ADDENDUM NO. 3 TO PLANS AND CONTRACT DOCUMENTS

FOR

MISSISSIPPI RIVER LONG DISTANCE SEDIMENT PIPELINE (BA-43 EB)
AND
BAYOU DUPONT MARSH AND RIDGE CREATION (BA-48)

JEFFERSON AND PLAQUEMINES PARISHES, LOUISIANA

Coastal Protection and
Restoration Authority of Louisiana

STATE OF LOUISIANA
COASTAL PROTECTION AND RESTORATION AUTHORITY

JULY 30TH, 2013

ADDENDUM NO. 3
Mississippi River Long Distance Sediment Pipeline (BA-43 EB) and Bayou Dupont Marsh and Ridge Creation (BA-48)

This addendum shall be considered part of the Plans, Specifications, and Contract Documents (except as noted otherwise) and is issued to change, amplify, or delete from or otherwise explain these documents where provisions of this addendum differ from those of the original documents. This addendum shall have precedence over the original documents and shall govern.

I. Responses to Questions Submitted by Contractors:

Contractor Question/Comment (1): Sheet 44 (permanent culvert crossing) calls out for a soil anchor for the MACMAT over rip rap used on the slopes. No detail for this soil anchor is given or indicated. Sheet 51 (permanent bridge crossing) detail D/49 calls out Soil Anchor Manta Ray MR-88 or equal. Another note pointing to the same soil anchor states "Fabric Anchor Plate, see F/51 "fabric Anchor Detail" Are the Soil Anchors and Fabric Anchors to be fabricated the same as listed on sheet 51 detail F/51?

CPRA Response (1): Yes, all identified soil anchors and fabric anchors are the same. Soil anchors are specified as Manta Ray MR-88 or approved equal and the fabric anchors are as shown in detail F/51 on Sheet 51 of 81 on the Plans.

Contractor Question/Comment (2): Appendix G is missing boring logs F-1, F-3, F-4, and F-5 and associated information. Please provide the missing information.

CPRA Response (2): See attached.

Contractor Question/Comment (3): Wills Point and Alliance borrow areas have been provided for use in construction of this project. We provide the following inquiries and concerns pertaining to these borrow areas.

a. Appendix E indicates magnetometer surveys were conducted at the Wills Point and Alliance South borrow areas, and summary tables of anomalies discovered in these areas have been provided. Were magnetometer surveys also performed in the Alliance borrow area? Significant and hazardous obstructions have been previously encountered in the Alliance borrow area. Please provide complete and current magnetometer data of the Alliance borrow area.

b. Based on results from a June 2013 hydrographic survey of the Wills Point and Alliance borrow areas, and considering the 500,000 CY reserve quantity required for potential construction of the Saltwater Barrier Sill, there appears to be insufficient quantity available to perform the work required in this contract. Please identify additional borrow sources that will be used, as well as corresponding surveys and details of the supplemental borrow area.

c. At the prebid meeting on 9-July-2013, it was stated that substantial shoaling was expected to occur within the Wills Point and Alliance borrow areas during the contract period, and thereby make up for any apparent shortfall of available borrow material that currently exists. Please provide the historical shoaling rates within the borrow area(s). Please provide the assumed shoaling rates for each borrow area expected to occur during the contract period, preferably on a per monthly basis, as the shoaling rate can be highly variable depending on river stage conditions.

d. The bid form (Unit Price Bid Form) requires separate pricing for the Wills Point and Alliance borrow areas in both Alternates 1 and 2 (Mobilization/Demobilization and Hydraulic Dredging). This bid form format implies that both of these borrow areas are not available for Contractor's use during construction of the Base Bid elements of work. Please confirm. We recommend the bid form for both Alternates 1 and 2 be structured same as the Base Bid, and not require separate pricing for both borrow areas. In doing so, this enables the planning and managed use of the borrow areas to be left to the discretion of the Contractor.

CPRA Response (3): The following responses to the questions and comments regarding Wills Point and Alliance Anchorage borrow areas are:

a. Significant portions of the Alliance Anchorage Borrow Area have been dredged on previous occasions for the BA-39 project and construction of the saltwater barrier sill. It is our understanding some obstructions such as an old anchor were encountered but were worked around. A previous magnetometer survey of the Alliance Anchorage Borrow Area region is attached.

b. There are no additional borrow areas permitted for this project. Based upon our estimates, sufficient material is available for the projects and as stated in Addendum 2 Response 4 adjustments to the marsh fill area will be made if required.

c. Any infilling (shoaling) of the borrow areas during dredging for the project work will provide additional material and is not considered in the borrow area volumes. Based upon our estimates, sufficient material is available for the project as stated in Addendum 2 Response 4. Infill rates for the contract period have not been evaluated.

d. Please refer to Addendum 2 Response 4. Alliance Anchorage Borrow Area is to be used for the base bid. The additive alternates shall bid as shown on the bid form with separate bid items for the two borrow areas.

Contractor Question/Comment (4): We request reasonable payment terms be incorporated into the contract, to ensure timely payment of Contractor invoices during performance of the work. Payment within 30 days or less of submission of progress invoice is a reasonable timeframe and should be incorporated into the contract.

CPRA Response (4): The State makes every attempt to pay invoices in a timely manner.

Contractor Question/Comment (5): Reference General Provisions GP-59. This clause stipulates that 5% shall be reserved from any payments due Contractor until 45 days after final acceptance.
a. Can this reserve amount be substituted with a bond or other form of guarantee such as a Letter of Credit?
b. We request a reasonable cap be placed on the max reserve amount withheld from Contractor.

CPRA Response (5): The terms outlined in GP-59 remain as stated.

Contractor Question/Comment (6): Reference Special Provisions SP-8. The clause specifies a boat be provided for exclusive use of Owner's Representatives. Boat transportation will be necessary in both the Mississippi River and in the marsh west of the Flood Protection Levee in order to observe all aspects of the work. Please confirm Contractor must provide suitable and timely boat transportation for Owner's Representatives to all project work features and locations, and that no boat needs not be exclusively dedicated for Owner's sole use.

CPRA Response (6): As stated in Addendum 2 Additional Clarifications a boat for exclusive use of the Owner's Representative is required for the project area in the marsh but a non-exclusive boat can be used on the Mississippi River provided it is available without unreasonable delay to the Owner's Representative.

Contractor Question/Comment (7): Reference Technical Specification TS-1.3. We request the ratio of mobilization be modified to reflect a more equitable and timely payment of not less than 60% of the lump sum price, payable upon commencement of dredging and placement of material in Reach 2 (Sta. 349+28).

CPRA Response (7): Payment for mobilization and demobilization has been modified. See revised TS-1.3 in Section II of this addendum.

Contractor Question/Comment (8): Reference Technical Specification TS-2.1 and elsewhere in the contract documents. Contractor is required to restore all access corridors and construction limits to preconstruction conditions prior to demobilization. West Ravenna Road is currently being heavily traveled with large trucks and heavy equipment, and we anticipate this use of the road will continue throughout the contract period. The road has already sustained significant damage from this traffic, and will continue to sustain more damage. How will Owner determine responsibility of road damage and repairs required due to Contractor's operations on this project versus the damages caused by other users of the road? Perhaps consider adding a bid line item to supply a maximum fixed quantity of crushed road aggregate for road repairs that are jointly used by others as well as the Contractor, such as the case at West Ravenna Road.

CPRA Response (8): The landowner agreements require the Contractor to restore the road to preconstruction conditions prior to demobilization and all costs associated with this are to be included in the lump sum item for "Mobilization and Demobilization" (REF. NO. 1).

Contractor Question/Comment (9): Reference Technical Specification TS-2.4.3 and elsewhere in the contract documents. Contractor is required to place dredge pipeline on the south side of West Ravenna Road. In consideration of the high volume of heavy traffic currently using this road, the potential damage/wear that would be caused to pipeline crossings, the need to avoid impedance with the other traffic, the proximity of the pipeline to the land booster locations and the corresponding need to cross W. Ravenna Road multiple times for each booster location, and for various other reasons, we request Contractor be given the option to construct the pipeline along the north side of West Ravenna Road.

CPRA Response (9): If the Contractor wishes to use the north side of the road, the Contractor must negotiate and secure any and all permissions required.

Contractor Question/Comment (10): Reference Technical Specification TS-3.4.2. Please clarify the term "inspected" as used in this clause. Does the "inspection" require Contractor perform additional surveys? Also, please confirm that 2 separate waiting periods of 21 days each are required prior to acceptance and calculation of payment quantities can occur. As a point of information, placement of a 6" lift of dredge material in such conditions is not constructible and is an unreasonable requirement for material consolidation or settlement rates that are largely beyond the Contractor's control. (See also the second paragraph of Technical Specification TS-7.12 regarding similar strict acceptance requirements.)

CPRA Response (10): See revisions to TS-3.4.2 in Section II of this addendum.

Contractor Question/Comment (11): Reference Technical Specification TS-3.4.3. Please confirm the intent is for all marsh creation areas to be surveyed in their entirety, along all transects, on a monthly basis, regardless of stage of construction. This requirement seems excessive.

CPRA Response (11): See revisions to TS-3.4.3 in Section II of this addendum.

Contractor Question/Comment (12): Reference Technical Specification TS-4.4. Please identify permissible access routes to be used in construction of the earthen containment dikes. Is dredging for access to the internal areas permissible?

CPRA Response (12): Please refer to Addendum 2 Response 1 and see permits for permissible dredging areas.

Contractor Question/Comment (13): Reference Technical Specification TS-7.4. The clause specifies placement of buoys along submerged pipeline routes every 150'. This spacing is incredibly close and will not be permitted by the US Coast Guard.

CPRA Response (13): Buoys shall be placed every 150' or as per US Coast Guard requirements. See revisions to TS-7.4 in Section II of this addendum.

Contractor Question/Comment (14): Reference Drawing Sheet 2 of 81, footnote 1. Please provide limitations to the increase/decrease of quantities, such as +/- 25% of the estimated bid quantities as has been stipulated in other CPRA contracts.

CPRA Response (14): No limitations are provided in this project. Any increase or decrease in quantities will be paid at the bid unit price.

Contractor Question/Comment (15): Reference Drawing Sheet 2 of 81, footnote 3. Please confirm any additional dikes requested would be constructed only along the containment dike alignments as provided in the contract documents.

CPRA Response (15): All containment dikes are planned to be constructed along the alignments shown. Field adjustments may be required that will change the overall length of containment dike. Any addition or deduction will be at the Contractor's bid price per linear foot as stated in Footnote 3, Sheet 2 of 81 of the Plans.

Contractor Question/Comment (16): Reference Drawing Sheets 41, 42, and 43 of 81. Must the dirt road, gravel road, and flood protection levee crossings be constructed entirely of crushed stone? Is it acceptable to construct the base of the crossings with earthen material and provide a minimum thickness layer of crushed stone on the surface?

CPRA Response (16): Yes, it is acceptable to construct the base of the crossings with earthen material and provide a minimum layer thickness of crushed stone of 1 foot on the surface.

Contractor Question/Comment (17): Reference Drawing Sheet 46 of 81, Details 11 and 12. The Entergy O/H lines provide very limited vertical clearance and will significantly interfere with access and placement of the land based boosters. Can the O/H lines be disconnected during installation and removal of booster equipment? Will Entergy bury the lines at these locations to avoid multiple disconnections and reconnections over time?

CPRA Response (17): The Contractor shall make any arrangements and obtain any necessary permissions from Entergy regarding the O/H lines as it relates to disconnection or burial of lines, as required. Contact information is provided in Note 8 on Sheet 2 of 81 of the Plans.

Contractor Question/Comment (18): We request the bid opening date be extended at least 2 additional weeks beyond August 6, 2013.

CPRA Response (18): Per Addendum 1, the bid opening was extended to August 6, 2013 at 2:00 pm CDT. This remains the bid opening time.

Contractor Question/Comment (19): Can we widen the crowns of the dikes for Reach 2 to the inside of the permanent access corridor?

CPRA Response (19): The earthen containment dike crowns may be widened to the inside but cannot extend into the permanent access corridor and must remain within the area shown for Reach 2 on the Plans and upon completion of the work meet the lines and grades shown on the Plans.

Contractor Question/Comment (20): Will the contractor be allowed to drill water wells for service water at the landside booster locations?

CPRA Response (20): The contractor shall be required to obtain permission from the landowner for water wells and secure any permits required for water wells. Water shall be dispersed in according to local, state and federal laws and without adverse impacts to the landowner and his lessees.

Contractor Question/Comment (21): Bid Form: Please combine item 10A & 10B, combine item 14A & 14B, combine item 15A & 15B, and combine item 17A & 17B. Leave it up to the contractor to determine which borrow area to use. By not combining these items you are overstating the value of the contract and ultimately bidding on items that will not be executed.

CPRA Response (21): The bid form remains as stated. One, both, or neither additive alternates may be awarded.

Contractor Question/Comment (22): Appendix A: Supplemental Information (pages A1 – A-5) indicate that Plant & Equipment, Dredge Data Sheets and Statement of Experience should be submitted with the work plan after the bid opening, is this correct?

CPRA Response (22): That is correct. They are not required prior to bid opening.

II. Revisions to Specifications:

Page 54, TS-1.3: The wording of this section is revised. TS-1.3 shall now read:

> *"Ten percent (10%) of the mobilization/demobilization lump sum price will be paid to the Contractor upon completion of mobilization from the Mississippi River to just past LA-23 (STA 20+00), an additional 10% will be paid on mobilization to Ravenna Road (STA 140+00), an additional 10% will be paid on mobilization to the flood protection levee (STA 232+00), an additional 10% will be paid on mobilization and start of dredge material placement on Reach 2 (STA 349+28), an additional 10% will be paid on mobilization and dredge material placement at the BA-48 marsh creation area (STA 400+00), an additional 10% will be paid on mobilization and dredge material placement at the LDSP marsh creation area (STA 470+00), and an additional 10% will be paid on mobilization to the Barataria Waterway at the end of the corridor (STA 570+22). The remaining 30% will be paid to the Contractor upon final acceptance of the Work and removal of all equipment and unused materials."*

Page 66, TS-3.4.2: The wording of this section is revised. TS-3.4.2 shall now read:

> *"After the earthen ridges have been constructed, the centerline of the earthen ridges shall be surveyed a minimum of every one hundred feet (100') with cross sections surveyed a minimum of every four hundred feet (400'). The cross sections shall be surveyed every five feet (5') and at major points of inflection or grade change. The elevation and coordinates shall be recorded and used to create plan views and cross sections of the earthen ridges to ensure that the earthen ridges have been constructed to the dimensions shown on the Plans and as per TS 5.5.*

Completed earthen ridges will be surveyed 21 days after the final lift has been constructed to the lines, grades, and tolerances shown on the Plans. If the earthen ridges meet the lines and grades specified, they will be accepted. If the inspected ridge has undergone settlement greater than 6.0", the Engineer shall determine if an additional lift of material is needed. Earthen ridges that have received an additional lift of material will be resurveyed 14 days after receiving the additional lift. If the ridges meet the lines and grades specified, they will be accepted."

Page 66, TS-3.4.3: The wording of this section is revised. TS-3.4.3 shall now read:

"Transects shall be surveyed at points every fifty feet (50') along each transect line. The marsh creation area shall be surveyed at all survey transects shown on the Plans as well as all points of inflection. The Engineer shall evaluate the process surveys to determine if the fill lift is to be accepted or modified as per TS-7.12. The Contractor shall perform additional survey transects in marsh fill areas as deemed necessary by the Engineer. Those portions of dredge fill which are modified must also be resurveyed. Plan views and cross sections shall be used for the calculation of the marsh fill volume. The marsh fill quantities shall be calculated using a method that is approved by the Engineer, such as the average end area method or AutoCAD.

Process surveys for acceptance shall consist of transects spaced 400' apart in grid format and/or at locations directed by the Engineer and shall be stamped by a Professional Licensed Surveyor. The volume of each cell shall be calculated using the average end area method in both directions. The two volumes shall be averaged to yield the volume of the cell. The quantities of marsh fill material shall be calculated in cubic yards.

Process surveys to be used for payment shall include x,y,z data representing the intersection of the dredged fill material with the earthen containment dike or existing feature used as containment. Points shall be taken at transect and containment dike profile locations around the boundary of the marsh creation area where the pumped material meets the earthen containment dike or marsh fill area boundary and at any change in direction of marsh creation area boundary. These points shall be coded "MLN" and submitted in x,y,z format."

Page 75, TS-7.4: The wording of this section is revised. TS-7.4 shall now read:

"Dredge discharge lines that cross a navigable channel must be submerged. Submerged pipelines and any anchors securing the pipeline shall rest on the channel and shall be marked in accordance with USCG requirements. Submerged lines shall at no time reduce the depth and width of the existing channel in which it is placed by more than one foot (1.0'). The depth of any pipeline crossing a navigation channel shall be submitted to the USCG for publication. All submerged pipelines installed shall be marked with fluorescent orange buoys and signs stating "DANGER SUBMERGED PIPELINE" every one hundred fifty feet (150') or as directed by the US Coast Guard for the length of the pipeline. "DANGER SUBMERGED PIPELINE" signs shall also be placed at the beginning and end of all submerged pipelines and at all abrupt changes of direction.

Unless otherwise specified by the USCG, submerged pipelines are considered to require special marks and shall have USCG approved flashing yellow lights. When the submerged line is placed in shallow water, outside the navigable channel, where the possibility exists for small boats to cross over the submerged pipeline, the pipeline shall be marked with fluorescent orange buoys and signs stating "DANGER SUBMERGED PIPELINE" every one hundred fifty feet (150') or as directed by the US Coast Guard throughout the length of the submerged pipeline. Costs incurred by the Contractor for compliance with this section should be included in Bid Item No. 1, "Mobilization and Demobilization". A description of discharge line placement shall be included in the Work Plan."

III. Revision to Plans (revised sheets attached):

None included with this Addendum.

IV. Additional Clarifications:

None included with this Addendum.

Following pages contain the boring logs corresponding to F-1, F-3, F-4, and F-5 on Sheets 7 and 8 of 81 of the Plans.

LOCATION: See Plate 1

COORDINATES: N 29° 44' 29.7"
W 90° 00' 13.3"

SURFACE EL.: -38.9' NAVD88

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
					POORLY GRADED SAND WITH SILT (SP-SM), brown and gray, with layers of organics			7	30			
					SILTY SAND (SM), brown and gray	2.0						
5								32				
10					- with clay layers below 10'							
					POORLY GRADED SAND WITH SILT (SP-SM), medium-dense, brown and gray	14.0						
15				N=10				9	33			
				N=14								
				N=11				9	27			
20				N=12				11	27			
				N=4	**LEAN CLAY (CL)**, soft, gray, with sand pockets	22.0		91	47	46	22	24
					SILTY SAND (SM), medium-dense, gray	24.0						
25				N=29				25	19			
				N=42	- dense from 26' to 27.5'							
				N=19	- with clay pockets at 28'			22	26			
30				N=18								
				N=18				17	28			
35												
				N=14	- with a clay layer at 38.5'			7	29			

CLASSIFICATION

SHEAR STRENGTH

□ Penetrometer ◇ Torvane △ Field Vane

Unconfined ▼ Triaxial ● Miniature Vane ▲

KIPS PER SQ FT

0.5 1.0 1.5 2.0 2.5

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 44 ft at time of drilling.

COMPLETION DATE: April 13, 2012
TOTAL DEPTH: 84.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 84.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-1

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 2a

LOCATION: See Plate 1
COORDINATES: N 29° 44' 29.7"
W 90° 00' 13.3"
SURFACE EL.: -38.9' NAVD88

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH (□ Penetrometer, ◇ Torvane, △ Field Vane; ▼ Unconfined, ● Triaxial, ▲ Miniature Vane; KIPS PER SQ FT 0.5 1.0 1.5 2.0 2.5)
					SILTY SAND (SM), medium-dense, gray								
				N=26				13	29				
45													
				N=13									
50													
				N=23				8	29				
55													
					FAT CLAY (CH), firm, light gray and tan, with silt seams	56.0							
				N=7					37	56	23	33	
60													
				N=6				95	35				
65													
				N=4					46	64	24	40	
70													
					POORLY GRADED SAND WITH SILT (SP-SM), dense, gray and tan	71.0							
				N=46				11	23				
75													
				N=50				5	21				

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 44 ft at time of drilling.

COMPLETION DATE: April 13, 2012
TOTAL DEPTH: 84.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 84.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-1

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 2b

FCBR_LOG (FINAL) 04.55124014.GPJ FUGRO DATA TEMPLATE 042610.GDT 06/08/12

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH (KIPS PER SQ FT)
					LOCATION: See Plate 1 COORDINATES: N 29° 44' 29.7" W 90° 00' 13.3" SURFACE EL.: -38.9' NAVD88		CLASSIFICATION						□ Penetrometer ◇ Torvane △ Field Vane; Unconfined ▼ Triaxial ● Miniature Vane ▲; 0.5 1.0 1.5 2.0 2.5
					POORLY GRADED SAND WITH SILT (SP-SM), gray and tan	80.0							
						84.5							
85													
90													
95													
100													
105													
110													
115													

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 44 ft at time of drilling.

COMPLETION DATE: April 13, 2012
TOTAL DEPTH: 84.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 84.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-1

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 2c

FCBR_LOG (FINAL) 04.55124014.GPJ FUGRO DATA TEMPLATE 042610.GDT 06/08/12

LOCATION: See Plate 1

COORDINATES: N 29° 44' 13.3"
W 89° 59' 55.3"

SURFACE EL.: -45.2' NAVD88

DEPTH, FT	WATER LEVEL / SYMBOL / SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		N=22	**POORLY GRADED SAND (SP)**, medium-dense, brown			3	25			
		N=12								
5		N=2	- very loose from 4' to 8'			2	31			
		N=2				4	28			
		N=8	- loose below 8'			2	28			
10		N=10								
		N=9		13.0		5	27			
			POORLY GRADED SAND WITH SILT (SP-SM), medium-dense, gray							
15		N=18	- brown at 14' - brown and gray from 15' to 25'							
		N=13				11	25			
		N=4				7	33			
20										
		N=3				13	38			
25			- brown from 25' to 38'							
		N=34				8	29			
30										
		N=26	- medium-dense below 91'			9	31			
35										
		N=17	- brown and gray below 38'							

SHEAR STRENGTH

□ Penetrometer ◇ Torvane △ Field Vane

Unconfined ▼ Triaxial ● Miniature Vane ▲

KIPS PER SQ FT

0.5 1.0 1.5 2.0 2.5

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 52 ft at time of drilling.

COMPLETION DATE: April 6, 2012
TOTAL DEPTH: 74.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 74.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-3

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 3a

FCBR_LOG (FINAL) 04.55124014.GPJ FUGRO DATA TEMPLATE 042610.GDT 06/08/12

LOCATION: See Plate 1
COORDINATES: N 29° 44' 13.3"
W 89° 59' 55.3"
SURFACE EL.: -45.2' NAVD88

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH (KIPS PER SQ FT)
					SILTY SAND (SM), medium-dense, gray	40.0							
				N=15				12	32				
45													
				N=19	- with clay layers below 48'			14	29				
50													
					POORLY GRADED SAND WITH SILT (SP-SM), medium-dense, gray	52.0							
				N=15				5	29				
55													
				N=13	- with layers of organics at 57' - with a clay layer at 58'								
60													
				N=30				11	29				
65					**FAT CLAY (CH)**, very stiff, gray	65.0							
				N=19					54	77	25	52	
					SILTY SAND (SM), medium-dense, gray, with organic lenses	69.0							
70													
				N=11				18	28				
75						74.5							

SHEAR STRENGTH: □ Penetrometer, ◇ Torvane, △ Field Vane; Unconfined ▼, Triaxial ●, Miniature Vane ▲; KIPS PER SQ FT 0.5 1.0 1.5 2.0 2.5

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 52 ft at time of drilling.

COMPLETION DATE: April 6, 2012
TOTAL DEPTH: 74.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 74.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-3

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 3b

FCBR_LOG (FINAL) 04.55124014.GPJ FUGRO DATA TEMPLATE 042610.GDT 06/08/12

LOCATION: See Plate 1

COORDINATES: N 29° 43' 06.1"
W 89° 59' 21.6"

SURFACE EL.: -50.1' NAVD88

DEPTH, FT	WATER LEVEL / SYMBOL / SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
			POORLY GRADED SAND (SP), brown - with shell fragments from 0' to 8' - with wood fragments and organics to 10'			3	29			
5						4	20			
		N=13	- medium-dense from 8' to 14'			6	36			
10		N=16								
		N=12	- gray and brown from 12' to 57'			4	23			
		N=6	- loose from 14' to 16'							
15		N=22	- medium-dense from 16' to 22'			5	24			
		N=21								
20		N=26	- with clay pockets at 20'			9	25			
		N=34	- dense from 22' to 24'							
		N=27	- medium-dense from 24' to 32'			7	28			
25		N=20								
30										
		N=34	- dense from 32' to 40'			3	23			
35										
		N=33								

CLASSIFICATION

SHEAR STRENGTH

□ Penetrometer ◇ Torvane △ Field Vane

Unconfined ▼ Triaxial ● Miniature Vane ▲

KIPS PER SQ FT

0.5 1.0 1.5 2.0 2.5

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 57 ft at time of drilling.

COMPLETION DATE: April 3, 2012
TOTAL DEPTH: 68.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 68.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-4

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 4a

FCBR_LOG (FINAL) 04.55124014.GPJ FUGRO DATA TEMPLATE 042610.GDT 06/08/12

LOCATION: See Plate 1

COORDINATES: N 29° 43' 06.1"
W 89° 59' 21.6"

SURFACE EL.: -50.1' NAVD88

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
					POORLY GRADED SAND (SP), very dense, brown	40.0						
				N=67	- with shell fragments at 42'			5	22			
45												
				N=37	- medium-dense to dense below 47'							
50												
				N=25				7	23			
55												
					- with a clay layer from 56' to 57'							
					- gray below 57'			3	17			
60												
				N=29								
65												
				N=31	- with clay pockets at 67'			4	22			
						68.5						
70												
75												

SHEAR STRENGTH

□ Penetrometer ◇ Torvane △ Field Vane

Unconfined ▼ Triaxial ● Miniature Vane ▲

KIPS PER SQ FT

0.5 1.0 1.5 2.0 2.5

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 57 ft at time of drilling.

COMPLETION DATE: April 3, 2012
TOTAL DEPTH: 68.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 68.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-4

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 4b

LOCATION: See Plate 1
COORDINATES: N 29° 42' 39.7"
W 89° 59' 09.9"
SURFACE EL.: -49.8' NAVD88

DEPTH, FT	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		SILTY SAND (SM), brown, with gravel			27	48			
		POORLY GRADED SAND (SP), brown	2.0						
5					2	25			
					2	23			
10	N=13	- medium-dense from 11' to 13'			1	22			
	N=8	- loose from 13' to 21' - with shell fragments at 13'			3	22			
15	N=7	- with wood fragments at 15'			2	25			
	N=7								
20	N=9	- with organic layer at 18.5' - with wood fragments at 19'			3	33			
	N=21	- gray and brown from 21' to 27' - medium-dense from 21' to 32'							
	N=16				2	22			
25	N=18				3	22			
	N=19	- gray below 27'			4	26			
30	N=27								
	N=9	**POORLY GRADED SAND WITH SILT (SP-SM)**, loose to medium-dense, gray	32.0		9	28			
35	N=21				5	25			

CLASSIFICATION

SHEAR STRENGTH

□ Penetrometer ◇ Torvane △ Field Vane

Unconfined ▼ Triaxial ● Miniature Vane ▲

KIPS PER SQ FT 0.5 1.0 1.5 2.0 2.5

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 48.5 ft at time of drilling.

COMPLETION DATE: April 1, 2012
TOTAL DEPTH: 73.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 73.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-5

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 5a

FCBR_LOG (FINAL) 04.55124014.GPJ FUGRO DATA TEMPLATE 042610.GDT 06/08/12

LOCATION: See Plate 1

COORDINATES: N 29° 42' 39.7"
W 89° 59' 09.9"

SURFACE EL.: -49.8' NAVD88

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH (KIPS PER SQ FT)
				N=33	**POORLY GRADED SAND WITH SILT (SP-SM)**, dense, brown, with gravel - with wood fragments at 42'	40.0							
45				N=5	**CLAYEY SAND (SC)**, loose, gray, with shell fragments and wood	45.0		32	36	38	15	23	
50													
				N=16	**LEAN CLAY (CL)**, very stiff, gray and tan, with silt seams	52.0			22	44	14	30	
55													
					- with silty sand layers at 57'				29	36	16	20	
							94		28				●
60													
					FAT CLAY (CH), stiff to very stiff, gray and tan	62.0			35	58	21	37	
							86		33				●
65													
									39	69	24	45	
							82		37				●
70													
					SILTY SAND (SM), tan and gray	72.0		22	25				
						73.5							
75													

SHEAR STRENGTH: □ Penetrometer, ◇ Torvane, △ Field Vane; Unconfined ▼, Triaxial ●, Miniature Vane ▲; KIPS PER SQ FT 0.5 1.0 1.5 2.0 2.5

NOTES:

1. Terms and symbols defined on Plates 8a and 8b.
2. Depth to mudline below water surface = 48.5 ft at time of drilling.

COMPLETION DATE: April 1, 2012
TOTAL DEPTH: 73.5'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0' to 73.5'
BACKFILL: Cement-Bentonite Grout
LOGGER: L. Meyer

Fugro Consultants, Inc.

LDSP River Borings

LOG OF BORING NO. F-5

Plaquemines, Louisiana

Project No. 04.55124014

PLATE 5b

FCBR_LOG (FINAL) 04.55124014.GPJ FUGRO DATA TEMPLATE 042610.GDT 06/08/12

SOIL TYPES

- Fat clay, high plasticity
- Lean clay, low to moderate plasticity
- Clayey sand
- Silty Sand
- Clean sand, poorly graded

SAMPLER TYPES

- Thin-walled Tube
- Partial Recovery w/ Tube
- Auger
- Split-barrel
- No Recovery
- Pitcher
- Piston
- Geoprobe
- Liner

SOIL GRAIN SIZE

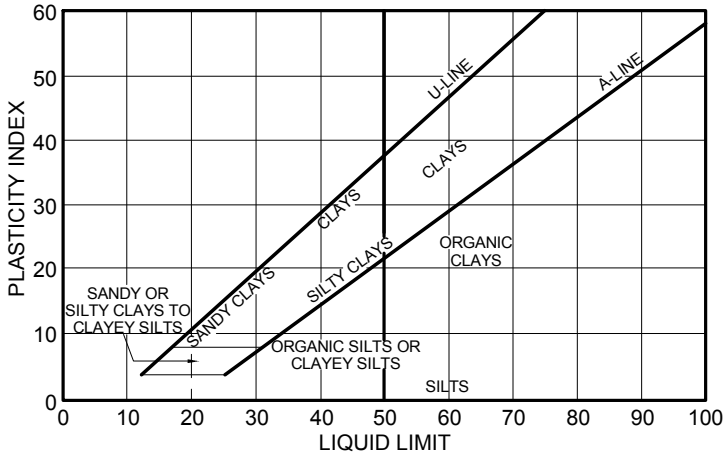
U.S. Standard Sieve

Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

6" 3" 3/4" 4 10 40 200

152 75.0 19.0 4.75 2.00 0.425 0.075 0.005 (mm)

PLASTICITY CHART



SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

DENSITY OF GRANULAR SOILS

Descriptive Term	*Relative Density, %	**Blows Per Foot (SPT)
Very Loose	< 15	0 to 4
Loose	15 to 35	5 to 10
Medium Dense	35 to 65	11 to 30
Dense	65 to 85	31 to 50
Very Dense	> 85	> 50

*Estimated from sampler driving record.
**Requires correction for depth, groundwater level, and grain size.

STRENGTH OF COHESIVE SOILS

Term	Undrained Shear Strength, ksf	Blows Per Foot (SPT) (approximate)
Very Soft	< 0.25	0 to 2
Soft	0.25 to 0.50	2 to 4
Firm	0.50 to 1.00	4 to 8
Stiff	1.00 to 2.00	8 to 16
Very Stiff	2.00 to 4.00	16 to 32
Hard	> 4.00	> 32

SHEAR STRENGTH TEST METHOD

U = Unconfined Q = Unconsolidated - Undrained Triaxial

P = Pocket Penetrometer T = Torvane V = Miniature Vane F = Field Vane

HAND PENETROMETER CORRECTION

Our experience has shown that the hand penetrometer generally overestimates the in-situ undrained shear strength of over consolidated Pleistocene Gulf Coast clays. These strengths are partially controlled by the presence of macroscopic soil defects such as slickensides, which generally do not influence smaller scale tests like the hand penetrometer. Based on our experience, we have adjusted these field estimates of the undrained shear strength of natural, overconsolidated Pleistocene Gulf Coast soils by multiplying the measured penetrometer reading by a factor of 0.6. These adjusted strength estimates are recorded in the "Shear Strength" column on the boring logs. Except as described in the text, we have not adjusted estimates of the undrained shear strength for projects located outside of the Pleistocene Gulf Coast formations.

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the time and places indicated, and can vary with time, geologic condition, or construction activity.

RESULTS OF BAYOU DUPONT GEOPHYSICAL SURVEY

By

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Report Submitted to:

Louisiana Department of Natural Resources
Coastal Engineering Division

Project Support: LADNR Purchase Order No. 3145209
Louisiana State University

September 28, 2007

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM – BAYOU DUPONT (BA-39)

INTRODUCTION

The Mississippi River Sediment Delivery System – Bayou Dupont Project (Project No. BA-39) is located in the Barataria Basin about 3.7 miles (5.9 km) northwest of Myrtle Grove as shown in Figure 1.

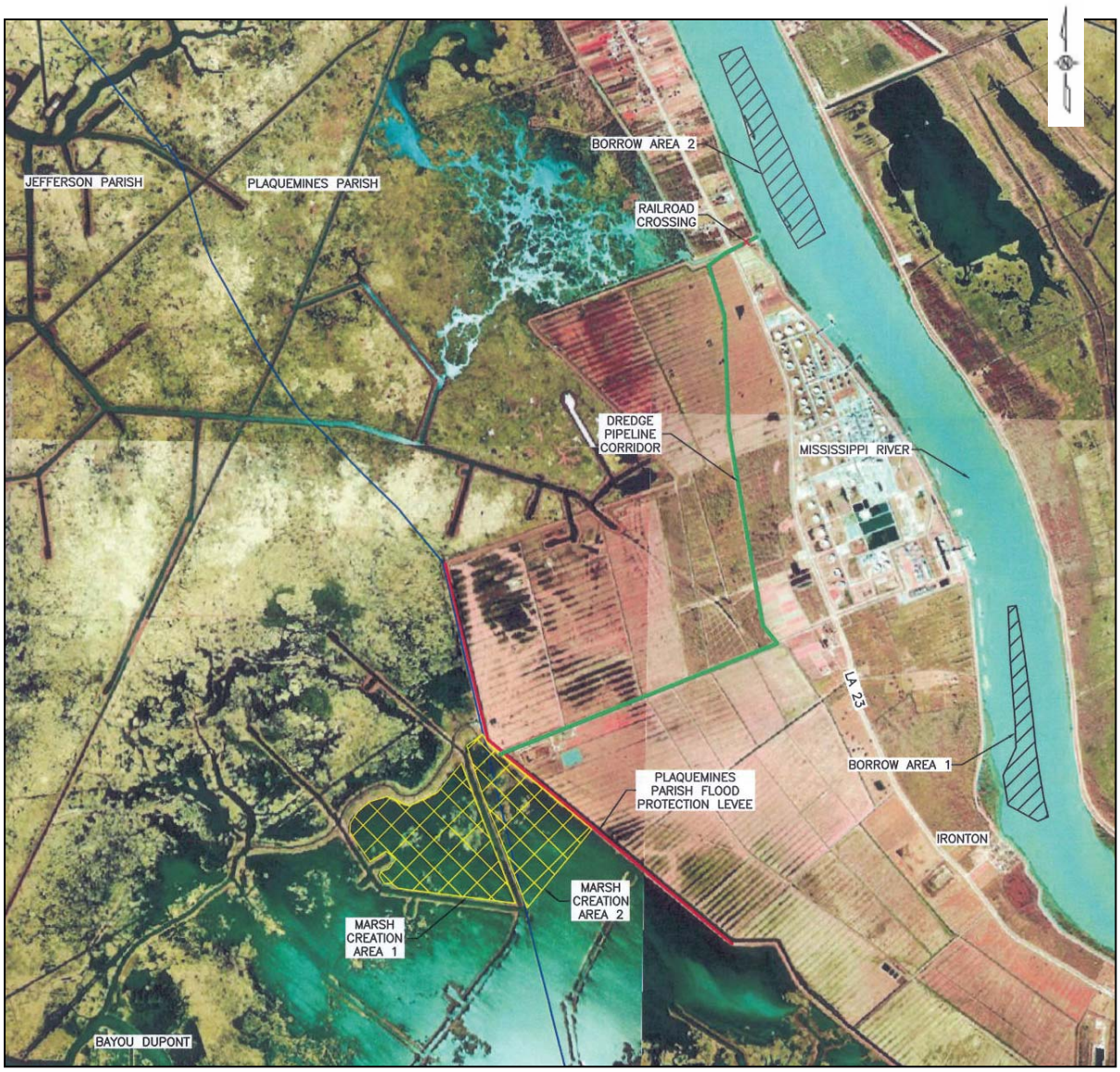

Figure 1 – Proposed Project Area and Features

The objective of the project is to create approximately 493 acres of sustainable marsh using the renewable resources of Mississippi River sediment. The project area is at present is mostly open water. The project area is located near the Mississippi River. The intent is to create

marsh by hydraulically dredging sediment from the Mississippi River to fill the open water and broken marsh areas west of the Plaquemines parish flood protection levee. (Figure1). Availability of compatible and adequate sediment and its location is critical to the success of the project. Approximately 3.5 million cubic yards of sediment are required for restoration.

Approximately 8.4 line miles (13.5 km) of bathymetric, side-scan sonar, high resolution seismic, and magnetic data were collected along preselected tracklines on August 2, 2007. This narrative describes the methodology and the results of the survey in the borrow area.

METHODS OF DATA COLLECTION AND ANALYSIS

A high resolution acoustic and magnetometer data collection survey was conducted for the proposed Bayou Dupont sand borrow area (Figure 1). Magnetometer data were collected simultaneously with side-scan sonar data, chirp sonar subbottom profiles, and bathymetry using standard procedures for riverine and shallow marine geophysical surveys (Roberts et al., 1999; Roberts et al., 2000, Finkl et al., 2006). The magnetometer was deployed approximately 100 ft (30 m) off the stern of the survey vessel. A full spectrum subbottom profiler was deployed just below the waterline on the starboard around mid-vessel position. The side-scan fish was deployed on a bowsprit 5 ft (1.5 m) ahead of the vessel in order to minimize turbulence and cavitation. This configuration mitigates vessel related noise in the acoustic data. Geographical coordinates were recorded for all the geophysical data collected, which is essential for integration of the various data sets.

Survey Vessel – R/V Coastal Profiler

The survey was accomplished using the R/V Coastal Profiler. Figure 2 shows this vessel which has an overall length of 41 ft (12.5 m) and a beam of 17 ft (5.2 m). The Profiler is a Lafitte Skiff style vessel designed primarily for shallow water operations. From the outset, this vessel was custom built for shallow water geophysical data acquisition and vibracoring. Special ribbing and other supports were included in the construction to accommodate lifting heavy loads and withstanding substantial sea states. Booms, davits, and wenches were custom built and located on the vessel at optimal sites for towing a variety of data-collection systems. The cabin was built to specifications for accomodation of our computer-based data acquisition units. Two 450 hp Catepillar (model 3126 B) engines power the Profiler. The vessel is equipped with a Simrad Auto Pilot which is essential for running straight survey lines. A 750 gallon fuel tank provides the capacity to run several days without refueling. The hull design and two diesel engines allow us to quickly run to the field sites (cruising speed ~ 22 kts). The Profiler can work comfortably on the continental shelf as well as in Louisiana's shallow bays and rivers. This vessel can operate in water depths as shallow as ~ 3 ft (1 m).

Navigation

Geographical coordinates were recorded simultaneously with all the geophysical data collected. Navigation data were acquired via a C&C Technologies GPS receiver system utilizing SatLoc3 differential GPS with sub-meter accuracy. The navigational data were delivered in real-time and these data were incorporated in the header information magnetometer, echo sounder, side-scan sonar and chirp digital data sets. The GPS-fix data were sent to the data acquisition

systems at a rate of one fix per second. Navigational control was maintained on an IBM compatible PC running ChartView Pro and ArcGIS software. A navigational chart with the plot of the survey plan was displayed by ChartView Pro along with the vessel's position, orientation, course, and speed.

Figure 2. The R/V Coastal Profiler, a custom built vessel for shallow water geophysical survey work and coring.

Magnetometer

A Geometrics Model G882 marine cesium magnetometer was used on the Bayou Dupont survey. The cesium magnetometer sensor and associated electronics modules are housed in a waterproof non-magnetic fiberglass tow body approximately 5 ft (1.5 m) length. This tow body or "fish" is easy to deploy and is equipped with 200 ft (61 m) of tow cable. The system has Maglog software which allows the operator to receive, display, and otherwise manage data from the fish on a PC. In addition, this software allows for integration of magnetometer data with GPS-derived location data.

The raw magnetometer data files were exported as text files to the Geometric software Magmap 2000 and the significant anomalies were flagged. The positions of these flagged anomalies were exported as text files and then imported into ArcGIS for mapping purposes. The offset related to magnetometer sensor position relative to the GPS antenna location on the vessel was calculated for each flagged position exported to ArcGIS. The magnetic anomalies were then superimposed along the tracklines of the side-scan sonar mosaic of the survey area. A table of magnetic anomaly positions and amplitudes was created and included in the Results section of this report (Table 1).

Table 1
Magnetometer Anomaly Summary

Number	Signature Type	Description	Amplitude	Counts	Longitude	Latitude	Interpretation
			Relative (nT)	(Seconds)	(dec deg)	(dec deg)	
1	**Monopolar**	**Extra large negative**	**900.820**	**160**	**-89.9772010**	**29.6945820**	**Dock, Pipelines and Cables**
2	**Dipolar**	**Small**	**24.310**	**30.6**	**-89.9801610**	**29.6995700**	**Unknown**
3	**Complex**	**Medium**	**37.180**	**48.9**	**-89.9836570**	**29.7071140**	**Unknown**
4	**Monopolar**	**Medium -**	**28.410**	**35.2**	**-89.9846110**	**29.7091890**	**Unknown**
5	**Monopolar**	**Medium -**	**31.110**	**34**	**-89.9862830**	**29.7127460**	**Unknown**
6	**Monopolar**	**Medium +**	**11.110**	**21.5**	**-89.9878920**	**29.7161480**	**Unknown**
7	**Complex**	**Medium**	**13.000**	**28**	**-89.9872280**	**29.7174120**	**Unknown**
8	**Monopolar**	**Small -**	**36.130**	**89.5**	**-89.9852070**	**29.7132880**	**Unknown**
9	**Monopolar**	**Small +**	**17.780**	**39**	**-89.9833200**	**29.7092630**	**Unknown**
10	Dipolar	Small	9.120	28.7	-89.9816450	29.7059580	Unknown
11	**Monopolar**	**Small -**	**14.070**	**19.4**	**-89.9803660**	**29.7036800**	Unknown
12	**Monopolar**	**Large -**	**107.870**	**80.3**	**-89.9765060**	**29.6953950**	**Dock, Pipelines and Cables**
13	**Monopolar**	**Medium -**	**26.010**	**51**	**-89.9759620**	**29.6976100**	**Pipelines and Cables**
14	Monopolar	Small -	6.960	35.8	-89.9777410	29.7011480	Unknown
15	Monopolar	Small -	5.740	33.6	-89.9793100	29.7042670	Unknown
16	Complex	Very Small	4.610	80.2	-89.9840420	29.7137020	Unknown
17	**Dipolar (Complex)**	**Medium**	**13.730**	**59.4**	**-89.9854780**	**29.7107010**	**Unknown**
18	Complex	Small -	9.690	25	-89.9870590	29.7104750	Unknown
19	Monopolar	Small -	5.540	32	-89.9861300	29.7112740	Unknown
20	**Monopolar**	**Small +**	**14.820**	**62.4**	**-89.9821570**	**29.7038670**	Unknown
21	**Dipole**	**Large**	**78.270**	**48.4**	**-89.9797380**	**29.6996410**	**Siphon Possible**
22	**Monopolar (Incomplete)**	**Large -**	**293.630**	**79.7**	**-89.9774350**	**29.6952010**	**Dock, Pipelines and Cables**
23	**Negative Drift**	**Small -**	**8.680**	**132.9**	**-89.9761070**	**29.6990370**	**Cable Crossing**
24	Monopolar	Small +	5.940	15.7	-89.9887680	29.7151040	Unknown

Side-Scan Sonar

Side-scan sonar efficiently maps the water bottom, producing an image of the various features and sediment texture that occur there. Side-scan data show reflection amplitudes from acoustic energy output by the side-scan fish and reflected back from the water bottom. Bottom features such as sand waves and ripples are clearly imaged in side-scan data. Also, differences in bottom sediment types can be distinguished from reflection amplitude signatures. With ground truth calibration, discrimination and identification of bottom sediments, such as sand versus clay, is possible from reflection differences.

Side-scan data were acquired simultaneously on port and starboard channels using a Klein model 2260NV digital dual frequency (100 kHz/500 kHz) tow fish and a high fidelity, low loss armored single conductor coaxial tow cable, using methods described in Allen et al. (2005). The swath range of the sonograph was 200 m. Isis software was used for data acquisition and processing (Version 6.9.29.0, Triton Elics International Inc.). Slant, layback, and boat speed corrections were made with data collected during side-scan data acquisition. For these analyses, the 500 kHz channel data were used, since they provide better spatial surface resolution. The individual side-scan lines were converted to a georeferenced TIFF image with 0.7 ft (0.2 m) resolution in both latitude and longitude for representing the river bed of the potential borrow area.

Full Spectrum Subbottom Profiler

High frequency chirp subbottom profiling systems produce high resolution imaging of the shallow subsurface without strong “multiples” associated with other high resolution seismic sources such as boomers and sparkers. This feature makes the chirp sonar an ideal tool for imaging the shallow subsurface in sand searches. Different sediment types reflect the acoustic signal with different strengths, recorded in the chirp data. Therefore, bottom “hardness” can be interpreted from the amplitude of the sediment-water interface or initial bottom reflector. Subbottom data are useful for: 1) discrimination of shallow subsurface stratigraphy, different sediment types, and interpretation of deposition and erosion; and 2) improving the interpretation of geological controls of surface reflectance (side-scan sonar) data.

The EdgeTech SB512i towfish (frequency of 5-12 kHz) and Model FS 5B Signal Processor constitutes the chirp sonar system used on the survey. The subbottom data were acquired by selecting the frequency range of 2-12 kHz at 20 ms. This system is augmented with a CODA DA50 portable computer-based seismic data acquisition system. The system is equipped with a FSSB Network Interface, an analog acquisition card (for use with any analog SBP system), internal 60GB hard drive, and a DVD-RAM storage drive. CODA Geosurvey Windows Office Replay software was used as a digital data acquisition system and for displaying the data in real-time during the acquisition phase.

Subbottom data were saved in the industry standard SEG-Y format. Navigational data were retained for each shotpoint in the SEG-Y data.

RESULTS

Borings of the proposed Bayou Dupont sand borrow site indicate an abundance of sand (Figure 3). The boring logs indicate two distinctive sand types: (1) firm brown sand with occasional seams and disseminated woody organic particles and (2) firm gray sand containing both clay partings and layers of woody organics. It is unclear if both units represent channel sand or if the lower unit is distributary mouth bar sand associated with early progradation of the latest phase of Mississippi River delta-building. For the purpose of restoration, it is not important. What is important is that adequate sand resources are available for the Bayou Dupont project needs. Geophysical data from this survey certainly support the contention that adequate sand resources exist in the project area.

The side-scan sonar mosaic of Figure 4 images a dynamic channel bottom with sands moving down-river primarily as bedload transport by migrating bedforms of various dimensions. Analysis of echo-sounder profiles, chirp sonar profiles (Figure 5), and swaths of side-scan sonar images indicate that the most prevalent bedforms in the area are sand waves. Bigger waves**,** in general, are confined and best defined mostly to the western part of the potential borrow area as seen in the side sonar scan mosaic (Figure - 5). They are both symmetrical and asymmetrical. Slip faces of asymmetrical waves indicate downstream direction. In the western portion of the area these waves range in height from about 3 feet (1 m) to more than 6.5 feet (2 m) with a wave length of about 130 feet (40 m). These mobile bedforms are of a smaller dimension in the eastern part of the area with the height ranging from 1 to 3 feet (0.3 to 1 m) and amplitude 16 to 50 feet (5 to 15 m). The lighter reflection tone observed on the side scan sonar mosaic also indicates the sand. No prominent man-made sonar targets were observed within the study area except for a short section of the BP pipeline in the southwestern part of the site (Figure 4).

Figure 5 illustrates the chirp sonar subbottom profiles acquired along the middle NW-SE oriented survey line shown in the side-scan sonar mosaic of Figure 4. The chirp sonar profile illustrates little subbottom structure. This response on subbottom records in common in sand-dominated settings where sediments have a rather uniform grain size and therefore there are few internal horizons to create the acoustic impedance difference necessary to create reflection horizons. In addition, sand is very reflective. So, much of the energy is simply reflected at he sediment-water interface. Regardless, the response recorded on the chirp sonar records further substantiates the presence of sand throughout the project's proposed borrow area as documented by the borings of Figure 3.

Analysis of the magnetometer data generated by the Bayou Dupont survey identified 24 magnetic anomalies (Table 1). Close inspection of the side-scan sonar data associated with each survey line indicated that the only "hard target" corresponding to a magnetic anomaly was the western portions of the 20 inch and 24 inch BP pipelines (see Figure 4). No side-scan sonar targets were found for the other 23 magnetic anomalies. Because the river bed is composed of highly mobile sand deposits, burial of scattered magnetic debris is highly probable.

Figure 6 is a plot of the locations and relative strengths of the magnetic anomalies superimposed on the side-scan sonar mosaic. Table 1 summarizes the location data, amplitudes shapes, and durations of the anomalies. As is very clear from these data, magnetic anomalies 1,

12, and 22 (Figure 6) are very large deflections that reflect the combined magnetic deviations related to the massive steel dock at the Alliance Refinery and the two pipelines (20 inch and 24 inch BP pipelines) that cross the river in the southeastern part of the survey area. The very strong magnetic anomalies (1, 12, 22 in Table 1) associated with the massive steel dock had durations or peak widths (counts in Table 1) that obscure more subtle deflections associated with the BP pipelines. Rather uniform depression of the survey line oriented NE-SW that crosses the area of interest roughly parallel to and overlapping the Entergy cable crossing is uniformly depressed below background levels and either is responding to the cables (if they are metallic) or perhaps the neighboring pipelines.

Magnetic anomalies 2-11, 13-20, and 24 are small to medium sized deflections that are scattered throughout the survey area with no compelling trend. Figure 6 illustrates the distribution of these anomalies and the associated color coding provides an indicator of relative amplitude. These anomalies have monoploar, dipolar, or complex signatures and are of limited amplitude and duration when compared to anomalies 1, 12, and 22. They have characteristics consistent with isolated ferrous objects such as anchors, lengths of pipe, chains vessel equipment, trawl gear, discarded cable, and other metallic objects. Aside from the large magnetic deflections caused by the combined influence of the Alliance Refinery docking facility and the two BP pipelines, anomaly 21 stands out. This anomaly has a dipolar signature and occurs near the western margin of the survey area between the Entergy cable crossing and the siphons along the western bank of the river (see Figures 3 and 6). No targets were identified from the side-scan sonar data at this site and the site seems too far from the siphons to be strongly affected. This anomaly is isolated, but should be treated with respect if dredging operations are initiated in the proposed borrow area. In my opinion, there are no indications of shipwrecks, sunken barges, or other large-scale metallic objects in the proposed borrow area.

SUMMARY

High resolution acoustic data collected on the Bayou Dupont survey underscore that this site has abundant sand resources. The primary data set from this survey, the magnetometer data, identify 24 magnetic anomalies within the project area. Three of the anomalies are huge (1, 12, and 22). The peaks of these anomalies are so large that they are interpreted to incorporate several features, the Alliance Refiner docking facility as well as the two BP pipelines and possibly the Entergy cables. Certainly, extraction of sand resources for the Bayou Dupont project should be confined to areas well north of the pipeline and cable crossings.

Except for anomaly 21, the remaining magnetic anomalies north of the cable crossing are small scattered throughout the project area. These anomalies are consistent with localized metallic debris such as pieces of pipe, anchors, etc. and do not represent large-scale obstructions to dredging. However, anomaly 21 is large enough to warrant concern in a dredging operation. There are no indictors of man-made debris on the side-scan or chirp sonar records for anomaly 21 or any of the other anomalies north of the cable crossing. Therefore, they are considered to be buried by the migrating sand waves common to this part of the Mississippi River channel.

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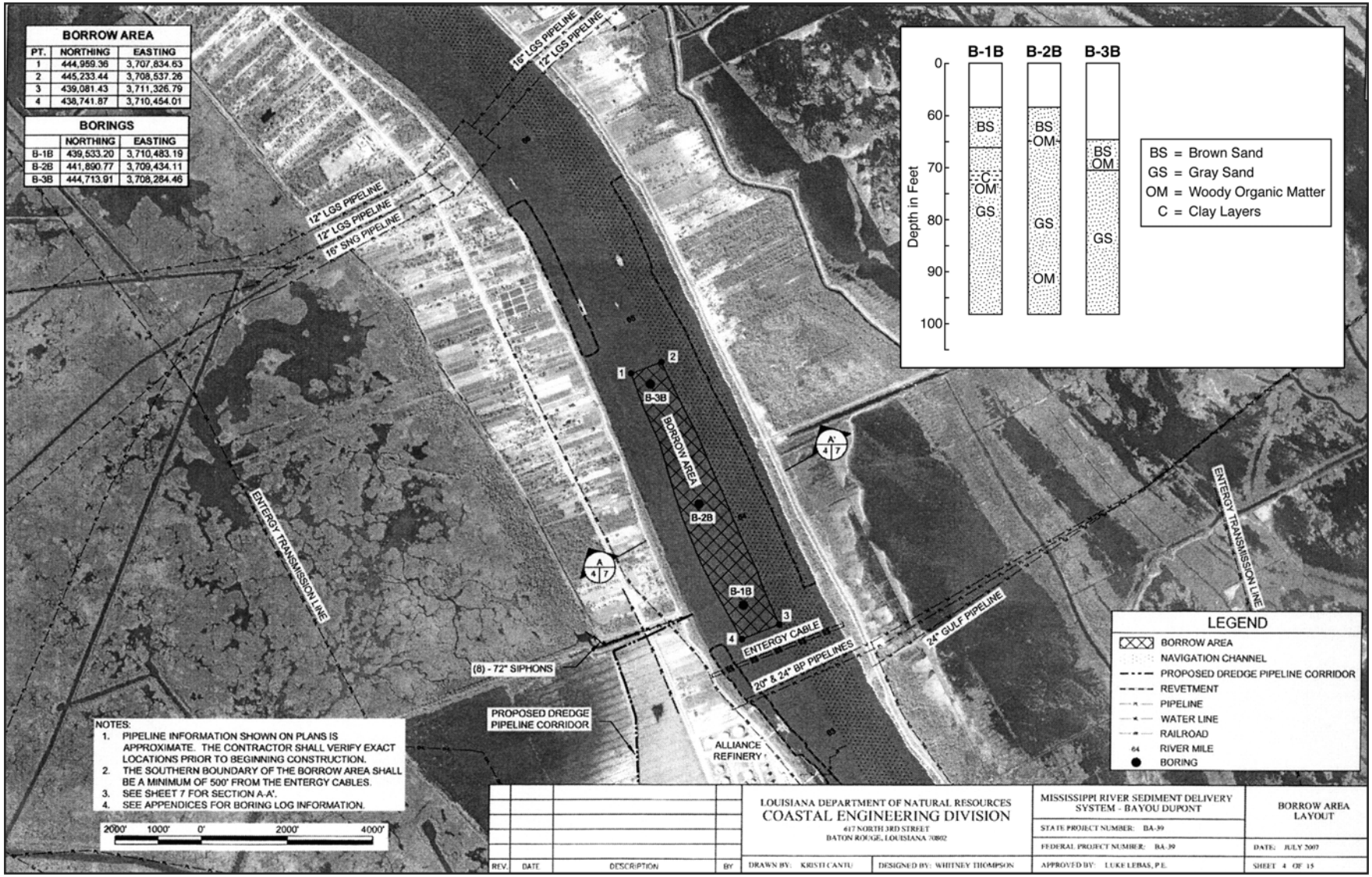


Figure 3. Project Site and Boring Characteristics.

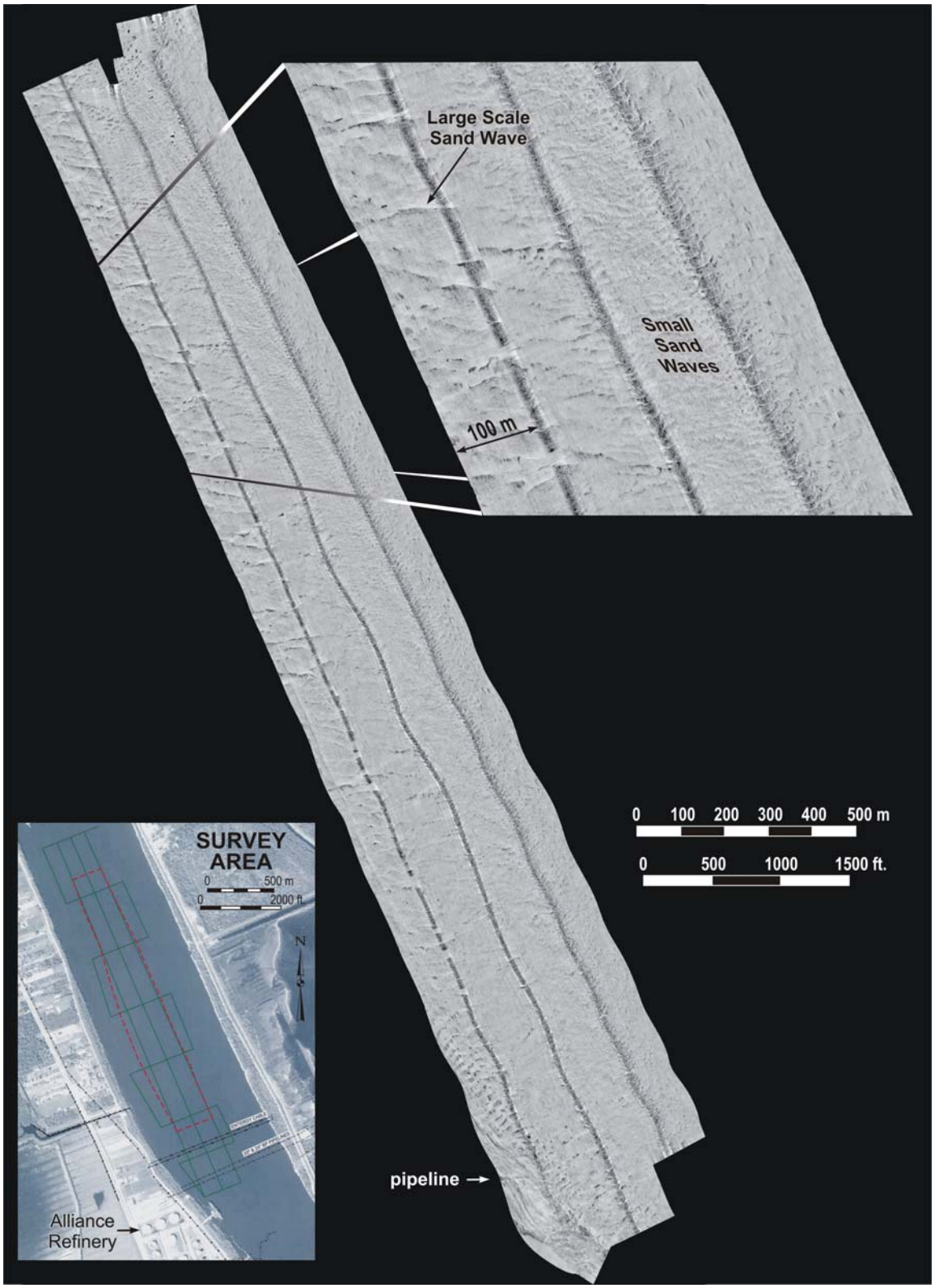


Figure 4. Side-Scan Sonar Mosaic.

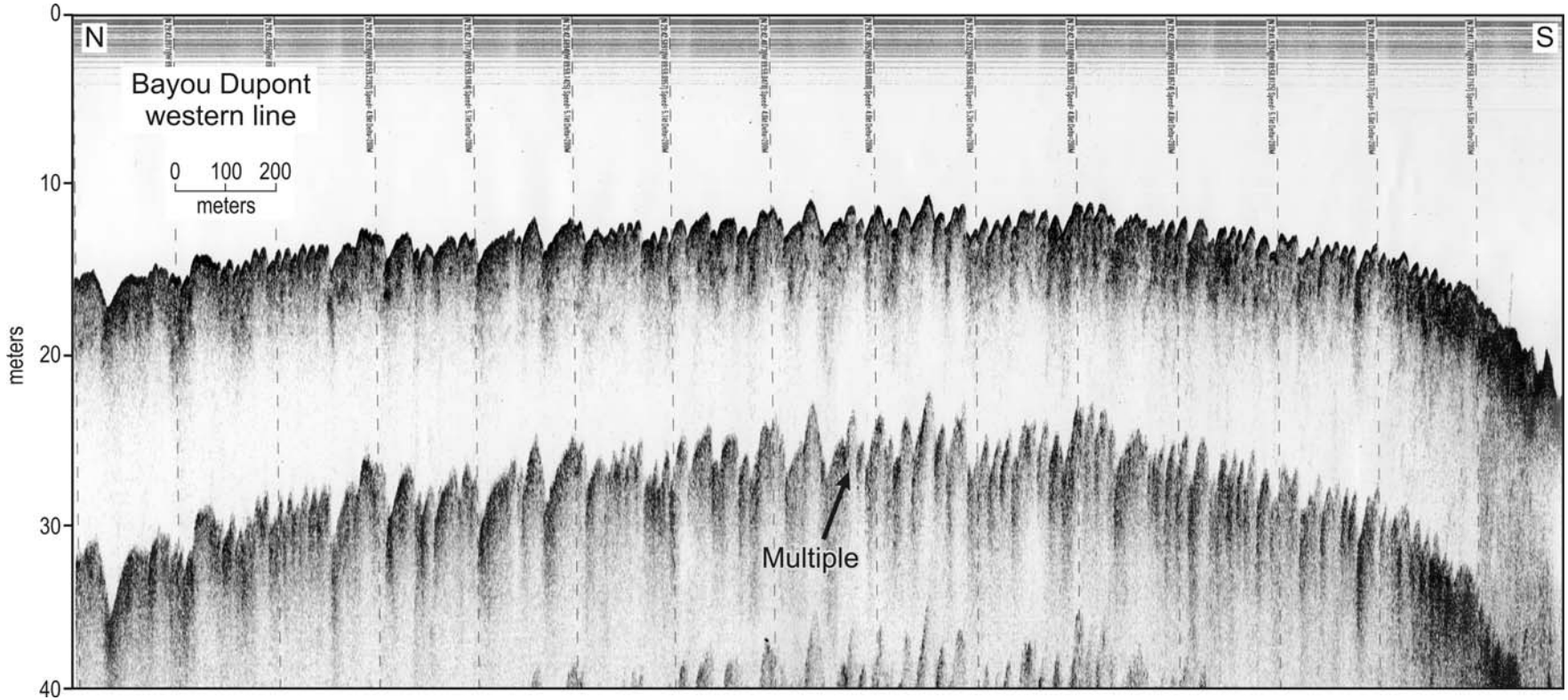
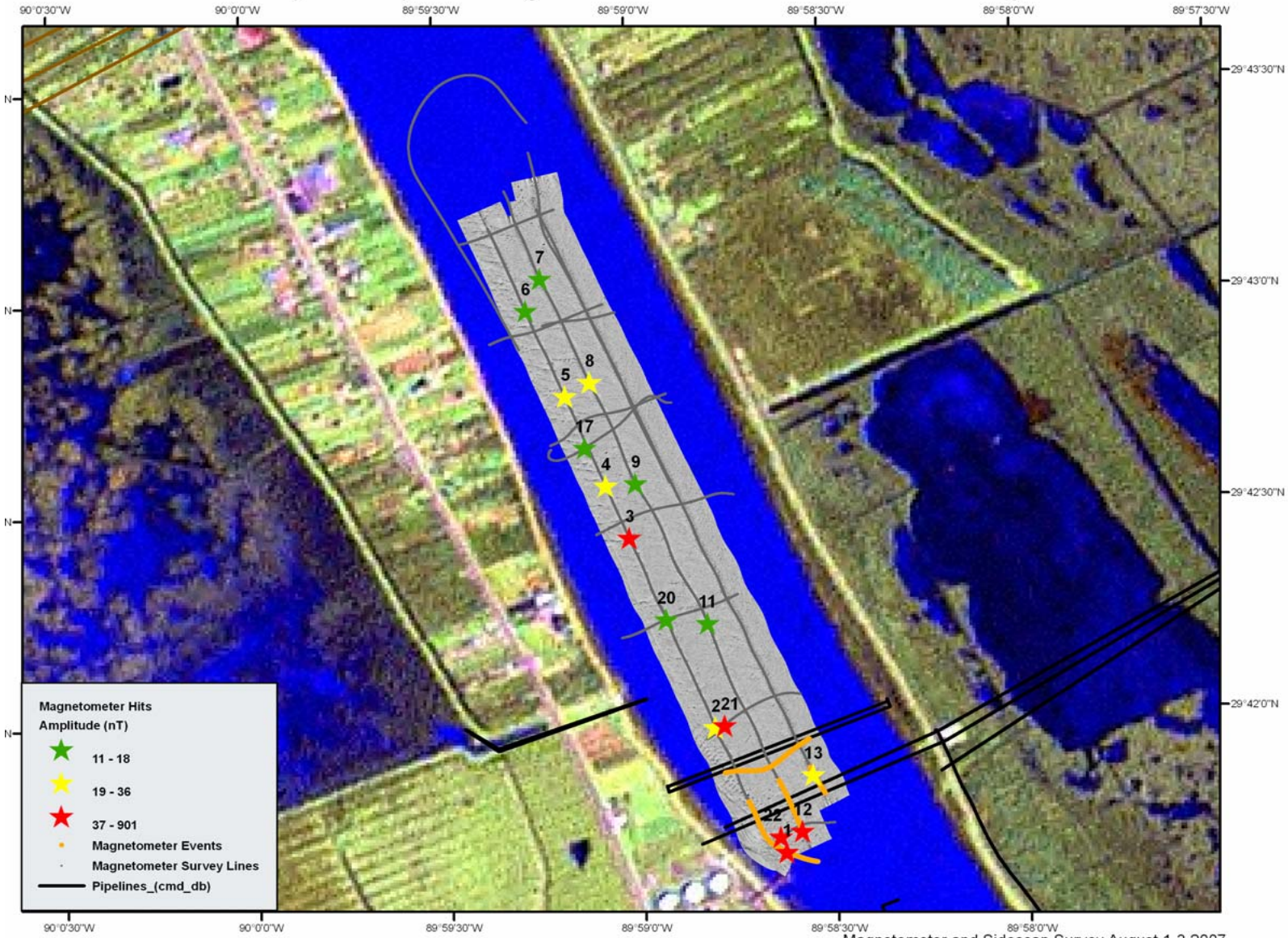


Figure 5. Chirp Sonar Profile (Middle Survey Line of Figure 4).

Bayou Dupont Magnetometer and Sidescan Survey



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