolts: $V = \frac{(2280 \text{ lbs/ft})(4 \text{ ft})}{4 \text{ bolts}} = 9.12^k/4 = 2.28^k/\text{bolt}$

Use 3/4" φ A307 bolts, V_{allow} 3.3^k
(from ASD 9th, Table I-D, pg. 4-5)

Min. Spacing = 3d = 3(3/4) = 2 1/4" (pg. 5-76)

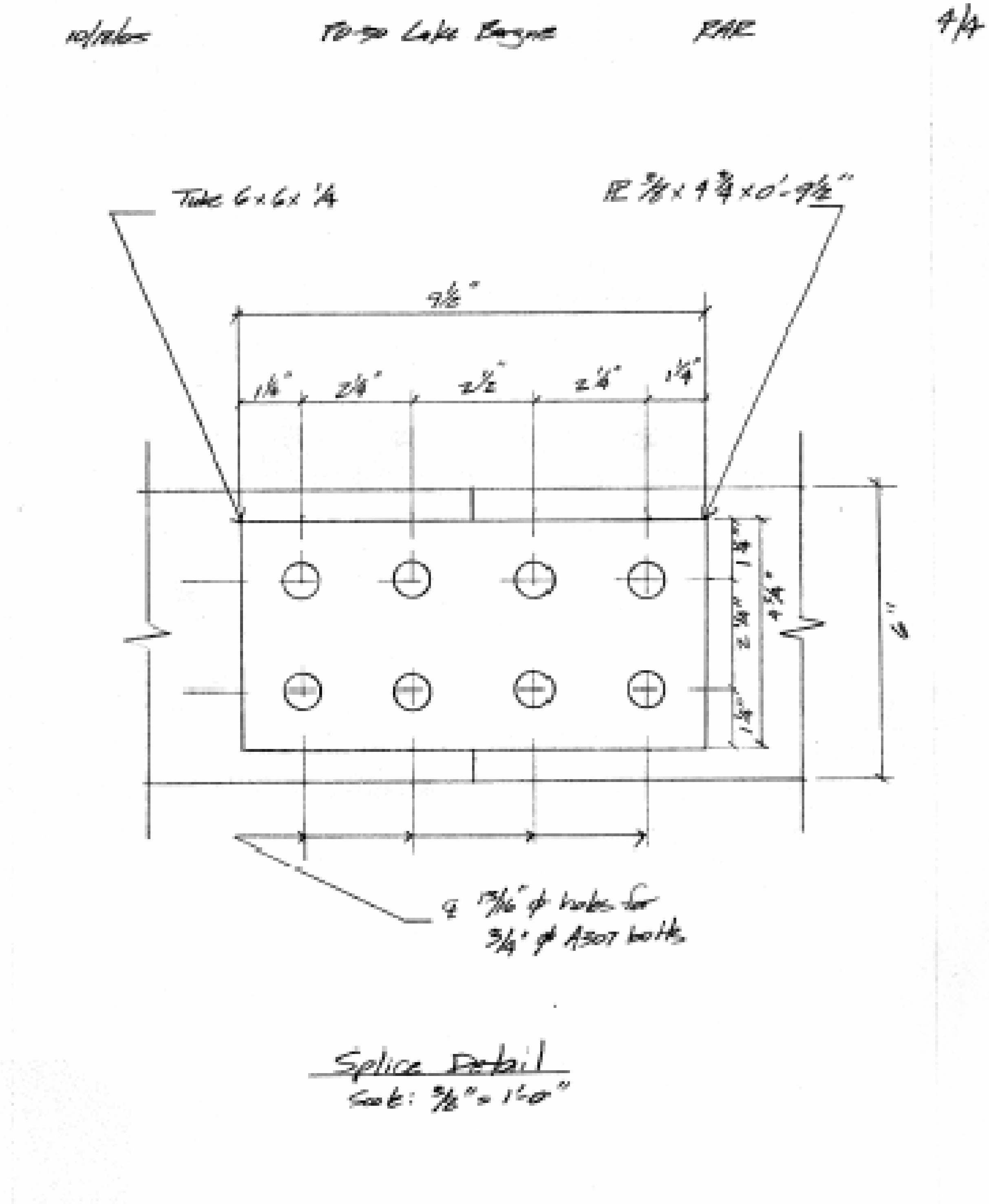
Min. Edge Distance = 1 1/4" (Table J3.5, pg 5-76)

Plate: $V = 9.12^k$ Assume no bending, shear only

$F_v = 0.4 F_y = 14.4$ ksi

$A_{req} = V/F_v = 9.12^k / 14.4 \text{ksi} = 0.63 \text{ in}^2$

Use PL 3/8 x 4 3/4 x 0'-8 1/4", A = 1.78 in²


PO-30 Lake Borgne
Tube 6 x 6 x 1/4
9 1/2"
1 1/4"
2 1/4"
2 1/2"
2 1/4"
1 1/4"
13/16" ϕ holes for
3/4" ϕ A307 bolts
Splice Detail

Appendix I

Letter from EPA Region VI to Chitimacha Tribe of Louisiana

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

AUG 2 5 2005

Kimberly Walden
Cultural Director
Chitimacha Tribe of Louisiana
P.O. Box 661
Charenton, LA 70523

Subject: Lake Borgne Shoreline Protection Project, PO-30,
Letter from Chitimacha Tribe of Louisiana dated April 6, 2005

Dear Ms. Walden:

Thank you for your continued interest in the Lake Borgne Shoreline Protection Project (PO-30) being planned under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). As you know, the 30% level design plans called for an additive alternate using end-on construction methods to place a rock dike in the area of two cultural resources sites (16SB39 and 16SB154). These two sites have been identified as eligible for listing in the National Register of Historic Places. EPA Region 6 shares your concern over the potential for adverse impacts by placing stone on these sites. In order to meet the intent and requirements of the National Environmental Policy Act of 1969 and Section 106 of the National Historic Preservation Act, we have requested the Department of Natural Resources (LDNR) remove the additive alternate as shown on the 30% level plans. By maintaining a sufficient buffer distance from these areas (16SB39 and 16SB154), any impacts due to the construction of this project will be avoided. Final drawings and specifications will be clearly marked to avoid any and all activity and/or disturbances within the buffer area. We plan to request funds for construction from the CWPPRA Task Force in January 2006. If construction funds are awarded, the contractor will be instructed during the pre-construction conference of the need to maintain this buffer during all construction activities and field inspectors will also be made aware of this requirement.

LDNR is currently in the process of preparing the final plans and specifications without the additive alternate. We anticipate holding a 95% Design Review meeting in October 2005. If you are interested in reviewing the 95% level plans and specifications, please advise Ms. Patty Taylor of my staff, at 214-665-6403, and she will notify you when they are available on the LDNR server for downloading.

Sincerely,

Sharon Fancy Parrish

for Jane B. Watson, Ph.D.
Chief
Ecosystems Protection Branch

cc: Mr. Chris L. Williams, P.E.
State of Louisiana Department of Natural Resources
Coastal Engineering Division
P.O. Box 44027
Baton Rouge, LA 70804-4027

Mr. Duke Rivet
Division of Archeology
State of Louisiana
Capitol Annex Bldg.
1051 North Third Street, Room 405
Baton Rouge, LA 70802

Mr. Kenneth Carlton
Mississippi Band of Choctaw
P.O. Box 6257
Philadelphia, MS 39350