APPENDIX A

Mississippi River Borrow Area
Geophysical Survey

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MISSISSIPPI RIVER BORROW AREA GEOPHYSICAL SURVEY

1.0 INTRODUCTION

The Mississippi River Borrow Area Geophysical Survey (Survey) was completed in support of the Preliminary Design Phase for the Riverine Sand Mining / Scofield Island Restoration Project (Project). The Project is sponsored by the Louisiana Department of Natural Resources (LDNR), State of Louisiana Office of Coastal Protection and Restoration (OCPR) and NOAA Fisheries. The Project design is funded and authorized in accordance with the provisions of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) (16 U.S.C.A., Sections 3951-3956) and has been approved by the Public Law 101-646 Task Force. The Project's CWPPRA designation is BA-40.

The purpose of the Survey was to collect geophysical design data for the Mississippi River borrow areas which shall serve as the sand sources for restoration of the beach and dune system on Scofield Island as fully described in the Preliminary Design Main Report and Mississippi River Borrow Area Design Analysis (Appendix E).

The scope of services included bathymetric, sidescan sonar, magnetometer, and subbottom profile data acquisition. Approximately 11 line miles of survey data were collected in the MR-B-09 area and approximately 12 line miles of data were collected in the MR-E-09 area. Line spacing on the primary survey lines was 200 to 400 feet in MR-B-09 and varied from 50 to 200 feet in MR-E-09. Several cross lines were run in each area at spacings ranging from 1500 to 2000 feet. The Survey was conducted by SJB Group, LLC. (SJB), Coastal Engineering Consultants, Inc. (CEC), Alpine Ocean Seismic Survey, Inc. (AOS), and C.H. Fenstermaker and Associates, Inc. (CHF). Details of the full geophysical and geotechnical surveys are described in AOS (2009a) and AOS (2009b), respectively.

2.0 SUMMARY OF PRIOR WORK

The selection of the Project borrow areas was based on the review of prior surveys and analyses that identified multiple areas within the river as containing significant quantities of beach compatible sand. The primary sources of this information included previous geophysical and geotechnical work performed by Coastal Planning and Engineering (CPE, 2004) and Finkl et al. (2005), transport methodology and conveyance corridor analysis (SJB and CEC, 2007a), Mississippi River mining impact assessment (SJB and CHF, 2007), Mississippi River borrow area mining technical analyses (SJB and CEC, 2007b; SJB and CEC, 2007c), previous cultural resources work performed by R. Christopher Goodwin & Associates, Inc. (CGA, 2008), and the Feasibility Study Phase analyses (SJB and CEC, 2008).

CPE (2004) and Finkl et al. (2005) identified potential sand sources within the lower Mississippi River including the two areas designated as MR-B and MR-E. Based on the subsequent surveys and analyses, the boundaries of the two areas were revised multiple times. For the Preliminary Design Phase, these borrow areas have been designated as MR-B-09 and MR-E-09 to reflect that while the approximate locations remained the same, the design limits were refined.

3.0 PROJECT AREA AND LOCATION

Borrow Area MR-B-09 is located on the east side of the Mississippi River near Empire, Plaquemines Parish, between approximate River Mile Marker (MM) 29 to 31, and Borrow Area MR-E-09 is located on the west side of the river south of Buras between approximate MM 23 to 24 as presented in Figure 1.

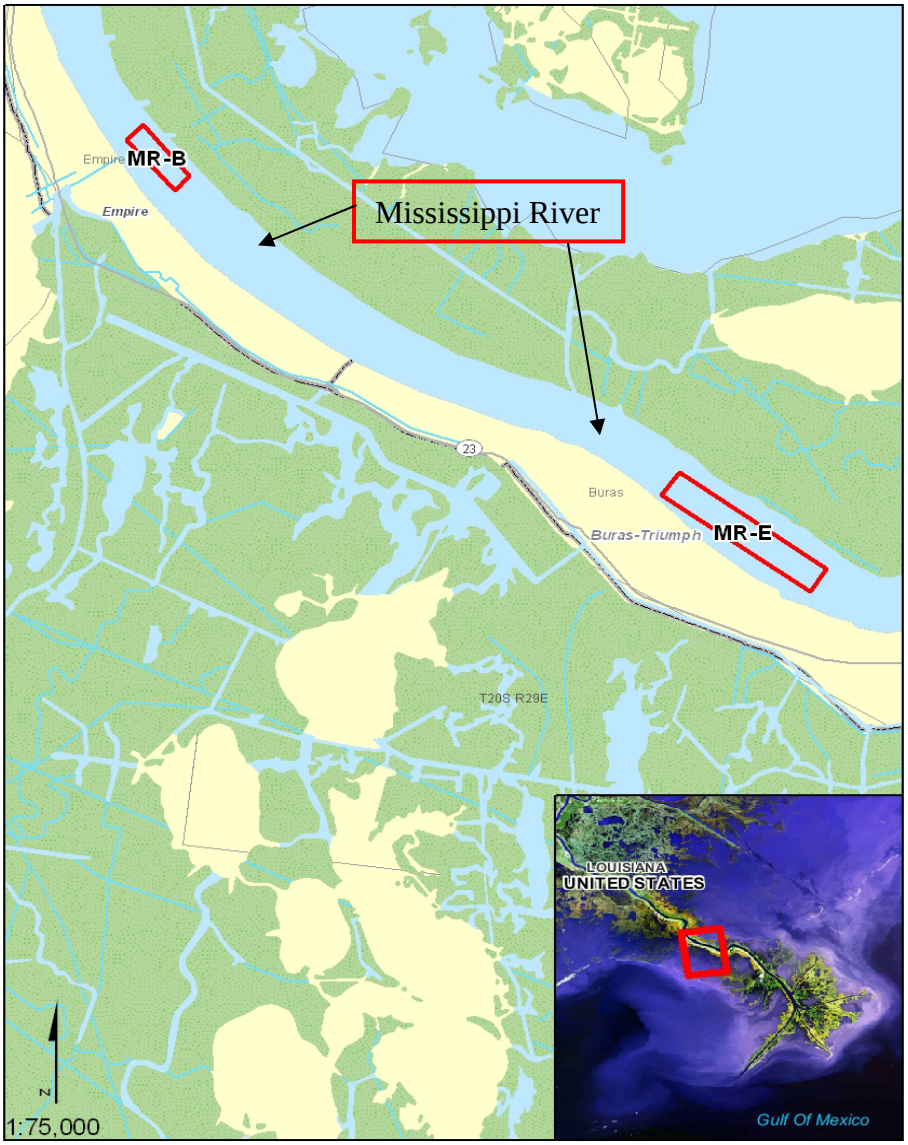

Figure 1: Mississippi River Borrow Area Survey Location Map

4.0 GEOPHYSICAL SURVEY METHODOLOGY

4.1 Survey Layout

The survey layout for Borrow Area MR-B-09 was approximately 600 feet by 11,800 feet located on the east side of the Mississippi River, and for Borrow Area MR-E-09 was approximately 900 feet by 6,700 feet located on the west side of the river. Line spacing and length varied and was adjusted in the field to maximize coverage throughout both survey areas. Chirp subbottom data was collected along the axis of the borrow area along with cross section lines to provide coverage with maximized subbottom structure of the borrow areas.

4.2 Survey Vessel

The vessel utilized for the survey was the M/V Laney, a 35-foot crew boat (Figure 2). The vessel provided adequate deck and lab space to accommodate the survey equipment and personnel. The M/V Laney was well suited for this type of survey work because of its excellent maneuverability and agility. Stability due to its size was not a problem because of the calm water conditions typical of the survey area.

Figure 2: MV Laney

4.3 Navigation System

Real time kinematic (RTK) satellite navigation was provided by CHF. The RTK system used a base station receiver with mobile units which marked their position relative to a fixed base station located at a nearby benchmark. The base station was referenced to North American Vertical Datum of 1988 (NAVD88). Typical nominal accuracy for this system is approximately 1cm horizontally and 2cm vertically and provides real time tidal corrections.

4.4 Bathymetry

Bathymetry was acquired using an Innerspace model 456 single beam echo sounder. Bathymetry data was corrected for RTK tides, draft and sensor offsets and recorded using Hypack Max software. Bathymetry data was processed and contoured in 2 foot intervals.

4.5 Sidescan Sonar

Sidescan sonar data was acquired using a Klein 3000 dual frequency tow fish and Sonar Pro acquisition software. The data was acquired at both 100 and 500 kHz at either 50 or 100 meter range per channel to maximize coverage throughout both survey areas. These settings were sufficient for locating debris and mapping sediment character within the borrow areas. The sidescan tow fish was operated at or very near a height equal to 10% of its range to maintain optimum tow geometry. Variations in cable out were recorded with a digital cable counter which sent layback information to the sonar computer. Changes in layback were automatically applied to the tow fish position using a dynamic layback change algorithm within the Sonar Pro sonar acquisition software. This method provides the highest precision and accuracy positioning of the tow fish available in relatively shallow water. Sidescan sonar data was reviewed, interpreted, and processed using Coda GeoSurvey software. Geo-referenced sonar mosaics of each borrow area were created.

4.6 Magnetometer

A Marine Magnetics SeaSpy Overhauser magnetometer was used for the surveys. Magnetometer data was collected within the southern half of MR-B-09 to confirm or disprove the presence of two reportedly removed pipelines crossing near Empire locks. Magnetometer data was collected throughout MR-E-09. The magnetometer was operated at 2-Hz cycle rate within 20 feet of the seabed whenever possible. These settings optimized the detection of buried metallic objects. Layback values were entered into SeaLink; software used for magnetic data acquisition. SeaLink stores the layback values and calculates the tow fish position based on the amount of cable out. The data was processed using MagPick software. Magnetic anomalies were identified and plotted on a magnetic residual anomaly map in terms of their location and amplitude for MR-B-09 and MR-E-09. Processing the data and producing magnetic residual anomaly images is useful because it eliminates the effects of the local and regional magnetic field. The resulting image clearly reveals discrete anomalies and increases overall interpretability of the magnetic data.

4.7 Subbottom Profiler

A Benthos model Chirp III gimble-mounted subbottom profiling system was used during the survey. This system is ideally suited for this type of survey, providing high resolution imaging

of the upper 10's of meters of sediment. Subbottom data was recorded with Chesapeake Sonar Map software and processed using Coda GeoSurvey. The data was acquired at 15 pings per second, or 67millisecond range with the dominant frequency between 2-7 kHz to provide the most resolution of the upper 10 meters of sediment possible. Vertical scale lines were plotted at 25-foot intervals of two-way travel time, based on an average sound velocity of 1600 m/s (5249 feet/second).

Chirp data was processed using Coda GeoSurvey. A flexible line plan was used in the field which allowed changes to be made to the survey grid based on the conditions and to optimize the required data coverage. As a result, time-based event (fix) marks were initially generated from the Chirp data every 30 seconds along line during post processing. During later post processing, a new set of fix marks were generated at a distance interval closer to 200 feet. These new fix marks are plotted on the basic survey navigation charts included as Charts 1 and 2 in Annex A1. This presentation allows easy correlation between a survey plan view with events and the Chirp data profiles.

5.0 DATA PRESENTATION AND DISCUSSION

5.1 Bathymetry

MR-B-09

Water depths ranged from 18 feet in the northeastern corner of MR-B-09 to about 84 feet in the western edge of the central portion of MR-B-09. The riverbed is generally flat along the borrow area averaging about 50 feet deep but shoals dramatically in portions approaching the eastern riverbank. The borrow area only exceeds 70-foot water depth in portions of the southwestern edge of MR-B-09. A plot of the bathymetric contours for the MR-B-09 area is included in Annex A1 as Chart 3.

MR-E-09

Water depths ranged from approximately 36 feet along the southwestern edge of the central portion of the borrow area to about 66 feet at the northern corner. The riverbed along the borrow area is gently undulating around 46 feet deep. The riverbed shoals dramatically just shoreward of the southwestern limits of the borrow area. A plot of the bathymetric contours for the MR-E-09 area is included in Annex A1 as Chart 4.

5.2 Magnetometer Results

MR-B-09

Numerous magnetic anomalies were found within the survey area as depicted on Figure 3 and the Data Tables in Annex A2 suggesting abundant scattered debris is concentrated in this area. Although only one anomaly (#91) clearly correlates with a sonar target (#11), it is likely most of

these anomalies are related to debris. No clear linear correlation was found among the anomalies suggesting the presence of a pipeline. Scattered debris may naturally collect in this area. A full size version of this figure is included in Annex A1 as Chart 5.

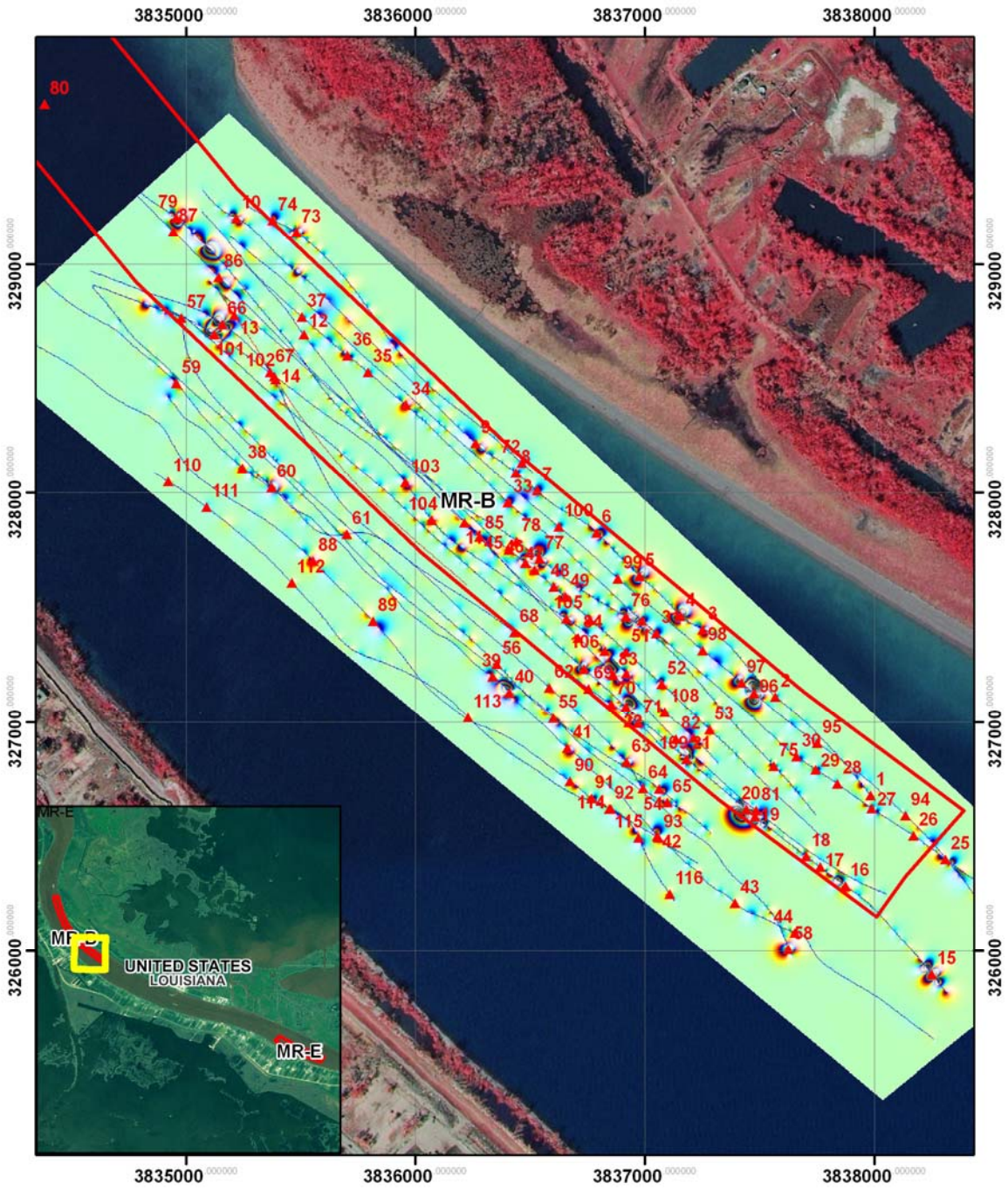

Figure 3: MR-B-09 Magnetic Anomalies

Anomalies superimposed over a residual magnetic anomaly map showing the magnetometer tracklines (blue) and the MR-B-09 preliminary boundary (red). Anomaly numbers correlate with the MR-B-09 magnetic anomaly list (Table 1).

MR-E-09 Numerous scattered magnetic anomalies were found within the survey area as depicted on Figure 4 and the Data Tables in Annex A2. None of the anomalies show a definitive alignment. The size and character of most of the anomalies is consistent with small scattered debris. Magnetic anomaly #33 aligns with sidescan target #38 (Table 2 and 3), which is very close to and likely related to the green channel marker buoy (anomaly #19 and #109). No large magnetic anomalies were found within the survey area. Although no large anomalies were detected, it does not rule out the possibility of larger debris being present at depth or between survey lines. Abundant scattered debris is expected throughout the entire are. A full size version of this figure is included in Annex A1 as Chart 6.

5.3 Bedform Definitions

The following terms are used to describe the bedforms observed in the sidescan and subbottom survey data. The values for bedform wave height and length are general characterizations and may vary.

- Megaripples: Mounds or ridges of sand which are asymmetrical and produced subaqueously by flowing water. The external morphology is similar to the larger sand wave, with a gently sloping, upstream side and a steeper downstream side. The crestline elongation extends transverse to the flow direction and is sinuous or lunate in plan. The wave height varies between 0.3 feet and 4 feet, while the wave length (spacing) between crests ranges from 3 feet to 40 feet. The down-current migration of the bedforms leads to the formation of cross-bedding in sediments which is the source of steeply dipping reflectors in the seismic records.
- Sand waves: Large-scale, transverse ridge of sand, with external morphology similar to that of the smaller-scale megaripple. The wave height is typically greater than 4 feet, while the wave length may range from 100 feet to over 1500 feet.

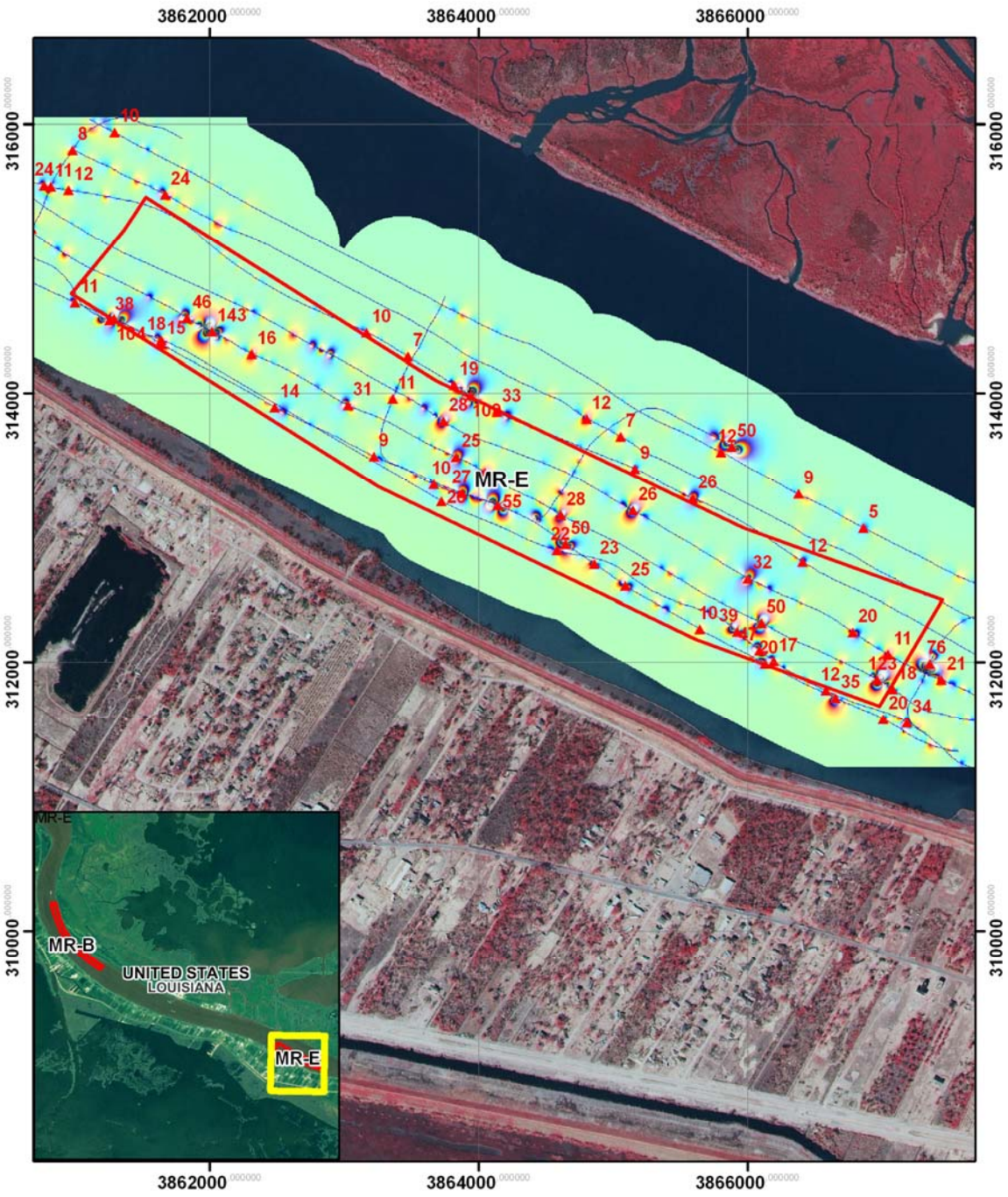

Figure 4: MR-E-09 Magnetic Anomalies

Anomalies superimposed over a residual magnetic anomaly map showing the magnetometer survey tracklines (blue) and the MR-E-09 preliminary boundary (red). Anomaly numbers correlate with the MR-E-09 magnetic anomaly list (Table 2).

5.4 Sidescan Sonar Results

MR-B-09

Sidescan sonar data was acquired in the southern portion of MR-B-09. The sidescan was used to identify any hazards to sand mining operations on the riverbed and to determine whether there were any exposed portions of two reportedly removed pipelines near the Empire locks.

No exposed pipelines or segments of pipe were found within the survey area. Twenty-eight sidescan targets were found within the survey area (Table 3). Of these, the largest target (#72) is 36 feet x 25 feet x 0.5 feet. This object is within 100 feet of magnetic anomalies #73 and #74, but it is unclear whether or not they are related. It's possible this target is naturally made and not debris related. A cluster of scattered debris (#s 58-62) and target #3 is found at or near magnetic anomaly #10. Numerous linear features were found within the survey area. However, the linear targets are generally aligned with the predominant current direction or riverbed morphology. It's unclear whether these features are man-made or of natural origin. As a result, they are classified in this report as linear targets (Table 4). The data primarily depict sand waves with superimposed megaripples throughout the survey area. No other significant features or hazards were found within MR-B-09. A full size version of the sidescan mosaic is included in Annex A1 as Chart 7. Given that the larger sidescan targets were predominantly a single linear target, it is not likely that these are related to an archaeological target, so no buffer area is plotted around these targets.

MR-E-09

Sidescan sonar data was acquired throughout the entire MR-E-09 borrow area. The data primarily depict sand waves with superimposed megaripples throughout most of MR-E except near the southwestern edge. Forty-four sonar targets, both discrete and scattered, were found within the survey area (Table 3). Sixteen linear targets were also found within the survey area (Table 4). A large linear target aligns with magnetic anomaly #10 but this is located out beyond the northern limit of the borrow area. The most significant hindrance to sand mining within MR-E-09 is marked by a large linear target and magnetic anomalies #26 and 27 where there appears to be a large "Y"-shaped section of pipe or other object approximately 300 feet long (Table 2 and 4). This object is located at or near the surface. A green marker buoy was located with the sidescan at 3863869.7 feet East, 314072.4 feet North. Other than relatively small miscellaneous debris, no other hazards were found with the sidescan in MR-E-09. A full size version of this figure is included in Annex A1 as Chart 8. The navigation fix marks generated for the sub-bottom data are shown for reference.

5.5 Chirp Subbottom Profiler Results

MR-B-09

The subbottom seismic profile data from the MR-B-09 survey area is characterized by significant variations in the nature of the seismic reflectors. These changes occur both horizontally and vertically along each line, and correspond to changes in sediment type within a given core and between adjacent cores. The core locations have been plotted on the trackline map for reference. Summaries of the geological logs of the cores have been plotted on portions of the geophysical survey data collected near each core. These sections of the data for MR-B-09 are presented in Charts 9 and 10 in Annex A1. The sections are located as labeled on Charts 1 and 2 in Annex A1.

Consistent with the sidescan sonar and bathymetric data, the river bottom morphology as observed on the subbottom data depicts sand waves with superimposed megaripples throughout MR-B-09. The sediments are cross-bedded due to active bedform migration in the down-current direction. The variation of bedform morphology along and across current suggests sediment transport may be significantly episodic and modulated by topographic variations along the borrow area. The sediment deposition and transport appears to be most stable along the southwestern flank of the borrow area in over 65 feet of water.

Section B1 of the subbottom data from MR-B-09, including fix marks 492-497, is located in the northern end of the area, and is near Vibracore MRB-08-07, as shown on the section. Sand ridges and cross bedded reflectors are also apparent on other portions of the seismic section between fixes 492-495.

Section B2 includes Vibracore MRB-08-07 between navigation fixes 498-502. The seismic reflectors present near the core are relatively flat-lying, indicative of interbedded sands and silts. However, between fixes 499 and 500, an obvious reflector dipping slowly toward the middle of the river appears to mark an erosional surface with sands predominant above, indicative of a thicker sand sequence down the middle of the survey area.

Section B3 includes a U-shaped survey line with its turn near Vibracore MRB-08-02, between fixes 519 and 527. There is a faint horizontal reflector at a depth of about 4-5 feet below the river bottom near the core. This horizontal reflector correlates with a shallow peat layer in the core. The reflector appears to end at the river bottom within 200 feet of the core as the section continues toward the middle of the river. Note the distinct reflector at a depth of about 22 feet at the core site. This reflector marks the top of a peat ledge which drops in elevation rapidly toward the middle of the river.

The seismic reflectors in the deeper water portions of the profile are interpreted as being indicative of cross bedded sediments, which are generally sandy.

Section B4, which extends perpendicular to the riverbank, includes fixes 227-232. There are no cores near this line. There are no distinct seismic reflectors in this section, and this uniformity in the geophysical record is generally indicative of uniform sediments, which are likely to be sandy, given the sand wave features present on the river bottom in this area.

Section B5 runs parallel to the shoreline, and includes Vibracores MRB-08-05 and MRB-08-06. The sediments in those two cores are similar, being composed mostly of thicker sand units with some thin clay layers. The seismic reflectors on this line are mostly relatively flat-lying, corresponding to the interbedded sands and silts in the cores.

Section B6 extends away from the riverbank to the east of Vibracore MRB-08-06. The nearshore end of the section includes a few horizontal reflectors, while the mid-river portion is characterized by several irregularly dipping reflectors, more indicative of cross-bedded sandy sediments. This corresponds with the megaripples and sand waves present on the river bottom in this area.

There is also a faint but detectable reflector between fixes 472 and 476. This reflector dips down rapidly toward the middle of the river, and may correspond to an old erosional surface, with sandy sediments above and older, perhaps more silty sediments below.

MR-E

The subbottom profile data collected within Borrow Area MR-E-09 are similar to the data from Borrow Area MR-B-09 in that there are significant vertical and horizontal changes in the nature of the reflectors along most of the survey lines. Geological summaries of the sediments present in most of the cores in this area have been plotted on the nearest geophysical profile. These sections of the data for MR-E-09 are presented in Charts 11 and 12 in Annex A1. The sections are located as labeled on Chart 2 in Annex A1.

The surface sediments throughout the majority of the borrow area consists of sand waves with superimposed megaripples migrating downstream.

Section E1 extends from the nearshore side of the borrow area on the west end of the profile toward the middle of the river at the east end of the profile. Fix 395, near the west end of this section, is located Section E2. The distinct reflector at a depth of about 26 feet below river bottom at fix 395 corresponds to a similar reflector at fix 127.5 on Section E2. This reflector marks the top of either a peat layer or an older erosional surface.

The variable subbottom reflectors in the mid-river portion of Section E1 are indicative of cross-bedded sediments and correspond to the area of large sand waves on the river bottom in this portion of the borrow area.

Section E2 is located parallel to and near the shoreline edge of the Borrow Area MR-E-09. There are strong reflectors at depths between 20 to 25 feet below the river bottom on this profile. These reflectors generally dip down to the northwest on the profile up to the area of fix 128 on the profile, and then the slope down is much more distinct, with additional shallower reflectors shown above the main reflectors. Based on the description of the sediments in core MRE-08-09, taken along this section, the basic groups of reflectors are indicative of either the top of a significant peat layer or an older erosional surface, based on the yellow coloration of the sediments. The majority of the sediments above this strong reflector are composed of recent sands and silts near shore.

Section E3 is a shore-normal line. The reflectors present on the west end of the line correspond to the peat layer in Section E2. There is a distinct change in the nature of the reflectors on this line east beyond fix 104. Beyond this point, the reflectors become more irregular, interpreted as being indicative of large scale cross bedded sands. This correlates well with the surficial megaripples and sand waves present in this portion of Borrow Area MR-E-09.

Section E4 is a short shore-parallel section with strong reflectors indicative of the peat and silty sediments found in this portion of the borrow site on other nearby survey lines.

Section E5 is similar to E1, with the reflector marking the peat layer being present on the west end, while toward the east end, the reflectors are much more irregular in the sand wave area, indicative of sandy sediments. A core taken in this area by others as part of a previous project contained all sandy sediments.

Section E6 is a shore parallel line which is a continuation to the southeast of Section E4. Note the strong reflector dipping down to the left or northwest near core MRE-08-11, which corresponds to the top of distinct yellow silt sediment unit in the core. Sediments below this reflector are likely to contain more silt than those above the reflector.

Section E7 is a shore normal line. The distinct reflector near 25 feet below river bottom on the west end of the line corresponds to the yellow silt surface. This reflector disappears toward the center of the river, where the sandy crossbedded sediments predominate.

In summary of the Borrow Area MR-E-09 sediments, the distribution of sand is generally uniform along the center and east portions of borrow area, with the main sand body thinning to silt and clay at the southwestern edge of the borrow area as the seabed rapidly shoals. The sand

body thickens rapidly heading away from southwestern shoreline inside the limits of the borrow area. The sand body continues northward outside of the borrow limits to the mapped extents of this survey in over 70 feet of water.

6.0 CONCLUSIONS

A geophysical and bathymetric survey was performed within Borrow Areas MR-B-09 and MR-E-09 Buras and Empire Louisiana. The magnetometer and sidescan sonar data suggests that a large amount of small scattered debris exists within each area with only a few potentially significant hazards. No pipeline or cable crossings were identified within either survey area. Both Borrow Areas MR-B-09 and MR-E-09 are abundant sources of sand which will likely replenish through time. No hazards were identified which would prohibit sand mining operations within either area.

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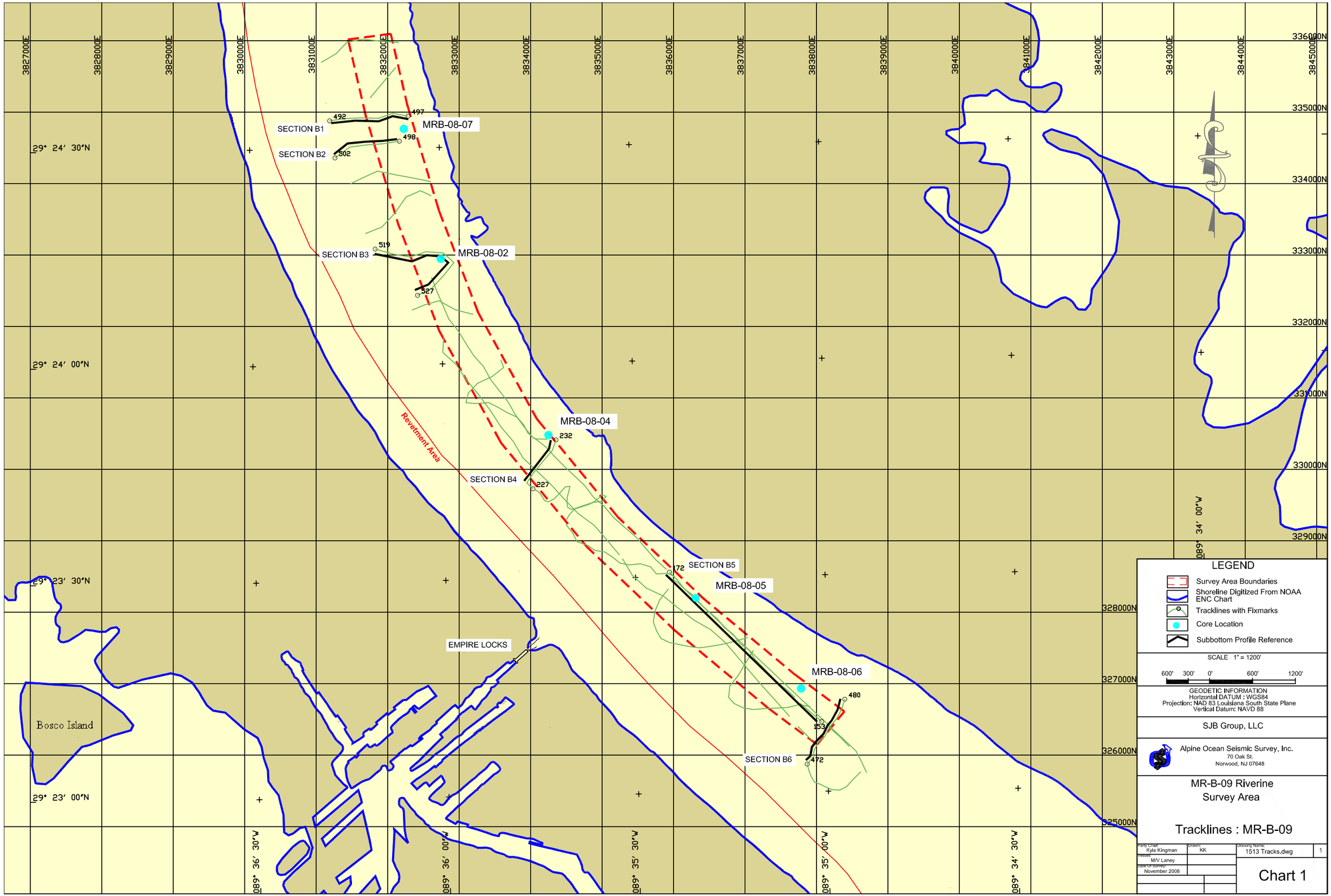
ANNEX A1

SURVEY CHARTS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29° 23′ 30″N
29° 23′ 00″N
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089° 36′ 00″W
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089° 35′ 00″W
089° 34′ 30″W
089° 34′ 00″W
SECTION B1
492
497
MRB-08-07
SECTION B2
498
502
SECTION B3
519
MRB-08-02
527
Revetment Area
MRB-08-04
232
SECTION B4
227
SECTION B5
172
MRB-08-05
EMPIRE LOCKS
MRB-08-06
480
153
SECTION B6
472
Bosco Island
LEGEND
Survey Area Boundaries
Shoreline Digitized From NOAA ENC Chart
Tracklines with Fixmarks
Core Location
Subbottom Profile Reference
SCALE 1" = 1200'
600' 300' 0' 600' 1200'
GEODETIC INFORMATION
Horizontal DATUM : WGS84
Projection: NAD 83 Louisiana South State Plane
Vertical Datum: NAVD 88
SJB Group, LLC
Alpine Ocean Seismic Survey, Inc.
70 Oak St.
Norwood, NJ 07648
MR-B-09 Riverine Survey Area
Tracklines : MR-B-09
Party Chief: Kyle Kingman
Drawn: KK
Drawing Name: 1513 Tracks.dwg
1
Vessel: M/V Laney
Date Of Survey: November 2008
Chart 1

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319000N 318000N 317000N 316000N 315000N 314000N 313000N 312000N 311000N 310000N 309000N 308000N

29° 21′ 30″N
29° 21′ 00″N
29° 20′ 30″N
29° 20′ 00″N

089° 32′ 30″W
089° 31′ 30″W
089° 31′ 00″W
089° 30′ 30″W
089° 30′ 00″W
089° 29′ 30″W

Cable Area
Cable Area
Cable Area
Revetment Area
Revetment Area
Revetment Area
Revetment Area

SECTION E1
391
124
399
SECTION E2
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MRE-08-09
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MRE-08-05
SECTION E3
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98
380
MRE-08-13
MRE-08-08
MRE-08-07
SECTION E4
351
352
MRE-08-11
SECTION E5
373
SECTION E7
357
362
356
SECTION E6

LEGEND

- Survey Area Boundaries
- Shoreline Digitized From NOAA ENC Chart
- Tracklines with Fixmarks
- Core Location
- Subbottom Profile Reference

SCALE 1" = 1200'

600' 300' 0' 600' 1200'

GEODETIC INFORMATION
Horizontal DATUM : WGS84
Projection: NAD 83 Louisiana South State Plane
Vertical Datum: NAVD 88

SJB Group, LLC

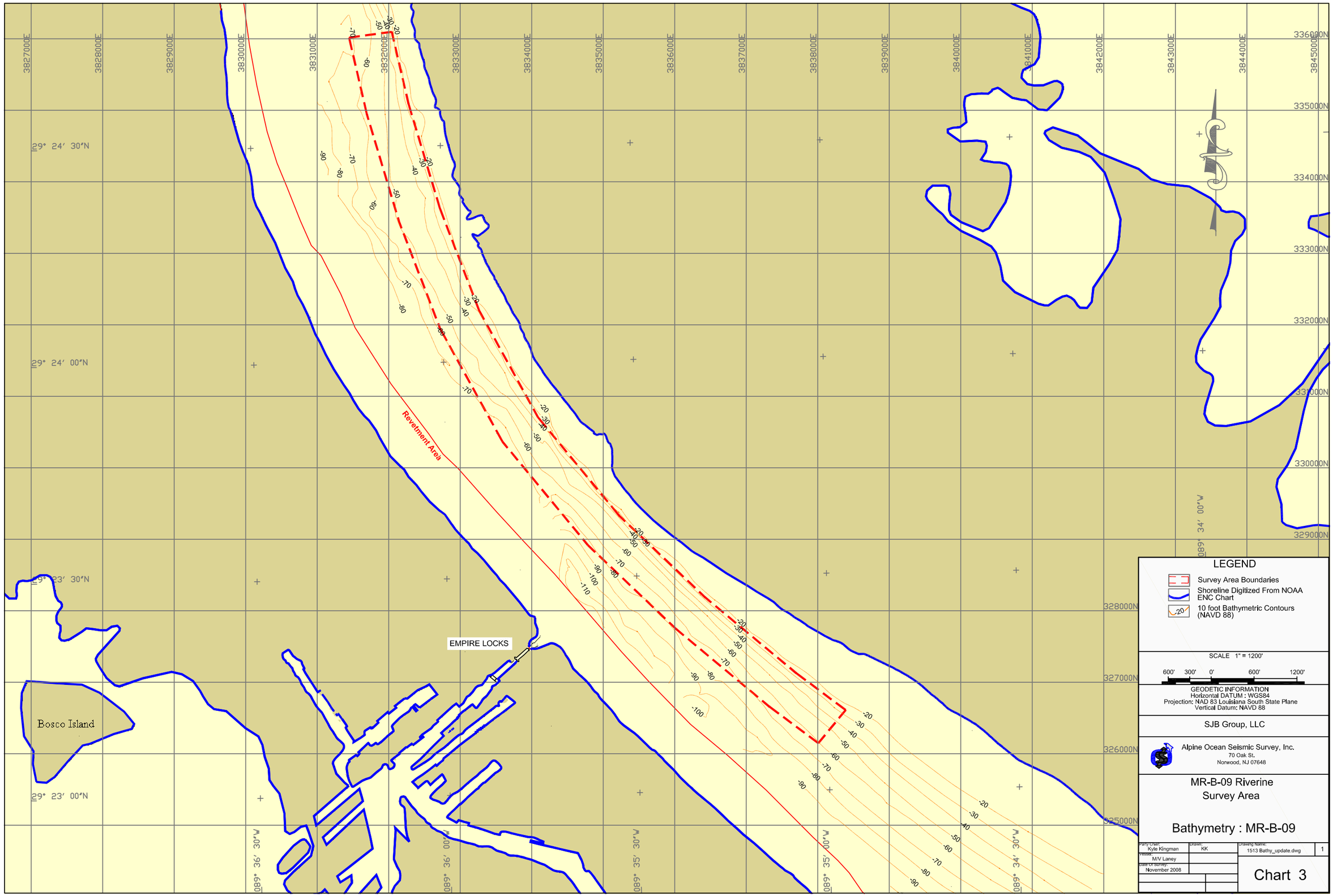
Alpine Ocean Seismic Survey, Inc.
70 Oak St.
Norwood, NJ 07648

MR-E-09 Riverine
Survey Area

Tracklines : MR-E-09

Party Chief: Kyle Klingman	Drawn: KK	Drawing Name: 1513 Tracks.dwg	1
Vessel: M/V Laney			
Date of Survey: November 2008			

Chart 2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3840000E
3841000E
3842000E
3843000E
3844000E
3845000E
336000N
335000N
334000N
333000N
332000N
331000N
330000N
329000N
328000N
327000N
326000N
325000N
29° 24′ 30″N
29° 24′ 00″N
29° 23′ 30″N
29° 23′ 00″N
089° 34′ 00″W
089° 36′ 30″W
089° 36′ 00″W
089° 35′ 30″W
089° 35′ 00″W
089° 34′ 30″W
Revetment Area
EMPIRE LOCKS
Bosco Island
LEGEND
Survey Area Boundaries
Shoreline Digitized From NOAA ENC Chart
10 foot Bathymetric Contours (NAVD 88)
SCALE 1" = 1200'
600' 300' 0' 600' 1200'
GEODETIC INFORMATION
Horizontal DATUM : WGS84
Projection: NAD 83 Louisiana South State Plane
Vertical Datum: NAVD 88
SJB Group, LLC
Alpine Ocean Seismic Survey, Inc.
70 Oak St.
Norwood, NJ 07648
MR-B-09 Riverine Survey Area
Bathymetry : MR-B-09
Party Chief: Kyle Kingman
Drawn: KK
Drawing Name: 1513 Bathy_update.dwg
1
Vessel: M/V Laney
Date Of Survey: November 2008
Chart 3

3856000E 3857000E 3858000E 3859000E 3860000E 3861000E 3862000E 3863000E 3864000E 3865000E 3866000E 3867000E 3868000E 3869000E 3870000E 3871000E 3872000E 3873000E

319000N 318000N 317000N 316000N 315000N 314000N 313000N 312000N 311000N 310000N 309000N 308000N

29° 21′ 30″N

29° 21′ 00″N

29° 20′ 30″N

29° 20′ 00″N

089° 31′ 30″W 089° 31′ 00″W 089° 30′ 30″W 089° 30′ 00″W 089° 29′ 30″W 089° 29′ 00″W

089° 28′ 30″W

Cable Area

Cable Area

Cable Area

Revetment Area

Revetment Area

Revetment Area

Revetment Area

-80 -70 -60 -50 -40 -30 -20

LEGEND

- Survey Area Boundaries
- Shoreline Digitized From NOAA ENC Chart
- 10 foot Bathymetric Contours (NAVD 88)

SCALE 1" = 1200'

600' 300' 0' 600' 1200'

GEODETIC INFORMATION
Horizontal DATUM : WGS84
Projection: NAD 83 Louisiana South State Plane
Vertical Datum: NAVD 88

SJB Group, LLC

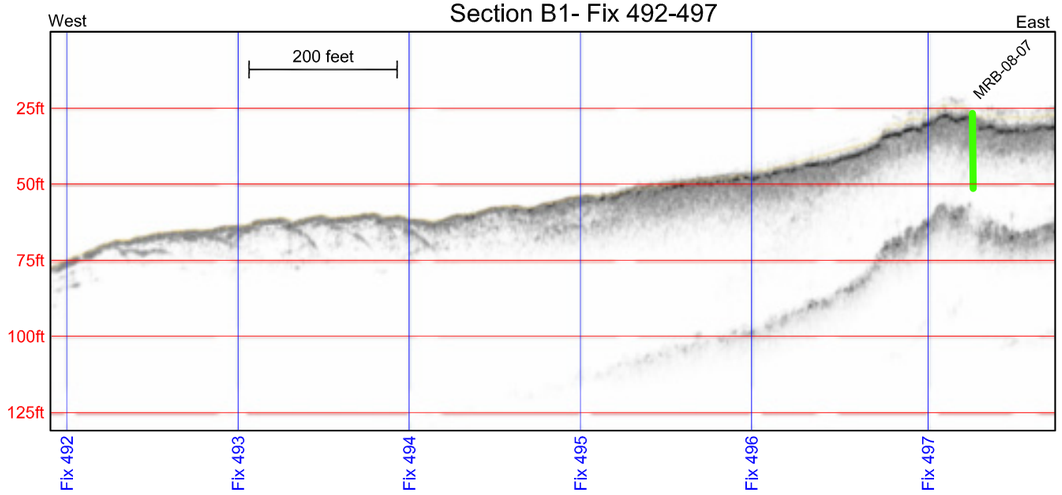
Alpine Ocean Seismic Survey, Inc.
70 Oak St.
Norwood, NJ 07648

MR-E-09 Riverine
Survey Area

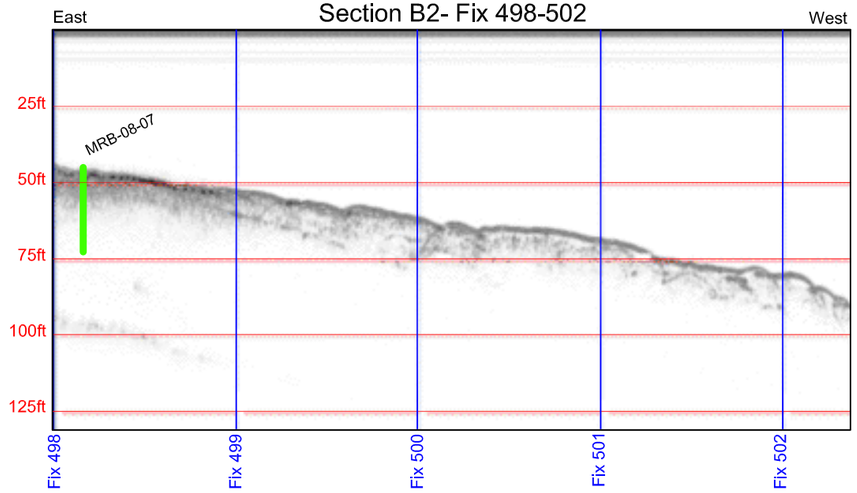
Bathymetry : MR-E-09

Party Chief: Kyle Kingman	Drawn: KK	Drawing Name: 1513 Bathy_Update.dwg	1
Vessel: M/V Laney			
Date of Survey: November 2008		Chart 4	

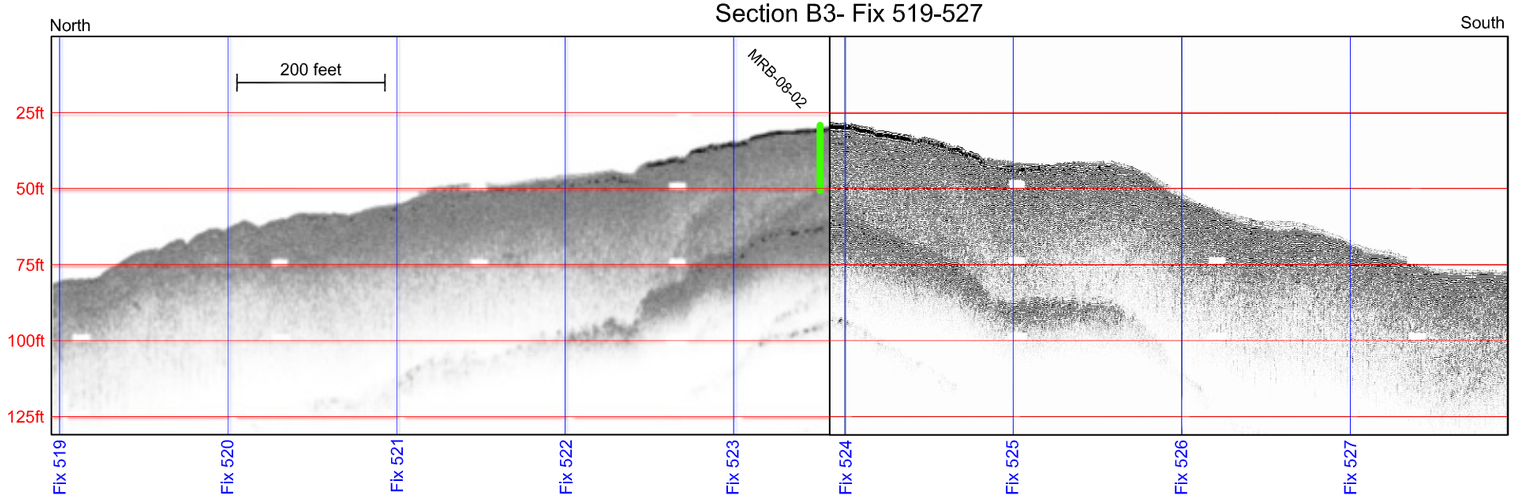
Section B1- Fix 492-497



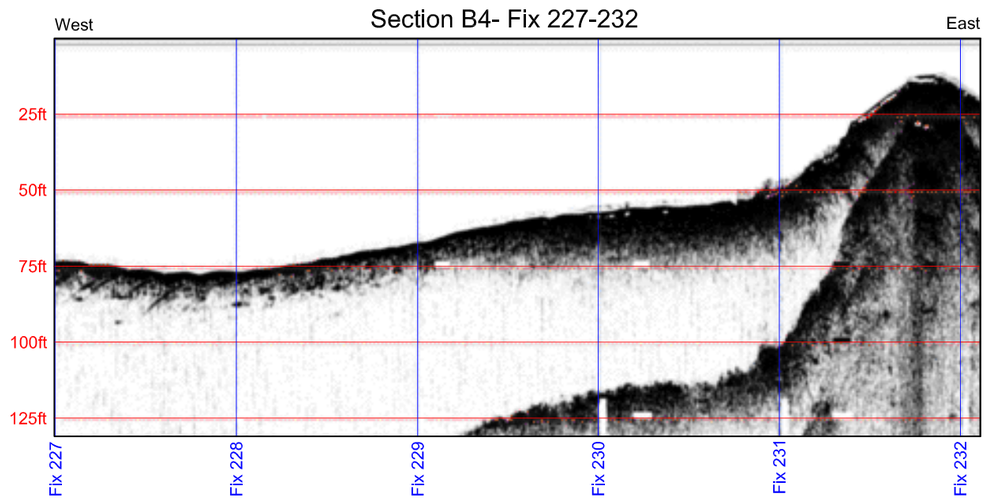
Section B2- Fix 498-502



Section B3- Fix 519-527



Section B4- Fix 227-232



MRB-08-07

Core Depth(ft)	Sediment Description
0 - 4.3	Mud
4.3 - 16.4	Interbedded Silt & Sand Layers
16.4 - 19.8	Peat
19.8 - 23.5	Interbedded Silt & Sand Lenses

MRB-08-02

Core Depth(ft)	Sediment Description
0 - 3.9	Sand and Mud
3.9 - 5.8	Peat
5.8 - 12.4	Layers of Sand & Silt
12.4 - 19	Peat
19 - 22.4	Layers of Sand & Mud
22.4 - 23	Sandy Peat

LEGEND

- Vibracore Location
- Fix Mark
- Water Depth Mark

VERTICAL SCALE
(1 inch = 50 feet)

50'
25'
0'

Horizontal Scale as Shown

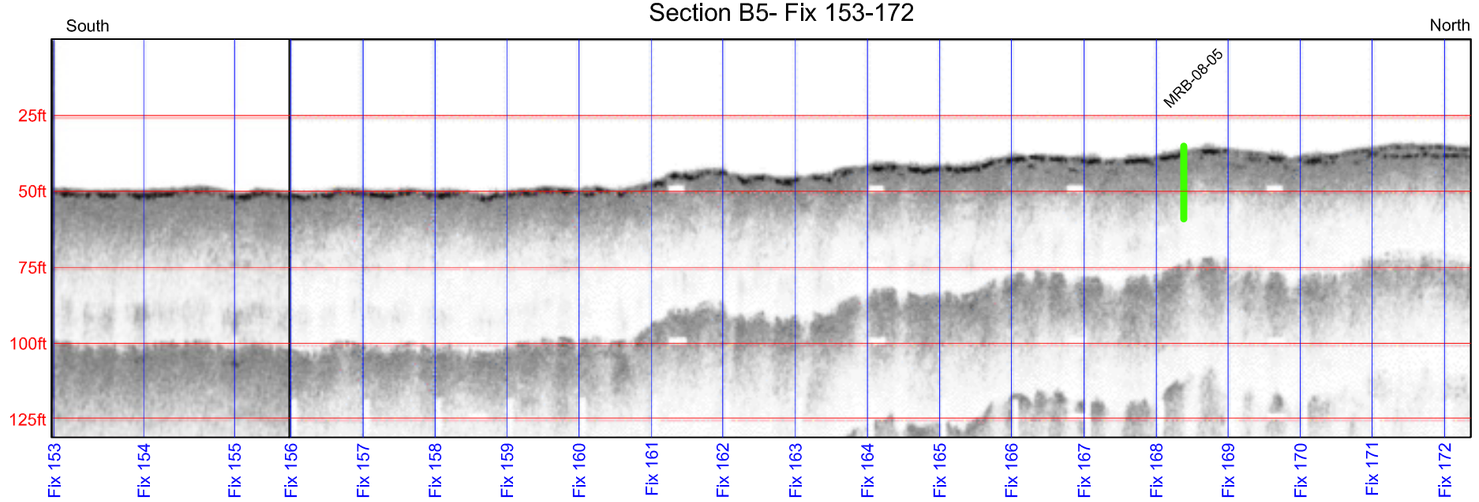
SJB Group, LLC

Alpine Ocean Seismic Survey, Inc.
70 Oak St.
Norwood, NJ 07648

MR-B-09 Riverine
Survey Area
Subbottom Profiles: MR-B-09

Party Chief: Kyle Kingman	Drawn: NG	Drawing Name: 1513 Profiles.dwg	1
Vessel: M/V Laney			
Date Of Survey: November 2008			
		Chart 9	

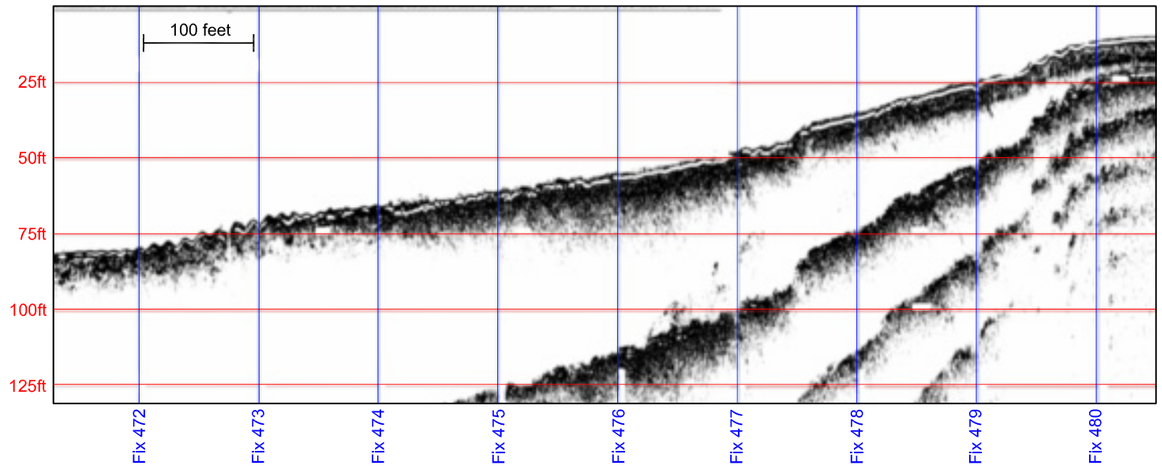
Section B5- Fix 153-172



MRB-08-05

Core Depth(ft)	Sediment Description
0 - 5.5	Sand & Mud Layers
5.5 - 14.9	Fine to Coarse Sand
14.9 - 16.8	Mud
16.8 - 20.5	Fine Sand

Section B6- Fix 472-480



LEGEND

- Vibracore Location
- Fix Mark
- Water Depth Mark

VERTICAL SCALE
(1 inch = 50 feet)

50'
25'
0'

Horizontal Scale as Shown

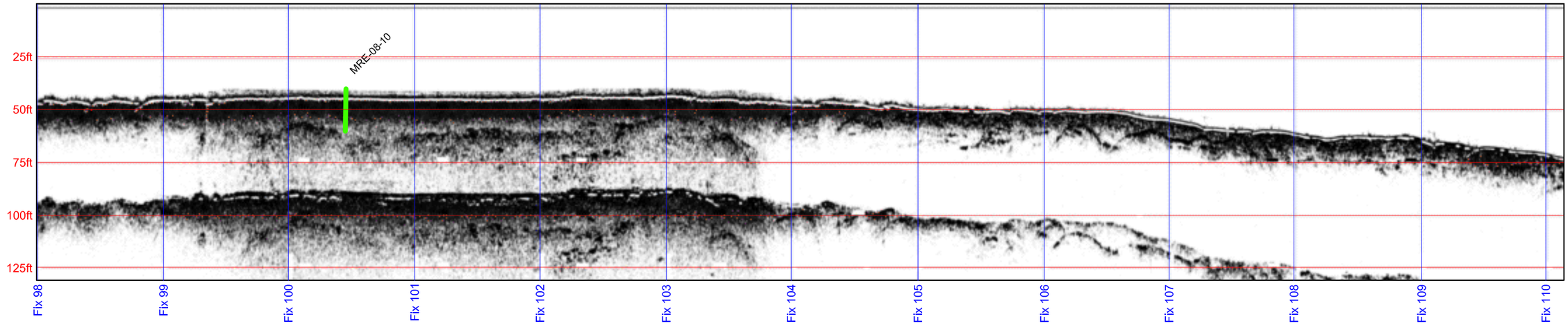
SJB Group, LLC

Alpine Ocean Seismic Survey, Inc.
70 Oak St.
Norwood, NJ 07648

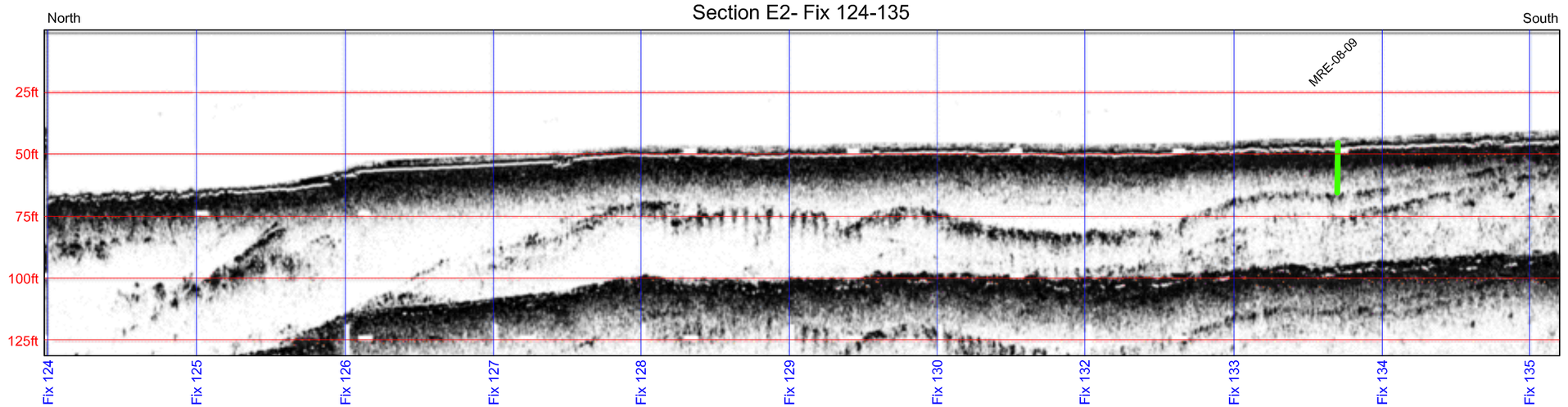
MR-B-09 Riverine
Survey Area
Subbottom Profiles: MR-B-09

Party Chief: Kyle Kingman	Drawn: NG	Drawing Name: 1513 Profiles.dwg	1
Vessel: M/V Laney			
Date Of Survey: November 2008		Chart 10	

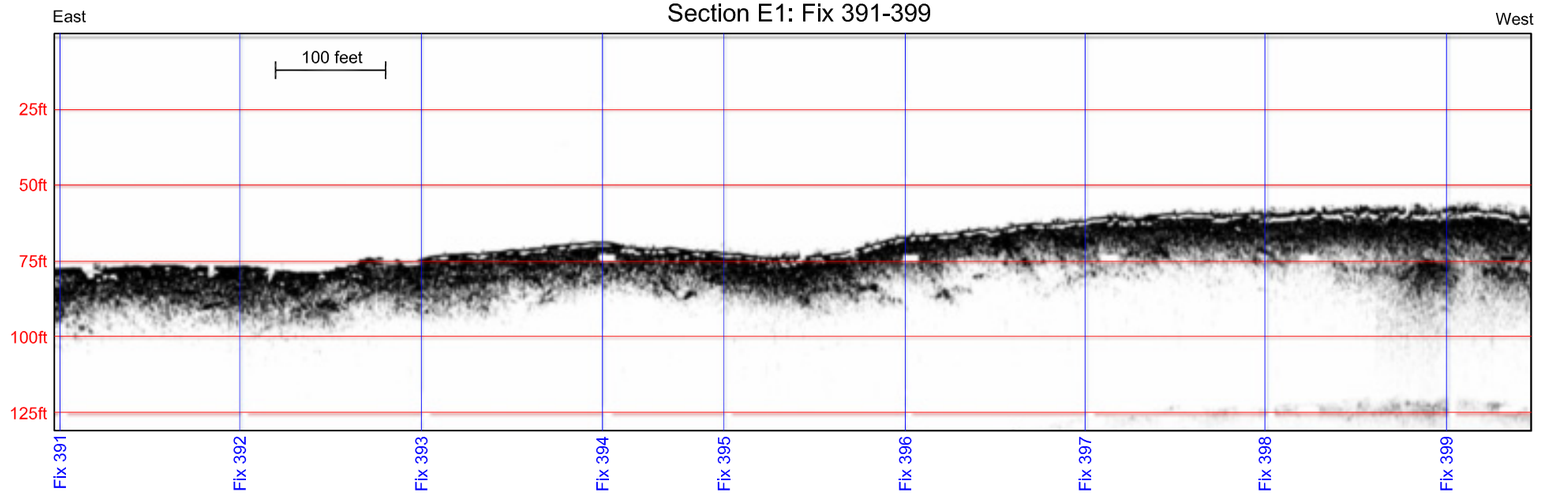
Section E3- Fix 98-110



Section E2- Fix 124-135



Section E1: Fix 391-399



MRE-08-09

Core Depth(ft)	Sediment Description
0 - 5	Mud
5 - 8	Fine Sand
8 - 9.7	Sand w/ Abundant Peat
9.7 - 12.9	Sand
12-9 - 18	Muddy Sand w/ Peat

MRE-08-10

Core Depth(ft)	Sediment Description
0 - 3	Mud
3 - 17	Fine Sand
17 - 18.3	Silty Fine Sand & Mud Lenses - Yellow Brown at 15 feet

LEGEND

- Vibracore Location
- Fix Mark
- Water Depth Mark

VERTICAL SCALE
(1 inch = 50 feet)

50'
25'
0'

Horizontal Scale as Shown

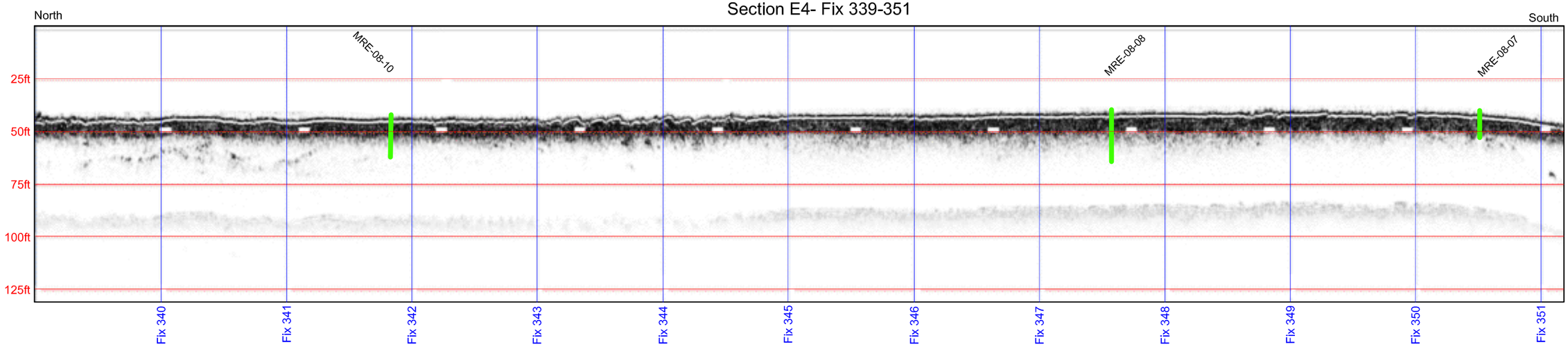
SJB Group, LLC

Alpine Ocean Seismic Survey, Inc.
70 Oak St.
Norwood, NJ 07648

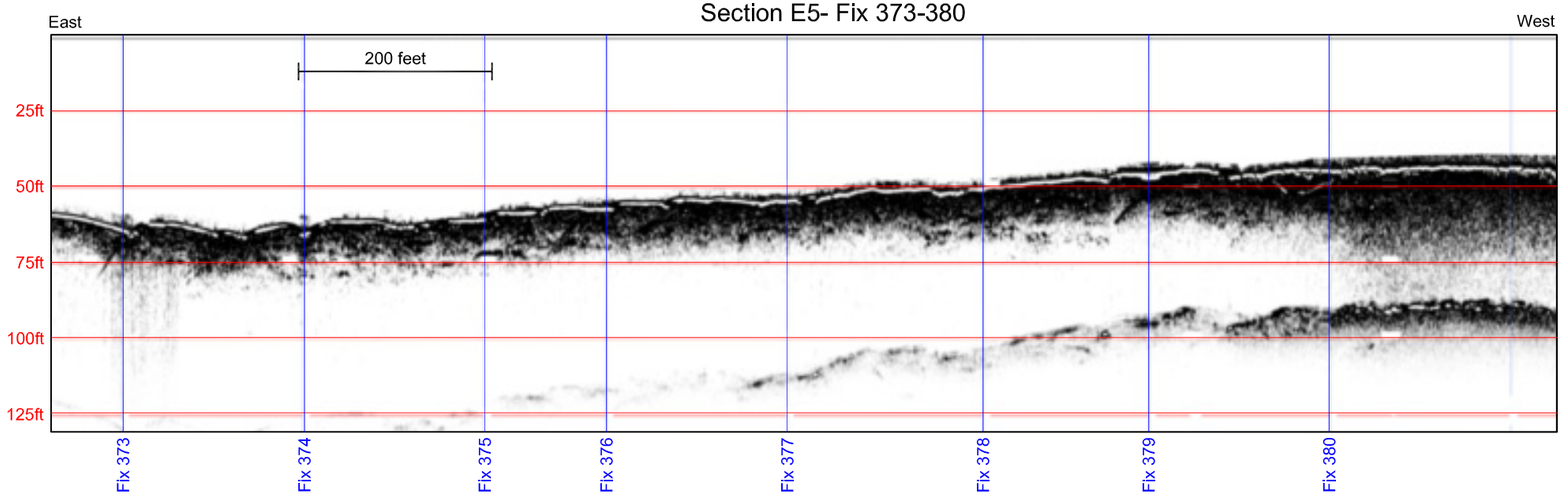
MR-E-09 Riverine
Survey Area
Subbottom Profiles: MR-E-09

Party Chief: Kyle Klingman	Drawn: NG	Drawing Name: 1513 Profiles.dwg | 1
Vessel: M/V Laney		
Date Of Survey: November 2008		Chart 11

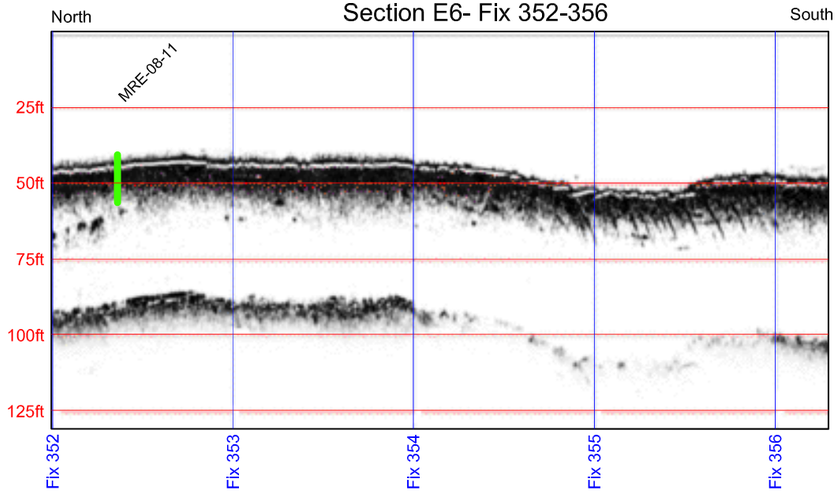
Section E4- Fix 339-351



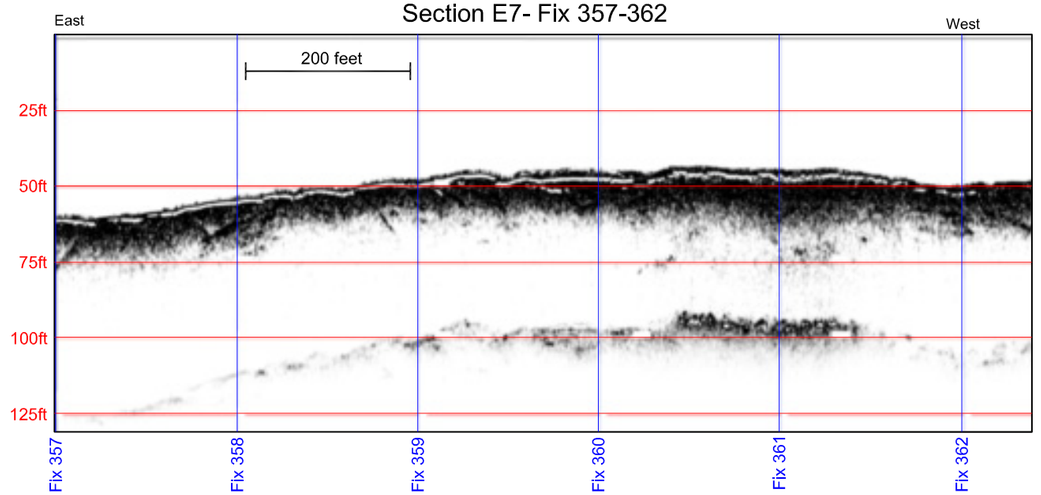
Section E5- Fix 373-380



Section E6- Fix 352-356



Section E7- Fix 357-362



MRE-08-07

Core Depth(ft)	Sediment Description
0 - 1.8	Mud
1.8 - 9.5	Sand
9.5 - 16.3	Interbedded Silt & Sand Layers

MRE-08-08

Core Depth(ft)	Sediment Description
0 - 10.4	Interbedded Mud & Sand Layers
10.4 - 14.2	Peat in a Sandy Mud Matrix
14.2 - 21.3	Mud
21.3 - 25	Sand

MRE-08-11

Core Depth(ft)	Sediment Description
0 - 2.3	Silt & Silty Sand
2.3 - 13.3	Fine Sand
13.3 - 17	Fine Sand & Mud Lenses - Yellow Brown at 15 feet

MRE-VC-09 - See Chart 11
MRE-VC-10 - See Chart 11

LEGEND

- Vibracore Location
- Fix Mark
- Water Depth Mark

VERTICAL SCALE
(1 inch = 50 feet)

50'
25'
0'

Horizontal Scale as Shown

SJB Group, LLC

Alpine Ocean Seismic Survey, Inc.
70 Oak St.
Norwood, NJ 07648

MR-E-09 Riverine
Survey Area
Subbottom Profiles: MR-E-09

Party Chief: Kyle Klingman	Drawn: NG	Drawing Name: 1513 Profiles.dwg	1
Vessel: M/V Laney			
Date Of Survey: November 2008		Chart 12	

ANNEX A2

DATA TABLES

Table 1: MR-B-09 Magnetic Anomalies

#	X	Y	GAMMA
1	3837985.63	326679.48	14
2	3837570.25	327110.66	23
3	3837253.50	327403.61	51
4	3837155.75	327461.63	604
5	3836977.25	327636.55	430
6	3836790.63	327825.44	47
7	3836531.30	328008.90	30
8	3836438.50	328086.36	29
9	3836262.13	328216.63	27
10	3835219.88	329200.33	56
11	3836214.75	327868.48	17
12	3835514.50	328690.47	14
13	3835211.50	328774.84	25
14	3835392.13	328496.67	9
15	3838251.72	325896.52	140
16	3837874.25	326283.67	47
17	3837764.25	326365.78	24
18	3837703.50	326412.53	88
19	3837480.75	326586.52	111
20	3837443.85	326617.54	617
21	3837183.25	326837.86	512
22	3836917.22	327066.94	319
23	3836735.38	327231.53	138
24	3838716.13	326045.41	15
25	3838310.63	326399.72	53
26	3838171.38	326502.66	8
27	3837989.75	326621.03	26
28	3837840.00	326728.81	7
29	3837744.38	326792.28	39
30	3837662.50	326848.23	13
31	3837050.26	327388.12	26
32	3836988.85	327442.26	44
33	3836404.20	327957.85	38
34	3835959.98	328382.35	26
35	3835793.50	328526.25	11
36	3835704.75	328599.31	32
37	3835506.13	328767.72	9

#	X	Y	GAMMA
38	3835247.45	328106.79	18
39	3836337.63	327198.64	34
40	3836411.13	327127.31	163
41	3836662.63	326886.84	32
42	3837053.88	326500.03	70
43	3837393.72	326208.20	8
44	3837655.25	326079.69	16
45	3836408.00	327749.17	28
46	3836481.75	327692.28	50
47	3836520.45	327661.66	33
48	3836603.00	327589.97	93
49	3836653.63	327544.52	61
50	3836763.25	327444.97	29
51	3836919.04	327305.85	13
52	3837075.00	327164.80	78
53	3837282.63	326968.05	30
54	3837063.13	326707.97	29
55	3836602.63	327018.30	26
56	3836355.50	327252.58	16
57	3834980.25	328763.66	39
58	3837626.72	326006.84	53
59	3834958.88	328477.73	17
60	3835375.52	328021.84	39
61	3835702.48	327818.30	14
62	3836585.00	327149.02	11
63	3836920.00	326823.75	90
64	3836993.00	326710.44	19
65	3837098.50	326647.92	25
66	3835159.75	328735.95	114
67	3835368.50	328525.80	9
68	3836432.75	327391.78	8
69	3836756.00	327144.39	11
70	3836854.50	327076.13	24
71	3836971.38	326995.97	124
72	3836464.89	328130.63	18
73	3835481.75	329138.03	251
74	3835378.60	329191.45	49
75	3837563.50	326807.63	47
76	3836918.50	327458.97	156
77	3836542.25	327710.05	176
78	3836441.88	327787.92	33

#	X	Y	GAMMA
79	3834959.00	329200.61	106
80	3834385.00	329698.88	28
81	3837485.13	326612.88	27
82	3837136.00	326925.64	33
83	3836862.75	327205.56	83
84	3836710.15	327367.73	7
85	3836280.25	327806.70	14
86	3835144.00	328942.56	33
87	3834945.00	329141.42	6
88	3835554.33	327702.38	18
89	3835815.75	327439.55	18
90	3836674.63	326740.02	18
91	3836768.50	326665.78	38
92	3836846.38	326620.19	17
93	3837059.63	326493.80	13
94	3838137.13	326590.56	12
95	3837752.75	326906.95	9
96	3837476.63	327124.61	1667
97	3837421.38	327172.19	77
98	3837252.38	327312.44	16
99	3836883.75	327624.45	16
100	3836626.81	327850.76	24
101	3835123.13	328692.20	88
102	3835386.25	328509.25	15
103	3835956.88	328044.03	35
104	3836070.55	327879.36	34
105	3836658.88	327449.86	85
106	3836826.88	327310.92	59
107	3836920.25	327211.27	53
108	3837087.75	327043.06	15
109	3837213.50	326932.66	28
110	3834923.13	328048.34	10
111	3835090.50	327936.67	12
112	3835461.50	327606.16	15
113	3836230.88	327018.91	9
114	3836851.25	326619.63	6
115	3836973.00	326493.25	27
116	3837109.38	326247.08	31

Table 2: MR-E-09 Magnetic Anomalies

#	X	Y	GAMMA
1	3860264.00	315055.61	22
2	3860523.00	314900.83	13
3	3860675.63	315223.50	4
4	3860772.25	315545.06	24
5	3860818.00	315536.17	11
6	3860950.54	315510.18	12
7	3860981.13	315810.25	8
8	3861000.50	314670.70	11
9	3861255.64	314538.77	38
10	3861293.43	315939.06	10
11	3861289.19	314550.34	104
12	3861640.61	314393.32	18
13	3861642.00	314362.95	15
14	3861672.00	315477.41	24
15	3861834.38	314556.06	46
16	3862017.88	314455.44	143
17	3862314.51	314287.92	16
18	3862484.75	313895.91	14
19	3863029.75	313909.95	31
20	3863167.00	314449.69	10
21	3863221.78	313529.48	9
22	3863361.20	313959.95	11
23	3863475.52	314273.37	7
24	3863665.99	313323.70	10
25	3863738.72	313791.82	28
26	3863724.25	313195.25	26
27	3863832.74	313525.37	25
28	3863818.50	314061.70	19
29	3863879.31	313252.87	27
30	3863941.13	313984.53	109
31	3864049.64	313409.13	17
32	3864140.75	313162.72	55
33	3864137.08	313861.01	33
34	3864582.38	312829.13	22
35	3864612.79	313088.38	28
36	3864647.13	312874.98	50
37	3864803.99	313809.99	12
38	3864862.63	312727.89	23
39	3865058.25	313675.68	7

#	X	Y	GAMMA
40	3865092.75	312564.88	25
41	3865147.58	313127.32	26
42	3865164.76	313435.17	9
43	3865593.34	313217.41	26
44	3865644.53	312244.12	10
45	3865803.48	313559.40	12
46	3865885.02	313602.73	50
47	3865924.75	312227.09	39
48	3866002.25	312619.51	32
49	3866103.91	312290.75	50
50	3866090.50	312085.56	47
51	3866131.36	311988.06	20
52	3866194.13	312008.28	17
53	3866379.38	313248.89	9
54	3866409.78	312743.40	12
55	3866585.34	311788.90	12
56	3866655.62	311731.79	35
57	3866783.65	312222.24	20
58	3866863.93	312992.70	5
59	3866964.66	311868.72	123
60	3867010.25	311575.47	20
61	3867046.45	312057.60	11
62	3867080.00	311798.06	18
63	3867187.64	311548.38	34
64	3867355.63	311986.88	76
65	3867444.31	311868.96	21
66	3868071.06	312012.54	23
67	3868594.87	311657.71	143

Table 3: Sidescan Sonar Targets

NMH = No measurable height

#	NAME	Length (ft)	Width (ft)	Height (ft)	EASTING	NORTHING
1	Target	2.9	2.5	0.3	3834527.47	329486.50
2	Target	17.2	12.4	NMH	3834984.63	328204.52
3	Target	12.2	2.9	1.7	3835164.64	329169.71
4	Target	12.1	3.1	2.4	3835430.27	328908.37
5	Target	10.4	6.2	1.2	3835521.17	328669.17
6	Target	25.9	11.6	NMH	3835622.19	328635.77
7	Target	9.4	1.8	2.1	3835628.04	328806.31
8	Target	9.9	4.0	1.6	3835712.33	328461.89
9	Target	7.6	2.1	0.8	3835836.26	328372.10
10	Target	8.9	6.1	NMH	3836601.29	326774.80
11	Target	6.6	10.0	NMH	3836749.52	326643.47
12	Target	2.1	8.1	NMH	3836779.84	326621.53
13	Target	13.7	2.6	NMH	3836874.58	326501.48
14	Target	16.9	9.2	NMH	3837024.84	326430.52
15	Target	10.5	4.8	1.8	3837283.51	327123.86
16	Target	10.9	2.9	NMH	3837657.72	326806.21
17	Target	76.0	83.1	NMH	3859612.74	315589.17
18	Target	12.8	2.9	1.4	3859746.83	316254.29
19	Target	14.8	5.1	NMH	3860290.45	315905.84
20	Target	6.0	4.5	NMH	3861035.87	315677.41
21	Target	21.0	32.0	NMH	3861183.85	314319.18
22	Target	16.5	10.9	1.3	3861371.65	314188.50
23	Target	7.5	1.6	NMH	3861721.96	315650.65
24	Target	11.8	6.1	NMH	3861792.25	314145.60
25	Target	7.9	10.3	NMH	3861819.67	314090.26
26	Target	9.4	7.2	0.4	3861857.86	314104.58
27	Target	26.6	2.8	0.4	3861961.90	314032.86
28	Target	16.4	2.9	0.2	3862024.61	314045.62
29	Target	13.1	1.3	0.8	3862025.78	314726.53
30	Target	2.8	3.4	0.3	3862166.64	313760.92
31	Target	22.8	12.6	NMH	3862277.68	314577.65
32	Target	5.1	2.8	NMH	3862772.04	313905.81
33	Target	11.7	0.7	0.9	3862902.66	313378.27
34	Target	11.0	2.4	NMH	3862950.33	313419.83
35	Target	18.1	1.8	NMH	3862962.40	313485.05
36	Target	13.3	14.6	NMH	3863073.71	313389.76
37	Target	48.2	46.3	36.5	3863872.32	314070.94
38	Target	8.5	0.7	NMH	3864132.70	313873.90

#	NAME	Length (ft)	Width (ft)	Height (ft)	EASTING	NORTHING
39	Target	7.0	5.3	NMH	3864250.65	313261.79
40	Target	20.4	10.3	NMH	3864266.25	312825.40
41	Target	19.1	2.8	NMH	3864314.05	312740.99
42	Target	6.8	0.8	1.6	3864509.81	314194.37
43	Target	11.4	1.5	NMH	3864609.19	312632.05
44	Target	16.1	8.2	NMH	3864684.50	313306.51
45	Target	9.0	6.9	2.9	3865015.86	313493.32
46	Target	5.3	3.9	NMH	3865034.54	313482.23
47	Target	4.6	1.9	NMH	3865077.18	312486.98
48	Target	28.2	7.8	0.2	3865088.96	312569.07
49	Target	31.3	18.3	0.6	3865103.99	312534.73
50	Target	4.8	3.5	NMH	3866435.48	312623.27
51	Target	14.9	13.8	NMH	3866893.69	312477.92
52	Target	11.4	9.3	NMH	3866908.09	312398.59
53	Target	6.9	6.5	NMH	3866930.69	312501.47
54	Target	6.9	7.1	NMH	3867899.07	312405.32
55	Target	3.0	3.5	NMH	3868039.16	312084.76
56	Target	3.9	1.8	NMH	3868272.82	311854.65
57	Target	4.0	1.4	NMH	3868552.17	312109.34
58	Scattered				3835160.24	329283.91
59	Scattered				3835165.49	329249.00
60	Scattered				3835167.52	329199.60
61	Scattered				3835178.23	329215.16
62	Scattered				3835196.59	329196.11
63	Scattered				3835307.28	329009.93
64	Scattered				3835908.09	327556.77
65	Scattered				3836702.47	326456.93
66	Scattered				3836739.31	326526.93
67	Scattered				3836836.36	326551.71
68	Scattered				3838172.79	326256.00
69	Scattered				3861835.83	314059.39
70	Scattered				3861899.60	314016.49
71	Scattered				3862006.18	313944.36
72	Target	36.0	25.0	0.5	3835401.84	329091.55

Table 4: Linear Sidescan Sonar Targets

Little or no measurable height or significant width

#	NAME	Length (ft)	EASTING	NORTHING
1	Linear Target	52	3835407.00	329089.56
2	Linear Target	33	3835420.76	328541.12
3	Linear Target	28	3834672.50	328617.21
4	Linear Target	30	3835522.56	328106.57
5	Linear Target	14	3835466.67	328170.55
6	Linear Target	18	3835466.44	328083.14
7	Linear Target	23	3835468.86	328115.64
8	Linear Target	12	3835478.43	328139.20
9	Linear Target	32	3835440.52	328136.92
10	Linear Target	58	3836433.78	327892.11
11	Linear Target	99	3836428.46	327641.03
12	Linear Target	43	3836704.08	327769.28
13	Linear Target	43	3836884.13	327397.99
14	Linear Target	288	3837073.96	327441.37
15	Linear Target	20	3836892.94	326683.45
16	Linear Target	14	3836543.01	326687.32
17	Linear Target	73	3836544.60	326774.02
18	Linear Target	21	3837377.21	326836.82
19	Linear Target	32	3860465.80	314855.50
20	Linear Target	25	3861125.73	314415.96
21	Linear Target	8	3861121.70	314423.22
22	Linear Target	17	3861134.46	314417.88
23	Linear Target	509	3861345.46	316055.03
24	Linear Target	76	3861277.94	316067.76
25	Linear Target	65	3861717.99	314778.31
26	Linear Target	20	3862119.75	313932.34
27	Linear Target	9	3862059.04	313963.15
28	Linear Target	44	3862712.90	313972.16
29	Linear Target	95	3863872.10	314011.67
30	Linear Target	228	3863781.92	313151.73
31	Linear Target	75	3863874.99	313177.05
32	Linear Target	75	3863832.28	313229.08
33	Linear Target	84	3863924.34	313120.24
34	Linear Target	27	3864139.95	313310.21
35	Linear Target	24	3864727.97	312673.61
36	Linear Target	13	3865420.81	313329.88
37	Linear Target	40	3865305.80	312447.39
38	Linear Target	143	3865087.20	312506.64
39	Linear Target	22	3866429.58	311555.13

#	NAME	Length (ft)	EASTING	NORTHING
40	Linear Target	20	3867660.94	312678.06
41	Linear Target	51	3867655.51	311326.65
42	Linear Target	19	3868523.29	311972.81