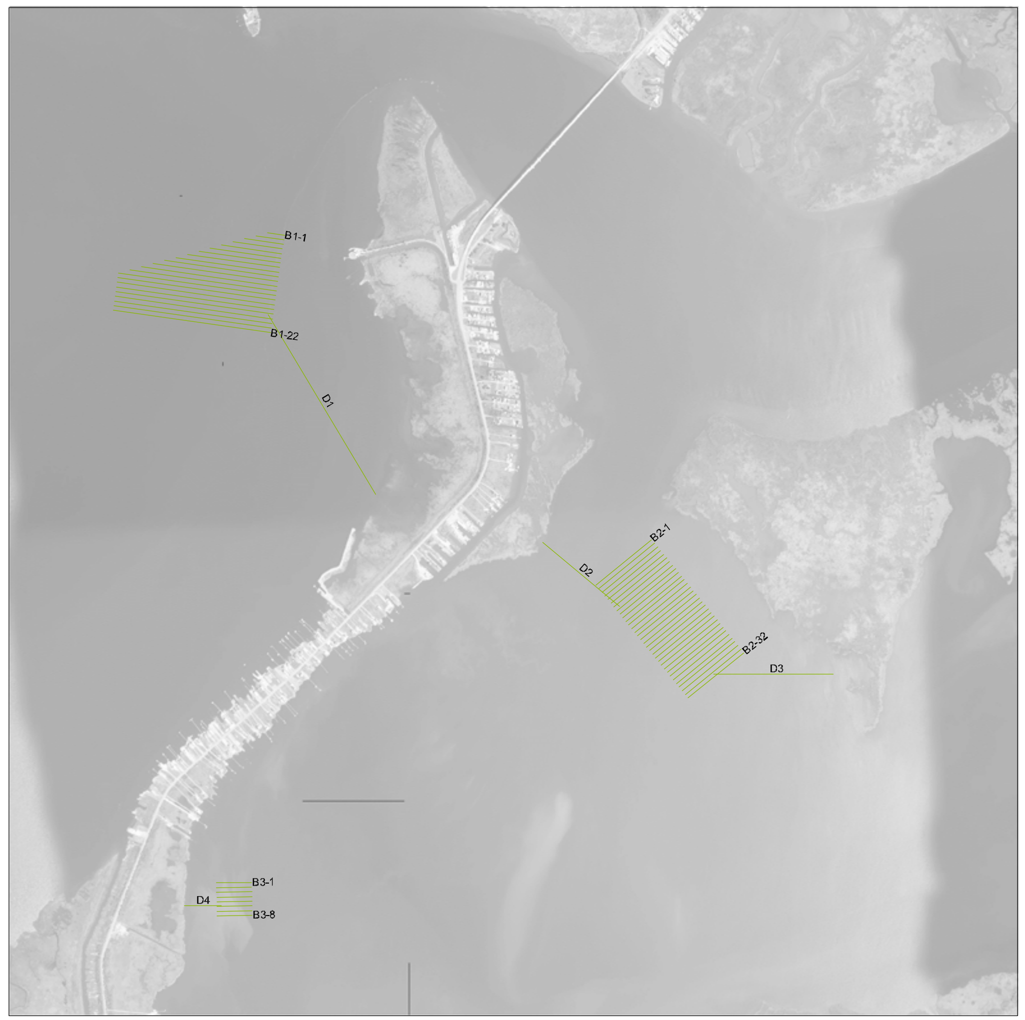
PO-169

NEW ORLEANS LANDBRIDGE
SHORELINE STABILIZATION
AND MARSH CREATION PROJECT (BORROW AREAS)
ORLEANS PARISH, LOUISIANA



Grid

Prepared for the
State of Louisiana
Coastal Protection and Restoration Authority

Contract No. 4400005539 (2503-15-21)
Task Order No. 3

PRELIMINARY

SCALE: 1" = 2000'
2000' 0 1000' 2000'
FEET

COASTAL PROTECTION AND
RESTORATION AUTHORITY
150 Terrace Avenue
Baton Rouge Louisiana 70802

PO-169

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION AND MARSH CREATION PROJECT (BORROW AREAS)

Date: June 16, 2017	Drawn By: RJB
Job. No.: 17-007	Checked By: CDR
Revision Date:	Drawing Name: 17-007 New Orleans Landbridge Borrow Area.dwg

CHUSTZ SURVEYING, LLC
211 Richy Street
New Roads, LA 70760
Tel: 225-638-5949
Fax: 225-638-3924

COVER

Survey Dates: May 16–19, 2017

Aerial imagery was acquired from ESRI World Imagery Map Server.

Horizontal Datum = NAD83, Louisiana South State Plane Zone 1702, U.S. Survey Feet

Vertical Datum = NAVD 88, Feet

Project Benchmark = CRMSPO–SM–25 (X = 3,792,271.06' Y = 618,174.14' Z = 6.34')

Staff Gage: 4" x 4" treated wooden post with ceramic coated face plate
Latitude: 30° 09' 26.1" N
Longitude: 89° 39' 54.4" W

LEGEND

Borrow Area Transects

PRELIMINARY

SCALE: 1" = 1000'
1000' 0 500' 1000'
FEET

COASTAL PROTECTION AND RESTORATION AUTHORITY
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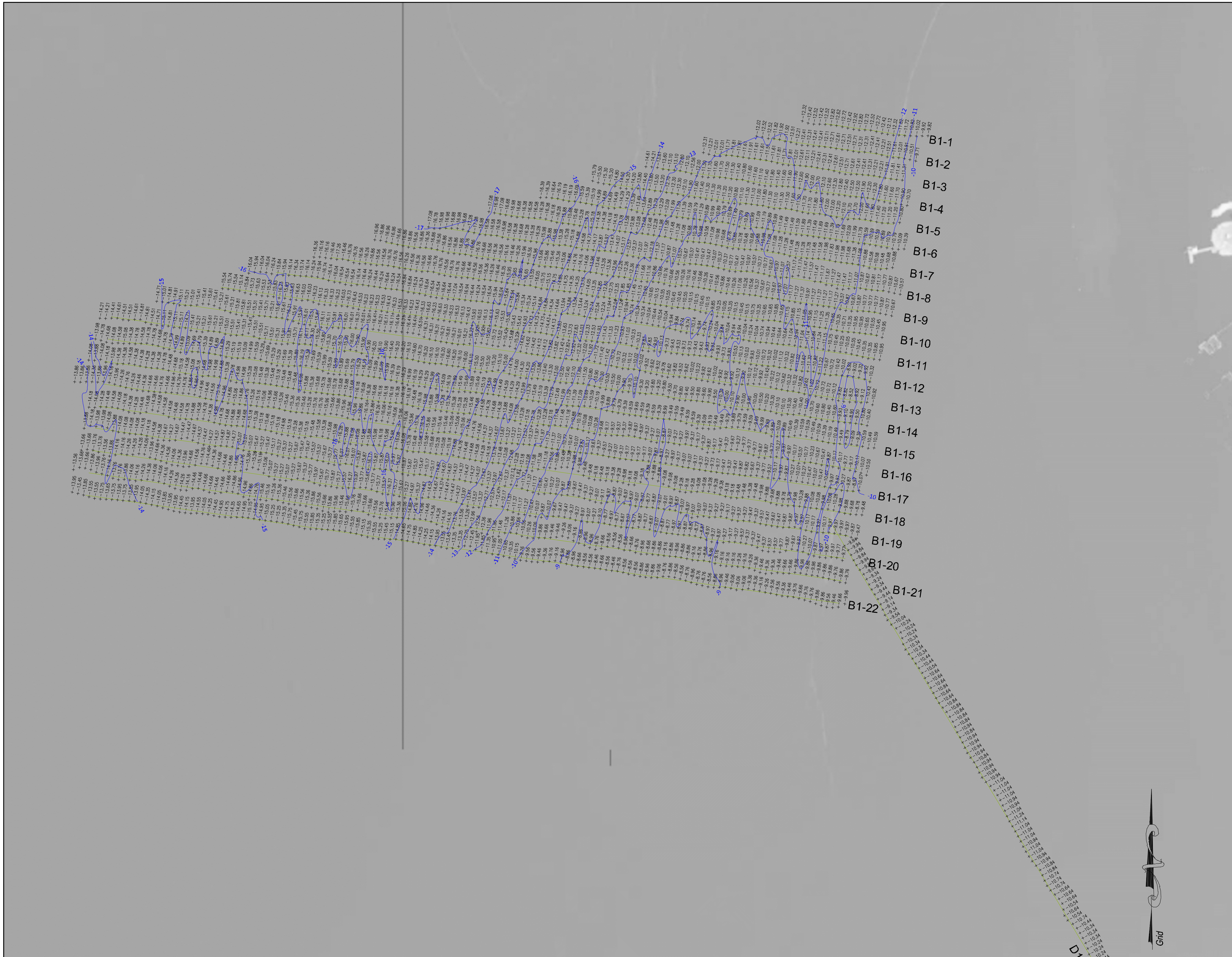
INDEX



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LEGEND

Borrow Area Transects

PRELIMINARY

SCALE: 1" = 200'
200' 0 100' 200'
FEET

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SHEET 1 OF 11

Survey Dates: May 16–19, 2017

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LEGEND

Borrow Area Transects

PRELIMINARY

SCALE: 1" = 200'

200' 0 100' 200'

FEET

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NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION AND MARSH CREATION PROJECT (BORROW AREAS)

PLAN VIEW

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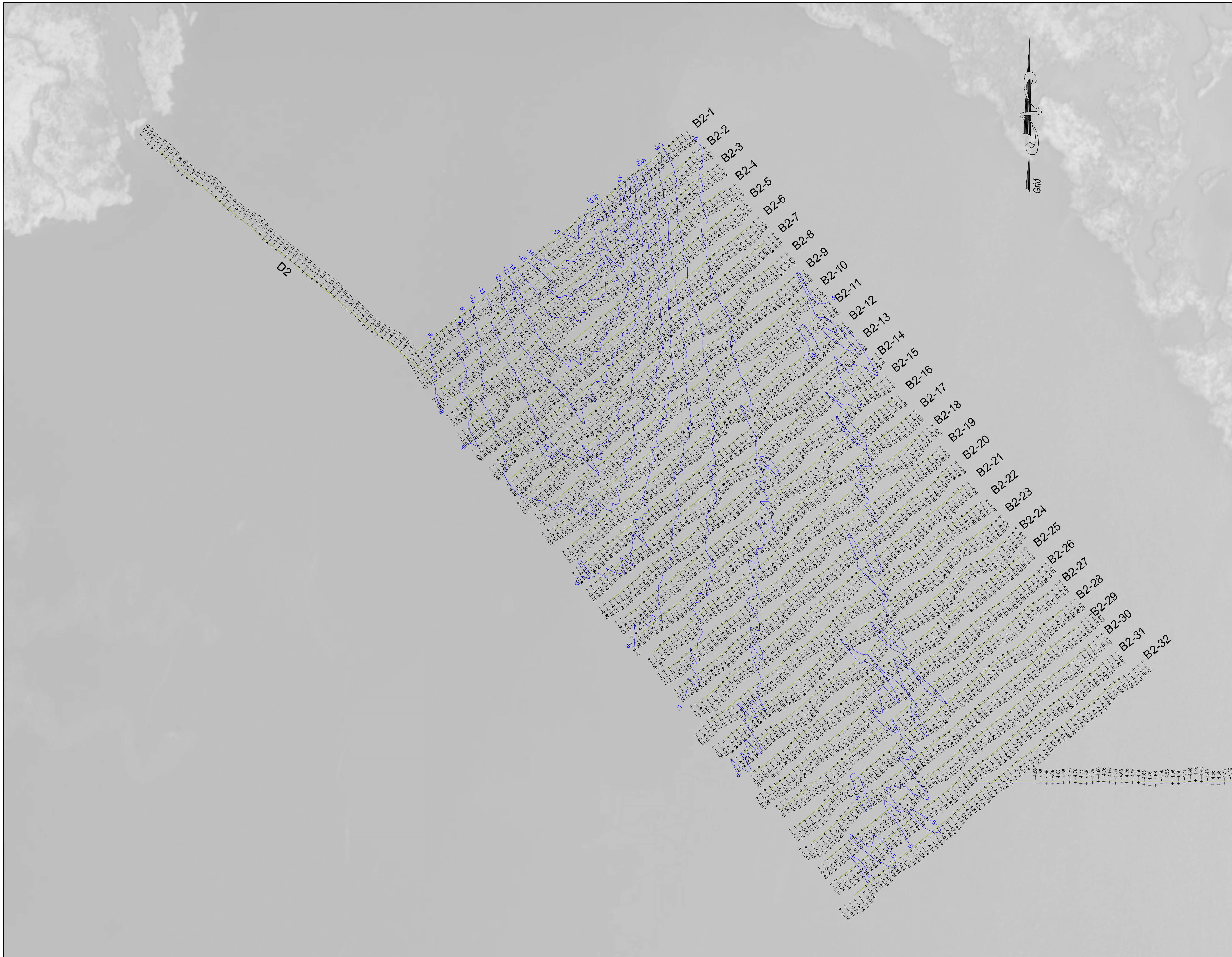
SHEET 2 OF 11



Survey Dates: May 16–19, 2017

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Vertical Datum = NAVD 88, Feet

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LEGEND

Borrow Area Transects

PRELIMINARY

SCALE: 1" = 200'

200' 0 100' 200'

FEET

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LEGEND

Borrow Area Transects

PRELIMINARY

SCALE: 1" = 200'

200' 0 100' 200'

FEET

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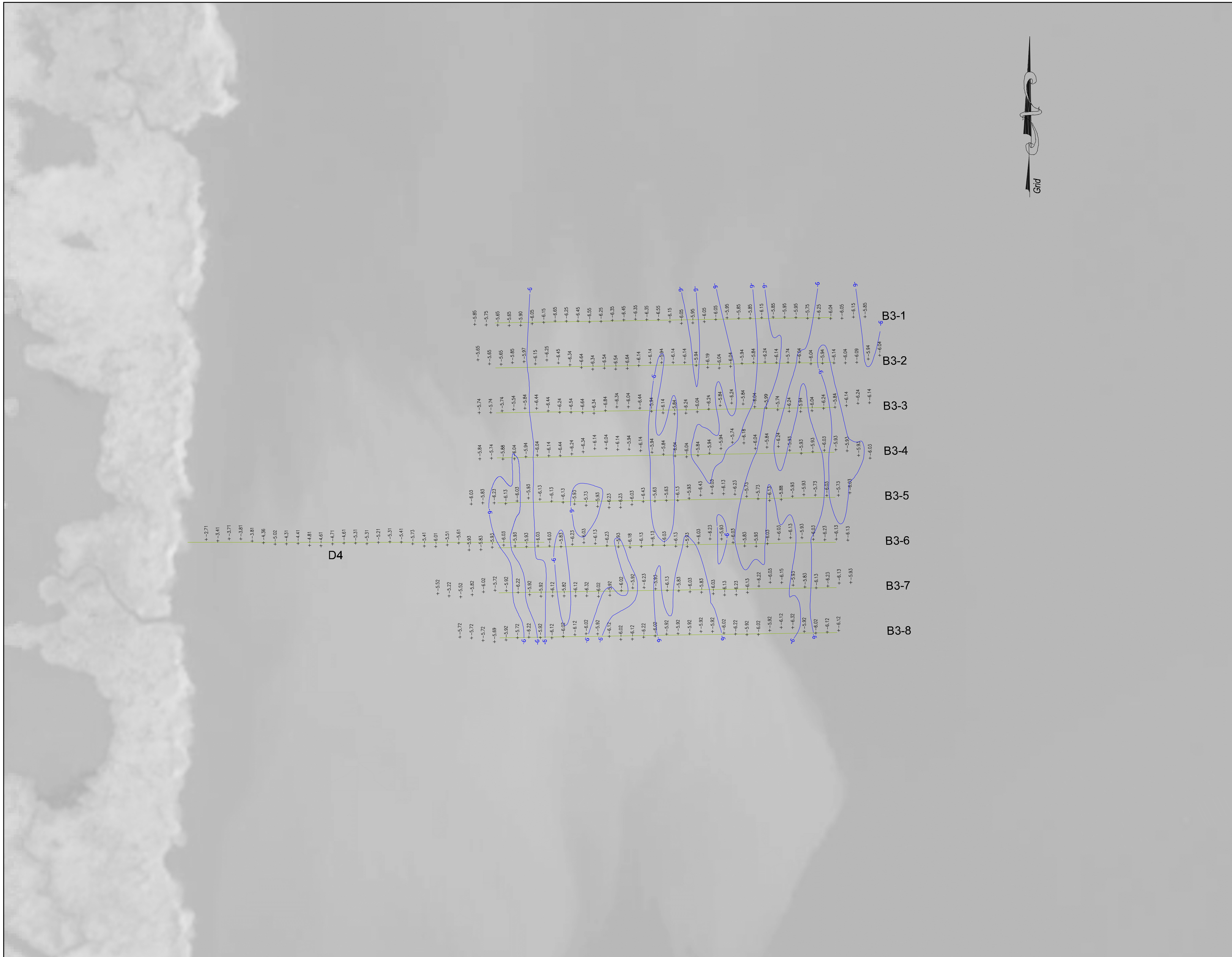

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LEGEND

Borrow Area Transects

PRELIMINARY

SCALE: 1" = 100'

100' 0 50' 100'

FEET

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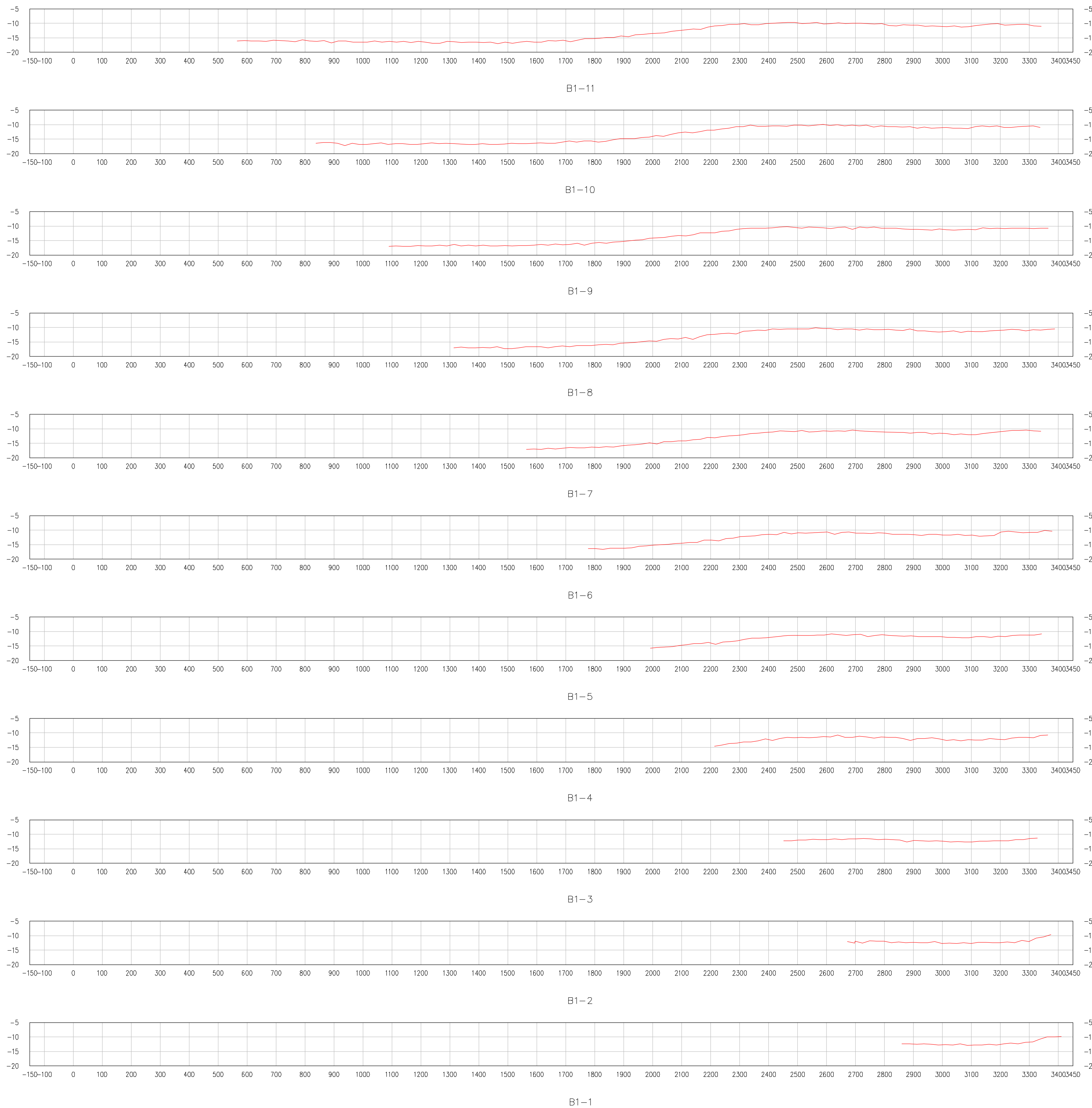

PRELIMINARY

SCALE: 1" = 200'
200' 0 100' 200'
HORIZONTAL (FEET)

SCALE: 1" = 20'
20' 0 10' 20'
VERTICAL (FEET)

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 Terrace Avenue
Baton Rouge Louisiana 70802

PO-169

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION AND MARSH CREATION PROJECT (BORROW AREAS)

CROSS SECTION VIEW

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CHUSTZ SURVEYING, LLC
211 Richy Street
New Roads, LA 70760
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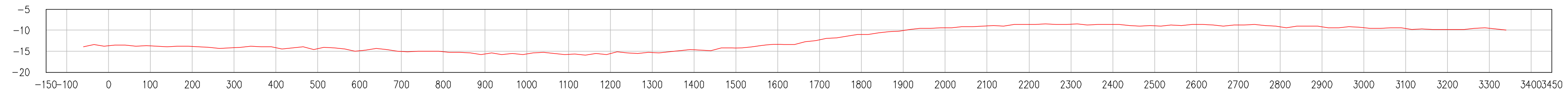
SHEET 6 OF 11



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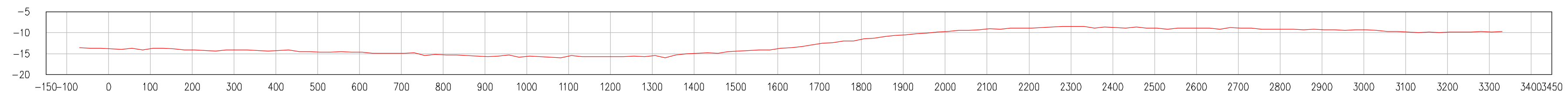

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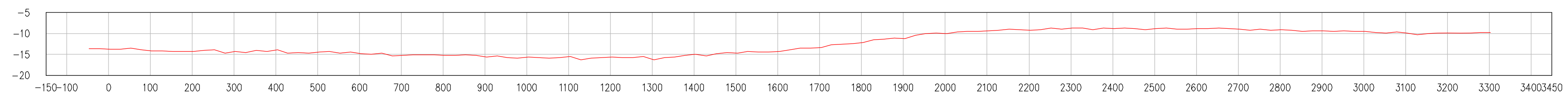

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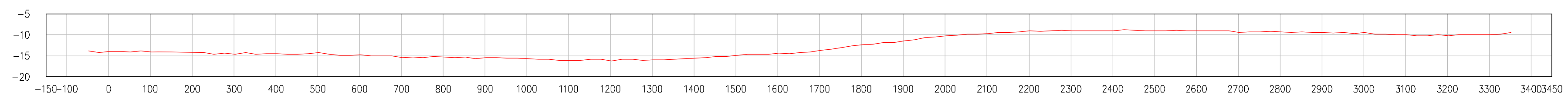

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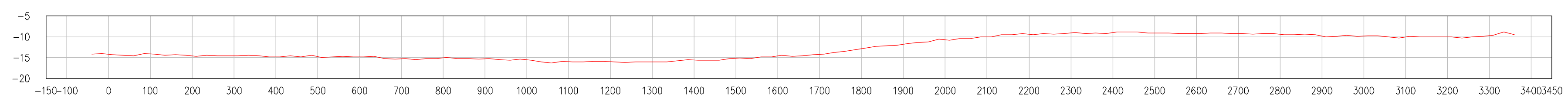

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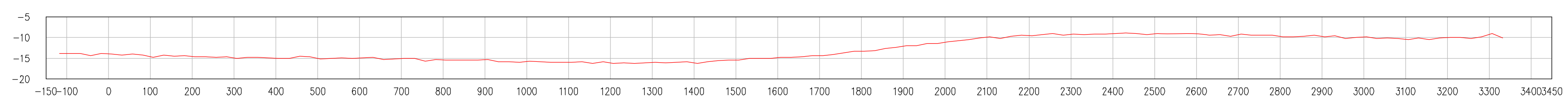

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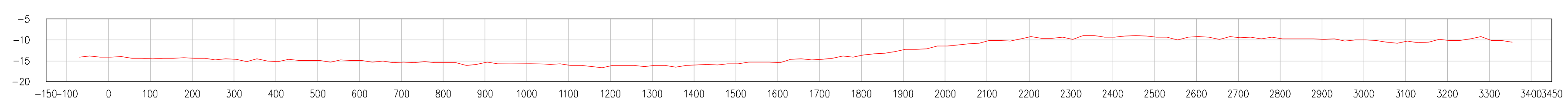

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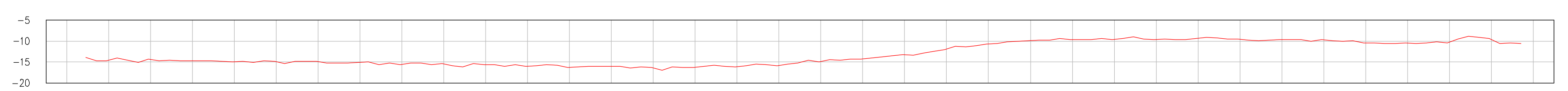

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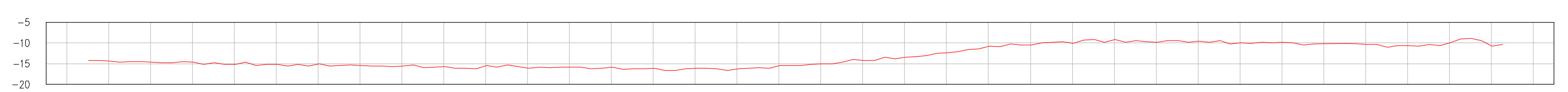

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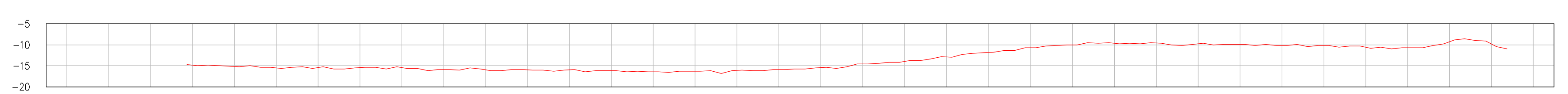

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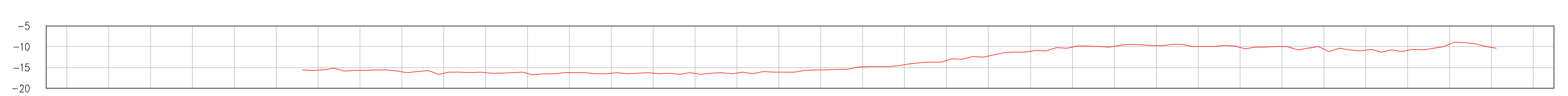

B1–12

Survey Dates: May 16–19, 2017

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PRELIMINARY

SCALE: 1" = 200'
200' 0 100' 200'
HORIZONTAL (FEET)

SCALE: 1" = 20'
20' 0 10' 20'
VERTICAL (FEET)

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 Terrace Avenue
Baton Rouge Louisiana 70802

PO-169

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION AND MARSH CREATION PROJECT (BORROW AREAS)

CROSS SECTION VIEW

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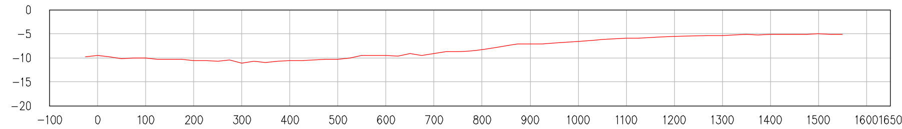

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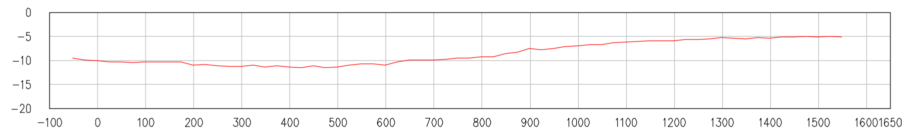

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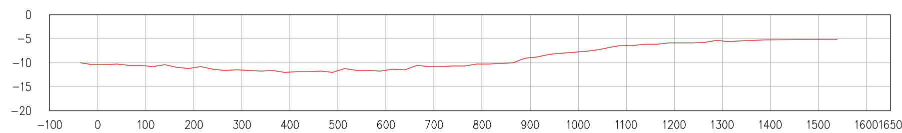

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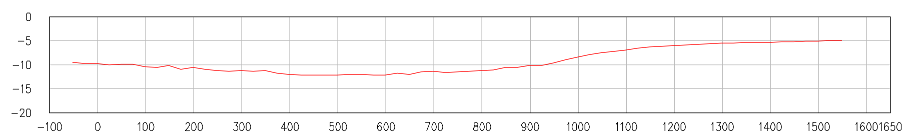

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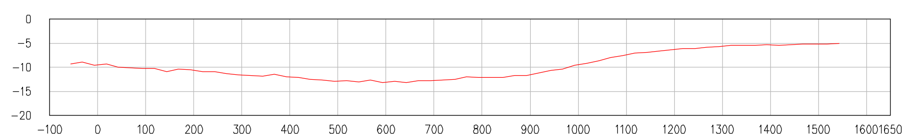

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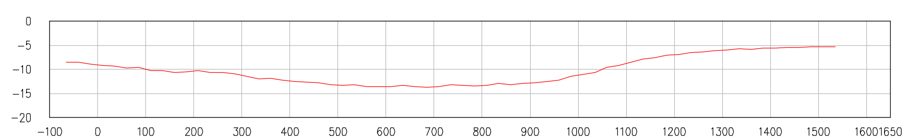

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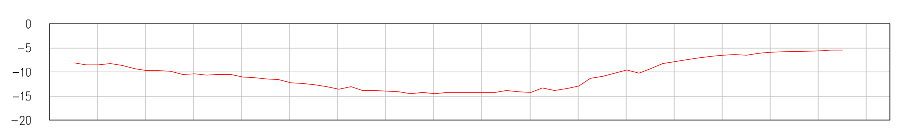

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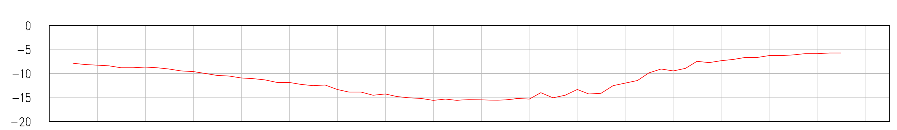

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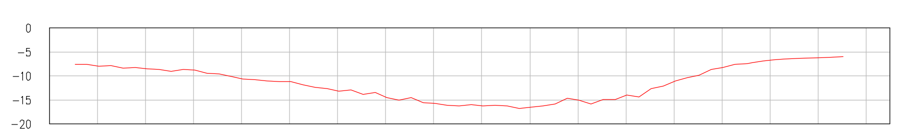

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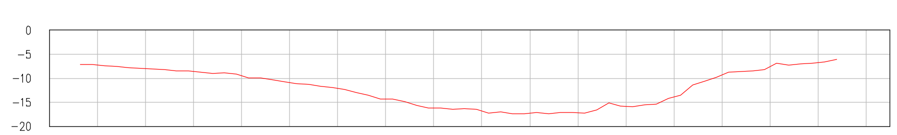

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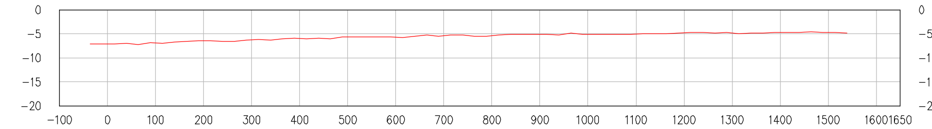

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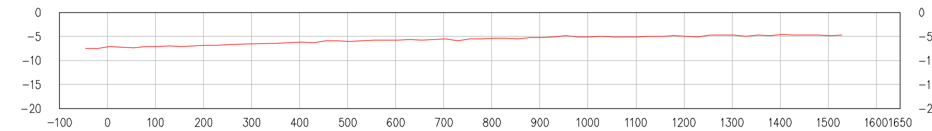

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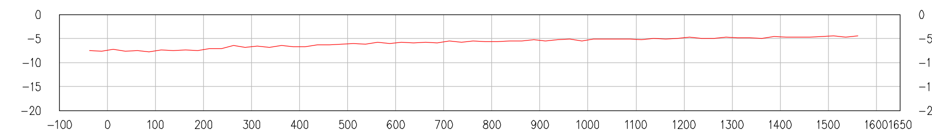

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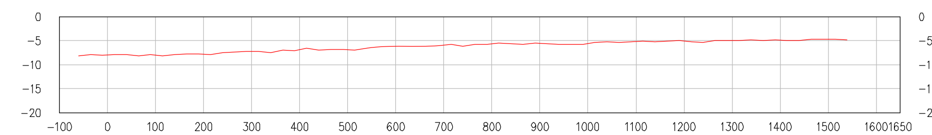

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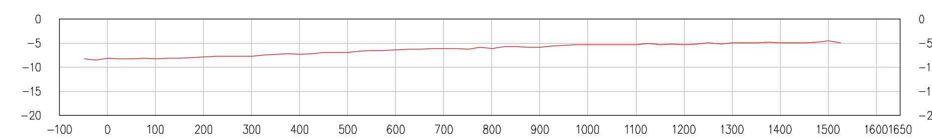

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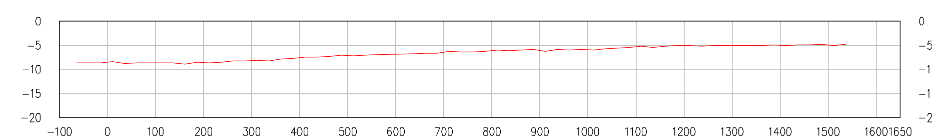

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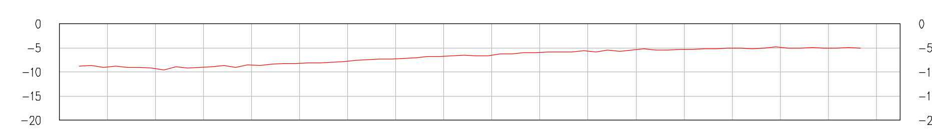

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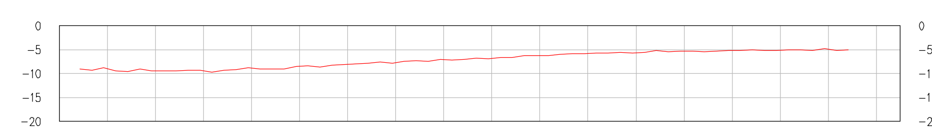

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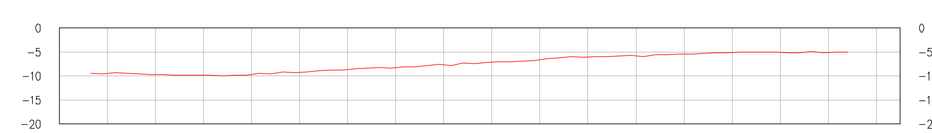

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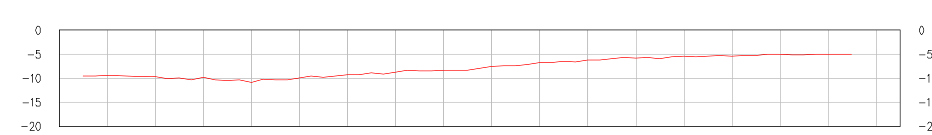

B2–11

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HORIZONTAL (FEET)

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VERTICAL (FEET)

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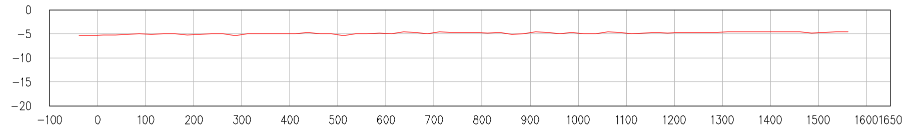

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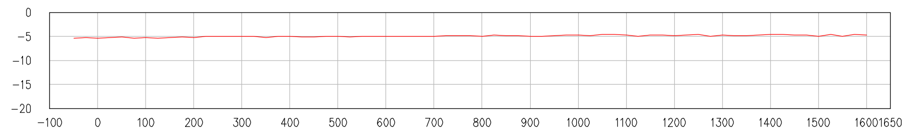

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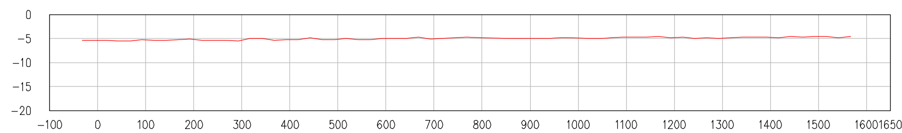

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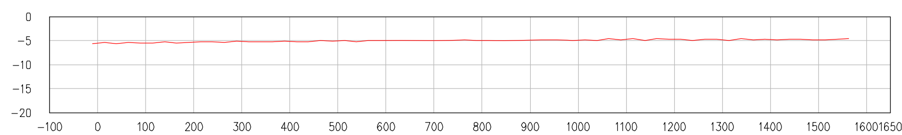

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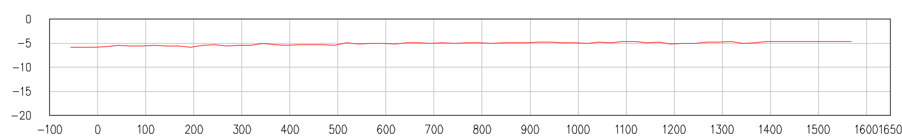

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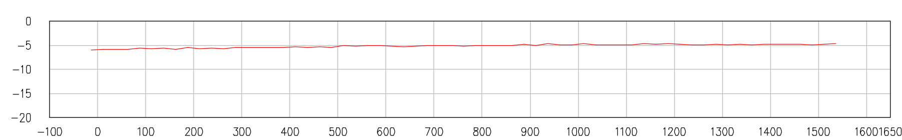

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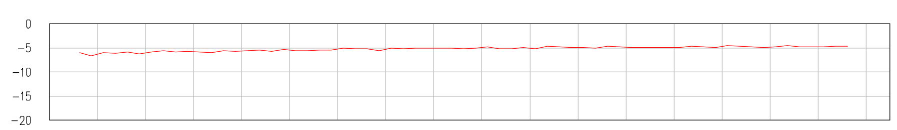

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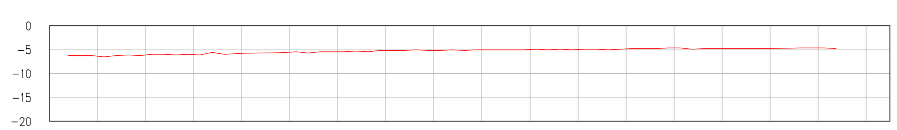

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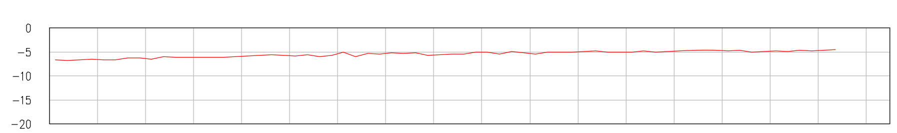

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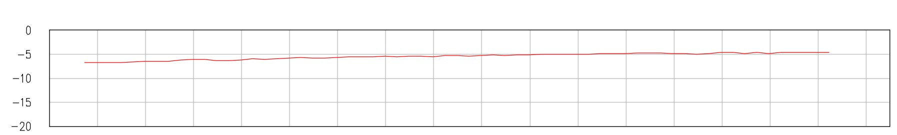

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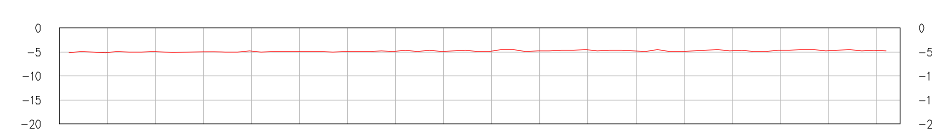

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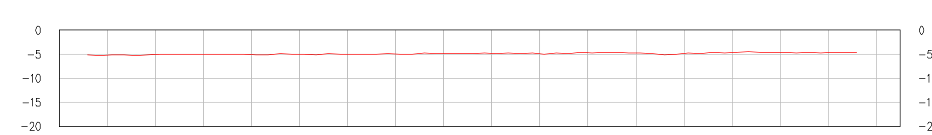

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Survey Dates: May 16–19, 2017

Aerial imagery was acquired from ESRI World Imagery Map Server.

Horizontal Datum = NAD83, Louisiana South State Plane Zone 1702, U.S. Survey Feet

Vertical Datum = NAVD 88, Feet

Project Benchmark = CRMSPO–SM–25 (X = 3,792,271.06' Y = 618,174.14' Z = 6.34')

Staff Gage: 4" x 4" treated wooden post with ceramic coated face plate
Latitude: 30° 09' 26.1" N
Longitude: 89° 39' 54.4" W

PRELIMINARY

SCALE: 1" = 200'
200' 0 100' 200'
HORIZONTAL (FEET)

SCALE: 1" = 20'
20' 0 10' 20'
VERTICAL (FEET)

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 Terrace Avenue
Baton Rouge Louisiana 70802

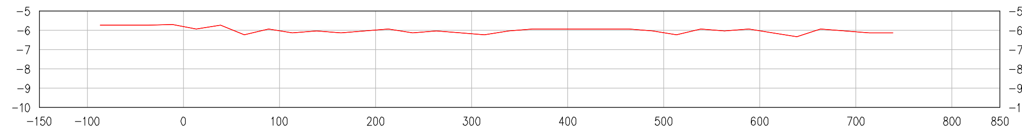
PO-169

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION AND MARSH CREATION PROJECT (BORROW AREAS)

CROSS SECTION VIEW

Date: June 16, 2017	Drawn By: RJB
Job. No.: 17–007	Checked By: CDR
Revision Date:	Drawing Name: 17–007 New Orleans Landbridge Borrow Area.dwg

CHUSTZ SURVEYING, LLC
211 Richy Street
New Roads, LA 70760
Tel: 225-638-5949
Fax: 225-638-3924



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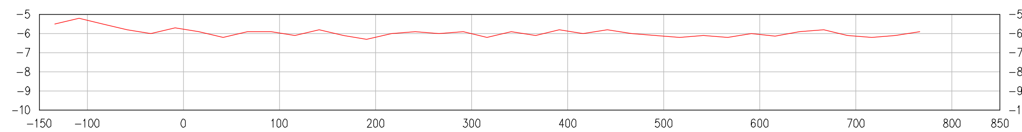

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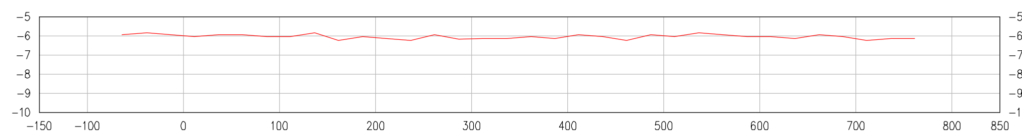

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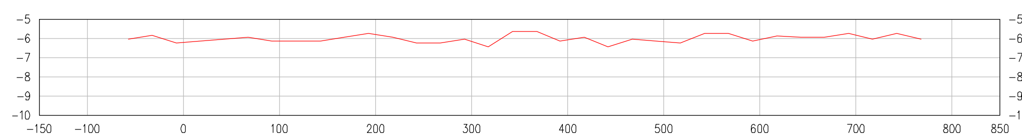

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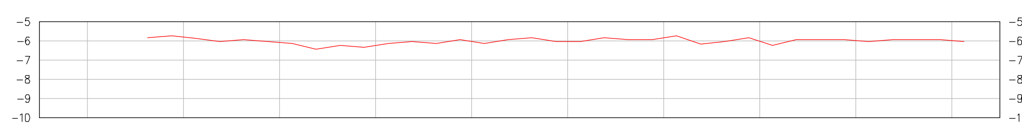

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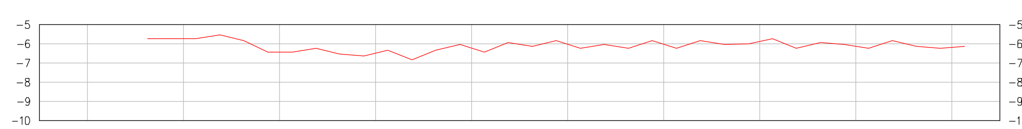

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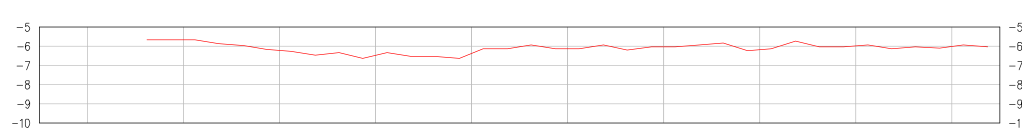

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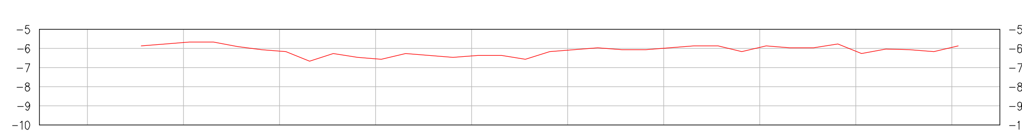


B3-1

Survey Dates: May 16–19, 2017

Aerial imagery was acquired from ESRI World Imagery Map Server.

Horizontal Datum = NAD83, Louisiana South State Plane Zone 1702, U.S. Survey Feet

Vertical Datum = NAVD 88, Feet

Project Benchmark = CRMSPO-SM-25 (X = 3,792,271.06' Y = 618,174.14' Z = 6.34')

Staff Gage: 4" x 4" treated wooden post with ceramic coated face plate
Latitude: 30° 09' 26.1" N
Longitude: 89° 39' 54.4" W

PRELIMINARY

SCALE: 1" = 100'
100' 0 50' 100'
HORIZONTAL (FEET)

SCALE: 1" = 5'
5' 0 5'
VERTICAL (FEET)

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 Terrace Avenue
Baton Rouge Louisiana 70802

PO-169

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION AND MARSH CREATION PROJECT (BORROW AREAS)

CROSS SECTION VIEW

Date: June 16, 2017	Drawn By: RJB
Job. No.: 17-007	Checked By: CDR
Revision Date:	Drawing Name: 17-007 New Orleans Landbridge Borrow Area.dwg

CHUSTZ SURVEYING, LLC
211 Richy Street
New Roads, LA 70760
Tel: 225-638-5949
Fax: 225-638-3924

Survey Dates: May 16–19, 2017

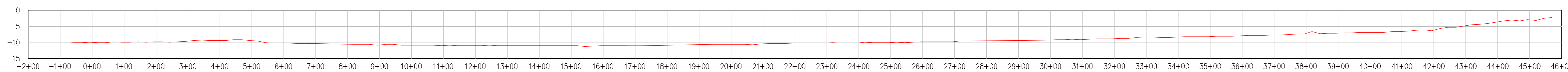
Aerial imagery was acquired from ESRI World Imagery Map Server.

Horizontal Datum = NAD83, Louisiana South State Plane Zone 1702, U.S. Survey Feet

Vertical Datum = NAVD 88, Feet

Project Benchmark = CRMSPO–SM–25 (X = 3,792,271.06' Y = 618,174.14' Z = 6.34')

Staff Gage: 4" x 4" treated wooden post with ceramic coated face plate
Latitude: 30° 09' 26.1" N
Longitude: 89° 39' 54.4" W



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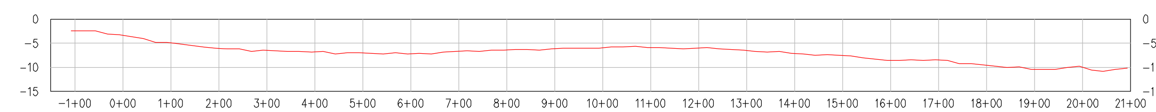

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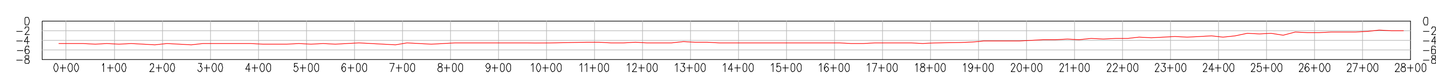

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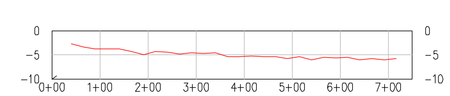

D4

PRELIMINARY

SCALE: 1" = 200'
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HORIZONTAL (FEET)

SCALE: 1" = 20'
20' 0 10' 20'
VERTICAL (FEET)

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 Terrace Avenue
Baton Rouge Louisiana 70802

PO-169

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION AND MARSH CREATION PROJECT (BORROW AREAS)

CROSS SECTION VIEW

Date: June 16, 2017	Drawn By: RJB
Job. No.: 17–007	Checked By: CDR
Revision Date:	Drawing Name: 17–007 New Orleans Landbridge Borrow Area.dwg

CHUSTZ SURVEYING, LLC
211 Richy Street
New Roads, LA 70760
Tel: 225-638-5949
Fax: 225-638-3924

Survey Report

New Orleans Landbridge Shoreline Stabilization & Marsh Creation Project (PO-169) Additional Sureys (Borrow Areas)

St. Tammany Parish, Louisiana

Prepared for the
State of Louisiana
Coastal Protection and Restoration Authority

Contract No. 4400005539 (2503-15-21)
Task Order No. 3

Chustz Surveying Inc.
211 Richy Street
New Roads, LA 70760
225-638-5949

August 2017

Section 1
General Project Description and Background

This project was conducted by Chustz Surveying, LLC for the State of Louisiana, Office of Coastal Protection and Restoration Authority (CPRA) under contract 4400005539, New Orleans Landbridge Shoreline Stabilization & Marsh Creation Project (PO-169) Additional Surveys, St. Tammany Parish, Louisiana.

1.1 Statement of Work to be Performed

The required work consists of a comprehensive survey of approximately 2050 acres of marsh and approximately 2.0 linear miles of profile at the designated site. The survey includes 62 cross sections at 98 foot intervals to cover the marsh borrow sites, four centerline profiles for access, reading of gauges three times a day, geophysical survey and cultural resource investigation, and a magnetometer survey.

Section 2
Survey Methodology and Data Processing

2.1 Permission and Access

No land owners were contacted for this survey as the entirety of the work was performed either on public land or water.

2.2 Horizontal and Vertical Control

Horizontal control for this job was constrained to DGPS on board the survey vessel and then tied to the Louisiana South State Plane Coordinate System, referencing the North American Datum of 1983 (NAD83-2011). Vertical control was constrained to “TBM 1” which was set for the original PO-169 survey (Reference Appendix A for vicinity map and photo). “TBM 1” is a 16” bolt set by CSI at the south-southeast corner of a concrete pad for handicap parking, located inside the fenced area of the Fort Pike boat landing area. It was surveyed utilizing RTK survey methods with Trimble© R-10 and R-6 receivers, and a TSC3 data collector with the base set on monument “CRMS PO SM 25”. The vertical control references the North American Vertical Datum of 1988 (NAVD88-Geoid 12A).

2.3 Borrow Area and Dredge Pipeline Alignment Bathymetric Survey

On May 16, 2017, CSI deployed a two person single beam hydrographic survey party to begin the hydrographic survey. First, they located “TBM 1” and ran a level loop to a temporary gauge set at the boat launch and back to establish a water surface elevation. The crew then began the survey at the B1 site, surveying cross sections B1-1 through B1-17 that day. The crew returned the next day and collected the remaining cross sections for the B1 site, along with profile D1. The following day, the crew surveyed cross sections B2-8 though B2-32, B3-1 through B3-8, and profiles D2, D3, and D4. This completed all of the dredge pipeline alignment profile surveys and the bathymetric survey for the B3 site. The next day, May 19, 2017, the crew returned to the site to complete the job and collected cross sections B2-1 through B2-7. The gauge were read three times a day except for the last day where it was read twice as the final data only took two hours to collect.

2.4 Geophysical Survey and Cultural Resource Investigation

The geophysical survey and cultural resource investigation was conducted by Fugro as a subcontractor of CSI. Reference Appendix B for the Geophysical Survey Report and Cultural Resource Investigation.

2.5 Magnetometer Survey

The magnetometer survey was conducted by Fugro as a subcontractor of CSI. Reference Appendix B for the Magnetometer Survey Report and Drawings.

2.6 Office Processing

The single beam hydrographic survey data for this job was submitted to the CSI office and processed using the latest version of Hypack. Once all the data was processed, it was compiled in Terramodel and QC/QA procedures were conducted. Once complete, the data for the required deliverables was extracted and final deliverables were produced using AutoCAD and Microsoft Office. The preliminary submittal package was delivered on Friday, June 16, 2017.

Appendix A

TBM 1 Photos

New Orleans Landbridge Shoreline Stabilization & Marsh Creation Project (PO-169)

St. Tammany Parish, Louisiana

Vicinity Map

Photo

Appendix B

Geophysical Survey Report, Cultural Resource Investigation, Magnetometer Survey Report and Drawings

New Orleans Landbridge Shoreline Stabilization & Marsh Creation Project (PO-169)

St. Tammany Parish, Louisiana

Chustz Surveying, Inc.

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION & MARSH CREATION PROJECT (PO-169)

August 29, 2017

Submitted to:
Daniel Reed
Project Manager
Chustz Surveying, Inc.
211 Richy Street
New Roads, LA 70760

Submitted by:
Fugro Geospatial, Inc.
200 Dulles Drive
Lafayette, Louisiana 70506

Fugro Job No. 170089

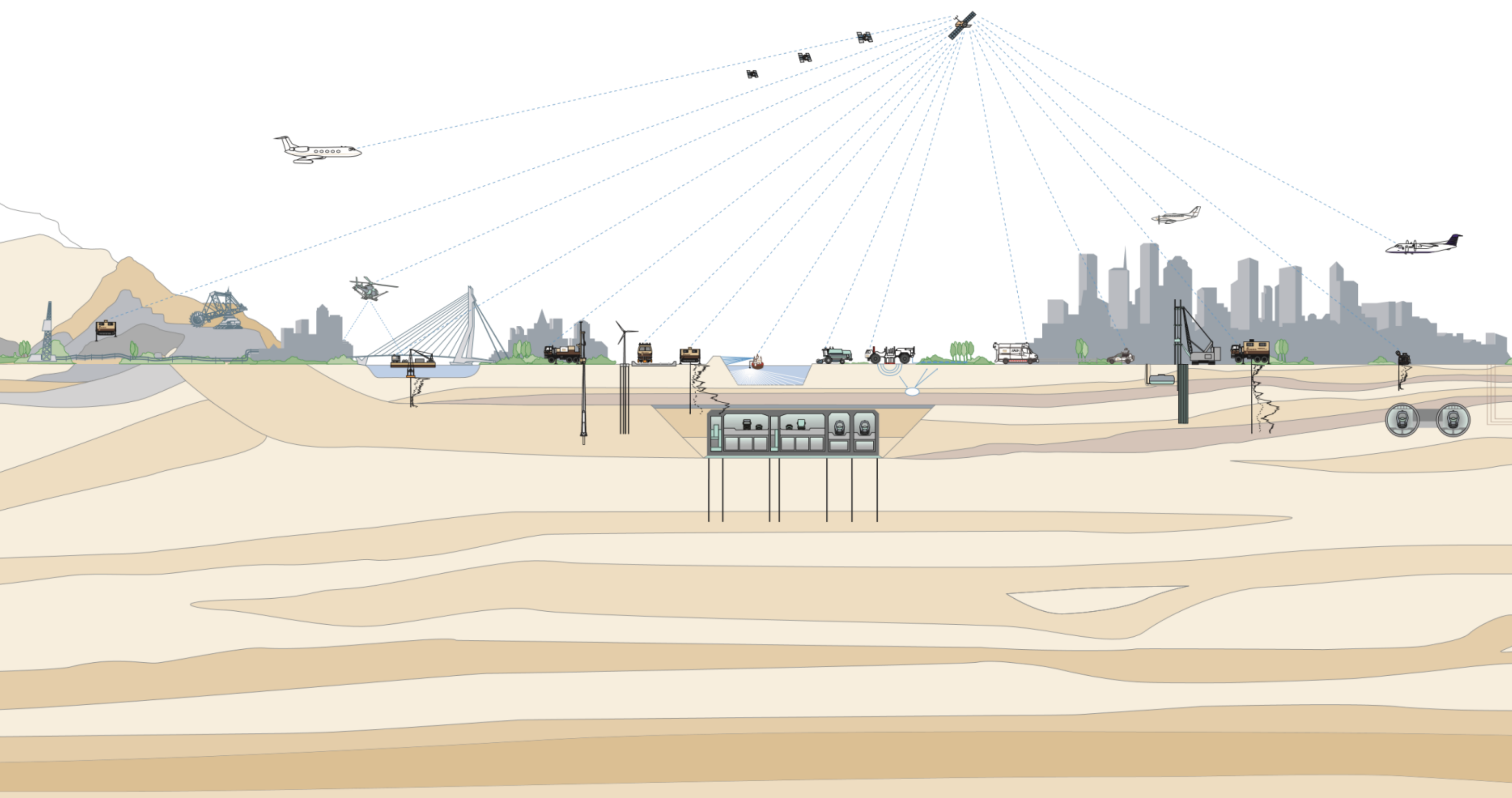


Table of Contents

APPENDICES

A. CHARTS

B. SUB-BOTTOM SEISMIC FIGURES

C. SIDESCAN SONAR CONTACT REPORT

D. MAGNETOMETER TABLE

E. FIELD NOTES

F. CULTURAL RESOURCES REPORT

G. SUPPORTING DOCUMENTS FROM CPRA

1 COMPANY INFORMATION

Fugro is an internationally-acclaimed consulting firm that specializes in the provision of technical data and information required to design, construct, and maintain large structures and infrastructure in a safe, reliable, and efficient manner. We have been at the forefront of providing geospatial knowledge for over 50 years. Our complete geospatial approach assists our clients through the entire life span of a project: We begin with feasibility and continue through to post-construction and maintenance. Our comprehensive, integrated survey services have been used by a diverse set of industries including oil and gas, rail, electric utility, and government agencies. Access to Fugro's global resources allows us to deliver optimal solutions for projects of every scale.

Fugro is a global company with approximately 11,500 employees in about 60 countries, including active offices in Lafayette, Louisiana, Frederick, Maryland, and Rapid City, South Dakota. Fugro Geospatial, Inc. is a wholly-owned subsidiary of Fugro NV, a Dutch corporation whose shares are publicly traded on the Amsterdam Mid-Cap Exchange. Throughout the world the multiple Fugro offices work as One Fugro to provide the most experience and best possible solutions for our clients. Fugro holds a strong market position due to in-house developed technologies, high value services, and a strong international and regional presence. Our highly-qualified specialists work with modern technologies and systems at locations all over the world.

Our ultimate purpose is to contribute to developing a livable world by turning geospatial data into knowledge. We have continuously provided survey services for 59 years. Fugro provides registered, licensed Professional Land Surveyors throughout the Gulf Coast region. We provide a regulatory services group able to able to obtain necessary federal, state, and local permits. Fugro also offers hydrographic survey services for underwater projects such as oyster assessments, bathymetric hazard surveys, and coastal restoration projects. Furthermore, we provide high-precision FLI-MAP aerial LiDAR technology for projects such as rail, pipeline, and transmission line route surveys. As needed, 3D laser scanning services are also available.

2 SCOPE

The New Orleans Landbridge Shoreline Stabilization & Marsh Creation Project (PO-169) is funded under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) in Priority Project List 24. The Coastal Protection and Restoration Authority (CPRA), in partnership with US Fish and Wildlife Service (USFWS), have been authorized to execute Phase I (Engineering and Design) of PO-169. The objective of this project is to create, maintain, and nourish existing deteriorating wetlands through hydraulic dredging as well as provide additional protection to the lake shorelines with earthen berms.

In support of this project Fugro Geospatial, Inc. (Fugro) was contracted by Chustz Surveying, Inc. to conduct geophysical investigations of the proposed borrow areas and their respective dredge pipeline corridors, as well as other areas which may be impacted by subsurface infrastructure. FGI collected magnetometer, sub-bottom seismic, and sidescan sonar data in an attempt to identify hazards and describe the seismic stratigraphy within the project areas. The methodologies and results of this survey are detailed in the following report.

2.1 Project Location

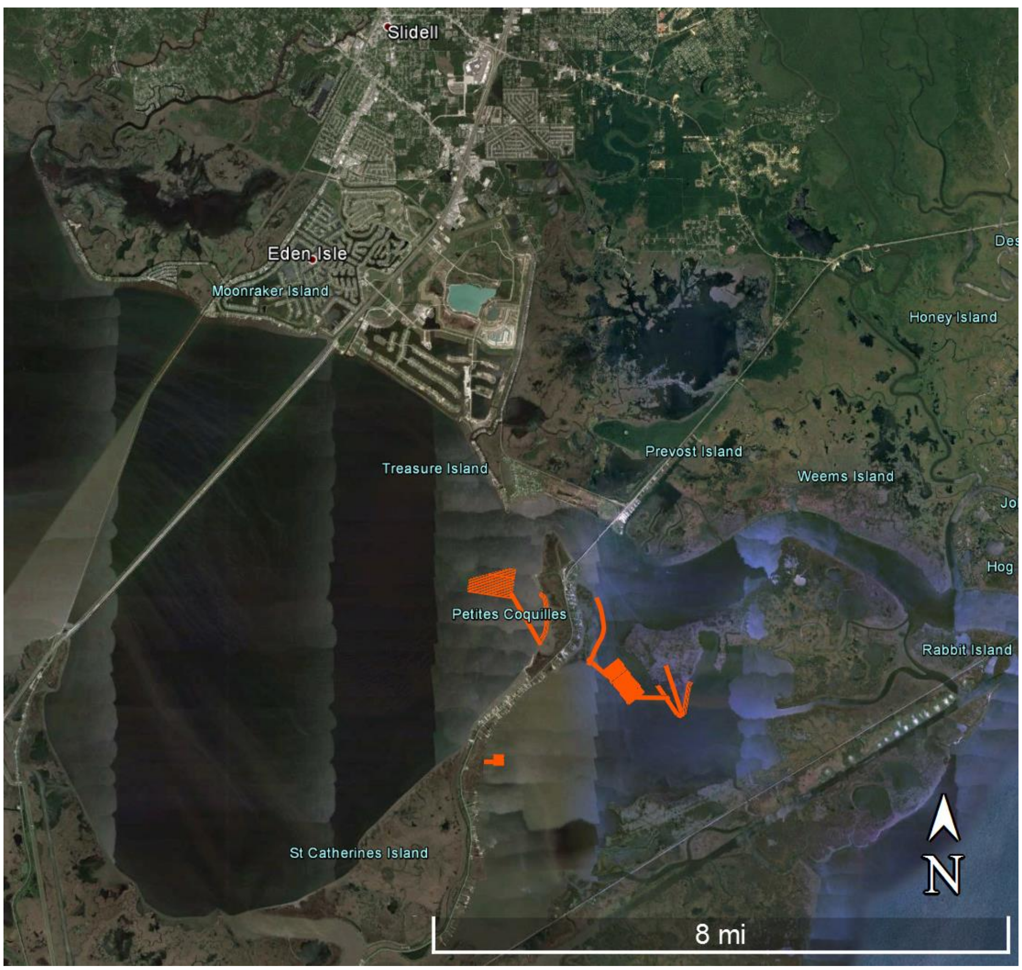


Figure 1: Project Location shown located south of Slidell, Louisiana on either side of Highway 90. Surveying transects are depicted in red.

3 EQUIPMENT/SURVEY SYSTEM(S)

3.1.1 HyPack Navigation and Acquisition Software

HYPACK, Inc. develops Windows-based software for the hydrographic and dredging industry and is one of the most successful worldwide providers of hydrographic and navigation software. HYPACK is one of the most widely used hydrographic surveying packages in the world, with over 4,000 users. It provides the surveyor with all of the tools needed to design their survey, collect data, process it, reduce it, and generate final products.

3.1.2 Geometrics G-858 Land Magnetometer

The G-858 is a cost-effective and compact land magnetometer with the performance of a Cesium Vapor sensor. This sensor facilitates the detection of ferrous hazards in support of utilities, environmental, petroleum and archeological surveys. The system is capable of sampling at a rate of up to 10Hz, enabling the user to quickly cover a large survey area without comprising sampling density. It is ruggedly engineered and never requires additional calibration once leaving the factory.

3.1.3 Geometrics G882 Magnetometer

For the detection of magnetic anomalies associated with ferrous objects, Fugro proposes using a Geometrics G-882 Cesium Vapor Magnetometer. The G-882 has delivered to the industry a cost-effective and compact magnetometer with the performance of a Cesium Vapor sensor. This facilitates the detection of ferrous hazards as small as a hand-held screwdriver provided that the sensor is deployed close to the water-bottom. It is proven capable of detecting and mapping a wide range of ferrous hazards, including anchor chains, cables, pipelines, and other man-made debris. It boasts an absolute accuracy of less than 3 nT throughout its operating range.

3.1.4 Edgetech 4125 Side Scan Sonar 400/900 KHz

Water-bottom acoustic imaging is accomplished using an Edgetech 4125 Side Scan Sonar operating at dual frequencies of 400 and 900 kHz. While operating at 400 kHz, it has an operating range of 150 m and a resolution of 2.3 cm. At 900 kHz, the operating range is 75 m and the resolution is 1.5 cm. Frequency availability is especially important when selecting a side scan sonar. Higher frequencies provide better resolution while sacrificing range, with the opposite being true for lower frequencies. The Edgetech 4125 enables the user to collect sonar data at two frequencies simultaneously. This provides the interpreter with two distinct datasets that can be interpreted independently to positively identify sonar contacts.

3.1.5 SonarWiz Geophysical Processing Software Suite

SonarWiz is a proprietary software suite produced by Chesapeake Technology purpose built for processing and analyzing sonar data. SonarWiz enables the user to import a variety of file types from different geophysical instruments. Processing features include gain manipulation, lay-back calculation, and a full suite of mapping tools.

3.1.6 Edgetech 3100 SB-424 Sub-Bottom Profiler

The Edgetech 3100 SB-424 Sub-Bottom Profiler employs Edgetech's Full Spectrum CHIRP technology, which optimizes the penetration and resolution by operating at a swept frequency between 4-24 kHz. The 3100 system is ideally suited for shallow water investigations requiring detailed analyses of sub-surface geological structure. The vertical resolution of the SB-424 ranges from 4-8 cm, while the penetration ranges from 2-40 m. This variability in performance is dictated by the sedimentary properties unique to the specific survey area. Sediments with higher impedance or anechoic properties may impart significant acoustic attenuation resulting in diminished vertical penetration.

4 SURVEY CONTROL

Horizontal Datum	Vertical Datum	Geoid Model	Projection	Units
NAD83	NAVD88	N/A	State Plane Louisiana South	US Survey Feet

All geophysical data collected during this survey was positioned using DPGS with proprietary Fugro corrections.

5 METHODOLOGY AND RESULTS

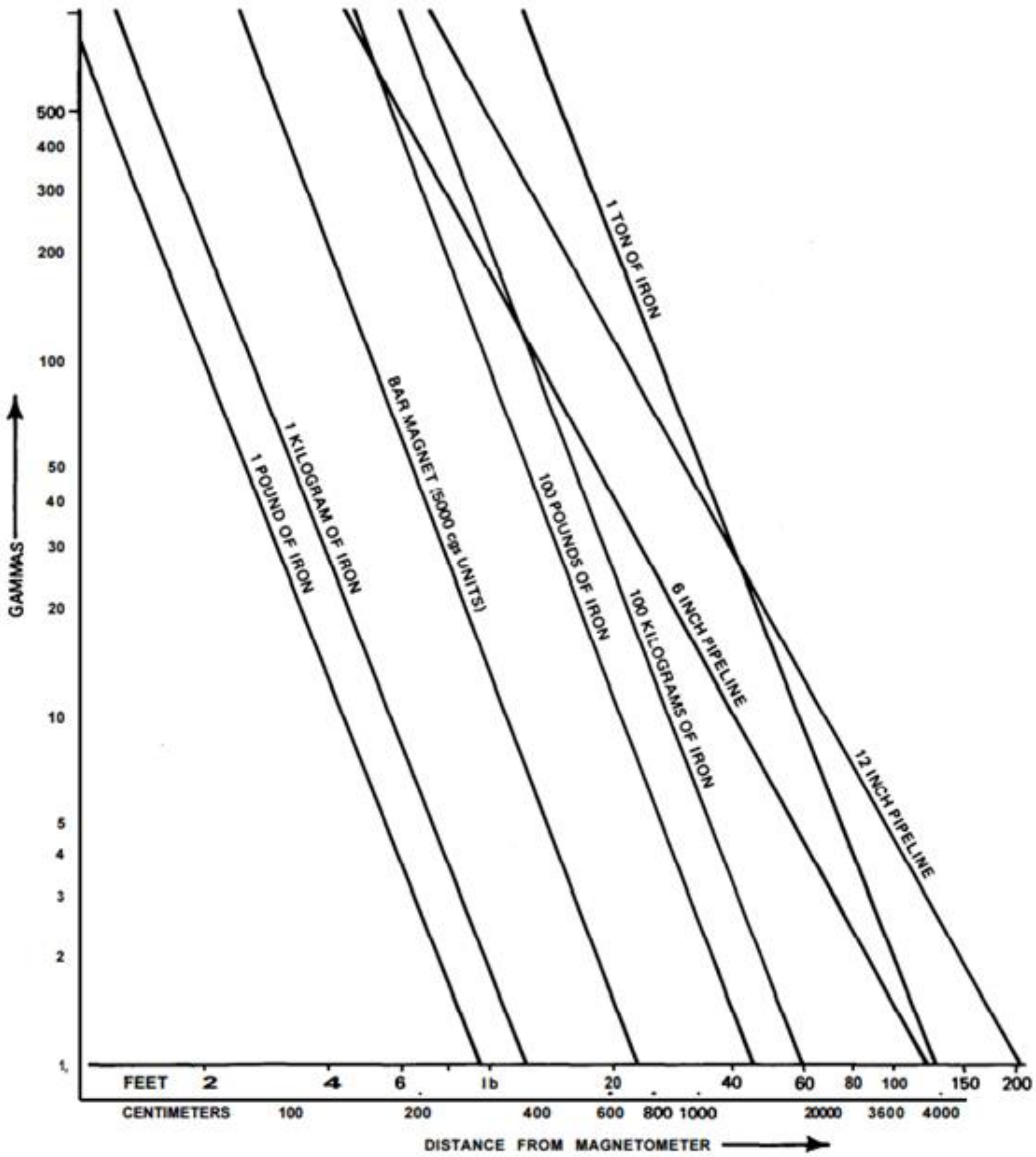
5.1 Magnetometer Survey

Fugro collected a marine magnetometer survey within the project areas to identify the locations of ferrous debris and plausible pipelines that may impact future construction and development activities. The magnetometer survey began on May 17, 2017 and was completed on May 19, 2017. A Registered Professional Archeologist was aboard the surveying vessel at all times throughout the survey. Magnetometer data was collected using a Geometrics G-882 marine magnetometer positioned using DGPS with proprietary Fugro corrections. All positioning and magnetometer data were recorded using the Hypack hydrographic and navigation software suite. Approximately 37 survey lines miles were collected over 86 survey lines. A 24' surveying vessel was used in open water, supplemented by an airboat used to provide access to survey lines located in the marsh. A map of these tracklines is viewable in Appendix A.

The magnetometer data was processed and interpreted using the SonarWiz geophysics software suite. Layback values were applied to all magnetometer data. Deflections from the ambient magnetic field within the survey area were identified and interpreted as anomalies. Interpretations recorded the position, duration, and amplitude of each anomaly. The geometry of each anomaly was also described in terms of monopole, dipole, or complex.

A total of 120 magnetic anomalies were identified in the project area, ranging from 10 to 1,401 gamma in amplitude, and 16 to 170 feet in duration. All identified anomalies were mapped, and may be viewed in Appendix A. A detailed table of the interpreted anomalies is viewable in Appendix D. The geometry of these magnetic anomalies was then securitized to determine whether they were potentially the product of subsurface infrastructure. Based on this analysis, no pipelines could be readily identified in the project area. Additionally, the Louisiana Department of Natural Resources database does not indicate the presence of pipeline in the survey areas. The magnetic anomalies are therefore interpreted to be the product of ferrous debris in the area. The ferrous debris likely producing these anomalies may still pose a hazard to certain operations, and therefore caution is still advised when operating in their vicinity.

The differences observed in the interpreted anomalies within this report could be the result of several unique variables. The nomogram in Figure 2 provides a visual reference of the relationship between a ferrous object and the magnetic deflection generated by the object. The amplitude and signature width (duration) of a magnetic deflection are dependent on a variety of factors that include object size and orientation, ferrous content, and distance from the sensor (Breiner 1999). Due to the multitude of variables producing the interpreted anomalies, reliable conclusions drawn from magnetometer data alone can be limited.



INSTRUCTIONS FOR USE:

To use the nomogram, select a given weight or type of object from among the diagonal labeled lines. Then choose a distance along the bottom line (abscissa) of the graph and follow a vertical line upwards from that distance until it intersects the diagonal line of the selected object. At that point, move horizontally to the left to a value on the vertical axis (ordinate) of the graph and read the intensity in gammas.

At a given distance, the intensity is proportional to the weight of the object. Therefore, for an object whose weight is not precisely that of the labeled lines, simply multiply the intensity in gammas by the ratio of the desired weight to the labeled weight on the graph. If the distance desired does not appear on the graph, remember that for a typical object the intensity is inversely proportional to the cube of the distance and for a long pipeline the intensity is inversely proportional to the square of the distance between magnetometer sensor and object. Due to the many uncertainties described herein, the estimates derived from this nomogram may be larger or smaller by a factor of 2 to 5 or perhaps more.

Figure 2: Nomogram taken from Breiner 1999.

5.2 Sidescan Sonar Survey

Fugro conducted a sidescan sonar survey of the project area to identify any potential hazards or culturally significant objects within the project area. Acoustic imagery of the water bottom was captured using an Edgetech 4125 Dual Frequency Side Scan Sonar positioned using DGPS with proprietary Fugro corrections. Approximately 27 survey lines miles were collected over 74 survey lines aboard a 24’ surveying vessel.

Sonar data was then imported into the SonarWiz geophysics processing suite. Layback and offset calculations were applied. All files were bottom-tracked to facilitate slant-range corrections. Acoustic gains were adjusted to optimize the visual appearance of the imagery, and a sonar mosaic was assembled and exported as a GEOTIFF. The sonar data was scrutinized for sonar contacts, which were identified, dimensioned, and described when possible. Other features that were interpreted to possibly impact the project were outlined in shapefiles and mapped.

A total of 101 sonar contacts were identified and mapped in the project area. These ranged in size from ~2 ft^2 to in excess of 650 ft^2. The majority of the contacts were unidentified debris and crab traps. A full contact report, including images, available interpretations, and dimensions is available for viewing in Appendix C.

Of the 101 sonar contacts mapped, 69 were located in Borrow Area 1 and the respective dredge pipeline corridor, 20 were located in Borrow Area 2 and the respective dredge pipeline corridors, and 12 were located in Borrow Area 3 and the respective dredge pipeline corridor. The contacts in Borrow Area 3 are mainly comprised of what are interpreted to be crab traps. Contacts of significant dimensions are located in Borrow Area 1 and the respective dredge pipeline corridor. These included contacts 9, 22, 23, 25, 26, 32, 33, 47, 48, 56, 63, and 65. Contact 78 is also of significant dimensions and is located in Borrow Area 2. High intensity acoustic backscatter, identified as probable oyster reefs, were also identified and outlined in the charts available for viewing in Appendix A. These probable oyster reefs will mainly impact Borrow Area 1 and the dredge pipeline corridor running east from Borrow Area 2.

5.1 Sub-bottom Seismic Survey

Fugro collected sub-bottom seismic profile data in support of the hazard survey and to describe the seismic stratigraphy of the proposed borrow areas. The sub-bottom seismic survey began on May 17, 2017 and was completed on May 18, 2017. A Registered Professional Archeologist was aboard the surveying vessel at all times throughout the survey. All sub-bottom data was collected using an Edgetech 3100 SB424 sub-bottom profiler operating at a swept frequency of 4-24 kHz, and was positioned using DGPS with proprietary Fugro corrections. The average depth penetration below the seafloor recorded by the instrument during the survey was ~15 feet. Approximately 27 survey lines miles were collected over 74 survey lines aboard a 24’ surveying vessel. A map of these tracklines is viewable in Appendix A.

All subsurface geophysical data was processed and interpreted by Fugro using the SonarWiz geophysical software suite. Data was initially inspected to ensure no errors in navigation were recorded during the survey. All seismic files were then bottom tracked to establish the seafloor for the purposes of measuring sequence thickness and eliminating water column noise. Acoustic gains were adjusted to optimize the seismic image for interpretation. Data was then examined for any contacts that may be interpreted to be hazardous or culturally significant. Seismic stratigraphy was also identified and is described in the following sections.

5.2 Seismic Stratigraphy

In each borrow area and respective dredge pipeline corridor, the deepest and continuous seismic sequence boundary was identified and mapped. Where the seismic lines overlapped from borrow area to dredge pipeline corridor, the same boundary was identified and mapped continuously throughout both areas. The boundaries were identified as erosional surface based on the observable presence of truncated reflectors and distinct and continuous changes in seismic character. All seismic features located above the mapped boundaries were also identified and described. An isopach was then computed based on the thickness of the seismic sequence between the sequence boundary and the seafloor. An assumed velocity of 1500 m/s was used for all depth and thickness calculations. The isopach maps produced from these computations are viewable in Appendix A. Illustrations of interpreted representative seismic cross sections from each area surveyed are also available in Appendix B.

The sequence boundaries determined to be the base of the analyzed seismic sequence are not related to any lithological data, as core samples are currently unavailable for corroboration. To establish any geological framework of the survey area, several core samples would be required. Therefore, no conclusions regarding the specific depositional environment or chronology of the discussed seismic sequences will be provided in this report. Additionally, the seismic reflectors identified as the seismic sequence boundaries are not assumed to be contemporaneous, and therefore may represent separate exposure surfaces.

5.2.1 Borrow Area 1

The interpreted sub-bottom seismic line representing this area is Line BA1-5, viewable in Appendix B. The seismic sequence boundary identified in Borrow Area 1 and the associated dredge pipeline corridor was named “BA-1.” This boundary presented as a medium-high amplitude reflection overlaying an area of low-amplitude reflectivity in the west, and truncated, downlapping, medium-high amplitude reflectors overlaying an area of low-amplitude reflectivity in the east. In the central portion of the borrow area, BA-1 dips below the acoustic multiple and is indistinguishable. This area was mapped as an “Area of Uncertainty” within the isopach maps. The Area of Uncertainty is interpreted to be a local topographic low associated with an incised channel feature that runs continuously north-south throughout the survey area.

In the eastern portion of the borrow area, BA-1 is directly overlain by downlapping, medium-high amplitude reflectors that truncate into the interpreted boundary. These reflectors constitute a group of oblique clinoforms that prograde in a westerly direction from the eastern limit of the survey area and terminate as prograded channel fill in the incised channel feature previously described. Directly overlaying these clinoforms and channel fill are several sub-parallel, semi-continuous reflectors that constitute the remainder of the seismic sequence.

5.2.2 Borrow Area 1 Dredge Pipeline Corridor

The interpreted sub-bottom seismic line representing this area is Line D1-3, viewable in Appendix B. The BA-1 boundary was also mapped in the dredge pipeline corridor that proceeds from the shoreline into Borrow Area 1. In the seismic data captured from the corridor, this boundary presented as a medium-high amplitude reflection overlaying an area of low-amplitude reflectivity. In the eastern portion of the corridor, BA-1 is directly overlain by downlapping, medium-high amplitude reflectors that truncate into the boundary. These reflectors constitute a group of oblique to sigmoidal clinoforms that prograde in a westerly direction from the eastern limit of the survey area and appear to proceed throughout the corridor. Directly overlaying these clinoforms are several parallel/sub-parallel, discontinuous reflectors that constitute the remainder of the seismic sequence. The oyster reefs visible in the sidescan sonar mosaic are also visible in the seismic recovered from the corridor area. They present as high amplitude, mounded reflectors that attenuate all seismic reflection below their location.

5.2.3 Borrow Area 2

The interpreted sub-bottom seismic line representing this area is Line BA2-20, viewable in Appendix B. The seismic sequence boundary identified in Borrow Area 2 and the associated dredge pipeline corridors was named "BA-2." This boundary presented as a medium-amplitude reflector overlying high-amplitude, truncated parallel reflectors in the northeastern portion of the borrow area, and overlaying an area of low-amplitude reflectivity in the southwestern portion of the survey area. In the northeastern portion of the borrow area, BA-2 is overlain by several high-amplitude u-shaped reflectors. This is interpreted to be a small incised channel and the associated channel fill. In the southwestern terminus of the survey, a series of onlapping, medium-amplitude, u-shaped reflectors overlay BA-2. This is interpreted to be a larger incised channel reaching depths of approximately 20 feet beneath the seafloor, and the associated channel fill. An area of diffuse high-amplitude reflectivity is located in this channel, and changes in geometry throughout the study area. This diffuse reflectivity is interpreted to be caused by gas-rich sediments, and may obscure the actual location of BA-2. More information, such as core samples, would be needed to confirm the location of BA-2 in the area of gas-rich sediments. The portion of the seismic sequence above the channel fill, and throughout much of the central portion of the borrow area, is dominated by low-amplitude reflectivity interspersed with discontinuous, high-amplitude reflectors.

5.2.4 Borrow Area 2 Western Dredge Pipeline Corridor

The interpreted sub-bottom seismic line representing this area is Line D2-2, viewable in Appendix B. The previously described BA-2 was mapped as the seismic sequence boundary in the eastern dredge pipeline corridor of Borrow Area 2. In the dredge pipeline corridor, the boundary presented as a medium-amplitude reflector overlying high-amplitude, truncated parallel reflectors and medium amplitude, diffuse reflectivity. Four incised channels are observed in the seismic cross section, each with slightly varying fill patterns. Moving from northwest to southeast, the fill patterns of each respective channel are interpreted as chaotic, concordant, complex and prograded. The area between the channel fill and seafloor is dominated by discontinuous, chaotic, high-amplitude reflectors. In the southeastern most limit of the pipeline corridor, the upper part of the sequence transitions to semi-continuous, sub-parallel, high amplitude reflectors.

5.2.5 Borrow Area 2 Eastern Dredge Pipeline Corridor

The interpreted sub-bottom seismic line representing this area is Line D3-1, viewable in Appendix B. The previously described BA-2 was mapped as the seismic sequence boundary in the western dredge pipeline corridor of Borrow Area 2. In the dredge pipeline corridor, the boundary presented as a medium-amplitude reflector overlying high-amplitude, truncated parallel reflectors and medium amplitude, diffuse reflectivity. Two incised channels are observed in the seismic cross section with their associated channel fill. The dipping reflectors beneath the easternmost incised channel are interpreted to be an artifact known as "seismic pull-down," often caused by the presence of hydrocarbons that have a slower acoustic velocity than the surrounding sediments. The incised channel may contain biogenic gas that resulted in this artifact in the data. Lastly, the area between the channel fill and seafloor is dominated by discontinuous, chaotic, high-amplitude reflectors.

5.2.6 Borrow Area 3 and Associated Dredge Pipeline Corridor

The interpreted sub-bottom seismic line representing these areas are Lines BA3-5 and D4-1, viewable in Appendix B. The seismic sequence boundary identified in Borrow Area 3 and the associated dredge pipeline corridors was named "BA-3." This boundary presented as a medium-amplitude reflector overlying high-amplitude parallel reflectors. The determination of this boundary was based largely on the observed seismic stratigraphy in the nearby Borrow Area 2, and the distinct change in seismic character at the traced horizon. The area between this boundary and the seafloor is characterized as a largely featureless volume of low-amplitude reflectivity, interspersed with discontinuous, high-amplitude reflectors. No features were observed in either Borrow Area 3 or the associated dredge pipeline corridor.

6 QUALITY ASSURANCE

Fugro has a totally integrated Quality Assurance System that is documented, implemented, and under the control of a quality manager. Certification and compliance of this system to the ISO standards listed below verifies our commitment to meet customer needs by providing the proper policies, procedures, and resources. The Quality Assurance System is used to provide job control and promote optimal client communication during all stages of a project – from the initial proposal to final invoicing. Implementation of our Quality Assurance System assures compliance with all applicable regulatory and ecological requirements. For data management, the Fugro quality system provides checks to validate and confirm that all survey data and processed data are interpreted and stored as required. The effectiveness of these business and operational processes are monitored, measured and analyzed as part of our compulsory quarterly management review of the Quality Assurance System which includes surveillance audits and certification renewal audits.

Fugro has qualified for and applied the following standards to our business and operational activities:

Quality Management System:
ISO 9001:2008
Certificate NO. UQA 4000406/AB
Approved by: Lloyd's Register Quality Assurance
Provision of Advanced Surveying, Mapping, Regulatory and Ecological Services for Land Applications and Airborne LIDAR data Collection and Interpretation

Occupational Health & Safety Management System:
OHSAS 18001:2007
Certificate NO. UQA 4000406/BB
Approved by: Lloyd's Register Quality Assurance
Provision of Advanced Surveying, Mapping, Regulatory and Ecological Services for Land Applications and Airborne LIDAR data Collection and Interpretation

If desired, Fugro can develop and implement a specific project Quality Assurance/Quality Control (QA/QC) plan for this project. Fugro ensures that all surveys and associated documentation will be accurate and will comply with accepted industry standards.

7 SAFETY

Fugro has developed and implemented an Occupational Health & Safety (OH&S) and Environmental Management System (EMS) to satisfy the needs of our customers, employees, shareholders, and community. We continually strive to improve our employee and company performance in the areas of health, safety, and protection of the environment. Fugro assures that all required safety equipment and gear including personal protective equipment (PPE) is included in its tendered prices.

Fugro also strives to prevent wasteful and inefficient operations, avoid damage to property and equipment, show respect for the environment, and, foremost, to protect the safety and well-being of all employees. Fugro employees will acquire all safety training as specified in the contract.

The schedule of safety meetings and drills for this project will include but is not limited to:

- Pre-job safety meetings
- Pre-job vessel health, safety, and environmental orientation including man overboard, fire, and abandon ship drills
- Daily tailgate safety meetings prior to each day's operations
- When a new procedure or piece of equipment is introduced, including a written Job Safety Analysis
- Document a Near Miss accident or Injury

Fugro ensures compliance with all applicable rules, regulations, orders, standards and interpretations promulgated under the Occupational Safety and Health Act (1997) and all other applicable laws, ordinances, rules, regulations and orders of anybody having jurisdiction over safety and health of persons or property or the protection of same to protect them from injury, illness, damage or loss. The Fugro project manager or his designee will conduct and document a daily safety meeting at the beginning of each work day. A copy of the daily safety meeting minutes will be furnished upon request.

Fugro ensures that personal protective equipment (PPE) will be utilized and maintained in accordance with the written PPE program. Training in the proper use, maintenance and inspection of PPE is provided to all Fugro employees prior to beginning work. Fugro will supply all required PPE required at the work site. Unless otherwise specified, the minimum PPE includes:

- Hard hats
- Safety glasses with side shields or side impact protection as necessary
- Safety toe shoes/boots (steel/composite toe or approved toe caps)
- Protective clothing with high visibility vest
- Task appropriate gloves

8 PROJECT MANAGEMENT

Key project management responsibilities include creating clear and attainable project objectives, building the project requirements, and managing the constraints of the accepted scope of work, project budget, schedule, safety, and quality standards. Fugro project managers act as Client representatives to determine and implement the exact needs of the Client in an effort to ensure Client satisfaction in all key project attributes. Our project managers bridge the gap between the survey crews and the Client and take full responsibility and authority required to complete each project.

8.1 Contact Information

By use of these specific contact points, Fugro ensures quality control and prompt action with respect to all project-related issues.

FUGRO CONTACT INFORMATION			
Address	200 Dulles Drive Lafayette, LA 70506		
Executive Vice President	Carlos Femmer, MBA	337.268.3167	cfemmer@fugro.com
Regional Operations Center Manager	Ryan Chapman, PLS	337.354.4538	rchapman@fugro.com
Project Manager	Paul Laverty	337.268.3133	p.laverty@fugro.com
Data Manager	Mark Spivey	337.268.3158	mspivey@fugro.com
Regional QHSEE Manager	Cathy Morris	713.346.4016	cmorris@fugro.com

9 REFERENCES

Breiner, S. *"Applications Manual for Portable Magnetometers."* Geometrics. San Jose, CA. 1999

RYAN H. CHAPMAN
PROFESSIONAL LAND SURVEYOR
LOUISIANA REGISTRATION NO. 5096

APPENDIX A: CHARTS

STATE PROJECT NUMBER PO-169

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION& MARSH CREATION PROJECT (PO-169)

ORLEANS PARISH, LOUISIANA

PREPARED FOR THE STATE OF LOUISIANA
COASTAL PROTECTION & RESTORATION AUTHORITY

STATE OF LOUISIANA
RYAN H. CHAPMAN
License No. 5096
PROFESSIONAL
LAND SURVEYOR

RYAN H. CHAPMAN
PROFESSIONAL LAND SURVEYOR
LOUISIANA REGISTRATION NO. 5096

CHUSTZ SURVEYING INC.

PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 3,000'

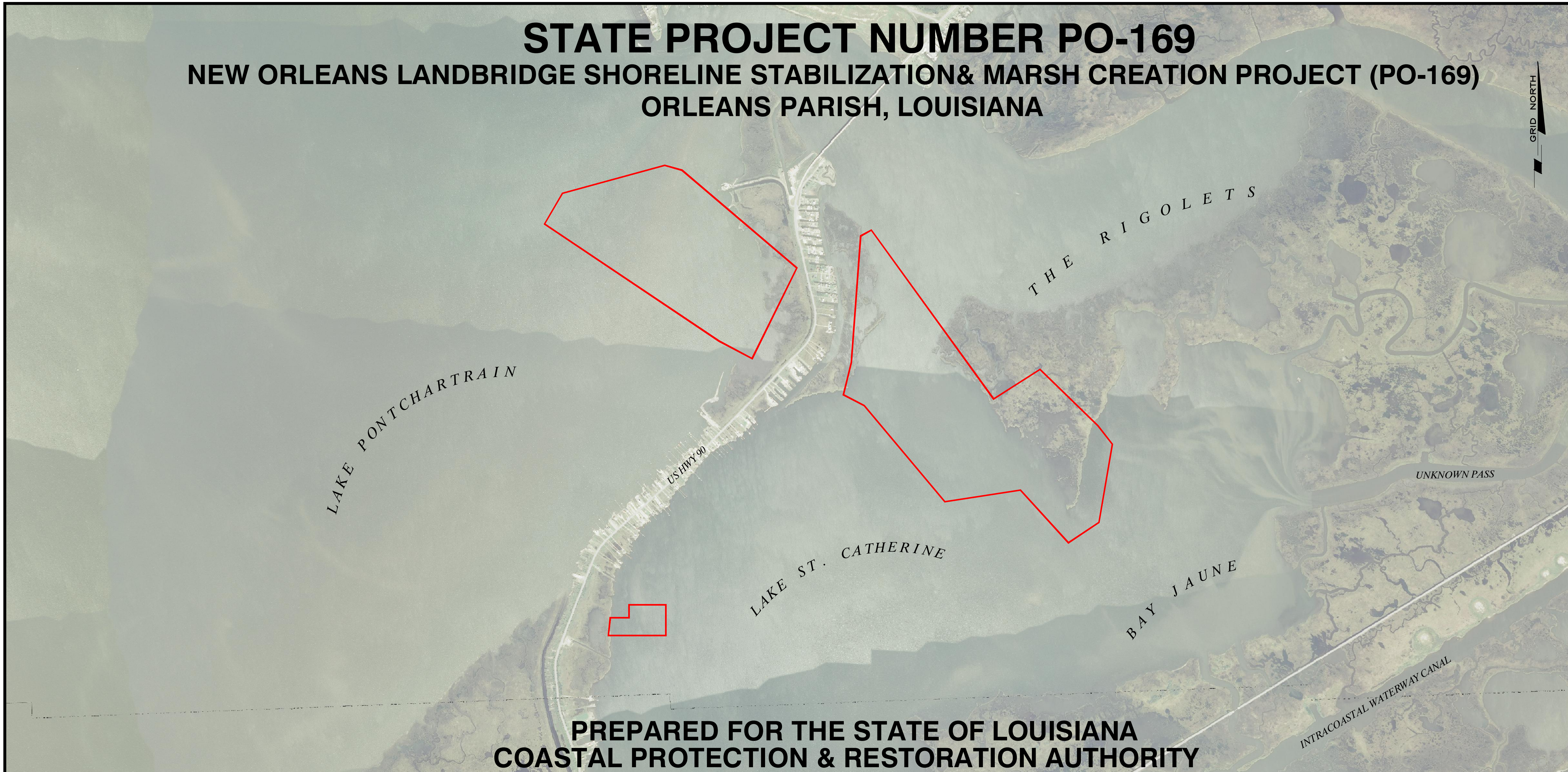
Proj. Mgr.: PHL
Revised:
Printed: 8/28/17

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 1	Of: 17
Dwgfile: L:\2017\170089\CAD\H170089_COVER				

STATE PROJECT NUMBER PO-169

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION& MARSH CREATION PROJECT (PO-169)

ORLEANS PARISH, LOUISIANA



PREPARED FOR THE STATE OF LOUISIANA
COASTAL PROTECTION & RESTORATION AUTHORITY

CHUSTZ SURVEYING INC.

PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

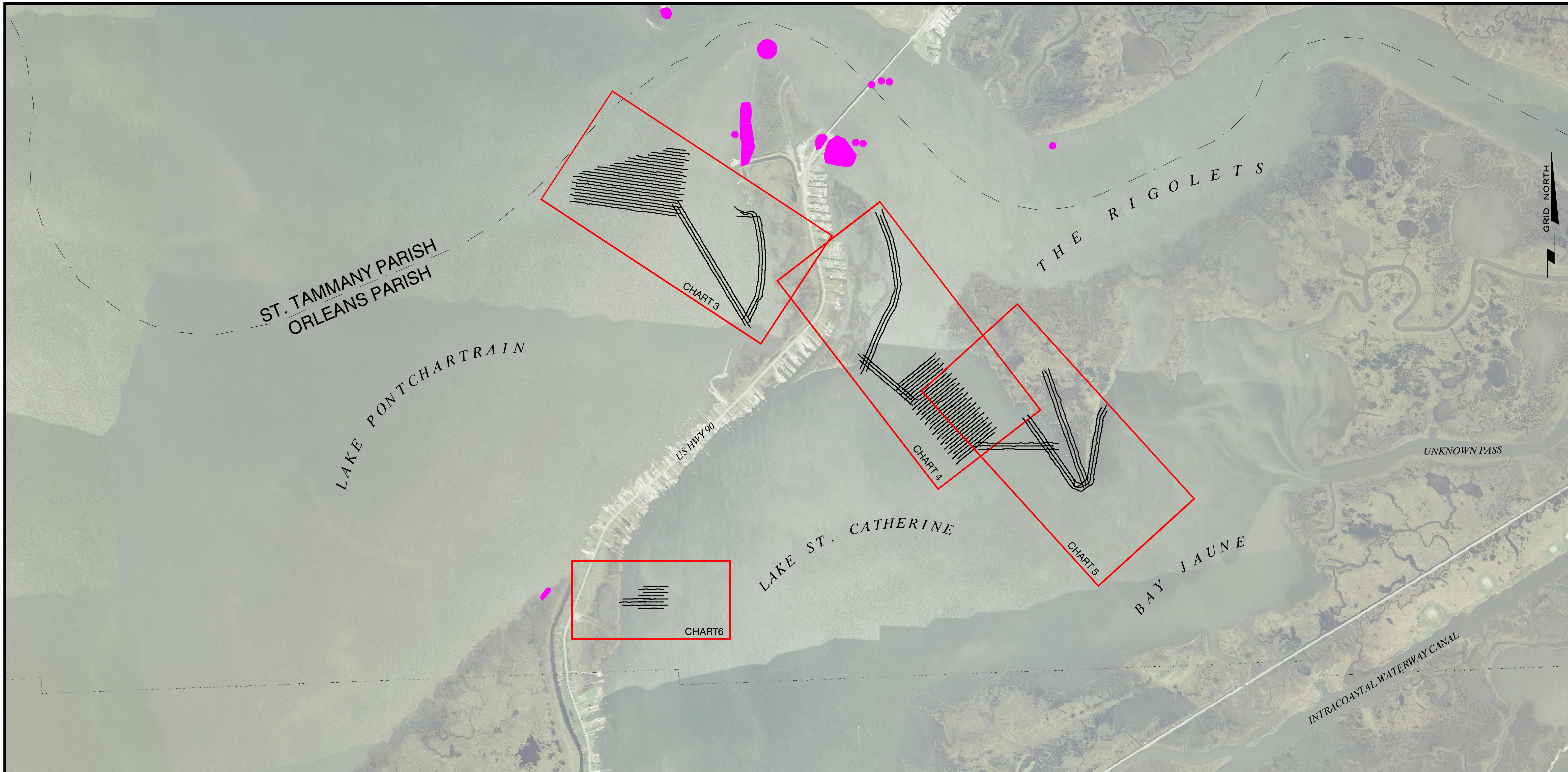
FUGRO GEOSPATIAL INC.

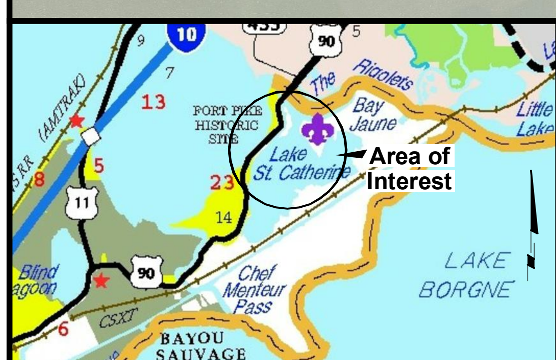
GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 — 3,000'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 1 Of: 17
Dwgfile: L:\2017\170089\CAD\H170089_COVER			





VICINITY MAP

NOT TO SCALE

LEGEND:

KNOWN ARCHAEOLOGICAL SITES (APPROXIMATE-TO BE AVOIDED)

SURVEY NOTES:

1. MAGNETOMETER SURVEYS WERE PERFORMED ON MAY 17-19, 2017.
2. AERIAL BACKGROUND IMAGERY ACQUIRED FROM NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) DATED 2013.
3. THE HORIZONTAL DATUM FOR ALL COORDINATES LISTED IS NAD83 (2011) EPOCH 2010.00- LOUISIANA STATE PLANE SOUTH ZONE (FEET).

CHUSTZ SURVEYING INC.

MAGNETOMETER SURVEY
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

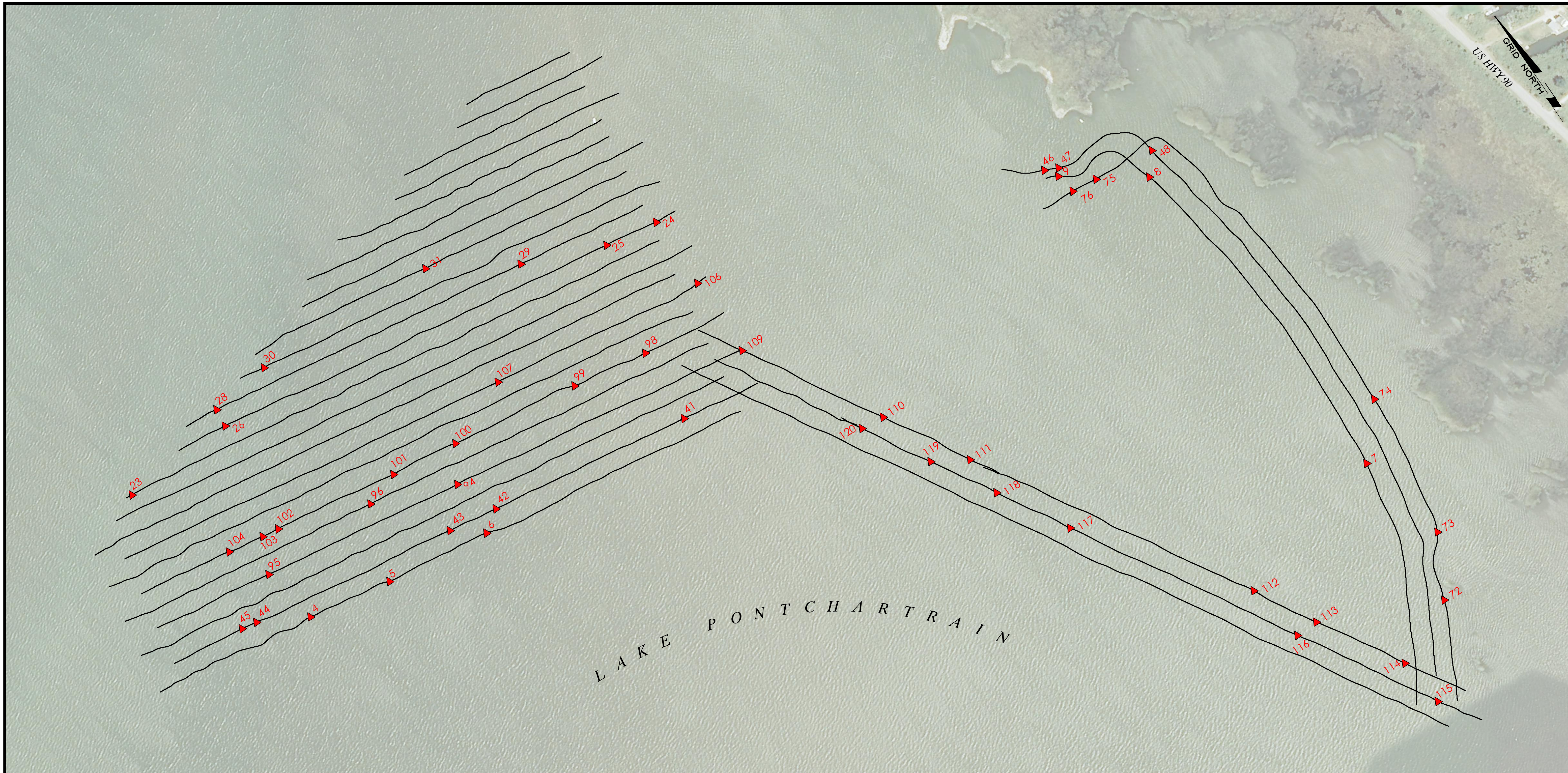
GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 3,000'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17–0089	Date: 6/14/17	Drwn: JDD	Chart: 2	Of: 17

Dwgfile: L:\2017\170089\CAD\H170089_COVER



LEGEND:

▲ 41 MAGNETIC ANOMALY ID# (SEE TABLE ON CHART 7)

TRACKLINES

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

CHUSTZ SURVEYING INC.

MAGNETOMETER MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 3	Of: 17

Dwgfile: L:\2017\170089\CAD\H170089_MAG

LEGEND:

▲ 41 MAGNETIC ANOMALY ID# (SEE TABLE ON CHART 7)

TRACKLINES

CHUSTZ SURVEYING INC.

MAGNETOMETER MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

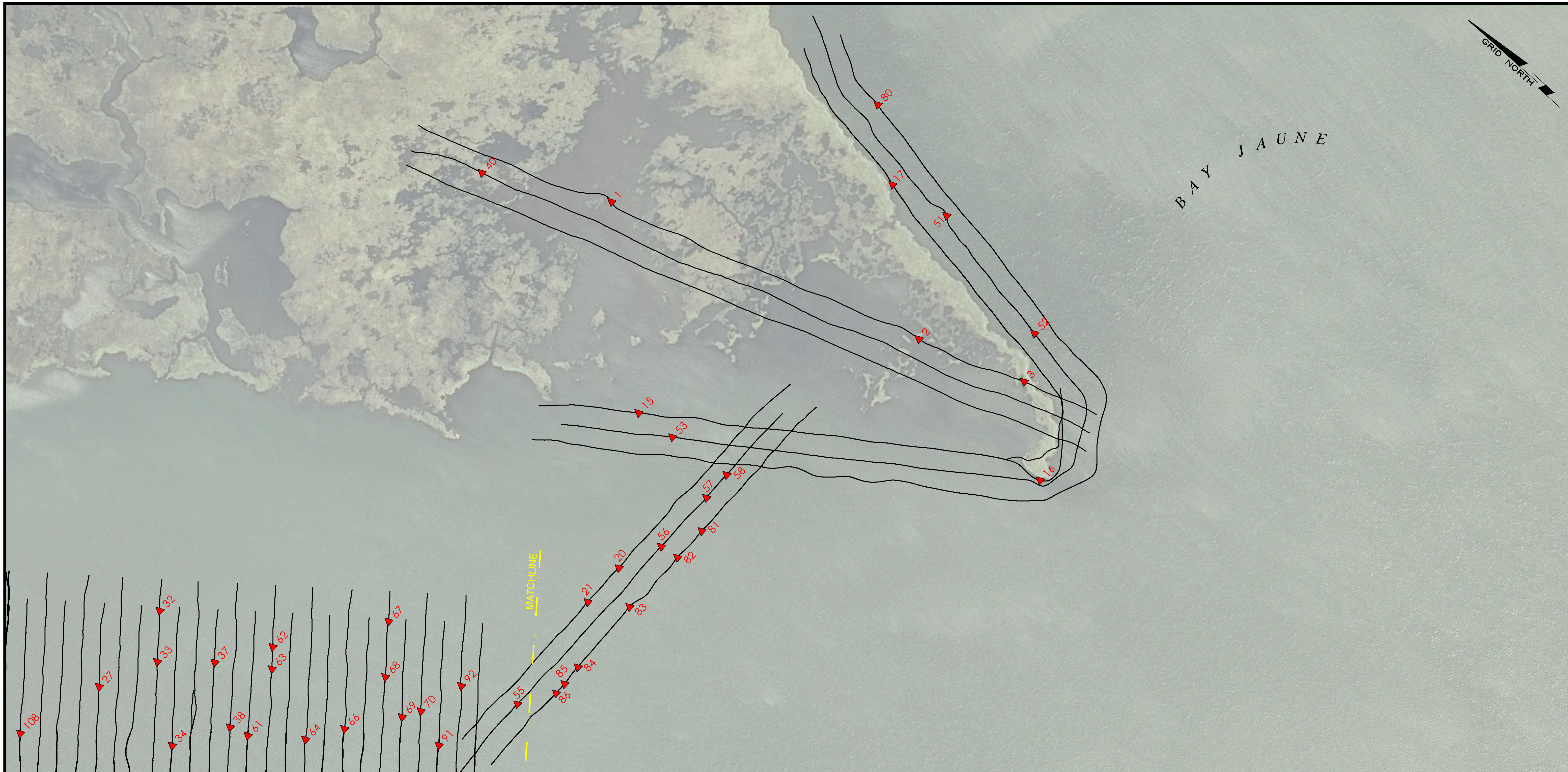
GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 4	Of: 17

Dwgfile: L:\2017\170089\CAD\H170089_MAG



LEGEND:

▲ 41 MAGNETIC ANOMALY ID# (SEE TABLE ON CHART 7)

TRACKLINES

CHUSTZ SURVEYING INC.

MAGNETOMETER MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

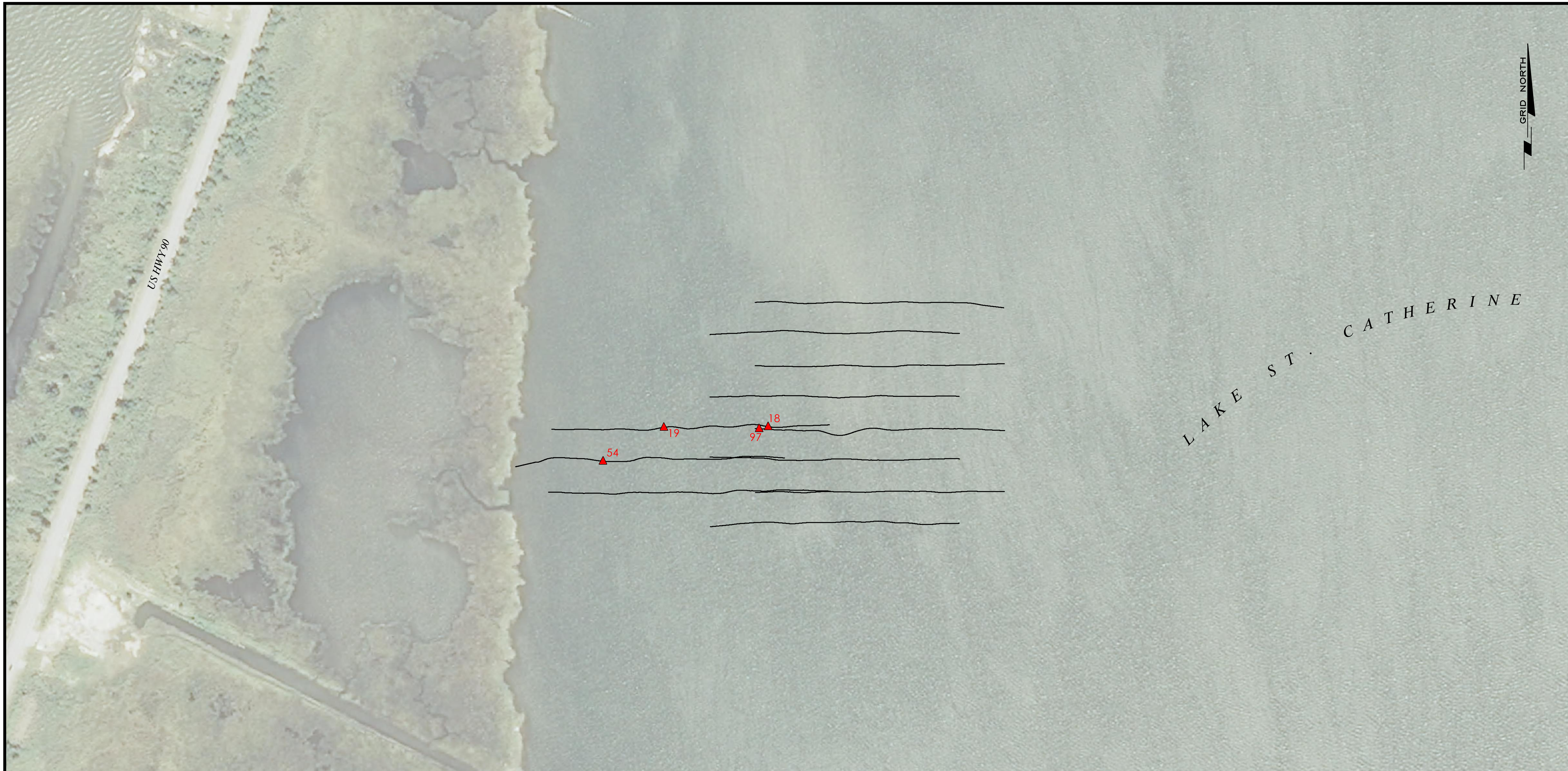
FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 5	Of: 17
Dwgfile: L:\2017\170089\CAD\H170089_MAG				



LEGEND:

▲ 41 MAGNETIC ANOMALY ID# (SEE TABLE ON CHART 7)

TRACKLINES

CHUSTZ SURVEYING INC.

MAGNETOMETER MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 300'

Proj. Mgr.: PHL Revised: Printed: 8/24/17	Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 6 Of: 17
	Dwgfile: L:\2017\170089\CAD\H170089_MAG			

UNIDENTIFIED MAGNETIC ANOMALIES

ANOMALY NUMBER	LINE NUMBER	SHOT PT. NUMBER	X COORDINATE	Y COORDINATE	AMPLITUDE (GAMMAS)	DURATION (FEET)	SIGNATURE
1	1	0.0	3,792,255.42'	601,688.05'	22	112	MONOPOLE
2	1	0.0	3,792,797.29'	600,037.19'	29	65	MONOPOLE
3	1	0.0	3,793,000.56'	599,488.07'	193	50	DIPOLE
4	1	2149.1	3,777,900.16'	607,769.25'	180	40	MONOPOLE
5	1	2166.9	3,778,340.69'	607,695.39'	86	40	DIPOLE
6	1	2189.3	3,778,895.83'	607,624.95'	260	73	DIPOLE
7	1	2843.3	3,782,873.74'	605,402.39'	34	54	MONOPOLE
8	1	2918.0	3,782,760.49'	607,254.45'	85	49	DIPOLE
9	1	2938.1	3,782,372.75'	607,518.20'	30	107	DIPOLE
10	1	3279.8	3,786,854.37'	607,238.00'	31	140	DIPOLE
11	1	3347.1	3,787,259.00'	605,610.01'	144	59	DIPOLE
12	1	3356.5	3,787,294.50'	605,378.50'	29	87	DIPOLE
13	1	3363.8	3,787,283.33'	605,197.52'	56	70	DIPOLE
14	1	3433.0	3,786,628.23'	603,609.50'	353	74	DIPOLE
15	1	3917.7	3,791,543.49'	600,852.90'	248	43	DIPOLE
16	1	3999.8	3,792,677.20'	599,084.13'	162	36	DIPOLE
17	1	4072.6	3,793,296.07'	600,674.03'	421	52	DIPOLE
18	1	4826.1	3,779,354.56'	595,572.00'	130	76	DIPOLE
19	1	4839.1	3,779,031.39'	595,569.96'	540	74	DIPOLE
20	1	4979.6	3,790,881.74'	600,390.03'	24	50	DIPOLE
21	1	4989.1	3,790,643.97'	600,391.41'	460	49	MONOPOLE
22	1	7294.4	3,787,468.74'	601,988.07'	30	86	MONOPOLE
23	11	0.0	3,777,482.21'	608,804.51'	46	49	DIPOLE
24	12	665.2	3,780,514.34'	608,473.59'	51	92	DIPOLE
25	12	676.5	3,780,235.79'	608,516.65'	130	134	DIPOLE
26	12	763.7	3,778,079.88'	608,833.56'	43	170	MONOPOLE
27	12	6550.5	3,788,625.35'	601,964.13'	291	54	DIPOLE
28	13	561.0	3,778,090.26'	608,927.31'	72	63	MONOPOLE
29	13	630.6	3,779,813.55'	608,681.63'	34	19	MONOPOLE
30	14	546.2	3,778,414.83'	608,972.40'	58	123	DIPOLE
31	15	408.4	3,779,390.84'	608,935.69'	29	37	MONOPOLE
32	15	6326.0	3,789,125.07'	601,996.00'	22	52	DIPOLE
33	15	6336.5	3,788,922.17'	601,828.55'	34	51	DIPOLE
34	16	6288.1	3,788,653.26'	601,481.14'	24	77	DIPOLE
35	17	6245.0	3,788,362.70'	601,109.56'	25	53	DIPOLE
36	18	6131.1	3,788,365.97'	600,999.93'	116	76	DIPOLE
37	18	6169.8	3,789,118.33'	601,606.69'	145	55	MONOPOLE
38	19	6087.2	3,788,924.49'	601,323.00'	149	54	DIPOLE
39	19	6108.6	3,788,508.81'	600,985.92'	110	55	MONOPOLE
40	2	0.0	3,791,916.68'	602,284.37'	373	55	DIPOLE
41	2	1996.5	3,780,071.78'	607,551.31'	37	51	DIPOLE
42	2	2039.5	3,779,005.14'	607,702.07'	39	50	MONOPOLE
43	2	2050.0	3,778,745.81'	607,740.05'	50	51	MONOPOLE
44	2	2094.2	3,777,652.34'	607,901.54'	126	52	MONOPOLE
45	2	2097.5	3,777,572.23'	607,914.43'	83	97	DIPOLE
46	2	2951.1	3,782,329.88'	607,583.74'	48	45	MONOPOLE
47	2	2954.0	3,782,397.20'	607,553.95'	66	62	DIPOLE
48	2	2973.6	3,782,847.77'	607,361.18'	159	56	DIPOLE
49	2	3524.8	3,786,525.00'	603,597.13'	40	129	DIPOLE
50	2	3586.7	3,787,151.44'	605,005.62'	34	57	MONOPOLE
51	2	4159.0	3,793,365.01'	600,359.70'	26	44	MONOPOLE
52	2	4189.4	3,793,219.38'	599,615.47'	62	49	DIPOLE
53	2	4304.5	3,791,567.07'	600,639.69'	325	69	DIPOLE
54	2	4866.1	3,778,843.31'	595,464.92'	39	57	DIPOLE
55	2	5047.3	3,790,008.87'	600,305.56'	88	45	DIPOLE
56	2	5091.4	3,791,110.81'	600,302.24'	448	44	DIPOLE
57	2	5105.1	3,791,453.75'	600,298.80'	125	43	MONOPOLE
58	2	5111.4	3,791,611.03'	600,300.81'	27	44	MONOPOLE
59	2	7393.1	3,786,462.75'	602,705.93'	15	38	MONOPOLE
60	20	6014.9	3,788,682.68'	600,999.47'	144	55	DIPOLE
61	20	6029.0	3,788,954.32'	601,226.46'	166	54	DIPOLE
62	21	5943.1	3,789,379.61'	601,439.46'	35	53	MONOPOLE
63	21	5947.7	3,789,292.39'	601,365.10'	237	53	DIPOLE
64	23	5834.8	3,789,138.83'	600,992.55'	148	52	MONOPOLE
65	23	5858.3	3,788,683.93'	600,621.50'	187	52	MONOPOLE
66	25	5705.2	3,789,314.94'	600,879.87'	64	52	DIPOLE
67	27	5556.5	3,789,878.20'	601,084.51'	309	50	DIPOLE
68	27	5568.0	3,789,655.59'	600,904.97'	46	52	DIPOLE
69	28	5527.7	3,789,560.12'	600,702.04'	38	52	DIPOLE
70	29	5447.7	3,789,648.32'	600,650.55'	298	50	DIPOLE
71	29	5468.0	3,789,257.59'	600,326.25'	121	51	DIPOLE
72	3	3123.6	3,782,815.11'	604,593.40'	61	46	DIPOLE
73	3	3137.8	3,782,981.26'	604,904.84'	104	50	DIPOLE
74	3	3168.3	3,783,090.84'	605,655.92'	19	53	MONOPOLE
75	3	3243.6	3,782,525.78'	607,397.15'	37	55	DIPOLE
76	3	3245.7	3,782,391.87'	607,412.04'	14	85	MONOPOLE
77	3	3768.3	3,787,062.61'	605,630.01'	31	57	MONOPOLE
78	3	3819.2	3,786,798.48'	604,420.86'	522	75	DIPOLE
79	3	3894.1	3,786,042.95'	602,708.44'	20	56	DIPOLE
80	3	4539.7	3,793,550.68'	601,008.02'	53	68	DIPOLE
81	3	5165.4	3,791,310.14'	600,201.16'	37	50	DIPOLE
82	3	5172.9	3,791,125.10'	600,202.90'	41	50	MONOPOLE
83	3	5187.0	3,790,770.32'	600,213.85'	40	49	MONOPOLE
84	3	5203.4	3,790,360.61'	600,202.78'	52	49	MONOPOLE
85	3	5207.8	3,790,249.61'	600,194.64'	53	49	MONOPOLE
86	3	5210.4	3,790,185.21'	600,195.31'	11	50	MONOPOLE
87	3	7138.0	3,787,550.53'	602,229.87'	35	136	DIPOLE
88	3	7487.4	3,787,067.68'	602,057.71'	1401	109	DIPOLE
89	3	7514.6	3,786,550.77'	602,497.96'	43	74	DIPOLE
90	30	5366.8	3,789,024.15'	600,019.15'	54	52	MONOPOLE
91	30	5395.2	3,789,579.44'	600,463.11'	34	52	DIPOLE
92	31	5315.0	3,789,884.61'	600,583.32'	97	50	DIPOLE
93	31	5355.1	3,789,107.37'	599,951.04'	110	51	MONOPOLE
94	4	1773.6	3,778,909.78'	607,918.03'	128	134	DIPOLE
95	4	1816.7	3,777,841.91'	608,071.36'	24	51	MONOPOLE
96	5	1630.3	3,778,481.73'	608,082.26'	86	16	DIPOLE
97	5	4719.0	3,779,326.30'	595,565.73'	119	53	DIPOLE
98	6	1456.9	3,780,093.37'	607,942.23'	93	152	DIPOLE
99	6	1473.0	3,779,694.88'	608,004.64'	103	90	DIPOLE
100	6	1500.3	3,779,018.55'	608,098.78'	34	91	DIPOLE
101	6	1514.6	3,778,664.22'	608,143.32'	19	49	DIPOLE
102	6	1540.9	3,778,013.15'	608,240.35'	67	51	DIPOLE
103	6	1544.5	3,777,924.47'	608,250.91'	23	90	MONOPOLE
104	6	1552.0	3,777,736.36'	608,281.98'	198	139	DIPOLE
105	6	6934.3	3,788,077.47'	602,275.88'	19	66	DIPOLE
106	8	0.0	3,780,516.91'	608,093.32'	41	115	DIPOLE
107	8	1215.9	3,779,377.03'	608,240.57'	142	82	DIPOLE
108	8	6791.0	3,788,173.15'	602,103.53'	31	83	DIPOLE
109	D1-1	2259.6	3,780,515.20'	607,676.16'	82	47	MONOPOLE
110	D1-1	2291.8	3,780,929.99'	606,986.40'	134	48	DIPOLE
111	D1-1	2311.8	3,781,181.59'	606,554.80'	373	72	DIPOLE
112	D1-1	2382.3	3,782,024.42'	605,178.68'	125	48	DIPOLE
113	D1-1	2396.7	3,782,202.70'	604,865.23'	226	47	DIPOLE
114	D1-1	2416.9	3,782,465.04'	604,434.34'	61	47	DIPOLE
115	D1-2	2442.3	3,782,497.42'	604,175.84'	127	22	MONOPOLE
116	D1-2	2474.4	3,782,084.15'	604,862.07'	38	51	MONOPOLE
117	D1-2	2526.3	3,781,415.51'	605,974.18'	43	48	DIPOLE
118	D1-2	2543.1	3,781,200.39'	606,337.28'	42	47	DIPOLE
119	D1-2	2558.2	3,781,006.57'	606,659.13'	35	45	DIPOLE
120	D1-2	2573.9	3,780,806.77'	606,998.10'	31	153	DIPOLE

CHUSTZ SURVEYING INC.

MAGNETOMETER CHART
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

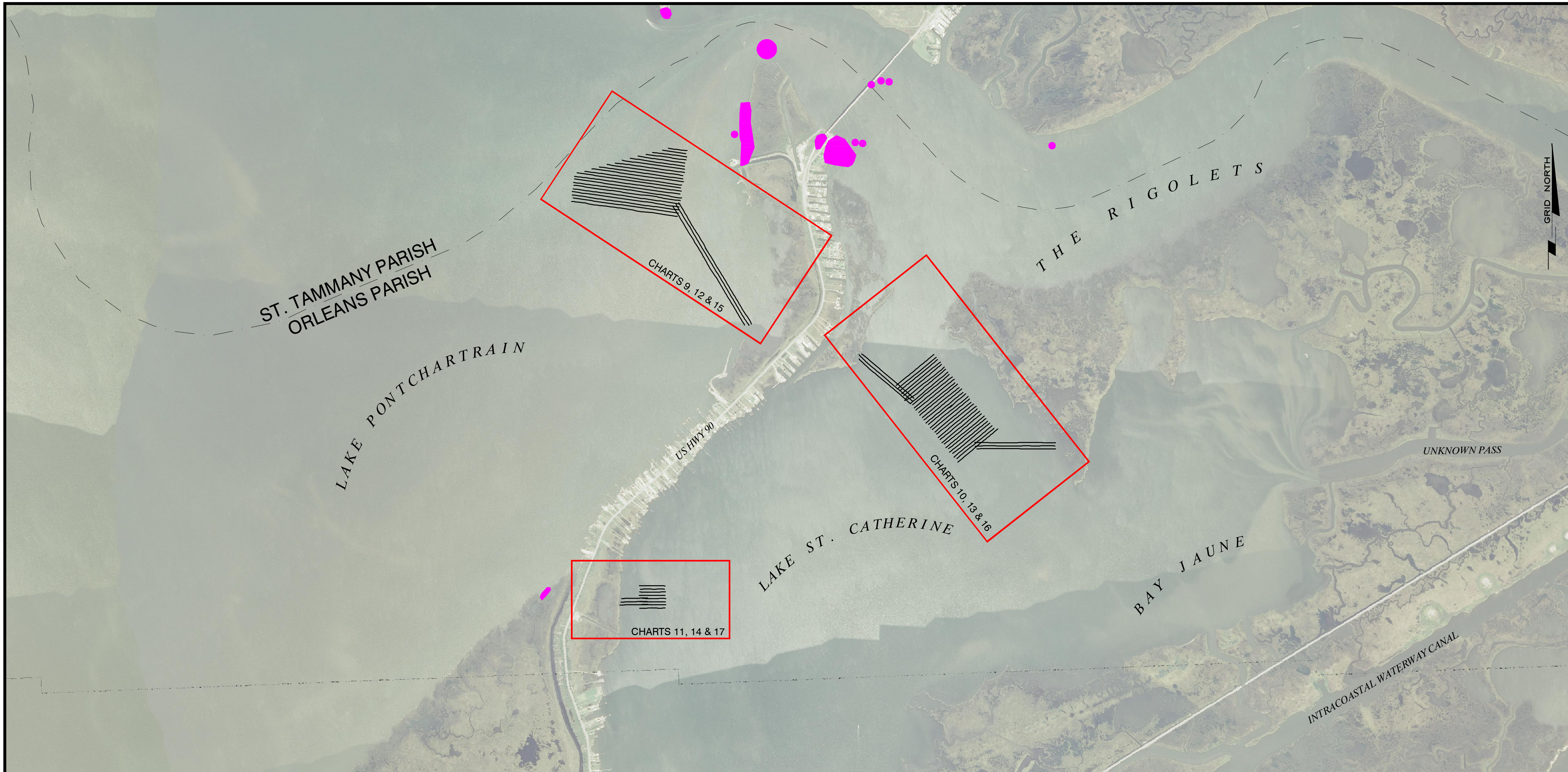
GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

NOT TO SCALE

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089 | Date: 6/14/17 | Drwn: JDD | Chart: 7 | Of: 17

Dwgfile: L:\2017\170089\CAD\H170089_MAG



VICINITY MAP
NOT TO SCALE

LEGEND:

KNOWN ARCHAEOLOGICAL SITES (APPROXIMATE-TO BE AVOIDED)

SURVEY NOTES:

1. MAGNETOMETER SURVEYS WERE PERFORMED ON MAY 17-19, 2017.
2. AERIAL BACKGROUND IMAGERY ACQUIRED FROM NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) DATED 2013.
3. THE HORIZONTAL DATUM FOR ALL COORDINATES LISTED IS NAD83 (2011) EPOCH 2010.00- LOUISIANA STATE PLANE SOUTH ZONE (FEET).

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

CHUSTZ SURVEYING INC.

SUB BOTTOM PROFILER, SONAR IMAGING & ISOPACH SURVEY
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 3,000'

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 8	Of: 17

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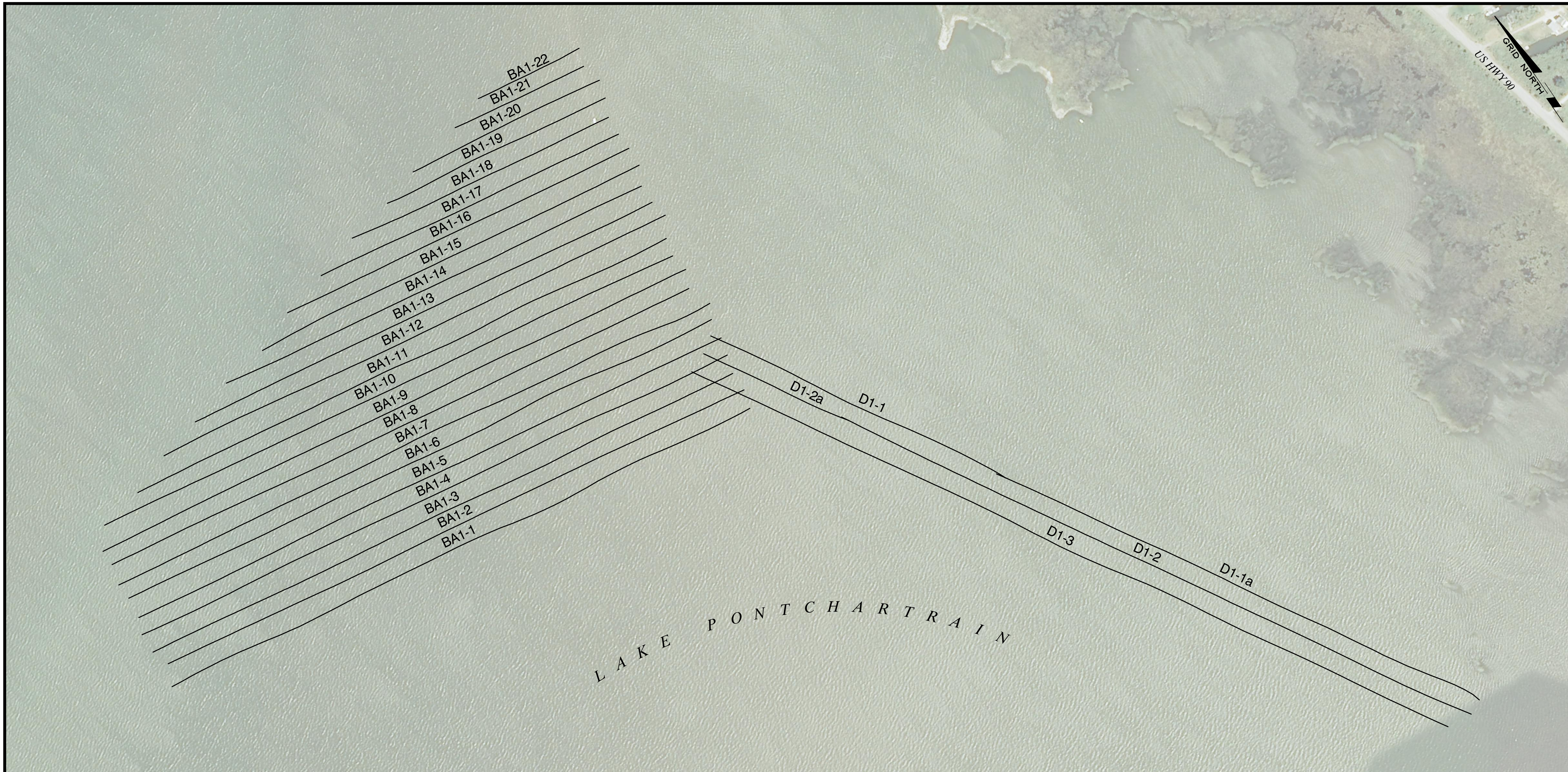


LEGEND:

BA1-1 SUB-BOTTOM PROFILER TRACKLINE

CHUSTZ SURVEYING INC.

SUB-BOTTOM PROFILER MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 9	Of: 17
Dwgfile: L:\2017\170089\CAD\H170089_SUB BOTTOM				

LEGEND:

BA1-1 SUB-BOTTOM PROFILER TRACKLINE

CHUSTZ SURVEYING INC.

SUB-BOTTOM PROFILER MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

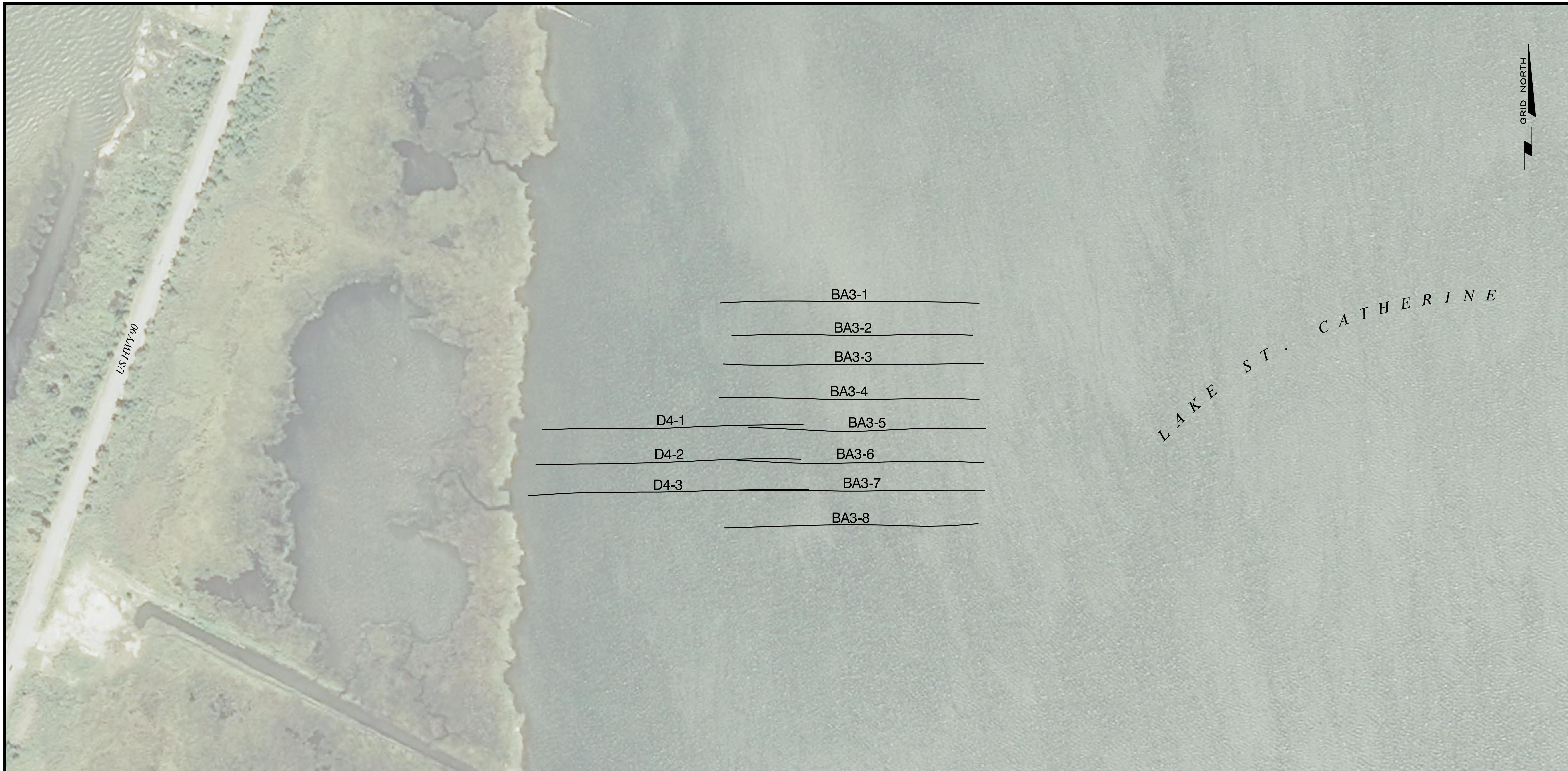
FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 10 Of: 17
Dwgfile: L:\2017\170089\CAD\H170089_SUB BOTTOM			



LEGEND:

BA1-1 SUB-BOTTOM PROFILER TRACKLINE

CHUSTZ SURVEYING INC.

SUB-BOTTOM PROFILER MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

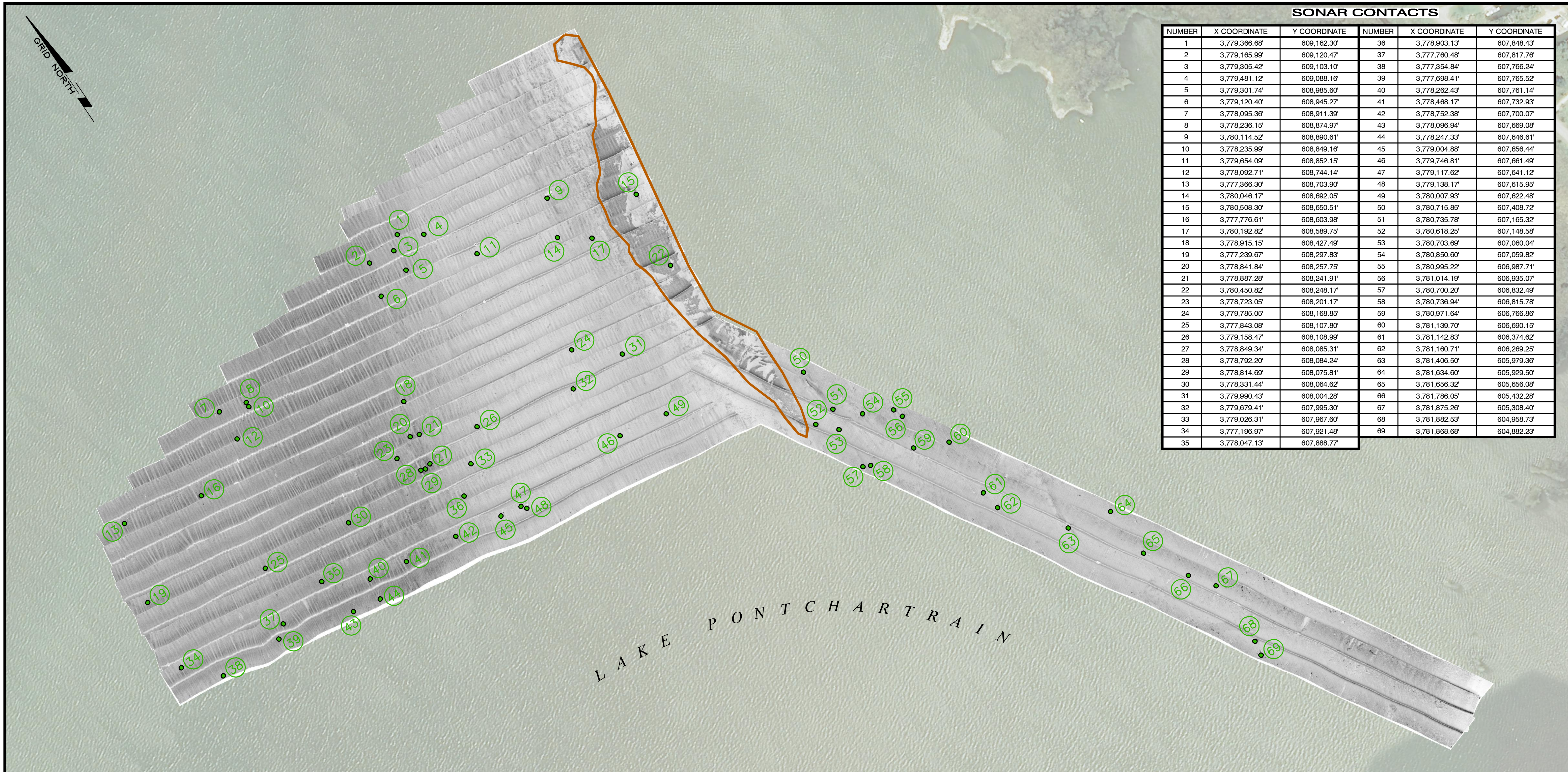
FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 300'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 11	Of: 17
Dwgfile: L:\2017\170089\CAD\H170089_SUB BOTTOM				



SONAR CONTACTS

NUMBER	X COORDINATE	Y COORDINATE	NUMBER	X COORDINATE	Y COORDINATE
1	3,779,366.68'	609,162.30'	36	3,778,903.13'	607,848.43'
2	3,779,165.99'	609,120.47'	37	3,777,760.48'	607,817.76'
3	3,779,305.42'	609,103.10'	38	3,777,354.84'	607,766.24'
4	3,779,481.12'	609,088.16'	39	3,777,698.41'	607,765.52'
5	3,779,301.74'	608,985.60'	40	3,778,262.43'	607,761.14'
6	3,779,120.40'	608,945.27'	41	3,778,468.17'	607,732.93'
7	3,778,095.36'	608,911.39'	42	3,778,752.38'	607,700.07'
8	3,778,236.15'	608,874.97'	43	3,778,096.94'	607,669.08'
9	3,780,114.52'	608,890.61'	44	3,778,247.33'	607,646.61'
10	3,778,235.99'	608,849.16'	45	3,779,004.88'	607,656.44'
11	3,779,654.09'	608,852.15'	46	3,779,746.81'	607,661.49'
12	3,778,092.71'	608,744.14'	47	3,779,117.62'	607,641.12'
13	3,777,366.30'	608,703.90'	48	3,779,138.17'	607,615.95'
14	3,780,046.17'	608,692.05'	49	3,780,007.93'	607,622.48'
15	3,780,508.30'	608,650.51'	50	3,780,715.85'	607,408.72'
16	3,777,776.61'	608,603.98'	51	3,780,735.78'	607,165.32'
17	3,780,192.82'	608,589.75'	52	3,780,618.25'	607,148.58'
18	3,778,915.15'	608,427.49'	53	3,780,703.69'	607,060.04'
19	3,777,239.67'	608,297.83'	54	3,780,850.60'	607,059.82'
20	3,778,841.84'	608,257.75'	55	3,780,995.22'	606,987.71'
21	3,778,887.28'	608,241.91'	56	3,781,014.19'	606,935.07'
22	3,780,450.82'	608,248.17'	57	3,780,700.20'	606,832.49'
23	3,778,723.05'	608,201.17'	58	3,780,736.94'	606,815.78'
24	3,779,785.05'	608,168.85'	59	3,780,971.64'	606,766.86'
25	3,777,843.08'	608,107.80'	60	3,781,139.70'	606,690.15'
26	3,779,158.47'	608,108.99'	61	3,781,142.83'	606,374.62'
27	3,778,849.34'	608,085.31'	62	3,781,160.71'	606,269.25'
28	3,778,792.20'	608,084.24'	63	3,781,406.50'	605,979.36'
29	3,778,814.69'	608,075.81'	64	3,781,634.60'	605,929.50'
30	3,778,331.44'	608,064.62'	65	3,781,656.32'	605,656.08'
31	3,779,990.43'	608,004.28'	66	3,781,786.05'	605,432.28'
32	3,779,679.41'	607,995.30'	67	3,781,875.26'	605,308.40'
33	3,779,026.31'	607,967.60'	68	3,781,882.53'	604,958.73'
34	3,777,196.97'	607,921.48'	69	3,781,868.68'	604,882.23'
35	3,778,047.13'	607,888.77'			

LEGEND:

35 SONAR CONTACT

PROBABLE OYSTER REEF

CHUSTZ SURVEYING INC.

SONAR IMAGE MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

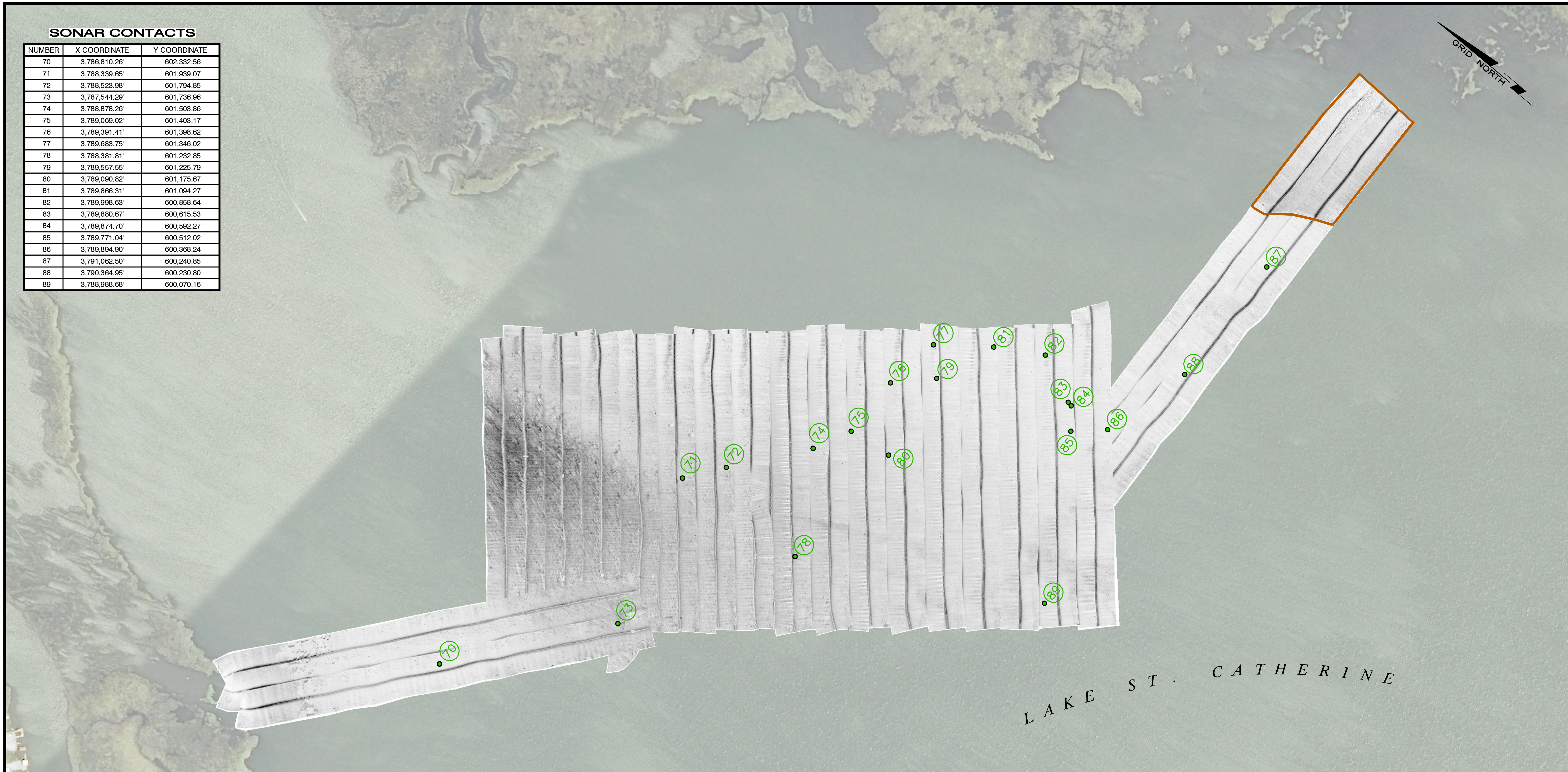
Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089 | Date: 6/14/17 | Drwn: JDD | Chart: 12 Of: 17

Dwgfile: L:\2017\170089\CAD\H170089_SONAR

SONAR CONTACTS

NUMBER	X COORDINATE	Y COORDINATE
70	3,786,810.26'	602,332.56'
71	3,788,339.65'	601,939.07'
72	3,788,523.98'	601,794.85'
73	3,787,544.29'	601,736.96'
74	3,788,878.26'	601,503.86'
75	3,789,069.02'	601,403.17'
76	3,789,391.41'	601,398.62'
77	3,789,683.75'	601,346.02'
78	3,788,381.81'	601,232.85'
79	3,789,557.55'	601,225.79'
80	3,789,090.82'	601,175.67'
81	3,789,866.31'	601,094.27'
82	3,789,998.63'	600,858.64'
83	3,789,880.67'	600,615.53'
84	3,789,874.70'	600,592.27'
85	3,789,771.04'	600,512.02'
86	3,789,894.90'	600,368.24'
87	3,791,062.50'	600,240.85'
88	3,790,364.95'	600,230.80'
89	3,788,988.68'	600,070.16'



LEGEND:

35 SONAR CONTACT

PROBABLE OYSTER REEF

CHUSTZ SURVEYING INC.

SONAR IMAGE MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089 | Date: 6/14/17 | Drwn: JDD | Chart: 13 Of: 17

Dwgfile: L:\2017\170089\CAD\H170089_SONAR

SONAR CONTACTS

NUMBER	X COORDINATE	Y COORDINATE
90	3,779,939.88'	595,632.42'
91	3,779,650.70'	595,621.69'
92	3,779,736.53'	595,620.65'
93	3,779,798.77'	595,614.19'
94	3,779,545.64'	595,584.27'
95	3,779,133.00'	595,553.97'
96	3,779,868.36'	595,483.47'
97	3,779,586.56'	595,394.50'
98	3,779,607.64'	595,390.40'
99	3,779,385.76'	595,345.78'
100	3,778,931.25'	595,295.53'
101	3,779,944.05'	595,290.08'

LEGEND:

35 SONAR CONTACT

PROBABLE OYSTER REEF

CHUSTZ SURVEYING INC.

SONAR IMAGE MAP
PO-169 GEOPHYSICAL SURVEY

ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 300'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089 | Date: 6/14/17 | Drwn: JDD | Chart: 14 Of: 17

Dwgfile: L:\2017\170089\CAD\H170089_SONAR

LEGEND:

CONTOUR LINES (THICKNESS IN FEET)

AREA OF UNCERTAINTY

SURVEY NOTES:

1. THE CONTOURS IN THESE CHARTS REPRESENT THE THICKNESS OF THE SEISMIC SEQUENCE DETAILED IN THE ACCOMPANYING REPORT. THEY DO NOT REFLECT WATER DEPTHS OR ELEVATIONS.

CHUSTZ SURVEYING INC.

ISOPACH MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

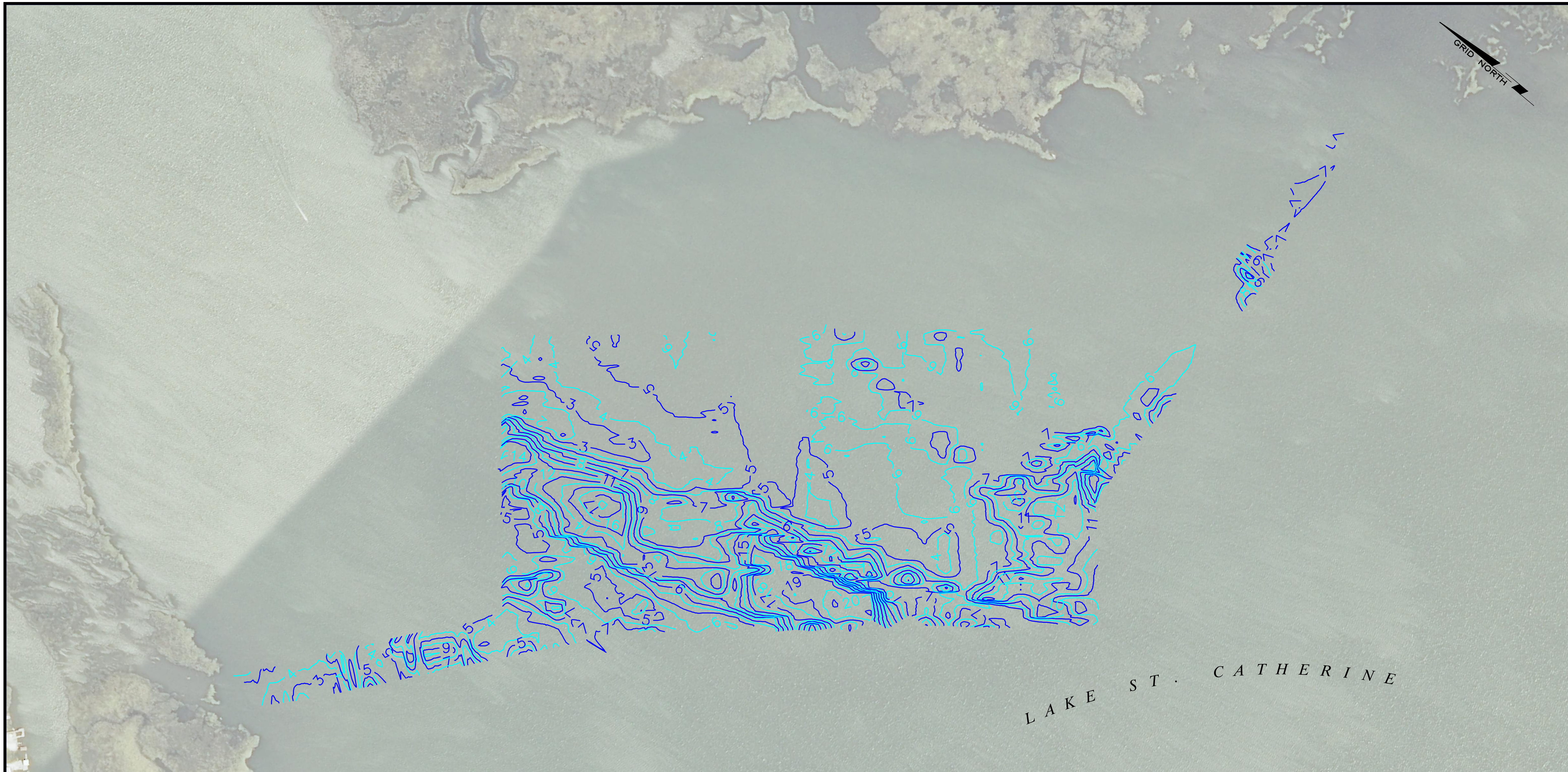
GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089 | Date: 6/14/17 | Drwn: JDD | Chart: 15 Of: 17

Dwgfile: L:\2017\170089\CAD\H170089_ISOPACH



LEGEND:

CONTOUR LINES (THICKNESS IN FEET)

SURVEY NOTES:

1. THE CONTOURS IN THESE CHARTS REPRESENT THE THICKNESS OF THE SEISMIC SEQUENCE DETAILED IN THE ACCOMPANYING REPORT. THEY DO NOT REFLECT WATER DEPTHS OR ELEVATIONS.

CHUSTZ SURVEYING INC.

ISOPACH MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 500'

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

Job No.: 17-0089	Date: 6/14/17	Drwn: JDD	Chart: 16 Of: 17
Dwgfile: L:\2017\170089\CAD\H170089_ISOPACH			

LEGEND:

CONTOUR LINES (THICKNESS IN FEET)

SURVEY NOTES:

1. THE CONTOURS IN THESE CHARTS REPRESENT THE THICKNESS OF THE SEISMIC SEQUENCE DETAILED IN THE ACCOMPANYING REPORT. THEY DO NOT REFLECT WATER DEPTHS OR ELEVATIONS.

Proj. Mgr.: PHL
Revised:
Printed: 8/24/17

CHUSTZ SURVEYING INC.

ISOPACH MAP
PO-169 GEOPHYSICAL SURVEY
ORLEANS PARISH, LOUISIANA

FUGRO GEOSPATIAL INC.

GEODETIC DATUM: NAD83
PROJECTION: LOUISIANA SOUTH
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 300'

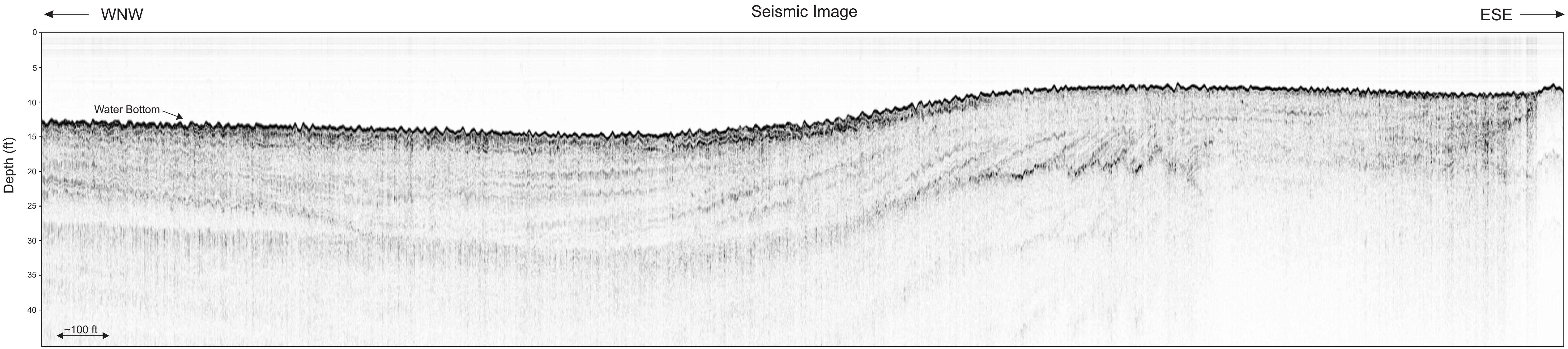
Job No.: 17-0089 | Date: 6/14/17 | Drwn: JDD | Chart: 17 Of: 17

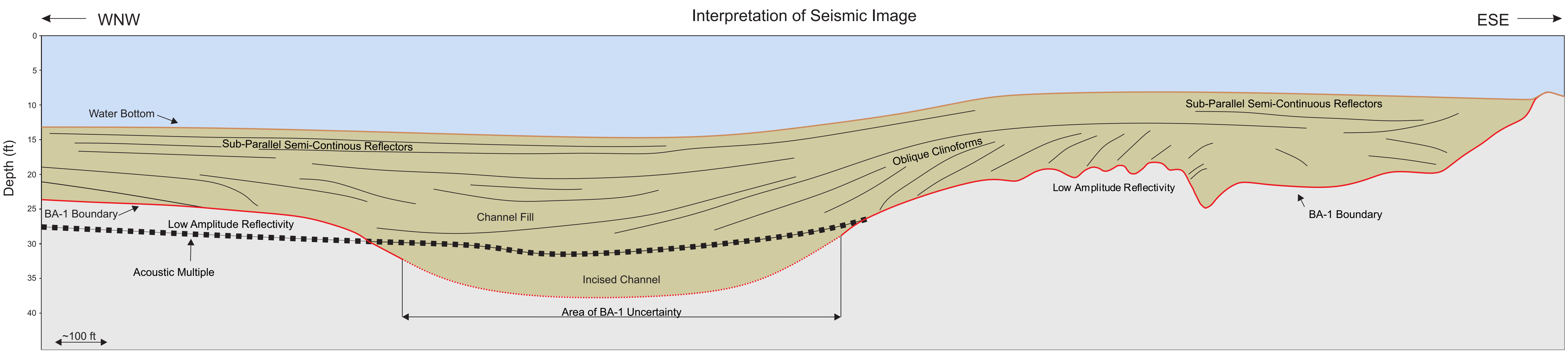
Dwgfile: L:\2017\170089\CAD\H170089_ISOPACH

APPENDIX B: SUB-BOTTOM SEISMIC FIGURES

Sub-bottom Seismic Line BA1-5

New Orleans Landbridge Shoreline Stabilization and Marsh Creation (PO-169)

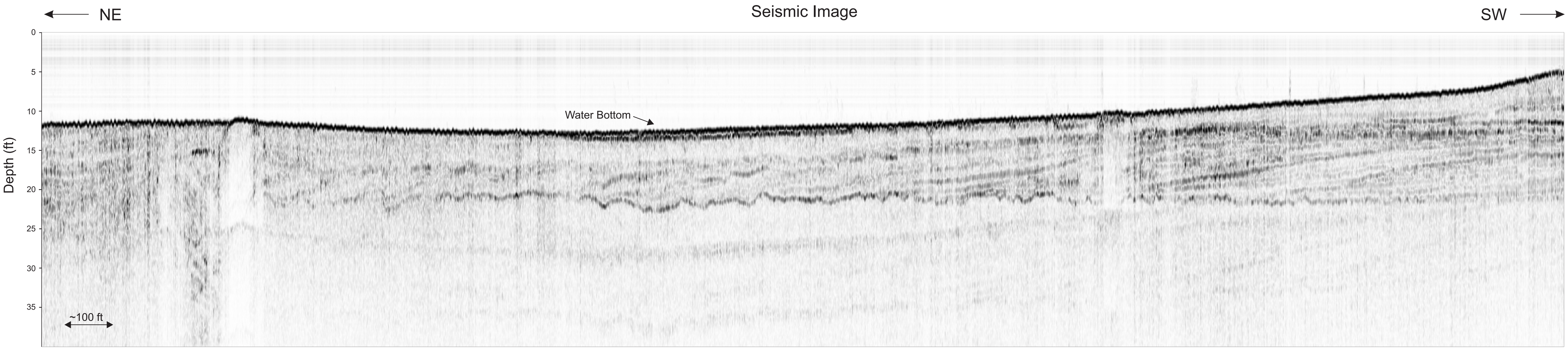


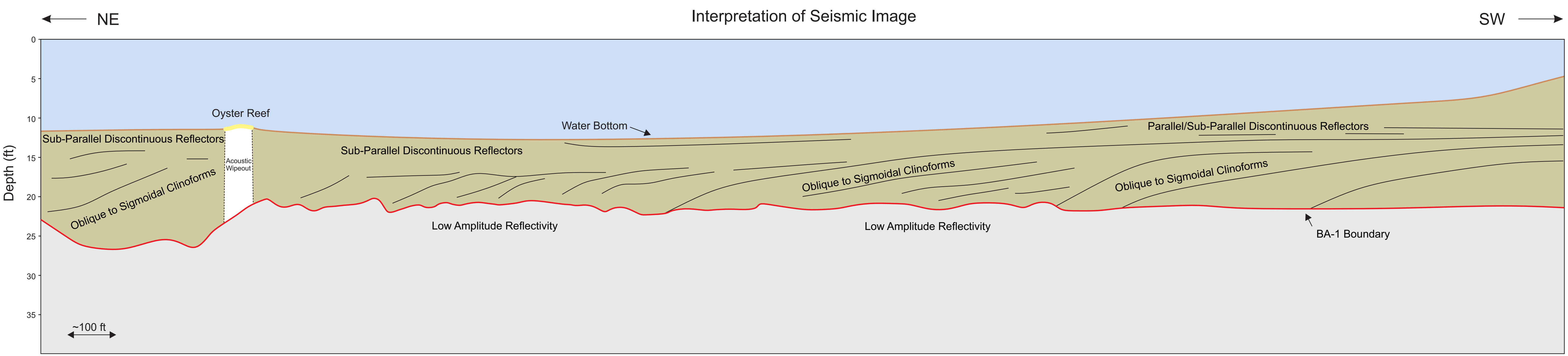


Sub-bottom Seismic Line BA1-5: All sub-bottom data were captured using an Edgetech 3100 SB424. Line BA1-5 is representative of Borrow Area 1. The interpreted seismic sequence boundary was named "BA-1," and was traced throughout the borrow area and associated dredge pipeline corridor. An isopach was calculated based on the thickness of the seismic sequence located above BA-1. The seismic stratigraphy in the seismic sequence above BA-1 was observed and described.

Sub-bottom Seismic Line D1-3

New Orleans Landbridge Shoreline Stabilization and Marsh Creation (PO-169)



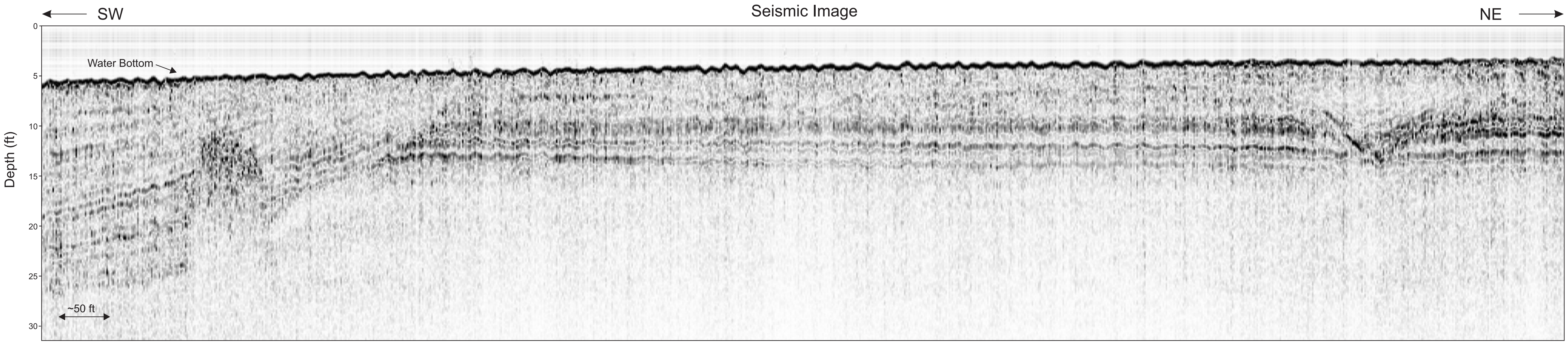


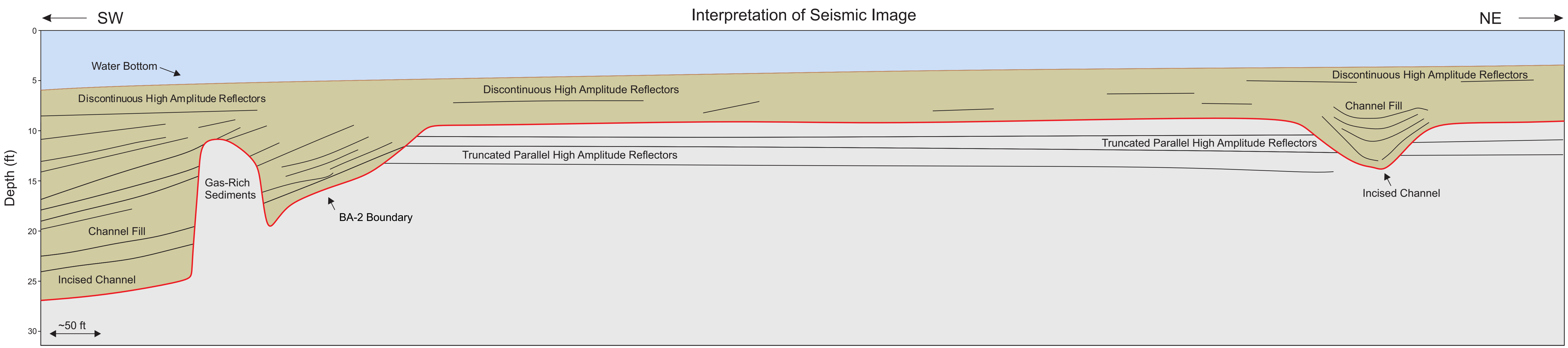
Sub-bottom Seismic Line D1-3: All sub-bottom data were captured using an Edgetech 3100 SB424. Line D1-3 is representative of the dredge corridor proceeding from the shoreline to Borrow Area 1. The interpreted seismic sequence boundary was named “BA-1,” and was traced throughout the dredge pipeline corridor. An isopach was calculated based on the thickness of the seismic sequence located above BA-1. The seismic stratigraphy in the seismic sequence above BA-1 was observed and described.

FUGRO

Sub-bottom Seismic Line BA2-20

New Orleans Landbridge Shoreline Stabilization and Marsh Creation (PO-169)

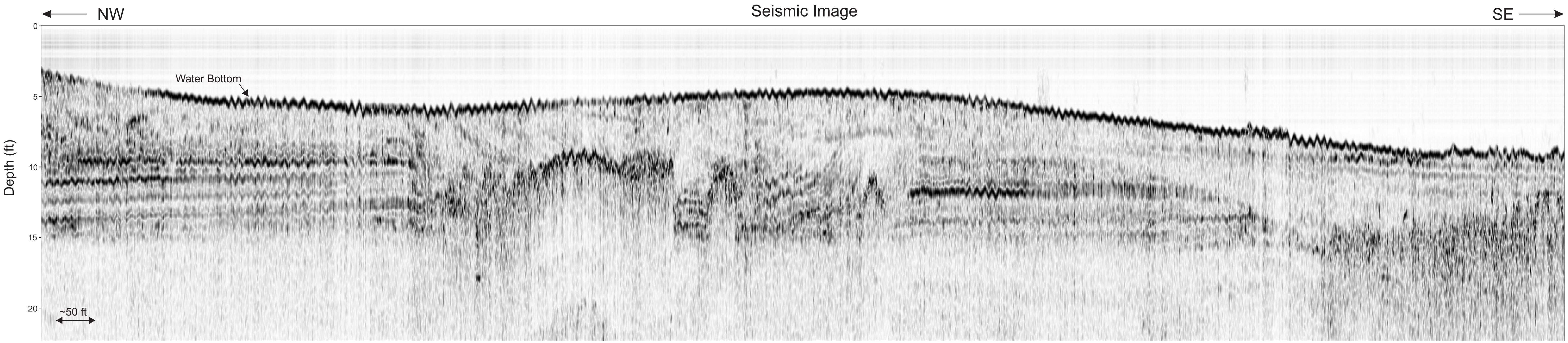


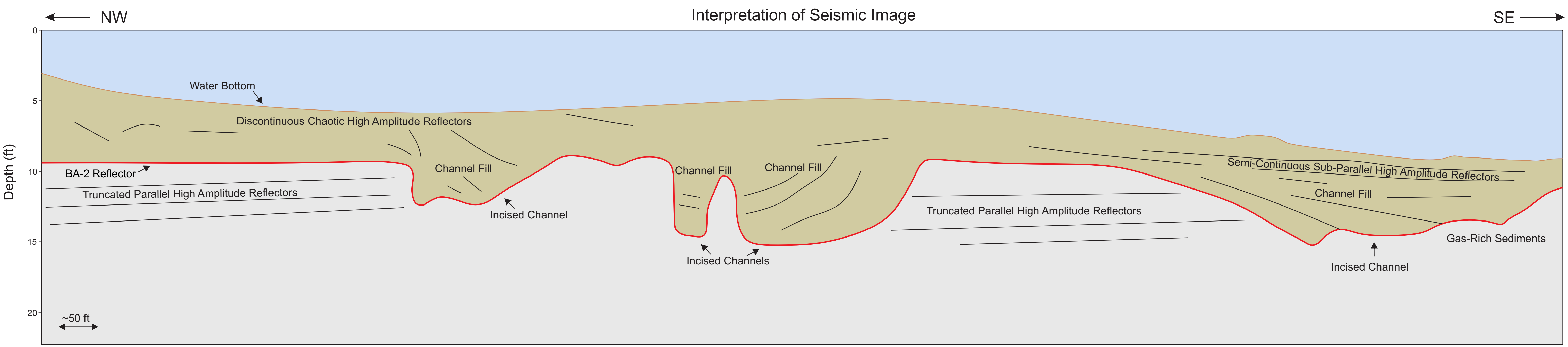


Sub-bottom Seismic Line BA-20: All sub-bottom data were captured using an Edgetech 3100 SB424. Line BA-20 is representative of Borrow Area 2. The interpreted seismic sequence boundary was named “BA-2,” and was traced throughout the borrow area and associated dredge pipeline corridor. An isopach was calculated based on the thickness of the seismic sequence located above BA-2. The seismic stratigraphy in the seismic sequence above BA-2 was observed and described.

Sub-bottom Seismic Line D2-2

New Orleans Landbridge Shoreline Stabilization and Marsh Creation (PO-169)

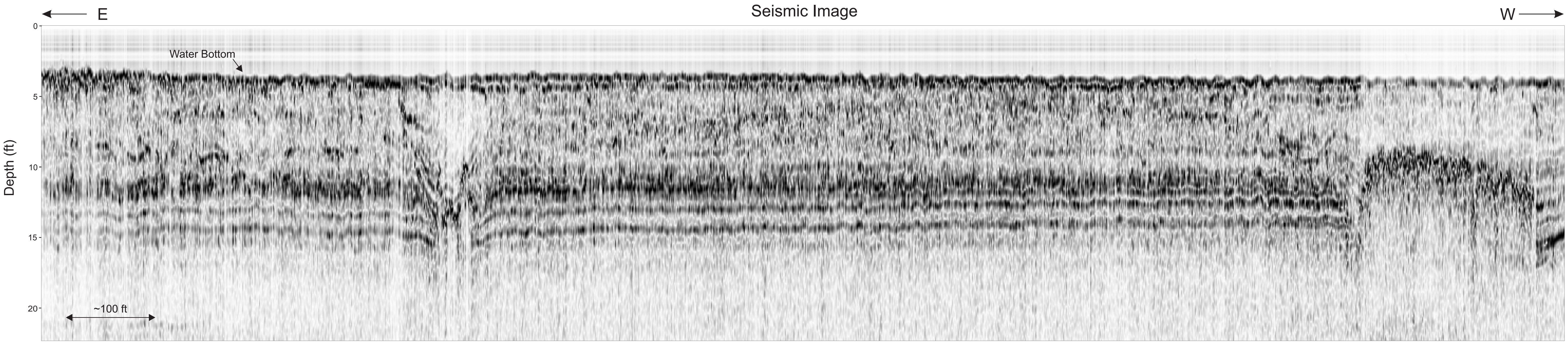


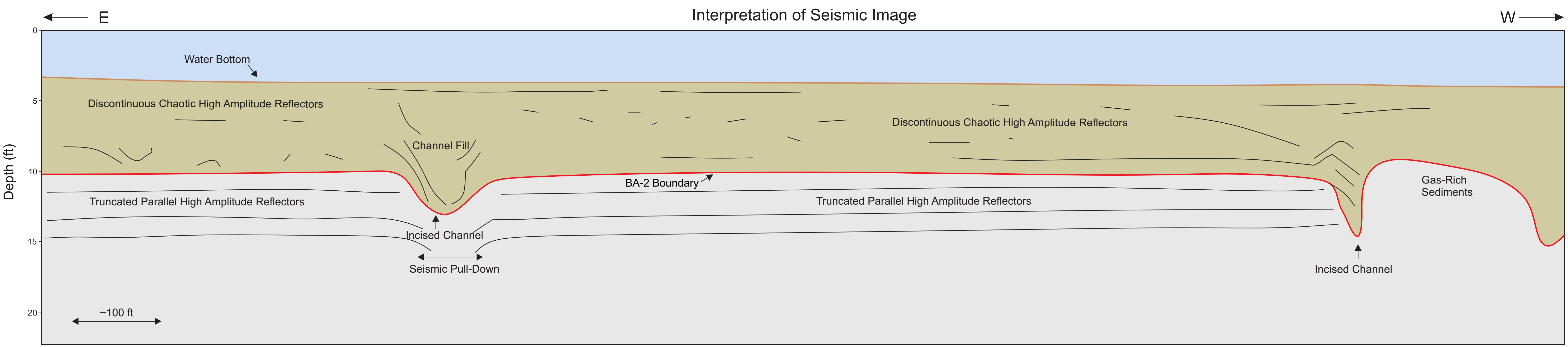


Sub-bottom Seismic Line D2-2: All sub-bottom data were captured using an Edgetech 3100 SB424. Line D1-3 is representative of the dredge corridor proceeding from the shoreline to Borrow Area 2. The interpreted seismic sequence boundary was named "BA-2," and was traced throughout the borrow area and associated dredge pipeline corridor. An isopach was calculated based on the thickness of the seismic sequence located above BA-2. The seismic stratigraphy in the seismic sequence above BA-2 was observed and described.

Sub-bottom Seismic Line D3-1

New Orleans Landbridge Shoreline Stabilization and Marsh Creation (PO-169)

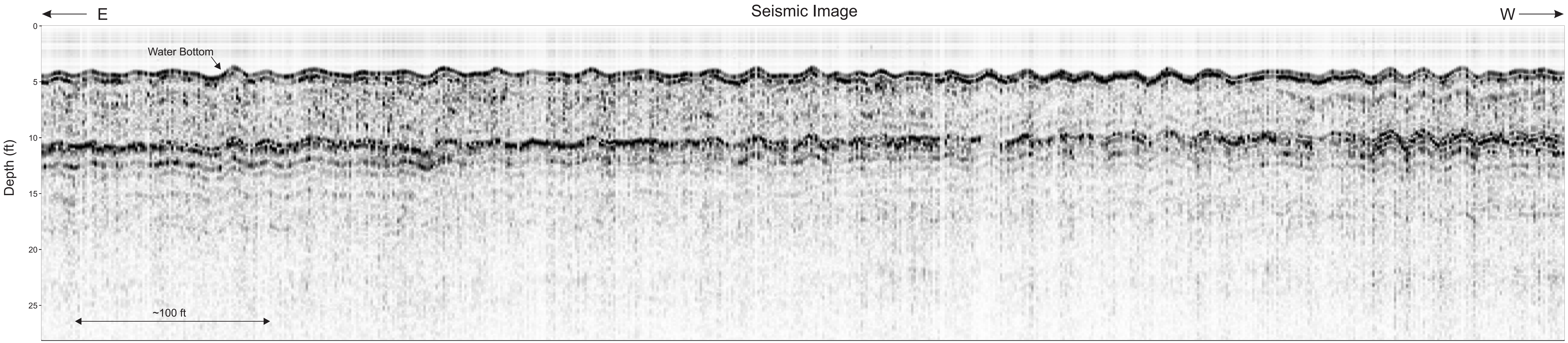


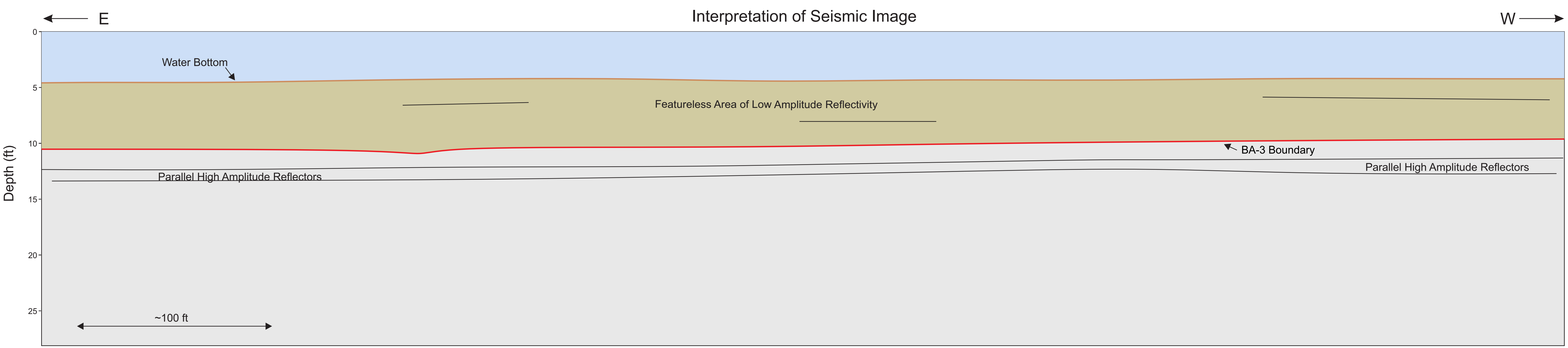


Sub-bottom Seismic Line D3-1: All sub-bottom data were captured using an Edgetech 3100 SB424. Line D3-1 is representative of the dredge corridor proceeding east from Borrow Area 2. The interpreted seismic sequence boundary was named "BA-2," and was traced throughout the borrow area and associated dredge pipeline corridor. An isopach was calculated based on the thickness of the seismic sequence located above BA-2. The seismic stratigraphy in the seismic sequence above BA-2 was observed and described.

Sub-bottom Seismic Line BA3-5

New Orleans Landbridge Shoreline Stabilization and Marsh Creation (PO-169)

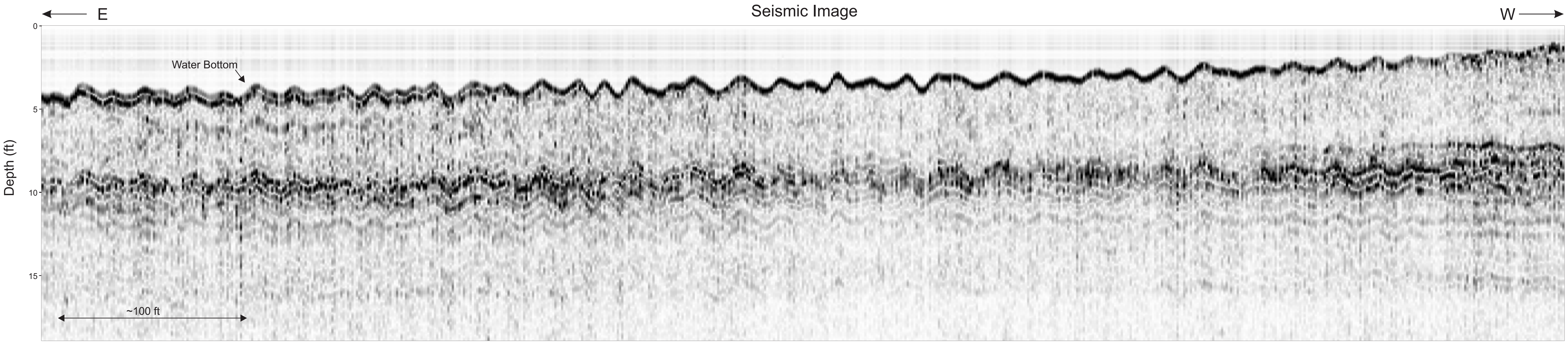


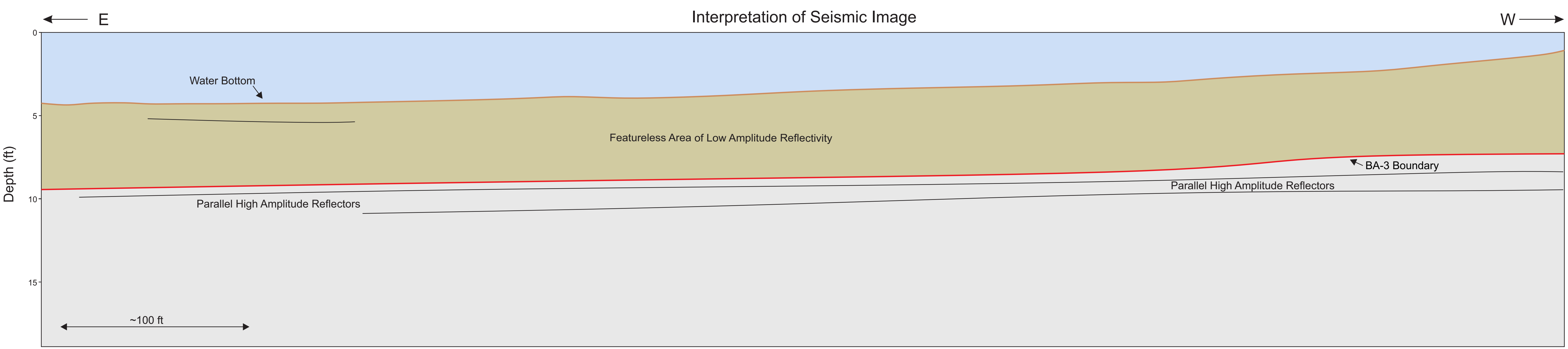


Sub-bottom Seismic Line BA3-5: All sub-bottom data were captured using an Edgetech 3100 SB424. Line BA3-5 is representative of Borrow Area 3. The interpreted seismic sequenceboundary was named “BA-3,” and was traced throughout the borrow area and associated dredge pipeline corridor. An isopach was calculated based on the thickness of the seismic sequence located above BA-3. The seismic stratigraphy in the seismic sequence above BA-3 was observed and described.

Sub-bottom Seismic Line D4-1

New Orleans Landbridge Shoreline Stabilization and Marsh Creation (PO-169)



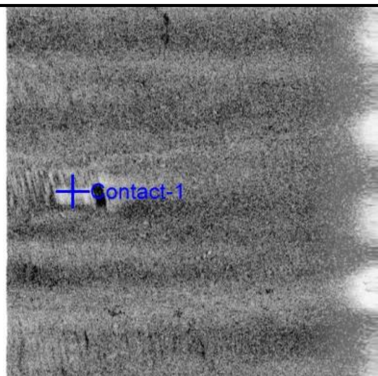
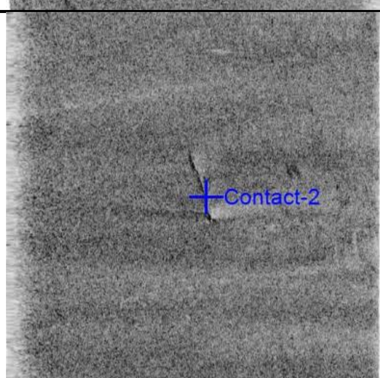
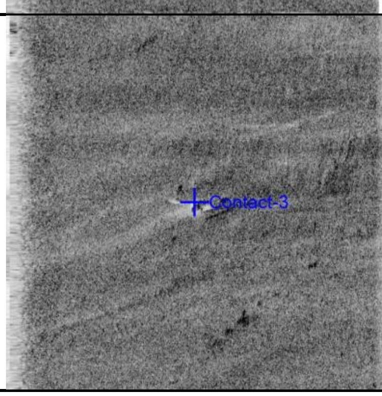


Sub-bottom Seismic Line D4-1: All sub-bottom data were captured using an Edgetech 3100 SB424. Line D4-1 is representative of the dredge corridor proceeding from the shoreline to Borrow Area 3. The interpreted seismic sequence boundary was named "BA-3," and was traced throughout the borrow area and associated dredge pipeline corridor. An isopach was calculated based on the thickness of the seismic sequence located above BA-3. The seismic stratigraphy in the seismic sequence above BA-3 was observed and described.

APPENDIX C: SIDESCAN SONAR CONTACT REPORT

Sonar Contact Report:

New Orleans Landbridge Shoreline Stabilization and Marsh Creation (PO-169)

Target Image	Target Info	User Entered Info
	**Contact-1** • Sonar Time at Target: 5/17/2017 4:28:16 PM • Click Position 30.1656406746 -89.7556773094 (WGS84) 30.1656406746 -89.7556773094 (LocalLL) (X) 3779366.68 (Y) 609162.30 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 5.84 US ft • Target Height: 0.46 US ft • Target Length: 12.95 US ft • Target Shadow: 3.01 US ft • Description: Unidentified Debris
	**Contact-2** • Sonar Time at Target: 5/17/2017 4:37:24 PM • Click Position 30.1655332466 -89.7563141507 (WGS84) 30.1655332466 -89.7563141507 (LocalLL) (X) 3779165.99 (Y) 609120.47 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 0.00 US ft • Target Height: 0.00 US ft • Target Length: 18.94 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-3** • Sonar Time at Target: 5/17/2017 4:30:37 PM • Click Position 30.1654802208 -89.7558737400 (WGS84) 30.1654802208 -89.7558737400 (LocalLL) (X) 3779305.42 (Y) 609103.10 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.36 US ft • Target Height: 0.00 US ft • Target Length: 3.36 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

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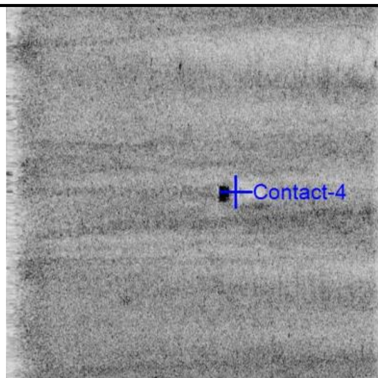
<td></td>
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Contact-4

- Sonar Time at Target: 5/17/2017 4:36:47 PM
- Click Position
30.1654324859 -89.7553184304 (WGS84)
30.1654324859 -89.7553184304 (LocalLL)
(X) 3779481.12 (Y) 609088.16 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

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Dimensions and attributes

- Target Width: 3.32 US ft
- Target Height: 0.00 US ft
- Target Length: 4.01 US ft
- Target Shadow: 0.00 US ft
- Description: Debris, Possible Crab Trap

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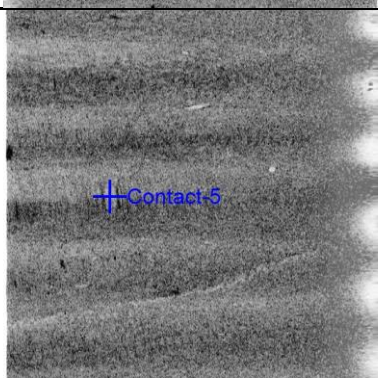
<td></td>
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Contact-5

- Sonar Time at Target: 5/17/2017 4:37:06 PM
- Click Position
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30.1651573041 -89.7558904874 (LocalLL)
(X) 3779301.74 (Y) 608985.60 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

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Dimensions and attributes

- Target Width: 4.36 US ft
- Target Height: 0.00 US ft
- Target Length: 5.58 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

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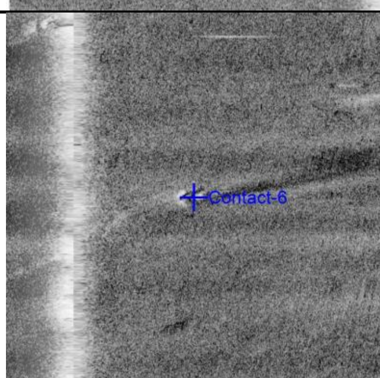
<td></td>
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Contact-6

- Sonar Time at Target: 5/17/2017 4:41:28 PM
- Click Position
30.1650532689 -89.7564660449 (WGS84)
30.1650532689 -89.7564660449 (LocalLL)
(X) 3779120.40 (Y) 608945.27 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

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Dimensions and attributes

- Target Width: 4.21 US ft
- Target Height: 0.00 US ft
- Target Length: 6.79 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

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Contact-7

- Sonar Time at Target: 5/17/2017 4:52:07 PM
- Click Position
30.1649988697 -89.7597109293 (WGS84)
30.1649988697 -89.7597109293 (LocalLL)
(X) 3778095.36 (Y) 608911.39 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

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Dimensions and attributes

- Target Width: 7.37 US ft
- Target Height: 0.00 US ft
- Target Length: 9.68 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

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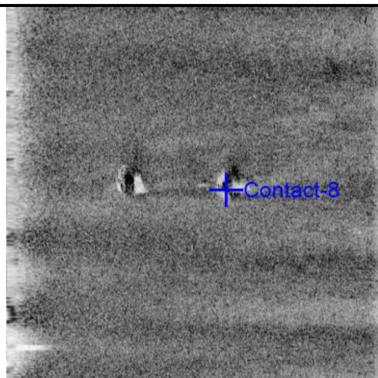
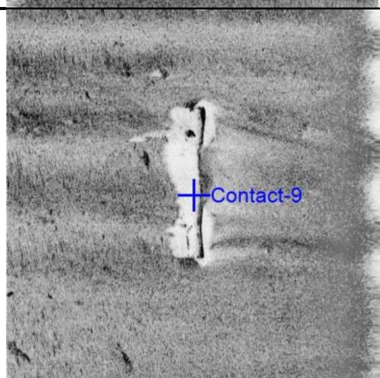
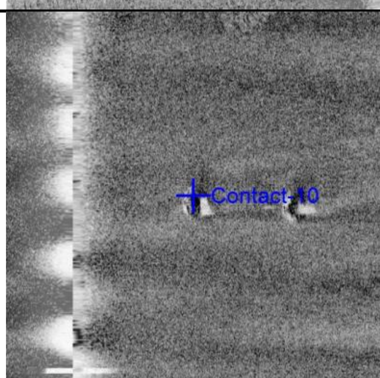
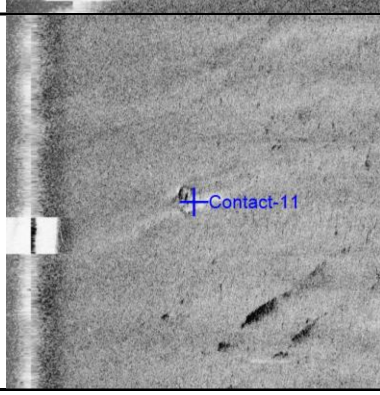
	**Contact-8** • Sonar Time at Target: 5/17/2017 5:03:34 PM • Click Position 30.1648934046 -89.7592670222 (WGS84) 30.1648934046 -89.7592670222 (LocalLL) (X) 3778236.15 (Y) 608874.97 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 7.45 US ft • Target Height: 0.00 US ft • Target Length: 7.98 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-9** • Sonar Time at Target: 5/17/2017 4:35:28 PM • Click Position 30.1648653328 -89.7533228687 (WGS84) 30.1648653328 -89.7533228687 (LocalLL) (X) 3780114.52 (Y) 608890.61 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 8.70 US ft • Target Height: 0.00 US ft • Target Length: 39.51 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-10** • Sonar Time at Target: 5/17/2017 5:03:34 PM • Click Position 30.1648224402 -89.7592686630 (WGS84) 30.1648224402 -89.7592686630 (LocalLL) (X) 3778235.99 (Y) 608849.16 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 5.70 US ft • Target Height: 0.00 US ft • Target Length: 7.48 US ft • Target Shadow: 0.00 US ft • Description:
	**Contact-11** • Sonar Time at Target: 5/17/2017 4:42:45 PM • Click Position 30.1647770307 -89.7547814281 (WGS84) 30.1647770307 -89.7547814281 (LocalLL) (X) 3779654.09 (Y) 608852.15 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 5.44 US ft • Target Height: 0.00 US ft • Target Length: 5.67 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

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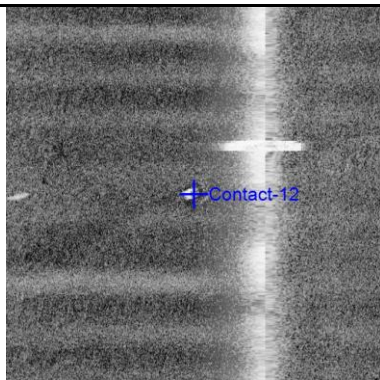
<td>
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<td>Contact-12
• Sonar Time at Target: 5/17/2017 5:07:11 PM
• Click Position
30.1645391074 -89.7597265694 (WGS84)
30.1645391074 -89.7597265694 (LocalLL)
(X) 3778092.71 (Y) 608744.14 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 4.03 US ft
• Target Height: 0.00 US ft
• Target Length: 4.08 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris, Possible Crab Trap</td>
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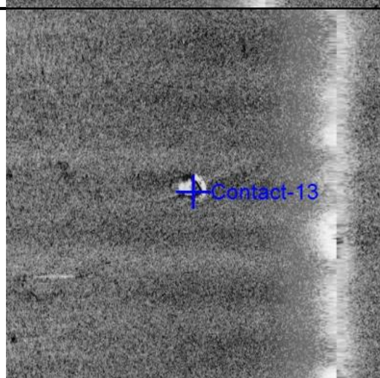
<td>
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<td>Contact-13
• Sonar Time at Target: 5/17/2017 5:20:06 PM
• Click Position
30.1644558823 -89.7620268021 (WGS84)
30.1644558823 -89.7620268021 (LocalLL)
(X) 3777366.30 (Y) 608703.90 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 8.89 US ft
• Target Height: 0.00 US ft
• Target Length: 6.92 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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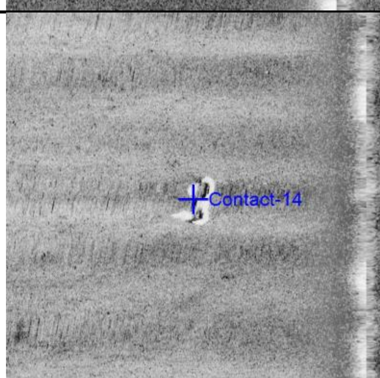
<td>
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<td>Contact-14
• Sonar Time at Target: 5/17/2017 4:56:38 PM
• Click Position
30.1643219767 -89.7535477908 (WGS84)
30.1643219767 -89.7535477908 (LocalLL)
(X) 3780046.17 (Y) 608692.05 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 4.06 US ft
• Target Height: 0.00 US ft
• Target Length: 12.84 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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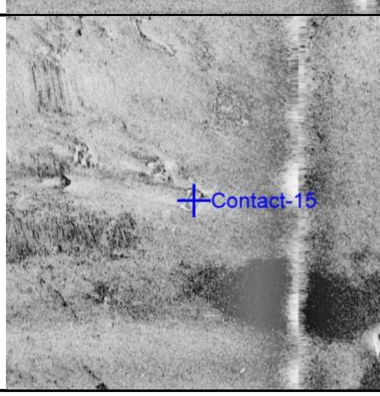
<td>
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<td>Contact-15
• Sonar Time at Target: 5/17/2017 4:45:50 PM
• Click Position
30.1641902552 -89.7520873762 (WGS84)
30.1641902552 -89.7520873762 (LocalLL)
(X) 3780508.30 (Y) 608650.51 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 3.79 US ft
• Target Height: 0.00 US ft
• Target Length: 5.99 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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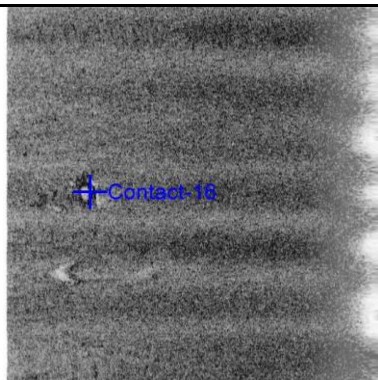
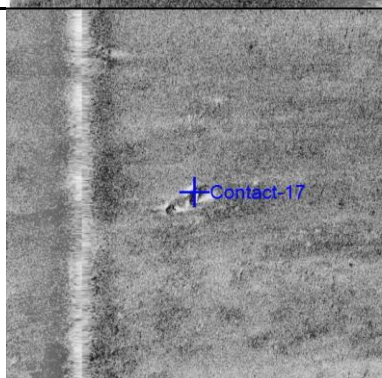


Contact-16

- Sonar Time at Target: 5/17/2017 5:19:18 PM
- Click Position
  30.1641656837 -89.7607328534 (WGS84)
  30.1641656837 -89.7607328534 (LocalLL)
  (X) 3777776.61 (Y) 608603.98 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 4.11 US ft
- Target Height: 0.00 US ft
- Target Length: 5.88 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

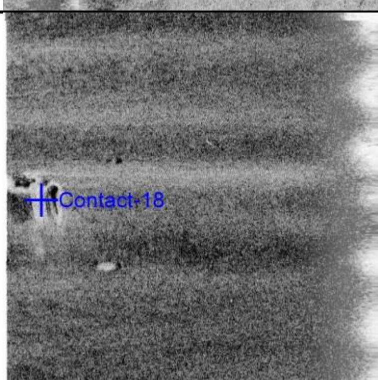


Contact-17

- Sonar Time at Target: 5/17/2017 4:56:59 PM
- Click Position
  30.1640351538 -89.7530882501 (WGS84)
  30.1640351538 -89.7530882501 (LocalLL)
  (X) 3780192.82 (Y) 608589.75 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 4.22 US ft
- Target Height: 0.00 US ft
- Target Length: 13.34 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

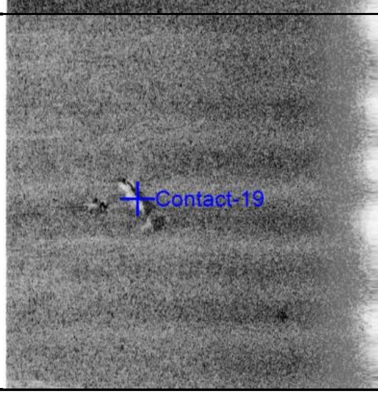


Contact-18

- Sonar Time at Target: 5/17/2017 5:17:03 PM
- Click Position
  30.1636374054 -89.7571380269 (WGS84)
  30.1636374054 -89.7571380269 (LocalLL)
  (X) 3778915.15 (Y) 608427.49 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 16.05 US ft
- Target Height: 0.00 US ft
- Target Length: 13.59 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

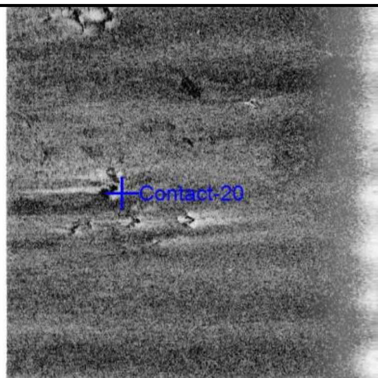
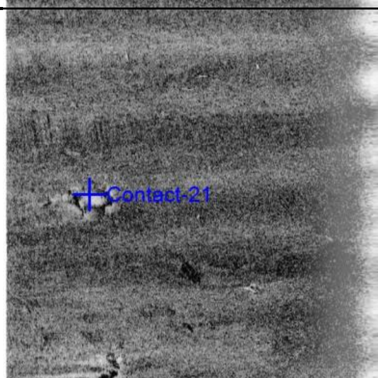
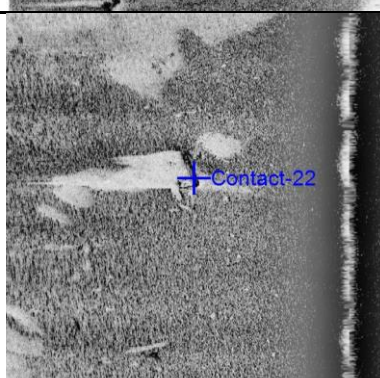


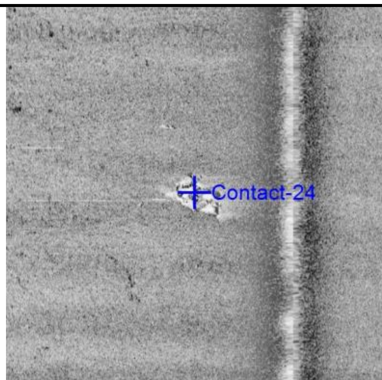
Contact-19

- Sonar Time at Target: 5/17/2017 5:52:30 PM
- Click Position
  30.1633441763 -89.7624450963 (WGS84)
  30.1633441763 -89.7624450963 (LocalLL)
  (X) 3777239.67 (Y) 608297.83 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 3.21 US ft
- Target Height: 0.00 US ft
- Target Length: 17.75 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

	**Contact-20** • Sonar Time at Target: 5/17/2017 5:33:27 PM • Click Position 30.1631734975 -89.7573773751 (WGS84) 30.1631734975 -89.7573773751 (LocalLL) (X) 3778841.84 (Y) 608257.75 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 8.67 US ft • Target Height: 0.00 US ft • Target Length: 10.38 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-21** • Sonar Time at Target: 5/17/2017 5:33:21 PM • Click Position 30.1631282181 -89.7572342936 (WGS84) 30.1631282181 -89.7572342936 (LocalLL) (X) 3778887.28 (Y) 608241.91 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 9.51 US ft • Target Height: 0.00 US ft • Target Length: 11.60 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-22** • Sonar Time at Target: 5/17/2017 5:13:57 PM • Click Position 30.1630861992 -89.7522868140 (WGS84) 30.1630861992 -89.7522868140 (LocalLL) (X) 3780450.82 (Y) 608248.17 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 7.08 US ft • Target Height: 0.00 US ft • Target Length: 10.19 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-23** • Sonar Time at Target: 5/17/2017 5:41:11 PM • Click Position 30.1630224279 -89.7577557030 (WGS84) 30.1630224279 -89.7577557030 (LocalLL) (X) 3778723.05 (Y) 608201.17 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 10.06 US ft • Target Height: 0.00 US ft • Target Length: 18.56 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

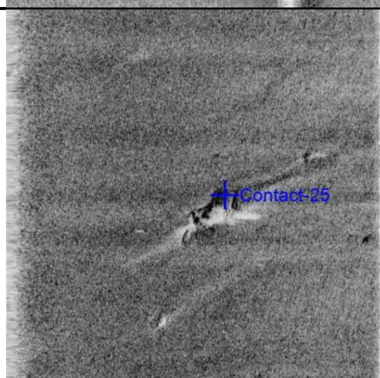


Contact-24

- Sonar Time at Target: 5/17/2017 5:31:34 PM
- Click Position
  30.1628933632 -89.7543968198 (WGS84)
  30.1628933632 -89.7543968198 (LocalLL)
  (X) 3779785.05 (Y) 608168.85 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 12.89 US ft
- Target Height: 0.00 US ft
- Target Length: 10.12 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

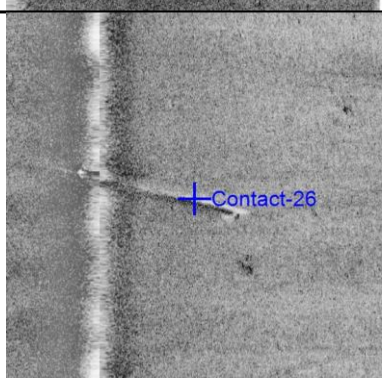


Contact-25

- Sonar Time at Target: 5/17/2017 5:55:08 PM
- Click Position
  30.1627989297 -89.7605440798 (WGS84)
  30.1627989297 -89.7605440798 (LocalLL)
  (X) 3777843.08 (Y) 608107.80 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 13.19 US ft
- Target Height: 0.00 US ft
- Target Length: 9.65 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris



Contact-26

- Sonar Time at Target: 5/17/2017 5:48:43 PM
- Click Position
  30.1627525107 -89.7563820057 (WGS84)
  30.1627525107 -89.7563820057 (LocalLL)
  (X) 3779158.47 (Y) 608108.99 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

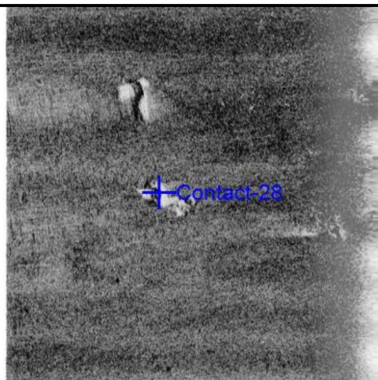
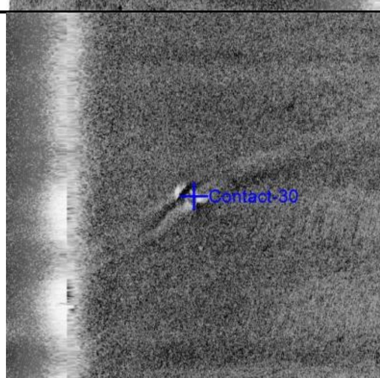
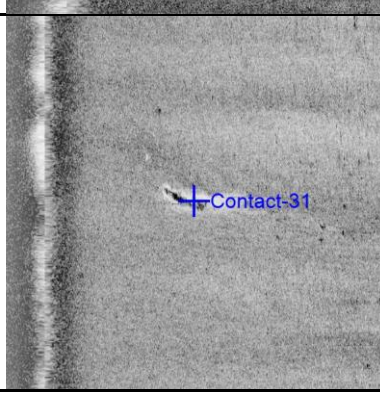
- Target Width: 2.68 US ft
- Target Height: 0.00 US ft
- Target Length: 60.74 US ft
- Target Shadow: 0.00 US ft
- Description: Possible Section of Pipe

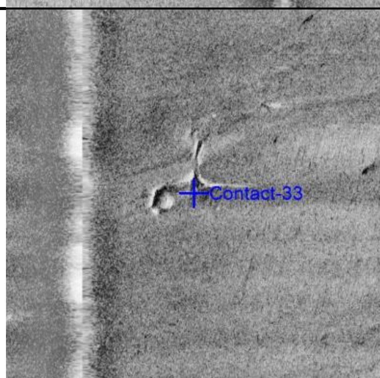
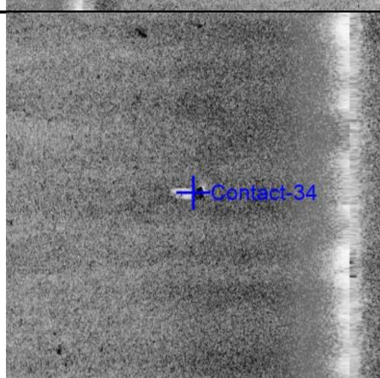
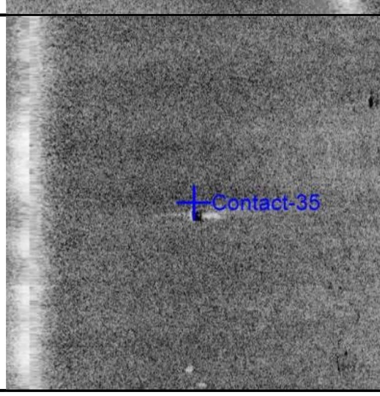
Contact-27

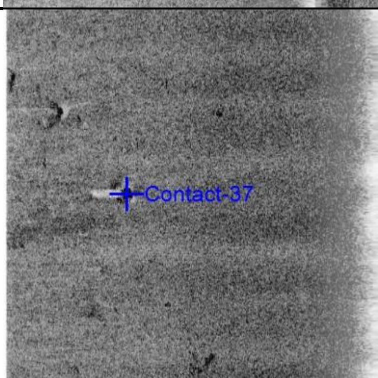
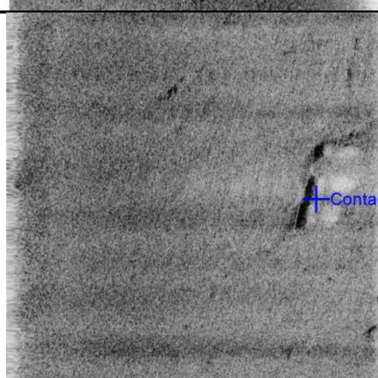
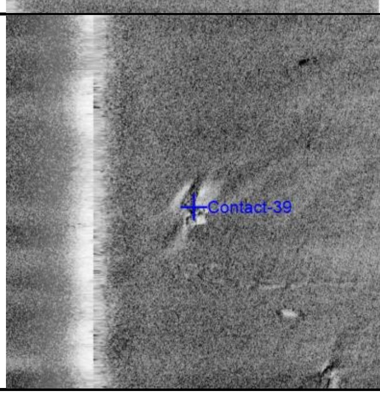
- Sonar Time at Target: 5/17/2017 5:49:19 PM
- Click Position
  30.1626990800 -89.7573611498 (WGS84)
  30.1626990800 -89.7573611498 (LocalLL)
  (X) 3778849.34 (Y) 608085.31 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

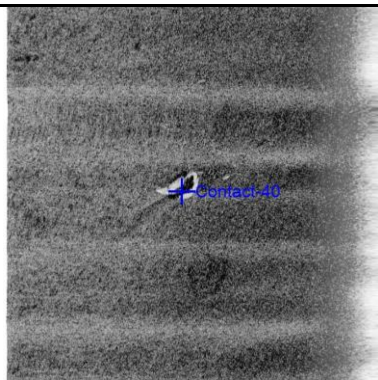
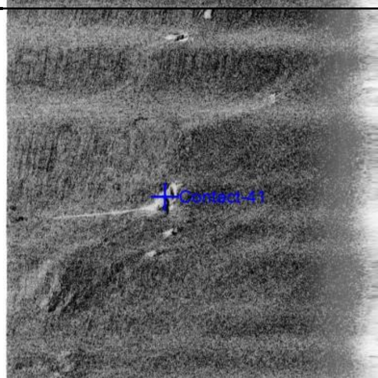
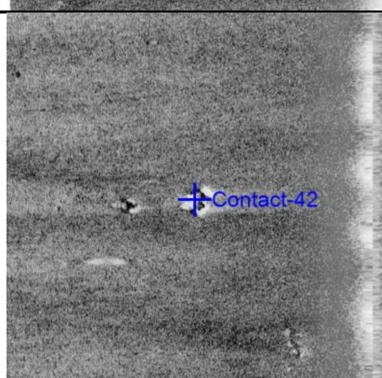
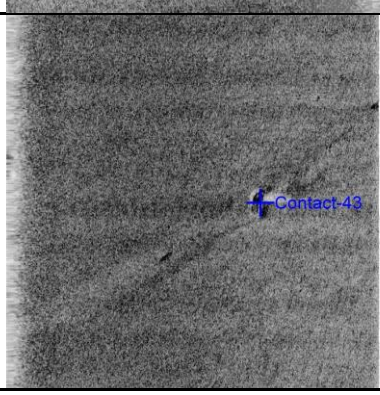
Dimensions and attributes

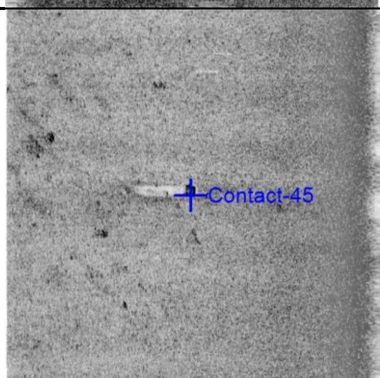
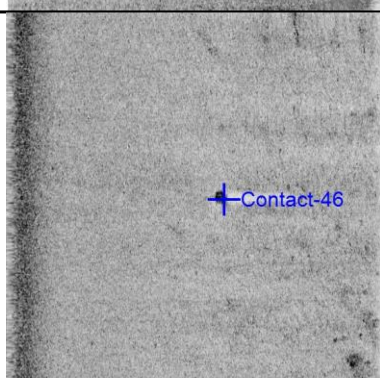
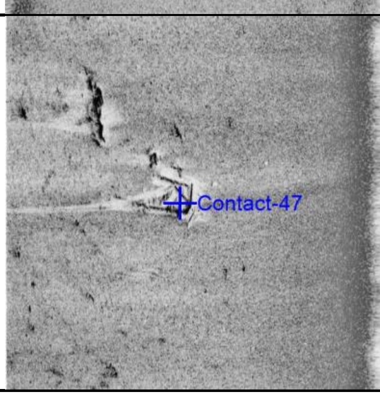
- Target Width: 10.18 US ft
- Target Height: 0.00 US ft
- Target Length: 6.28 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

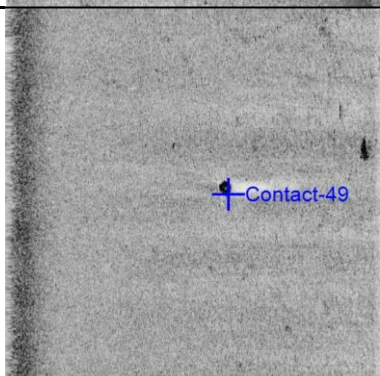
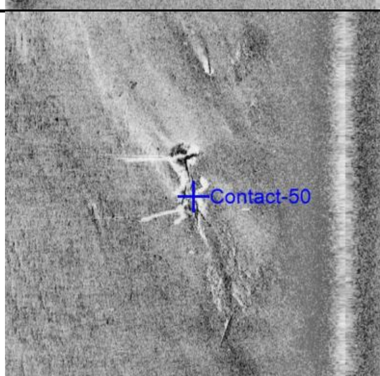
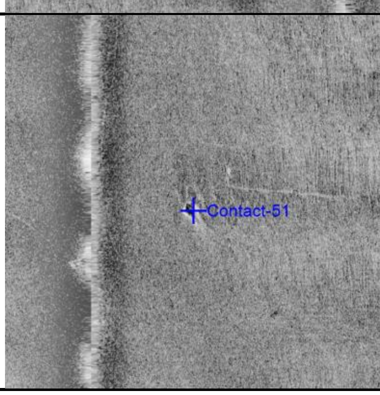
	**Contact-28** • Sonar Time at Target: 5/17/2017 5:49:26 PM • Click Position 30.1626983074 -89.7575419907 (WGS84) 30.1626983074 -89.7575419907 (LocalLL) (X) 3778792.20 (Y) 608084.24 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 14.08 US ft • Target Height: 0.00 US ft • Target Length: 5.94 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-29** • Sonar Time at Target: 5/17/2017 5:49:23 PM • Click Position 30.1626742646 -89.7574711963 (WGS84) 30.1626742646 -89.7574711963 (LocalLL) (X) 3778814.69 (Y) 608075.81 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 10.11 US ft • Target Height: 0.00 US ft • Target Length: 12.37 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-30** • Sonar Time at Target: 5/17/2017 5:56:17 PM • Click Position 30.1626617642 -89.7590007391 (WGS84) 30.1626617642 -89.7590007391 (LocalLL) (X) 3778331.44 (Y) 608064.62 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 10.20 US ft • Target Height: 0.00 US ft • Target Length: 14.51 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-31** • Sonar Time at Target: 5/17/2017 5:47:00 PM • Click Position 30.1624331015 -89.7537541766 (WGS84) 30.1624331015 -89.7537541766 (LocalLL) (X) 3779990.43 (Y) 608004.28 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.85 US ft • Target Height: 0.00 US ft • Target Length: 11.68 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

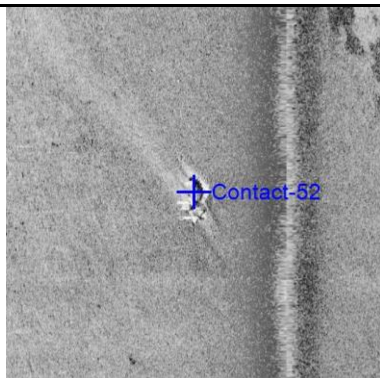
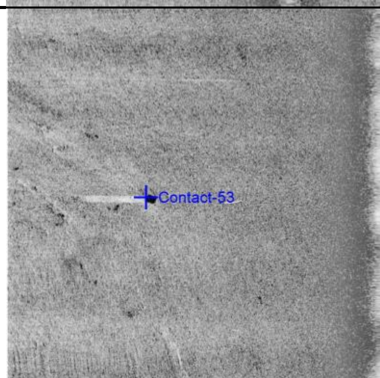
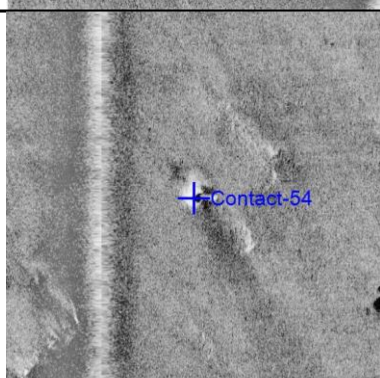
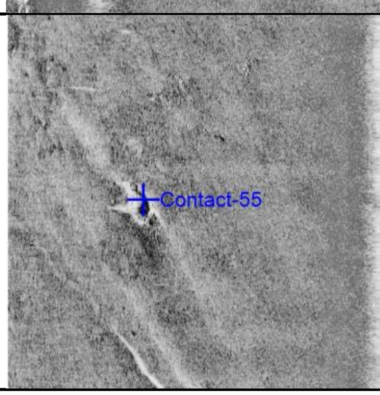
	**Contact-32** • Sonar Time at Target: 5/17/2017 5:47:38 PM • Click Position 30.1624202008 -89.7547386614 (WGS84) 30.1624202008 -89.7547386614 (LocalLL) (X) 3779679.41 (Y) 607995.30 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 14.24 US ft • Target Height: 0.00 US ft • Target Length: 47.79 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Sunken Vessel
	**Contact-33** • Sonar Time at Target: 5/17/2017 5:57:54 PM • Click Position 30.1623687464 -89.7568063299 (WGS84) 30.1623687464 -89.7568063299 (LocalLL) (X) 3779026.31 (Y) 607967.60 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 15.70 US ft • Target Height: 0.00 US ft • Target Length: 0.00 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-34** • Sonar Time at Target: 5/17/2017 6:24:04 PM • Click Position 30.1623110295 -89.7625965351 (WGS84) 30.1623110295 -89.7625965351 (LocalLL) (X) 3777196.97 (Y) 607921.48 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.98 US ft • Target Height: 0.00 US ft • Target Length: 3.90 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-35** • Sonar Time at Target: 5/17/2017 6:22:26 PM • Click Position 30.1621890173 -89.7599079561 (WGS84) 30.1621890173 -89.7599079561 (LocalLL) (X) 3778047.13 (Y) 607888.77 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.68 US ft • Target Height: 0.00 US ft • Target Length: 2.35 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap

	**Contact-36** • Sonar Time at Target: 5/17/2017 6:13:31 PM • Click Position 30.1620457483 -89.7572012820 (WGS84) 30.1620457483 -89.7572012820 (LocalLL) (X) 3778903.13 (Y) 607848.43 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 8.55 US ft • Target Height: 0.00 US ft • Target Length: 8.04 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-37** • Sonar Time at Target: 5/17/2017 6:22:58 PM • Click Position 30.1620045918 -89.7608180420 (WGS84) 30.1620045918 -89.7608180420 (LocalLL) (X) 3777760.48 (Y) 607817.76 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.41 US ft • Target Height: 0.00 US ft • Target Length: 4.15 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-38** • Sonar Time at Target: 5/17/2017 6:25:52 PM • Click Position 30.1618782400 -89.7621037654 (WGS84) 30.1618782400 -89.7621037654 (LocalLL) (X) 3777354.84 (Y) 607766.24 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.83 US ft • Target Height: 0.00 US ft • Target Length: 24.65 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-39** • Sonar Time at Target: 5/17/2017 6:26:43 PM • Click Position 30.1618633065 -89.7610167102 (WGS84) 30.1618633065 -89.7610167102 (LocalLL) (X) 3777698.41 (Y) 607765.52 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 8.59 US ft • Target Height: 0.00 US ft • Target Length: 12.32 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

	**Contact-40** • Sonar Time at Target: 5/17/2017 6:28:06 PM • Click Position 30.1618299817 -89.7592322970 (WGS84) 30.1618299817 -89.7592322970 (LocalLL) (X) 3778262.43 (Y) 607761.14 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 10.87 US ft • Target Height: 0.00 US ft • Target Length: 7.61 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-41** • Sonar Time at Target: 5/17/2017 6:28:37 PM • Click Position 30.1617446448 -89.7585825450 (WGS84) 30.1617446448 -89.7585825450 (LocalLL) (X) 3778468.17 (Y) 607732.93 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 6.92 US ft • Target Height: 0.00 US ft • Target Length: 8.41 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-42** • Sonar Time at Target: 5/17/2017 6:21:01 PM • Click Position 30.1616435470 -89.7576847218 (WGS84) 30.1616435470 -89.7576847218 (LocalLL) (X) 3778752.38 (Y) 607700.07 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 5.62 US ft • Target Height: 0.00 US ft • Target Length: 8.94 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-43** • Sonar Time at Target: 5/17/2017 6:27:44 PM • Click Position 30.1615830991 -89.7597599025 (WGS84) 30.1615830991 -89.7597599025 (LocalLL) (X) 3778096.94 (Y) 607669.08 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 6.31 US ft • Target Height: 0.00 US ft • Target Length: 6.45 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

	**Contact-44** • Sonar Time at Target: 5/17/2017 6:28:05 PM • Click Position 30.1615156411 -89.7592850448 (WGS84) 30.1615156411 -89.7592850448 (LocalLL) (X) 3778247.33 (Y) 607646.61 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 4.67 US ft • Target Height: 0.00 US ft • Target Length: 8.85 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-45** • Sonar Time at Target: 5/17/2017 6:20:30 PM • Click Position 30.1615140355 -89.7568876736 (WGS84) 30.1615140355 -89.7568876736 (LocalLL) (X) 3779004.88 (Y) 607656.44 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.14 US ft • Target Height: 0.00 US ft • Target Length: 2.25 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-46** • Sonar Time at Target: 5/17/2017 6:19:02 PM • Click Position 30.1614998374 -89.7545399554 (WGS84) 30.1614998374 -89.7545399554 (LocalLL) (X) 3779746.81 (Y) 607661.49 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.90 US ft • Target Height: 0.00 US ft • Target Length: 3.22 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-47** • Sonar Time at Target: 5/17/2017 6:20:17 PM • Click Position 30.1614676604 -89.7565316412 (WGS84) 30.1614676604 -89.7565316412 (LocalLL) (X) 3779117.62 (Y) 607641.12 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 7.56 US ft • Target Height: 0.00 US ft • Target Length: 20.49 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Sunken Vessel

	**Contact-48** • Sonar Time at Target: 5/17/2017 6:20:14 PM • Click Position 30.1613976675 -89.7564677073 (WGS84) 30.1613976675 -89.7564677073 (LocalLL) (X) 3779138.17 (Y) 607615.95 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 4.31 US ft • Target Height: 0.00 US ft • Target Length: 21.28 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-49** • Sonar Time at Target: 5/17/2017 6:18:29 PM • Click Position 30.1613826870 -89.7537154335 (WGS84) 30.1613826870 -89.7537154335 (LocalLL) (X) 3780007.93 (Y) 607622.48 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.12 US ft • Target Height: 0.00 US ft • Target Length: 2.77 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-50** • Sonar Time at Target: 5/17/2017 6:36:08 PM • Click Position 30.1607680954 -89.7514848878 (WGS84) 30.1607680954 -89.7514848878 (LocalLL) (X) 3780715.85 (Y) 607408.72 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 8.27 US ft • Target Height: 0.00 US ft • Target Length: 22.37 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Tree Detritus
	**Contact-51** • Sonar Time at Target: 5/17/2017 6:57:33 PM • Click Position 30.1600981387 -89.7514324494 (WGS84) 30.1600981387 -89.7514324494 (LocalLL) (X) 3780735.78 (Y) 607165.32 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.26 US ft • Target Height: 0.00 US ft • Target Length: 2.26 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap

	**Contact-52** • Sonar Time at Target: 5/17/2017 7:01:11 PM • Click Position 30.1600565577 -89.7518050521 (WGS84) 30.1600565577 -89.7518050521 (LocalLL) (X) 3780618.25 (Y) 607148.58 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 5.02 US ft • Target Height: 0.00 US ft • Target Length: 12.52 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-53** • Sonar Time at Target: 5/17/2017 6:57:23 PM • Click Position 30.1598098687 -89.7515386028 (WGS84) 30.1598098687 -89.7515386028 (LocalLL) (X) 3780703.69 (Y) 607060.04 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.26 US ft • Target Height: 0.00 US ft • Target Length: 2.18 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-54** • Sonar Time at Target: 5/17/2017 6:36:55 PM • Click Position 30.1598037039 -89.7510737814 (WGS84) 30.1598037039 -89.7510737814 (LocalLL) (X) 3780850.60 (Y) 607059.82 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 1.35 US ft • Target Height: 0.00 US ft • Target Length: 2.60 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-55** • Sonar Time at Target: 5/17/2017 6:37:11 PM • Click Position 30.1595999367 -89.7506193381 (WGS84) 30.1595999367 -89.7506193381 (LocalLL) (X) 3780995.22 (Y) 606987.71 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 5.70 US ft • Target Height: 0.00 US ft • Target Length: 9.56 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

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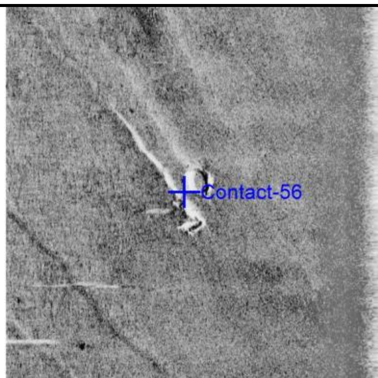
<td></td>
<td>Contact-56
• Sonar Time at Target: 5/17/2017 6:37:18 PM
• Click Position
30.1594544788 -89.7505616391 (WGS84)
30.1594544788 -89.7505616391 (LocalLL)
(X) 3781014.19 (Y) 606935.07 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 8.02 US ft
• Target Height: 0.00 US ft
• Target Length: 16.97 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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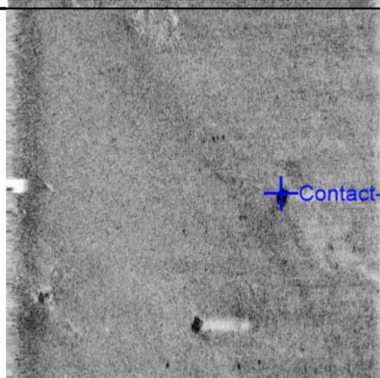
<td></td>
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• Sonar Time at Target: 5/17/2017 7:01:46 PM
• Click Position
30.1591843716 -89.7515595587 (WGS84)
30.1591843716 -89.7515595587 (LocalLL)
(X) 3780700.20 (Y) 606832.49 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 2.72 US ft
• Target Height: 0.00 US ft
• Target Length: 3.79 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris, Possible Crab Trap</td>
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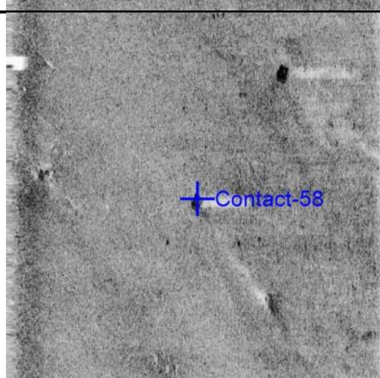
<td></td>
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• Sonar Time at Target: 5/17/2017 7:01:50 PM
• Click Position
30.1591370379 -89.7514440678 (WGS84)
30.1591370379 -89.7514440678 (LocalLL)
(X) 3780736.94 (Y) 606815.78 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
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• Target Width: 2.73 US ft
• Target Height: 0.00 US ft
• Target Length: 3.35 US ft
• Target Shadow: 0.00 US ft
• Description:</td>
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<td>Contact-59
• Sonar Time at Target: 5/17/2017 6:53:43 PM
• Click Position
30.1589936187 -89.7507036041 (WGS84)
30.1589936187 -89.7507036041 (LocalLL)
(X) 3780971.64 (Y) 606766.86 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 4.05 US ft
• Target Height: 0.00 US ft
• Target Length: 4.90 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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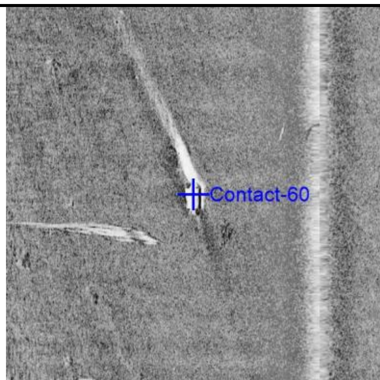
<td></td>
<td>Contact-60
• Sonar Time at Target: 5/17/2017 6:37:53 PM
• Click Position
30.1587763346 -89.7501752356 (WGS84)
30.1587763346 -89.7501752356 (LocalLL)
(X) 3781139.70 (Y) 606690.15 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 3.63 US ft
• Target Height: 0.00 US ft
• Target Length: 8.39 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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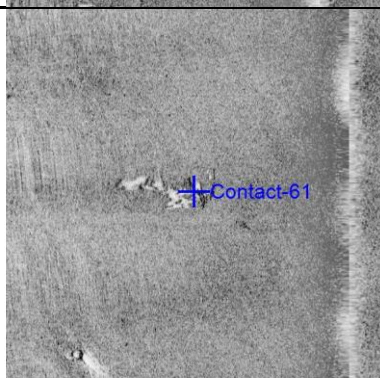
<td></td>
<td>Contact-61
• Sonar Time at Target: 5/17/2017 6:52:50 PM
• Click Position
30.1579086618 -89.7501791155 (WGS84)
30.1579086618 -89.7501791155 (LocalLL)
(X) 3781142.83 (Y) 606374.62 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 6.85 US ft
• Target Height: 0.00 US ft
• Target Length: 23.65 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris, Possible Tree Detritus</td>
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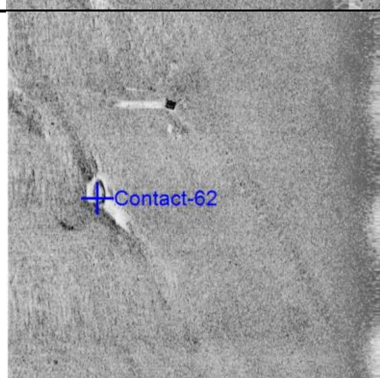
<td></td>
<td>Contact-62
• Sonar Time at Target: 5/17/2017 6:52:38 PM
• Click Position
30.1576182601 -89.7501271641 (WGS84)
30.1576182601 -89.7501271641 (LocalLL)
(X) 3781160.71 (Y) 606269.25 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 2.89 US ft
• Target Height: 0.00 US ft
• Target Length: 5.95 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
</tr>
<tr>
<td></td>
<td>Contact-63
• Sonar Time at Target: 5/17/2017 7:03:54 PM
• Click Position
30.1568118830 -89.7493621768 (WGS84)
30.1568118830 -89.7493621768 (LocalLL)
(X) 3781406.50 (Y) 605979.36 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td>Dimensions and attributes
• Target Width: 0.00 US ft
• Target Height: 0.00 US ft
• Target Length: 0.00 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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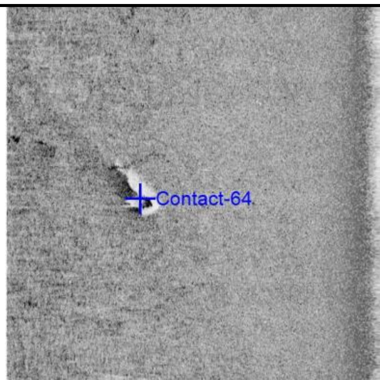
<td>
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<td><h3>Contact-64</h3>
• Sonar Time at Target: 5/17/2017 6:42:08 PM
• Click Position
30.1566661343 -89.7486426519 (WGS84)
30.1566661343 -89.7486426519 (LocalLL)
(X) 3781634.60 (Y) 605929.50 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td><h3>Dimensions and attributes</h3>
• Target Width: 6.14 US ft
• Target Height: 0.00 US ft
• Target Length: 14.68 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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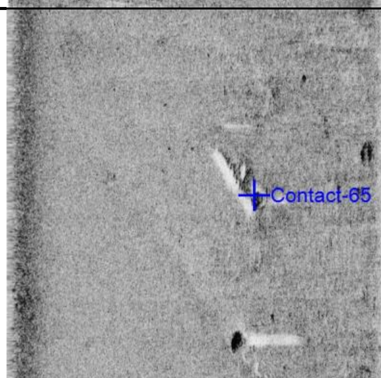
<td>
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<td><h3>Contact-65</h3>
• Sonar Time at Target: 5/17/2017 6:42:40 PM
• Click Position
30.1559135439 -89.7485859121 (WGS84)
30.1559135439 -89.7485859121 (LocalLL)
(X) 3781656.32 (Y) 605656.08 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td><h3>Dimensions and attributes</h3>
• Target Width: 5.65 US ft
• Target Height: 0.00 US ft
• Target Length: 20.23 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris</td>
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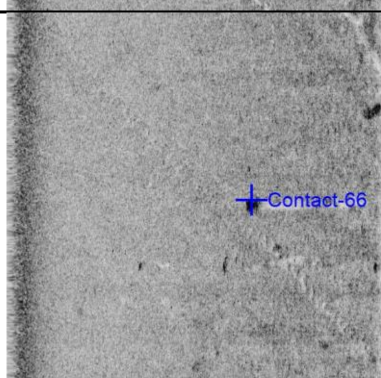
<td>
</td>
<td><h3>Contact-66</h3>
• Sonar Time at Target: 5/17/2017 6:43:12 PM
• Click Position
30.1552932670 -89.7481852366 (WGS84)
30.1552932670 -89.7481852366 (LocalLL)
(X) 3781786.05 (Y) 605432.28 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td><h3>Dimensions and attributes</h3>
• Target Width: 3.16 US ft
• Target Height: 0.00 US ft
• Target Length: 4.01 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris, Possible Crab Trap</td>
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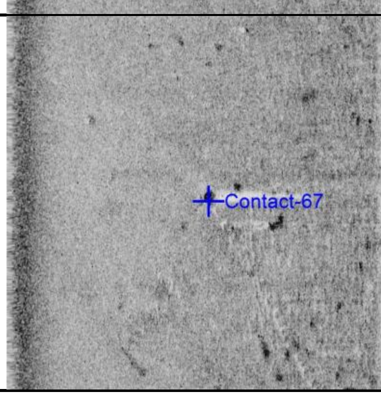
<td>
</td>
<td><h3>Contact-67</h3>
• Sonar Time at Target: 5/17/2017 6:43:32 PM
• Click Position
30.1549492788 -89.7479084301 (WGS84)
30.1549492788 -89.7479084301 (LocalLL)
(X) 3781875.26 (Y) 605308.40 (Projected Coordinates)
• Map Projection: LA83-SF-MOD</td>
<td><h3>Dimensions and attributes</h3>
• Target Width: 2.80 US ft
• Target Height: 0.00 US ft
• Target Length: 2.90 US ft
• Target Shadow: 0.00 US ft
• Description: Unidentified Debris, Possible Crab Trap</td>
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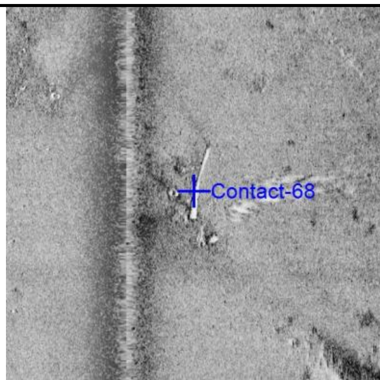
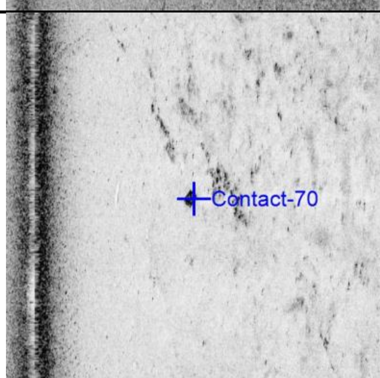
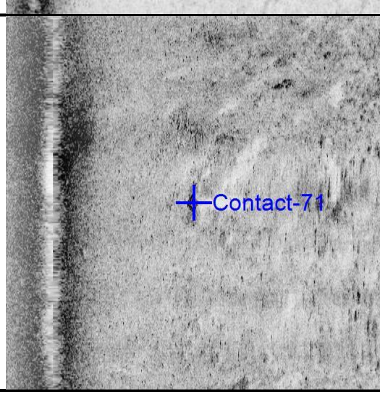
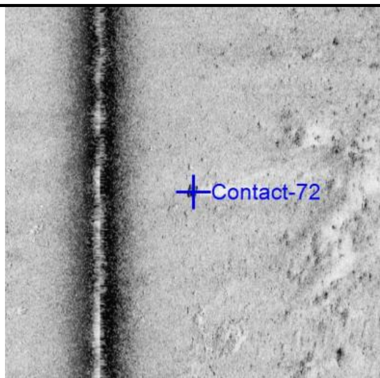
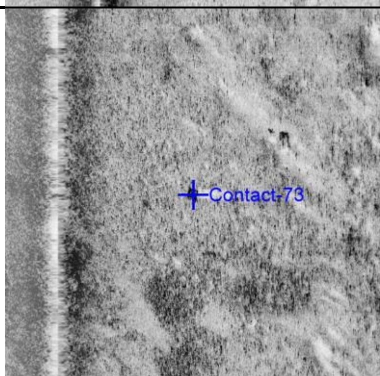
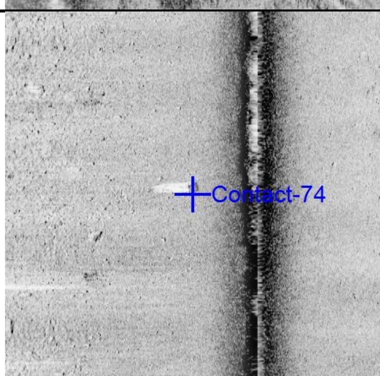
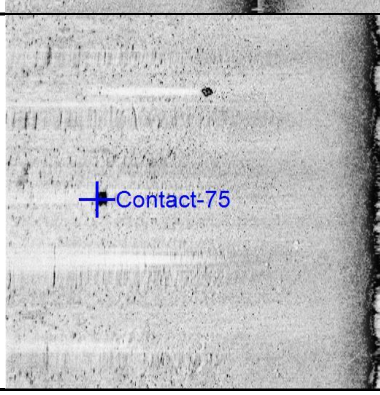
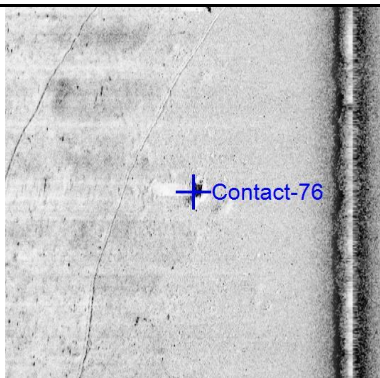
	**Contact-68** • Sonar Time at Target: 5/17/2017 7:06:08 PM • Click Position 30.1539875857 -89.7479007419 (WGS84) 30.1539875857 -89.7479007419 (LocalLL) (X) 3781882.53 (Y) 604958.73 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 1.73 US ft • Target Height: 0.00 US ft • Target Length: 20.04 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Pipe Segment
	**Contact-69** • Sonar Time at Target: 5/17/2017 7:06:14 PM • Click Position 30.1537777701 -89.7479479108 (WGS84) 30.1537777701 -89.7479479108 (LocalLL) (X) 3781868.68 (Y) 604882.23 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 0.00 US ft • Target Height: 0.00 US ft • Target Length: 0.00 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Pilings
	**Contact-70** • Sonar Time at Target: 5/18/2017 6:43:52 PM • Click Position 30.1465786224 -89.7324263861 (WGS84) 30.1465786224 -89.7324263861 (LocalLL) (X) 3786810.26 (Y) 602332.56 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.89 US ft • Target Height: 0.00 US ft • Target Length: 3.11 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-71** • Sonar Time at Target: 5/18/2017 5:53:23 PM • Click Position 30.1454378908 -89.7276054896 (WGS84) 30.1454378908 -89.7276054896 (LocalLL) (X) 3788339.65 (Y) 601939.07 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.91 US ft • Target Height: 0.00 US ft • Target Length: 2.95 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap

	**Contact-72** • Sonar Time at Target: 5/18/2017 5:42:58 PM • Click Position 30.1450342571 -89.7270287321 (WGS84) 30.1450342571 -89.7270287321 (LocalLL) (X) 3788523.98 (Y) 601794.85 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.67 US ft • Target Height: 0.00 US ft • Target Length: 3.00 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-73** • Sonar Time at Target: 5/18/2017 6:40:53 PM • Click Position 30.1449128156 -89.7301305913 (WGS84) 30.1449128156 -89.7301305913 (LocalLL) (X) 3787544.29 (Y) 601736.96 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.53 US ft • Target Height: 0.00 US ft • Target Length: 2.92 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-74** • Sonar Time at Target: 5/18/2017 5:23:53 PM • Click Position 30.1442205454 -89.7259208892 (WGS84) 30.1442205454 -89.7259208892 (LocalLL) (X) 3788878.26 (Y) 601503.86 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.62 US ft • Target Height: 0.00 US ft • Target Length: 2.52 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-75** • Sonar Time at Target: 5/18/2017 5:14:13 PM • Click Position 30.1439363191 -89.7253218965 (WGS84) 30.1439363191 -89.7253218965 (LocalLL) (X) 3789069.02 (Y) 601403.17 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.64 US ft • Target Height: 0.00 US ft • Target Length: 3.60 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap

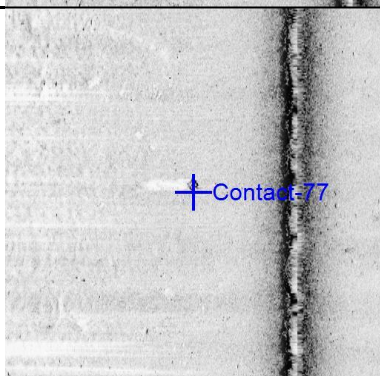


Contact-76

- Sonar Time at Target: 5/18/2017 5:09:22 PM
- Click Position
  30.1439113798 -89.7243021973 (WGS84)
  30.1439113798 -89.7243021973 (LocalLL)
  (X) 3789391.41 (Y) 601398.62 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 2.59 US ft
- Target Height: 0.00 US ft
- Target Length: 3.30 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris, Possible Crab Trap

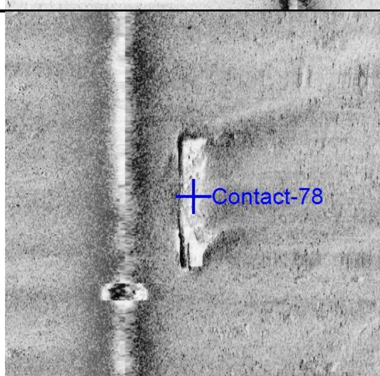


Contact-77

- Sonar Time at Target: 5/18/2017 5:00:46 PM
- Click Position
  30.1437554761 -89.7233797448 (WGS84)
  30.1437554761 -89.7233797448 (LocalLL)
  (X) 3789683.75 (Y) 601346.02 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 2.49 US ft
- Target Height: 0.00 US ft
- Target Length: 2.33 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris, Possible Crab Trap

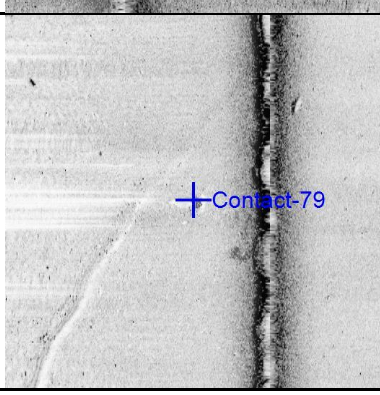


Contact-78

- Sonar Time at Target: 5/18/2017 5:31:13 PM
- Click Position
  30.1434945297 -89.7275034165 (WGS84)
  30.1434945297 -89.7275034165 (LocalLL)
  (X) 3788381.81 (Y) 601232.85 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

Dimensions and attributes

- Target Width: 6.80 US ft
- Target Height: 0.00 US ft
- Target Length: 34.68 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris

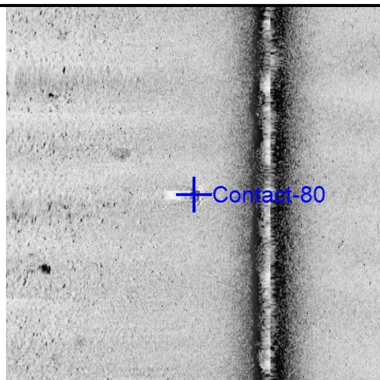
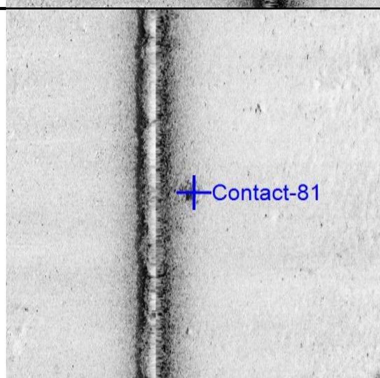
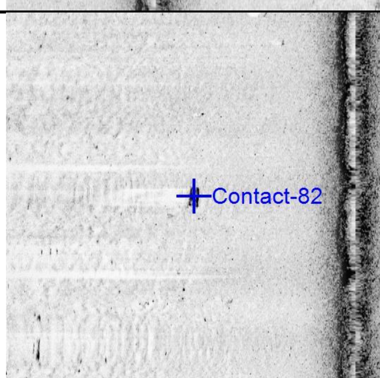
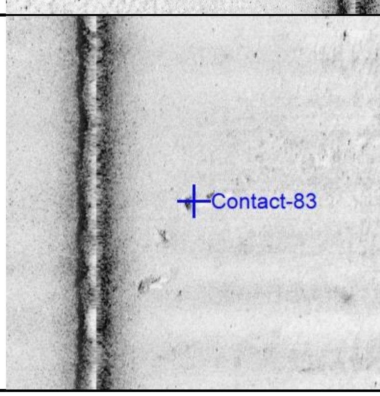


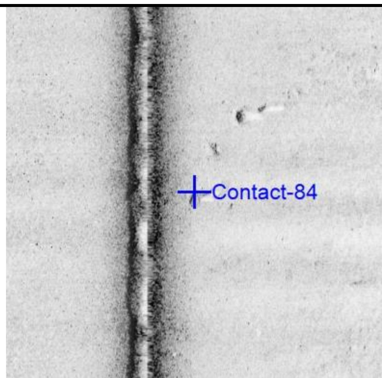
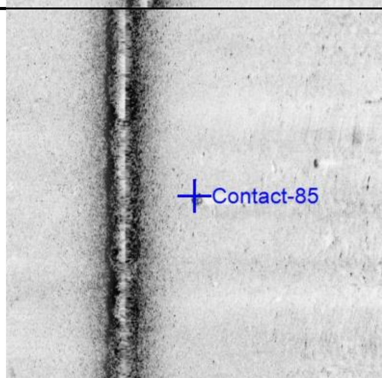
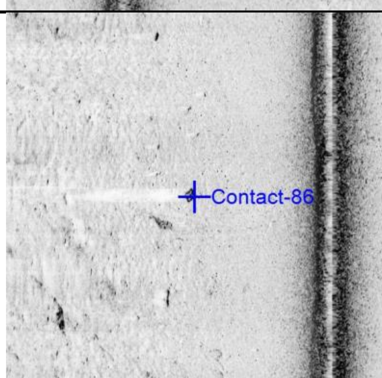
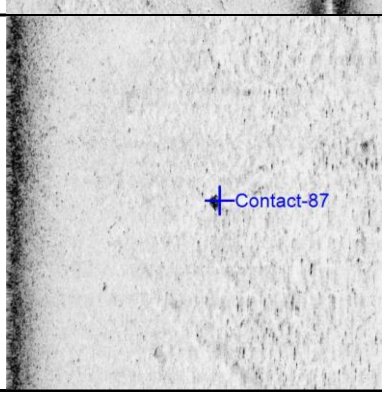
Contact-79

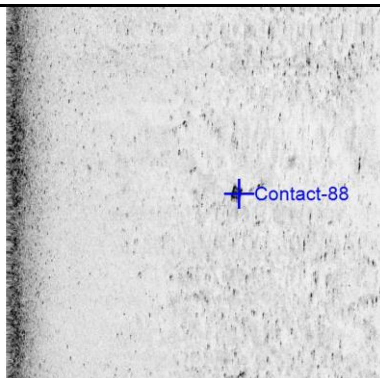
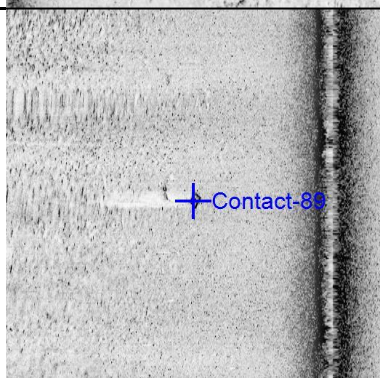
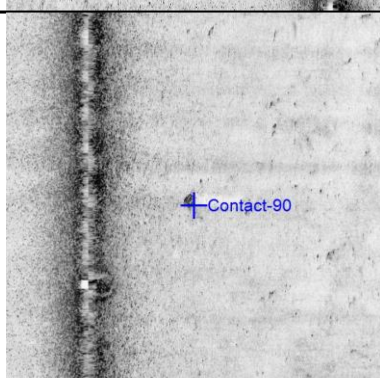
- Sonar Time at Target: 5/18/2017 5:00:26 PM
- Click Position
  30.1434297659 -89.7237843155 (WGS84)
  30.1434297659 -89.7237843155 (LocalLL)
  (X) 3789557.55 (Y) 601225.79 (Projected Coordinates)
- Map Projection: LA83-SF-MOD

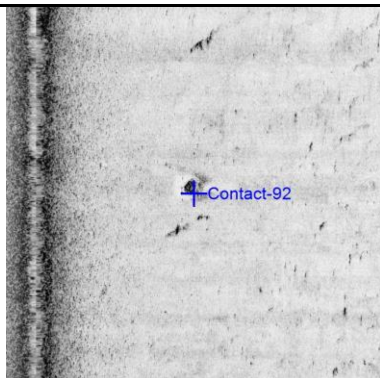
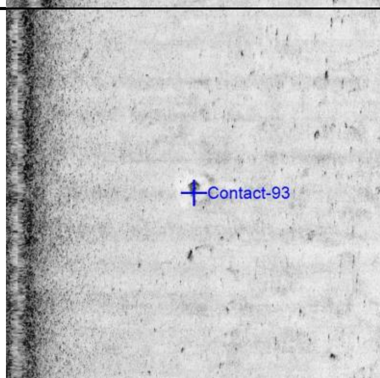
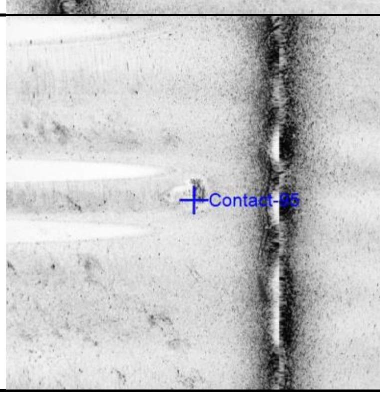
Dimensions and attributes

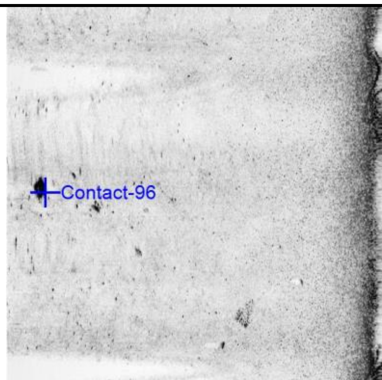
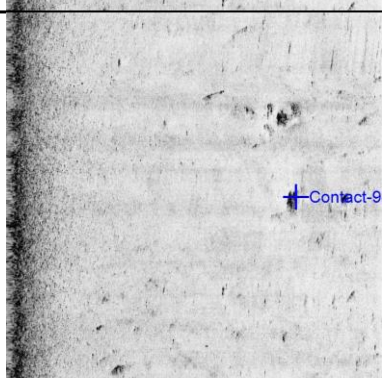
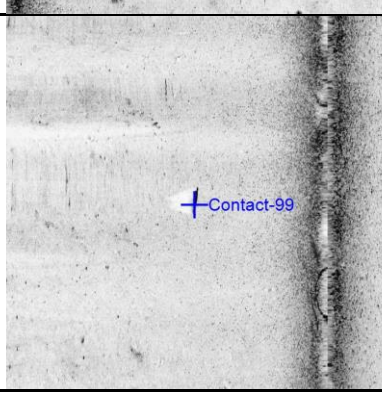
- Target Width: 3.00 US ft
- Target Height: 0.00 US ft
- Target Length: 2.64 US ft
- Target Shadow: 0.00 US ft
- Description: Unidentified Debris, Possible Crab Trap

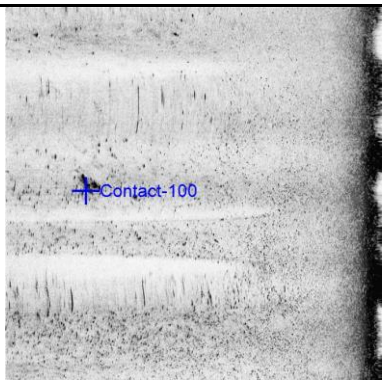
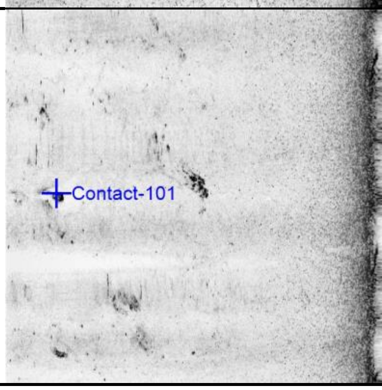
	**Contact-80** • Sonar Time at Target: 5/18/2017 5:10:04 PM • Click Position 30.1433099780 -89.7252630089 (WGS84) 30.1433099780 -89.7252630089 (LocalLL) (X) 3789090.82 (Y) 601175.67 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.42 US ft • Target Height: 0.00 US ft • Target Length: 3.06 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-81** • Sonar Time at Target: 5/18/2017 4:47:15 PM • Click Position 30.1430562394 -89.7228134069 (WGS84) 30.1430562394 -89.7228134069 (LocalLL) (X) 3789866.31 (Y) 601094.27 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 4.35 US ft • Target Height: 0.00 US ft • Target Length: 3.80 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-82** • Sonar Time at Target: 5/18/2017 4:38:45 PM • Click Position 30.1424032553 -89.7224052957 (WGS84) 30.1424032553 -89.7224052957 (LocalLL) (X) 3789998.63 (Y) 600858.64 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.56 US ft • Target Height: 0.00 US ft • Target Length: 5.10 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-83** • Sonar Time at Target: 5/18/2017 4:33:07 PM • Click Position 30.1417394044 -89.7227892534 (WGS84) 30.1417394044 -89.7227892534 (LocalLL) (X) 3789880.67 (Y) 600615.53 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.83 US ft • Target Height: 0.00 US ft • Target Length: 2.98 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

	**Contact-84** • Sonar Time at Target: 5/18/2017 4:33:09 PM • Click Position 30.1416756628 -89.7228091757 (WGS84) 30.1416756628 -89.7228091757 (LocalLL) (X) 3789874.70 (Y) 600592.27 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 4.14 US ft • Target Height: 0.00 US ft • Target Length: 7.06 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-85** • Sonar Time at Target: 5/18/2017 4:33:25 PM • Click Position 30.1414590330 -89.7231406679 (WGS84) 30.1414590330 -89.7231406679 (LocalLL) (X) 3789771.04 (Y) 600512.02 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.68 US ft • Target Height: 0.00 US ft • Target Length: 2.83 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-86** • Sonar Time at Target: 5/18/2017 4:13:22 PM • Click Position 30.1410589380 -89.7227552494 (WGS84) 30.1410589380 -89.7227552494 (LocalLL) (X) 3789894.90 (Y) 600368.24 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.81 US ft • Target Height: 0.00 US ft • Target Length: 2.99 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-87** • Sonar Time at Target: 5/18/2017 4:18:16 PM • Click Position 30.1406634839 -89.7190673225 (WGS84) 30.1406634839 -89.7190673225 (LocalLL) (X) 3791062.50 (Y) 600240.85 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.96 US ft • Target Height: 0.00 US ft • Target Length: 2.88 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap

 	**Contact-88** • Sonar Time at Target: 5/18/2017 4:16:42 PM • Click Position 30.1406628636 -89.7212743898 (WGS84) 30.1406628636 -89.7212743898 (LocalLL) (X) 3790364.95 (Y) 600230.80 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.71 US ft • Target Height: 0.00 US ft • Target Length: 3.50 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
 	**Contact-89** • Sonar Time at Target: 5/18/2017 4:42:27 PM • Click Position 30.1402743679 -89.7256352220 (WGS84) 30.1402743679 -89.7256352220 (LocalLL) (X) 3788988.68 (Y) 600070.16 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.81 US ft • Target Height: 0.00 US ft • Target Length: 3.38 US ft • Target Shadow: 0.00 US ft • Description:
 	**Contact-90** • Sonar Time at Target: 5/18/2017 3:17:57 PM • Click Position 30.1284188206 -89.7544535139 (WGS84) 30.1284188206 -89.7544535139 (LocalLL) (X) 3779939.88 (Y) 595632.42 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.13 US ft • Target Height: 0.00 US ft • Target Length: 2.83 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
 	**Contact-91** • Sonar Time at Target: 5/18/2017 3:17:12 PM • Click Position 30.1284002768 -89.7553686627 (WGS84) 30.1284002768 -89.7553686627 (LocalLL) (X) 3779650.70 (Y) 595621.69 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.56 US ft • Target Height: 0.00 US ft • Target Length: 2.43 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap

	**Contact-92** • Sonar Time at Target: 5/18/2017 3:17:26 PM • Click Position 30.1283941568 -89.7550972353 (WGS84) 30.1283941568 -89.7550972353 (LocalLL) (X) 3779736.53 (Y) 595620.65 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.22 US ft • Target Height: 0.00 US ft • Target Length: 2.26 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-93** • Sonar Time at Target: 5/18/2017 3:17:35 PM • Click Position 30.1283740607 -89.7549006499 (WGS84) 30.1283740607 -89.7549006499 (LocalLL) (X) 3779798.77 (Y) 595614.19 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.76 US ft • Target Height: 0.00 US ft • Target Length: 2.46 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-94** • Sonar Time at Target: 5/18/2017 3:19:59 PM • Click Position 30.1283013726 -89.7557026097 (WGS84) 30.1283013726 -89.7557026097 (LocalLL) (X) 3779545.64 (Y) 595584.27 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.58 US ft • Target Height: 0.00 US ft • Target Length: 2.54 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap(s)
	**Contact-95** • Sonar Time at Target: 5/18/2017 3:32:30 PM • Click Position 30.1282336665 -89.7570090957 (WGS84) 30.1282336665 -89.7570090957 (LocalLL) (X) 3779133.00 (Y) 595553.97 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 4.19 US ft • Target Height: 0.00 US ft • Target Length: 6.45 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris

	**Contact-96** • Sonar Time at Target: 5/18/2017 3:19:14 PM • Click Position 30.1280120101 -89.7546862258 (WGS84) 30.1280120101 -89.7546862258 (LocalLL) (X) 3779868.36 (Y) 595483.47 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.20 US ft • Target Height: 0.00 US ft • Target Length: 4.19 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap
	**Contact-97** • Sonar Time at Target: 5/18/2017 3:22:30 PM • Click Position 30.1277780469 -89.7555814418 (WGS84) 30.1277780469 -89.7555814418 (LocalLL) (X) 3779586.56 (Y) 595394.50 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 5.56 US ft • Target Height: 0.00 US ft • Target Length: 9.82 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-98** • Sonar Time at Target: 5/18/2017 3:22:33 PM • Click Position 30.1277659823 -89.7555149563 (WGS84) 30.1277659823 -89.7555149563 (LocalLL) (X) 3779607.64 (Y) 595390.40 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 3.47 US ft • Target Height: 0.00 US ft • Target Length: 5.21 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-99** • Sonar Time at Target: 5/18/2017 3:37:34 PM • Click Position 30.1276517033 -89.7562187004 (WGS84) 30.1276517033 -89.7562187004 (LocalLL) (X) 3779385.76 (Y) 595345.78 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 1.55 US ft • Target Height: 0.00 US ft • Target Length: 6.99 US ft • Target Shadow: 0.00 US ft • Description:

	**Contact-100** • Sonar Time at Target: 5/18/2017 3:38:38 PM • Click Position 30.1275307276 -89.7576584960 (WGS84) 30.1275307276 -89.7576584960 (LocalLL) (X) 3778931.25 (Y) 595295.53 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 5.31 US ft • Target Height: 0.00 US ft • Target Length: 9.10 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris
	**Contact-101** • Sonar Time at Target: 5/18/2017 3:24:30 PM • Click Position 30.1274774234 -89.7544552496 (WGS84) 30.1274774234 -89.7544552496 (LocalLL) (X) 3779944.05 (Y) 595290.08 (Projected Coordinates) • Map Projection: LA83-SF-MOD	**Dimensions and attributes** • Target Width: 2.78 US ft • Target Height: 0.00 US ft • Target Length: 2.93 US ft • Target Shadow: 0.00 US ft • Description: Unidentified Debris, Possible Crab Trap

APPENDIX D: MAGNETOMETER TABLE

MAGNETIC ANOMALY TABLE
(Louisiana South Coordinate System)

ANOMALY NO.	AMPLITUDE (GAMMAS)	DURATION (FEET)	ANOMALY SIGNATURE	X-COORD (FEET)	Y-COORD (FEET)	LAT83	LON83
1	22	112	MONOPOLE	3,792,255	601,688	30.144596	-89.715229
2	29	65	MONOPOLE	3,792,797	600,037	30.140036	-89.713589
3	193	50	DIPOLE	3,793,001	599,488	30.138519	-89.712970
4	179	40	MONOPOLE	3,777,900	607,769	30.161866	-89.760378
5	86	40	DIPOLE	3,778,341	607,695	30.161646	-89.758988
6	259	73	DIPOLE	3,778,896	607,625	30.161432	-89.757234
7	33	54	MONOPOLE	3,782,874	605,402	30.155170	-89.744745
8	85	49	DIPOLE	3,782,760	607,254	30.160266	-89.745022
9	29	107	DIPOLE	3,782,373	607,518	30.161006	-89.746238
10	30	140	DIPOLE	3,786,854	607,238	30.160064	-89.732070
11	143	59	DIPOLE	3,787,259	605,610	30.155573	-89.730862
12	28	87	DIPOLE	3,787,295	605,379	30.154935	-89.730760
13	55	70	DIPOLE	3,787,283	605,198	30.154438	-89.730803
14	352	74	DIPOLE	3,786,628	603,610	30.150097	-89.732946
15	247	43	DIPOLE	3,791,543	600,853	30.142328	-89.717518
16	161	36	DIPOLE	3,792,677	599,084	30.137420	-89.714011
17	420	52	DIPOLE	3,793,296	600,674	30.141768	-89.711982
18	129	76	DIPOLE	3,779,355	595,572	30.128275	-89.756308
19	540	74	DIPOLE	3,779,031	595,570	30.128281	-89.757330
20	23	50	DIPOLE	3,790,882	600,390	30.141081	-89.719632
21	459	49	MONOPOLE	3,790,644	600,391	30.141094	-89.720385
22	29	86	MONOPOLE	3,787,469	601,988	30.145606	-89.730358
23	46	49	DIPOLE	3,777,482	608,805	30.164728	-89.761656
24	51	92	DIPOLE	3,780,514	608,474	30.163704	-89.752076
25	129	134	DIPOLE	3,780,236	608,517	30.163833	-89.752955
26	43	170	MONOPOLE	3,778,080	608,834	30.164785	-89.759763
27	290	54	DIPOLE	3,788,625	601,964	30.145496	-89.726701
28	71	63	MONOPOLE	3,778,090	608,927	30.165043	-89.759726
29	34	19	MONOPOLE	3,779,814	608,682	30.164302	-89.754284
30	58	123	DIPOLE	3,778,415	608,972	30.165155	-89.758697
31	29	37	MONOPOLE	3,779,391	608,936	30.165017	-89.755611
32	22	52	DIPOLE	3,789,125	601,996	30.145564	-89.725118
33	33	51	DIPOLE	3,788,922	601,829	30.145112	-89.725768
34	24	77	DIPOLE	3,788,653	601,481	30.144167	-89.726634
35	24	53	DIPOLE	3,788,363	601,110	30.143156	-89.727569
36	116	76	DIPOLE	3,788,366	601,000	30.142855	-89.727564
37	144	55	MONOPOLE	3,789,118	601,607	30.144494	-89.725157
38	149	54	DIPOLE	3,788,924	601,323	30.143721	-89.725783
39	109	55	MONOPOLE	3,788,509	600,986	30.142811	-89.727113
40	373	55	DIPOLE	3,791,917	602,284	30.146249	-89.716274

MAGNETIC ANOMALY TABLE
(Louisiana South Coordinate System)

ANOMALY NO.	AMPLITUDE (GAMMAS)	DURATION (FEET)	ANOMALY SIGNATURE	X-COORD (FEET)	Y-COORD (FEET)	LAT83	LON83
41	36	51	DIPOLE	3,780,072	607,551	30.161185	-89.753517
42	38	50	MONOPOLE	3,779,005	607,702	30.161640	-89.756885
43	50	51	MONOPOLE	3,778,746	607,740	30.161754	-89.757704
44	126	52	MONOPOLE	3,777,652	607,902	30.162239	-89.761157
45	83	97	DIPOLE	3,777,572	607,914	30.162277	-89.761409
46	47	45	MONOPOLE	3,782,330	607,584	30.161188	-89.746370
47	65	62	DIPOLE	3,782,397	607,554	30.161103	-89.746159
48	158	56	DIPOLE	3,782,848	607,361	30.160556	-89.744741
49	40	129	DIPOLE	3,786,525	603,597	30.150066	-89.733273
50	33	57	MONOPOLE	3,787,151	605,006	30.153915	-89.731229
51	26	44	MONOPOLE	3,793,365	600,360	30.140901	-89.711778
52	61	49	DIPOLE	3,793,219	599,615	30.138860	-89.712272
53	324	69	DIPOLE	3,791,567	600,640	30.141741	-89.717453
54	39	57	DIPOLE	3,778,843	595,465	30.128000	-89.757929
55	87	45	DIPOLE	3,790,009	600,306	30.140882	-89.722397
56	448	44	DIPOLE	3,791,111	600,302	30.140830	-89.718912
57	124	43	MONOPOLE	3,791,454	600,299	30.140808	-89.717827
58	27	44	MONOPOLE	3,791,611	600,301	30.140807	-89.717329
59	14	38	MONOPOLE	3,786,463	602,706	30.147619	-89.733509
60	143	55	DIPOLE	3,788,683	600,999	30.142841	-89.726562
61	165	54	DIPOLE	3,788,954	601,226	30.143455	-89.725693
62	35	53	MONOPOLE	3,789,380	601,439	30.144024	-89.724338
63	236	53	DIPOLE	3,789,292	601,365	30.143823	-89.724617
64	147	52	MONOPOLE	3,789,139	600,993	30.142805	-89.725119
65	186	52	MONOPOLE	3,788,684	600,622	30.141802	-89.726575
66	64	52	DIPOLE	3,789,315	600,880	30.142488	-89.724567
67	309	50	DIPOLE	3,789,878	601,085	30.143029	-89.722776
68	46	52	DIPOLE	3,789,656	600,905	30.142544	-89.723488
69	38	52	DIPOLE	3,789,560	600,702	30.141990	-89.723799
70	298	50	DIPOLE	3,789,648	600,651	30.141845	-89.723523
71	121	51	DIPOLE	3,789,258	600,326	30.140968	-89.724773
72	61	46	DIPOLE	3,782,815	604,593	30.152948	-89.744966
73	104	50	DIPOLE	3,782,981	604,905	30.153798	-89.744427
74	18	53	MONOPOLE	3,783,091	605,656	30.155858	-89.744047
75	37	55	DIPOLE	3,782,526	607,397	30.160667	-89.745759
76	14	85	MONOPOLE	3,782,392	607,412	30.160714	-89.746182
77	31	57	MONOPOLE	3,787,063	605,630	30.155635	-89.731482
78	522	75	DIPOLE	3,786,798	604,421	30.152321	-89.732371
79	20	56	DIPOLE	3,786,043	602,708	30.147642	-89.734837
80	53	68	DIPOLE	3,793,551	601,008	30.142676	-89.711162

MAGNETIC ANOMALY TABLE
(Louisiana South Coordinate System)

ANOMALY NO.	AMPLITUDE (GAMMAS)	DURATION (FEET)	ANOMALY SIGNATURE	X-COORD (FEET)	Y-COORD (FEET)	LAT83	LON83
81	37	50	DIPOLE	3,791,310	600,201	30.140545	-89.718286
82	41	50	MONOPOLE	3,791,125	600,203	30.140557	-89.718871
83	40	49	MONOPOLE	3,790,770	600,214	30.140601	-89.719993
84	52	49	MONOPOLE	3,790,361	600,203	30.140586	-89.721289
85	52	49	MONOPOLE	3,790,250	600,195	30.140568	-89.721641
86	10	50	MONOPOLE	3,790,185	600,195	30.140572	-89.721845
87	35	136	DIPOLE	3,787,551	602,230	30.146268	-89.730089
88	1,401	109	DIPOLE	3,787,068	602,058	30.145813	-89.731624
89	42	74	DIPOLE	3,786,551	602,498	30.147043	-89.733240
90	54	52	MONOPOLE	3,789,024	600,019	30.140133	-89.725525
91	34	52	DIPOLE	3,789,579	600,463	30.141332	-89.723749
92	97	50	DIPOLE	3,789,885	600,583	30.141651	-89.722778
93	109	51	MONOPOLE	3,789,107	599,951	30.139942	-89.725265
94	127	134	DIPOLE	3,778,910	607,918	30.162237	-89.757177
95	24	51	MONOPOLE	3,777,842	608,071	30.162699	-89.760549
96	86	16	DIPOLE	3,778,482	608,082	30.162705	-89.758524
97	118	53	DIPOLE	3,779,326	595,566	30.128259	-89.756397
98	93	152	DIPOLE	3,780,093	607,942	30.162259	-89.753431
99	103	90	DIPOLE	3,779,695	608,005	30.162445	-89.754689
100	34	91	DIPOLE	3,779,019	608,099	30.162730	-89.756825
101	18	49	DIPOLE	3,778,664	608,143	30.162866	-89.757944
102	66	51	DIPOLE	3,778,013	608,240	30.163157	-89.760000
103	23	90	MONOPOLE	3,777,924	608,251	30.163189	-89.760280
104	197	139	DIPOLE	3,777,736	608,282	30.163282	-89.760874
105	18	66	DIPOLE	3,788,077	602,276	30.146374	-89.728420
106	41	115	DIPOLE	3,780,517	608,093	30.162658	-89.752084
107	142	82	DIPOLE	3,779,377	608,241	30.163106	-89.755685
108	31	83	DIPOLE	3,788,173	602,104	30.145896	-89.728125
109	81	47	MONOPOLE	3,780,515	607,676	30.161511	-89.752108
110	134	48	DIPOLE	3,780,930	606,986	30.159599	-89.750826
111	372	72	DIPOLE	3,781,182	606,555	30.158403	-89.750049
112	125	48	DIPOLE	3,782,024	605,179	30.154587	-89.747442
113	225	47	DIPOLE	3,782,203	604,865	30.153718	-89.746892
114	60	47	DIPOLE	3,782,465	604,434	30.152524	-89.746081
115	126	22	MONOPOLE	3,782,497	604,176	30.151812	-89.745990
116	37	51	MONOPOLE	3,782,084	604,862	30.153714	-89.747267
117	43	48	DIPOLE	3,781,416	605,974	30.156797	-89.749334
118	42	47	DIPOLE	3,781,200	606,337	30.157804	-89.749999
119	35	45	DIPOLE	3,781,007	606,659	30.158696	-89.750598
120	31	153	DIPOLE	3,780,807	606,998	30.159636	-89.751215

MAGNETIC ANOMALY TABLE
(Louisiana South Coordinate System)

ANOMALY NO.	AMPLITUDE (GAMMAS)	DURATION (FEET)	ANOMALY SIGNATURE	X-COORD (FEET)	Y-COORD (FEET)	LAT83	LON83
1	22	112	MONOPOLE	3,792,255	601,688	30.144596	-89.715229
2	29	65	MONOPOLE	3,792,797	600,037	30.140036	-89.713589
3	193	50	DIPOLE	3,793,001	599,488	30.138519	-89.712970
4	179	40	MONOPOLE	3,777,900	607,769	30.161866	-89.760378
5	86	40	DIPOLE	3,778,341	607,695	30.161646	-89.758988
6	259	73	DIPOLE	3,778,896	607,625	30.161432	-89.757234
7	33	54	MONOPOLE	3,782,874	605,402	30.155170	-89.744745
8	85	49	DIPOLE	3,782,760	607,254	30.160266	-89.745022
9	29	107	DIPOLE	3,782,373	607,518	30.161006	-89.746238
10	30	140	DIPOLE	3,786,854	607,238	30.160064	-89.732070
11	143	59	DIPOLE	3,787,259	605,610	30.155573	-89.730862
12	28	87	DIPOLE	3,787,295	605,379	30.154935	-89.730760
13	55	70	DIPOLE	3,787,283	605,198	30.154438	-89.730803
14	352	74	DIPOLE	3,786,628	603,610	30.150097	-89.732946
15	247	43	DIPOLE	3,791,543	600,853	30.142328	-89.717518
16	161	36	DIPOLE	3,792,677	599,084	30.137420	-89.714011
17	420	52	DIPOLE	3,793,296	600,674	30.141768	-89.711982
18	129	76	DIPOLE	3,779,355	595,572	30.128275	-89.756308
19	540	74	DIPOLE	3,779,031	595,570	30.128281	-89.757330
20	23	50	DIPOLE	3,790,882	600,390	30.141081	-89.719632
21	459	49	MONOPOLE	3,790,644	600,391	30.141094	-89.720385
22	29	86	MONOPOLE	3,787,469	601,988	30.145606	-89.730358
23	46	49	DIPOLE	3,777,482	608,805	30.164728	-89.761656
24	51	92	DIPOLE	3,780,514	608,474	30.163704	-89.752076
25	129	134	DIPOLE	3,780,236	608,517	30.163833	-89.752955
26	43	170	MONOPOLE	3,778,080	608,834	30.164785	-89.759763
27	290	54	DIPOLE	3,788,625	601,964	30.145496	-89.726701
28	71	63	MONOPOLE	3,778,090	608,927	30.165043	-89.759726
29	34	19	MONOPOLE	3,779,814	608,682	30.164302	-89.754284
30	58	123	DIPOLE	3,778,415	608,972	30.165155	-89.758697
31	29	37	MONOPOLE	3,779,391	608,936	30.165017	-89.755611
32	22	52	DIPOLE	3,789,125	601,996	30.145564	-89.725118
33	33	51	DIPOLE	3,788,922	601,829	30.145112	-89.725768
34	24	77	DIPOLE	3,788,653	601,481	30.144167	-89.726634
35	24	53	DIPOLE	3,788,363	601,110	30.143156	-89.727569
36	116	76	DIPOLE	3,788,366	601,000	30.142855	-89.727564
37	144	55	MONOPOLE	3,789,118	601,607	30.144494	-89.725157
38	149	54	DIPOLE	3,788,924	601,323	30.143721	-89.725783
39	109	55	MONOPOLE	3,788,509	600,986	30.142811	-89.727113
40	373	55	DIPOLE	3,791,917	602,284	30.146249	-89.716274

MAGNETIC ANOMALY TABLE
(Louisiana South Coordinate System)

ANOMALY NO.	AMPLITUDE (GAMMAS)	DURATION (FEET)	ANOMALY SIGNATURE	X-COORD (FEET)	Y-COORD (FEET)	LAT83	LON83
41	36	51	DIPOLE	3,780,072	607,551	30.161185	-89.753517
42	38	50	MONOPOLE	3,779,005	607,702	30.161640	-89.756885
43	50	51	MONOPOLE	3,778,746	607,740	30.161754	-89.757704
44	126	52	MONOPOLE	3,777,652	607,902	30.162239	-89.761157
45	83	97	DIPOLE	3,777,572	607,914	30.162277	-89.761409
46	47	45	MONOPOLE	3,782,330	607,584	30.161188	-89.746370
47	65	62	DIPOLE	3,782,397	607,554	30.161103	-89.746159
48	158	56	DIPOLE	3,782,848	607,361	30.160556	-89.744741
49	40	129	DIPOLE	3,786,525	603,597	30.150066	-89.733273
50	33	57	MONOPOLE	3,787,151	605,006	30.153915	-89.731229
51	26	44	MONOPOLE	3,793,365	600,360	30.140901	-89.711778
52	61	49	DIPOLE	3,793,219	599,615	30.138860	-89.712272
53	324	69	DIPOLE	3,791,567	600,640	30.141741	-89.717453
54	39	57	DIPOLE	3,778,843	595,465	30.128000	-89.757929
55	87	45	DIPOLE	3,790,009	600,306	30.140882	-89.722397
56	448	44	DIPOLE	3,791,111	600,302	30.140830	-89.718912
57	124	43	MONOPOLE	3,791,454	600,299	30.140808	-89.717827
58	27	44	MONOPOLE	3,791,611	600,301	30.140807	-89.717329
59	14	38	MONOPOLE	3,786,463	602,706	30.147619	-89.733509
60	143	55	DIPOLE	3,788,683	600,999	30.142841	-89.726562
61	165	54	DIPOLE	3,788,954	601,226	30.143455	-89.725693
62	35	53	MONOPOLE	3,789,380	601,439	30.144024	-89.724338
63	236	53	DIPOLE	3,789,292	601,365	30.143823	-89.724617
64	147	52	MONOPOLE	3,789,139	600,993	30.142805	-89.725119
65	186	52	MONOPOLE	3,788,684	600,622	30.141802	-89.726575
66	64	52	DIPOLE	3,789,315	600,880	30.142488	-89.724567
67	309	50	DIPOLE	3,789,878	601,085	30.143029	-89.722776
68	46	52	DIPOLE	3,789,656	600,905	30.142544	-89.723488
69	38	52	DIPOLE	3,789,560	600,702	30.141990	-89.723799
70	298	50	DIPOLE	3,789,648	600,651	30.141845	-89.723523
71	121	51	DIPOLE	3,789,258	600,326	30.140968	-89.724773
72	61	46	DIPOLE	3,782,815	604,593	30.152948	-89.744966
73	104	50	DIPOLE	3,782,981	604,905	30.153798	-89.744427
74	18	53	MONOPOLE	3,783,091	605,656	30.155858	-89.744047
75	37	55	DIPOLE	3,782,526	607,397	30.160667	-89.745759
76	14	85	MONOPOLE	3,782,392	607,412	30.160714	-89.746182
77	31	57	MONOPOLE	3,787,063	605,630	30.155635	-89.731482
78	522	75	DIPOLE	3,786,798	604,421	30.152321	-89.732371
79	20	56	DIPOLE	3,786,043	602,708	30.147642	-89.734837
80	53	68	DIPOLE	3,793,551	601,008	30.142676	-89.711162

MAGNETIC ANOMALY TABLE
(Louisiana South Coordinate System)

ANOMALY NO.	AMPLITUDE (GAMMAS)	DURATION (FEET)	ANOMALY SIGNATURE	X-COORD (FEET)	Y-COORD (FEET)	LAT83	LON83
81	37	50	DIPOLE	3,791,310	600,201	30.140545	-89.718286
82	41	50	MONOPOLE	3,791,125	600,203	30.140557	-89.718871
83	40	49	MONOPOLE	3,790,770	600,214	30.140601	-89.719993
84	52	49	MONOPOLE	3,790,361	600,203	30.140586	-89.721289
85	52	49	MONOPOLE	3,790,250	600,195	30.140568	-89.721641
86	10	50	MONOPOLE	3,790,185	600,195	30.140572	-89.721845
87	35	136	DIPOLE	3,787,551	602,230	30.146268	-89.730089
88	1,401	109	DIPOLE	3,787,068	602,058	30.145813	-89.731624
89	42	74	DIPOLE	3,786,551	602,498	30.147043	-89.733240
90	54	52	MONOPOLE	3,789,024	600,019	30.140133	-89.725525
91	34	52	DIPOLE	3,789,579	600,463	30.141332	-89.723749
92	97	50	DIPOLE	3,789,885	600,583	30.141651	-89.722778
93	109	51	MONOPOLE	3,789,107	599,951	30.139942	-89.725265
94	127	134	DIPOLE	3,778,910	607,918	30.162237	-89.757177
95	24	51	MONOPOLE	3,777,842	608,071	30.162699	-89.760549
96	86	16	DIPOLE	3,778,482	608,082	30.162705	-89.758524
97	118	53	DIPOLE	3,779,326	595,566	30.128259	-89.756397
98	93	152	DIPOLE	3,780,093	607,942	30.162259	-89.753431
99	103	90	DIPOLE	3,779,695	608,005	30.162445	-89.754689
100	34	91	DIPOLE	3,779,019	608,099	30.162730	-89.756825
101	18	49	DIPOLE	3,778,664	608,143	30.162866	-89.757944
102	66	51	DIPOLE	3,778,013	608,240	30.163157	-89.760000
103	23	90	MONOPOLE	3,777,924	608,251	30.163189	-89.760280
104	197	139	DIPOLE	3,777,736	608,282	30.163282	-89.760874
105	18	66	DIPOLE	3,788,077	602,276	30.146374	-89.728420
106	41	115	DIPOLE	3,780,517	608,093	30.162658	-89.752084
107	142	82	DIPOLE	3,779,377	608,241	30.163106	-89.755685
108	31	83	DIPOLE	3,788,173	602,104	30.145896	-89.728125
109	81	47	MONOPOLE	3,780,515	607,676	30.161511	-89.752108
110	134	48	DIPOLE	3,780,930	606,986	30.159599	-89.750826
111	372	72	DIPOLE	3,781,182	606,555	30.158403	-89.750049
112	125	48	DIPOLE	3,782,024	605,179	30.154587	-89.747442
113	225	47	DIPOLE	3,782,203	604,865	30.153718	-89.746892
114	60	47	DIPOLE	3,782,465	604,434	30.152524	-89.746081
115	126	22	MONOPOLE	3,782,497	604,176	30.151812	-89.745990
116	37	51	MONOPOLE	3,782,084	604,862	30.153714	-89.747267
117	43	48	DIPOLE	3,781,416	605,974	30.156797	-89.749334
118	42	47	DIPOLE	3,781,200	606,337	30.157804	-89.749999
119	35	45	DIPOLE	3,781,007	606,659	30.158696	-89.750598
120	31	153	DIPOLE	3,780,807	606,998	30.159636	-89.751215

APPENDIX E: FIELD NOTES

TAS137_170089 WEDNESDAY 5/17/17

0600	LEAVING OFFICE
1005	ARRIVED AT BOAT LAUNCH
1010	MOBE UP BOAT
1020	CALIBRATE EQUIPMENT
1107	SOL 22 SBP, SSS, + MAG
1109	SOL 21 seas 1 to 3
1112	SOL 20 SSS Range 30 Meters
1116	SOL 19 " "
1120	SOL 18 SSS Range 50 Meters
1125	SOL 18a SSS Range 30 Meters
1130	SOL 17 " "
1134	SOL 16
1140	SOL 15
1145	SOL 14
1151	SOL 13
1158	SOL 12
1205	SOL 11
1213	SOL 10
1221	SOL 9
1230	SOL 8
1237	SOL 7
1246	SOL 6
1253	SOL 5
1301	SOL 4

TIM SOMMER

TREVOR EVANS

Robert Westrick → Archaeologist

CHUSTZ

LAKE CATHERINE SBP, SSS, + MAG

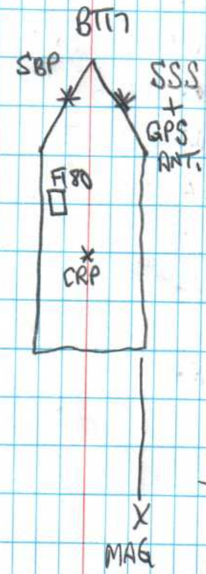
NAD 83 LA SOUTH

1702 (6010 012A), FEET

SBP OFFSETS

Y = -3.2'

X = 0.0'



SONAR OFFSETS

Y = 3.2'

X = -3.6'

MAG

-63.0' HYPACK OFFSET

LAYBACK

STARBOARD +3.60'

FORWARD -63.0'

TAS137_170089 WEDNESDAY 5/17/17

1309	SOL 3	
1317	SOL 2	
1325	SOL 1	
1335	SOL D1-1	
1340	SOL D1-1a	
1347	SOL D1-2	
1357	SOL D1-2a	
1359	SOL D1-3	
1416	SOL M1	Mag Only
1423	SOL M2	" "
1432	SOL M3	" "
1510	CHECK OUT ISLAND FOR AIR BOAT	
1700	BACK AT BOAT LAUNCH	
1800	AT HOTEL	

JCLS BOOK NO. 1138

0600	LEAVING HOTEL	
0700	ARRIVED AT BOAT LAUNCH	
0710	MOBE UP BOAT	
0735	CALIBRATE EQUIPMENT	
0804	SOL M2-1	Mag Only
0816	SOL M2-2	" "
0826	SOL M2-3	" "
0851	SOL M4-1	" "
0905	SOL M4-2	" "
0918	SOL M4-3	" "
1007	SOL BA3-1	(Sonar 30 Meter Range) SBP, SSS, + MAG
1010	SOL BA3-2	" "
1013	SOL BA3-3	" "
1016	SOL BA3-4	" "
1019	SOL BA3-5	" "
1021	SOL BA3-6	" "
1024	SOL BA3-7	" "
1027	SOL BA3-8	" "
1031	SOL D4-1	" " seas 1' to 3'
1034	SOL D4-2	" "
1037	SOL D4-3	" "
1108	SOL D3-1	" "
1115	SOL D3-2	" "
1121	SOL D3-3	" "

TIM SONNIER
TREVOR EVANS
ROBERT WESTRICK - ARCHAEOLOGIST

ONSITE
LAKE CATHERINE SBP, SSS, + MAG
NAD 83 LA SOUTH
GEOID 012A, FEET

BT17

SBP OFFSETS
Y = -3.2'
X = 0.0'

SONAR OFFSETS
Y = 3.2'
X = -3.6'

-63.0' LAYBACK MAG OFFSET LAYBACK

STARBOARD +3.60'
FORWARD -63.0'

1128	SOL	BA2-32	SBP, SSS,	MAG
1132	SOL	BA2-31	"	"
1136	SOL	BA2-30	"	"
1139	SOL	BA2-29	"	"
1143	SOL	BA2-28	"	"
1147	SOL	BA2-27	"	"
1150	SOL	BA2-26	"	"
1154	SOL	BA2-25	"	"
1158	SOL	BA2-24	"	"
1201	SOL	BA2-23	"	"
1205	SOL	BA2-22	"	"
1209	SOL	BA2-21	"	"
1212	SOL	BA2-20	"	"
1216	SOL	BA2-19	"	"
1219	SOL	BA2-18	"	"
1222	SOL	BA2-17	"	"
1228	SOL	BA2-17a	"	"
1230	SOL	BA2-16	"	"
1234	SOL	BA2-15	"	"
1238	SOL	BA2-14	"	"
1241	SOL	BA2-13	"	"
1245	SOL	BA2-12	"	"
1248	SOL	BA2-11	"	"
1252	SOL	BA2-10	"	"

1255	SOL	BA2-9	SBP, SSS, MAG
1259	SOL	BA2-8	"
1303	SOL	BA2-7	"
1305	SOL	BA2-7a	"
1308	SOL	BA2-6	"
1312	SOL	BA2-5	"
1315	SOL	BA2-4	"
1319	SOL	BA2-3	"
1322	SOL	BA2-2	"
1326	SOL	BA2-1	"
1331	SOL	D2-1	"
1336	SOL	D2-2	"
1341	SOL	D2-3	"

1410 HEADING TO ISLAND TO LOCATE POSSIBLE SPOTS TO PUT AIRBOAT ON ISLAND TOMORROW.

1700 BACK AT BOAT LAUNCH

1800 BACK AT HOTEL

TAS 139_170089 5/19/17 FRIDAY

0600	LEAVING HOTEL	
0715	ARRIVED AT BOAT LAUNCH	
0745	AIRBOAT ARRIVED	
0845	ARRIVED AT ISLAND	
0850	MOBE UP AIRBOAT	
0920	SOL M3-1	MAG ONLY FROM
0928	SOL M3-3	AIRBOAT
0938	SOL M3-2	
0948	SOL M4-1	
1004	DE MOBE AIRBOAT	
1130	BACK AT BOAT LAUNCH	
1500	BACK AT OFFICE	

TAS 139_170089 5/19/17 FRIDAY

TIM SONNIER

TREVOR EVANS

ROBERT WESTRICK - ARCHAEOLOGIST

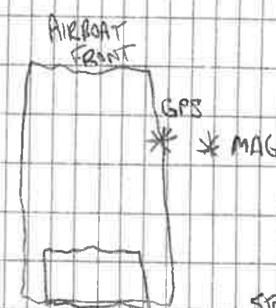
BRIAN ASHLEY - FEACHEUX AIR BOAT

CHUSTE

LAKE CATAGUNG - SBP, SSS, + MAG

NAD 83 LA SOUTH

GEOID 012A, FEET



MAG OFFSETS

Y = 4.0'

X = 0.0'

STARBOARD = 4.0'

FORWARD = 0.0'

APPENDIX F: CULTURAL RESOURCES REPORT

ARCHAEOLOGICAL ASSESSMENT
NEW ORLEANS LAND BRIDGE SHORELINE STABILIZATION AND MARSH CREATION PROJECT (PO-169)

ORLEANS PARISH, LOUISIANA

PREPARED FOR

Office of Coastal Protection & Restoration
Baton Rouge Office

SUBMITTED BY

Fugro Geospatial Inc.

June 2017

FGI Project No. 170089

Robert F. Westrick
Registered Professional Archaeologist

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 INTRODUCTION

The Coastal Protection & Restoration Authority (CPRA) contracted Fugro Geospatial, Inc. (FGI) to perform an Archaeological survey in relation to the New Orleans Landbridge Shoreline and Marsh Creation Project (PO-169), Orleans Parish, Louisiana. A Regional Map of the survey area can be found on page 2 (Figure 1) of the main report. The project area is located southeast of the city of Slidell in St. Tammany Parish, Louisiana in the Pontchartrain Basin flanking U.S. Highway 90 along the eastern shore of Lake Pontchartrain and areas surrounding Lake St. Catherine. The approximate coordinates for the center of the project are 30° 8'35.08"N and 89° 44'1.16"W (NAD 83).

Approximately 110 acres of marsh has been lost along the eastern shore of Lake Pontchartrain between Hospital Road and the Greens Ditch since 1956. One of the greatest impacts of marsh loss in the area can be attributed to tropical storms. Wetland losses were accelerated by winds and storm surge caused by Hurricane Katrina, which converted approximately 70 acres of interior marshland to open water.

Roughly 169 acres of marsh will be created and an additional 109 acres nourished using borrow material dredged from areas within Lake St. Catherine and Lake Pontchartrain. Containment dikes will be constructed around four marsh creation areas to retain *in-situ* soils and sediment during pumping. The lake shorelines will be enhanced with an earthen berm to add additional protection from wind induced wave fetch.

The borrow areas are referenced as Borrow Area 1, Borrow Area 2, and Borrow Area 3 on the study maps. Borrow Area 1 is located in Lake Pontchartrain while Borrow Areas 2 and 3 are located in Lake St. Catherine. All three locations are depicted on the Survey Area maps: Borrow Area 1 (Charts 3, 8, and 12), Borrow Area 2 (Charts 4, 9, and 13), Borrow Area 3 (Charts 6, 11, and 15). Additional survey lines were run along the shoreline and across the marsh in Borrow Area 2. These lines are shown on Charts 5, 10 and 14.

This archaeological assessment addresses the prehistoric and historic resources within the project area. A review of the Louisiana Division of Archaeology Master Site File in Baton Rouge and the National Register of Historic Places (NRHP) was conducted to identify any cultural resources potentially eligible for inclusion on the NRHP that might lie within the project area and to determine what, if any, impacts the proposed project would have on those resources. Additional research regarding the history of Orleans Parish was conducted at the Jefferson Caffery Louisiana Room collection at the Edith Garland Dupré Library, University of Louisiana at Lafayette on May 24 and 26, 2017.

A review of the available research material indicates no standing historic structures and no NRHP-listed properties within the proposed survey areas. Six (6) known archeological sites are located near the Area of Potential Effect (APE). These sites include three prehistoric shell middens, one prehistoric/historic site, a historic lighthouse and the historic ruins of Fort Pike, a 19th century military fortification. The 9.6 acre site also contains prehistoric components. The brick fortress is listed on the NRHP.

Unrecorded sites could be located within the survey area and care should be taken in areas of ridges, natural levees, or similar topography. Every reasonable effort has been made during this study to identify and evaluate possible locations of prehistoric and historic archaeological sites within the project area; however, the possibility exists that evidence can be overlooked. In the event that human remains or cultural material such as ceramics, pottery, or relic tools are encountered; the site should not be disturbed and the Louisiana Division of Archaeology should be contacted.

2.0 SURVEY DESCRIPTION

Geophysical operations were conducted by a FGI survey crew aboard *BT 17*, a 24-foot aluminum work skiff from May 17 and 18, 2017. An airboat was utilized to collect data for three additional survey lines on May 19, 2017. Lake conditions during data acquisition ranged from calm to a light chop. Geophysical instruments utilized for the survey included an Edgetech 4125 Side Scan Sonar (400 to 900 kHz), an Edgetech 3100 SB-424 Sub-Bottom Profiler, and a Geometrics 882 Cesium Vapor Magnetometer. Survey vessel positioning was accomplished using HyPack Navigation and Acquisition software. In addition, Fugro's globally corrected differential GPS (DGPS) was employed as a secondary positioning system, which provided DGPS positions in real time with sub-meter accuracy and provided vessel positions if RTK signal was lost. More detailed equipment descriptions and capabilities are listed below.

HyPack Navigation and Acquisition Software:

HYPACK, Inc. develops Windows-based software for the hydrographic and dredging industry and is one of the most successful worldwide providers of hydrographic and navigation software. HYPACK is one of the most widely used hydrographic surveying packages in the world, with over 4,000 users. It provides the surveyor with all of the tools needed to design their survey, collect data, process it, reduce it, and generate final products.

Trimble R8 RTK Surveying System:

The Trimble R8 GNSS receiver delivers reliable, precise positioning in the most challenging surveying environments through the exploitation of the proprietary R-Track™ technology. This feature compensates for intermittent signal loss and enables extended precision operation throughout brief RTK correction signal interruption. The R8 receiver boasts a horizontal accuracy of 1 cm and a vertical accuracy of 2 cm when operating in kinematic mode.

Geometrics G882 Magnetometer:

For the detection of magnetic anomalies associated with ferrous objects, Fugro proposes using a Geometrics G-882 Cesium Vapor Magnetometer. The G-882 has delivered to the industry a cost-effective and compact magnetometer with the performance of a Cesium Vapor sensor. This facilitates the detection of ferrous hazards as small as a hand-held screwdriver provided that the sensor is deployed close to the water-bottom. It is proven capable of detecting and mapping a wide range of ferrous hazards, including anchor chains, cables, pipelines, and other man-made debris. It boasts an absolute accuracy of less than 3 nT throughout its operating range.

Edgetech 4125 Side Scan Sonar:

Water-bottom acoustic imaging is accomplished using an Edgetech 4125 Side Scan Sonar operating at dual frequencies of 400 and 900 kHz. While operating at 400 kHz, it has an operating range of 150 m and a resolution of 2.3 cm. At 900 kHz, the operating range is 75 m and the resolution is 1.5 cm. Frequency availability is especially important when selecting a side scan sonar. Higher frequencies provide better resolution while sacrificing range, with the opposite being true for lower frequencies. The Edgetech 4125 enables the user to collect sonar data at two frequencies simultaneously. This provides the interpreter with two distinct datasets that can be interpreted independently to positively identify sonar contacts. A member of the Fugro group of companies with offices throughout the world. 7

SonarWiz Geophysical Processing Software Suite:

SonarWiz is a proprietary software suite produced by Chesapeake Technology purpose built for processing and analyzing sonar data. SonarWiz enables the user to import a variety of file types from different geophysical instruments. Processing features include gain manipulation, lay-back calculation, and a full suite of mapping tools.

Edgetech 3100 SB-424 Sub-Bottom Profiler:

The Edgetech 3100 SB-424 Sub-Bottom Profiler employs Edgetech's Full Spectrum CHIRP technology, which optimizes the penetration and resolution by operating at a swept frequency between 4-24 kHz. The 3100 system is ideally suited for shallow water investigations requiring detailed analyses of sub-surface geological structure. The vertical resolution of the SB-424 ranges from 4-8 cm, while the penetration ranges from 2-40 m. This variability in performance is dictated by the sedimentary properties unique to the specific survey area. Sediments with higher impedance or anechoic properties may impart significant acoustic attenuation resulting in diminished vertical penetration.

Survey Grid:

The survey grid pattern for Borrow Area 1 consisted of twenty-two (22) parallel primary tracklines (Line Nos. BA1-1 to BA1-22) and three (3) secondary lines (Line Nos. D1-1 to D1-3). The survey grid pattern for Borrow Area 2 consisted of thirty-two (32) parallel primary tracklines (Line Nos. BA2-1 to BA2-32) and six (6) secondary lines (Line Nos. D2-1 to D2-3 and D3-1 to D3-3) Six (6) additional survey lines were collected along the shoreline in the western portion of Borrow Area 2. Three of these lines were run across the marsh utilizing an airboat. The survey grid pattern for Borrow Area 3 consisted of eight (8) parallel primary tracklines (Line Nos. BA3-1 to BA3-8) and three (3) secondary lines collected closer to the shoreline (Line Nos. D4-1 to D4-3). The primary trackline spacing was 100 feet. The survey grid was designed to provide proper geophysical coverage within the study area (Chart 1 and 2).

The geodetic datum used during the geophysical survey and data interpretation was the North American Datum of 1983 (NAD83) and projected, using the Lambert Conformal Conic, into Zone Louisiana South SPCS. All coordinates referenced within this report are in this projection.

All grid units, along with scales and measurements are in feet. All grid units, scales and measurements are in U.S. survey feet.

3.0 ENVIRONMENTAL SETTING

Geography:

Orleans Parish is located in the southeastern part of Louisiana (Figure 1). It is bordered by St. Tammany Parish on the north, Jefferson Parish on the west, Plaquemines Parish on the south and St. Bernard Parish on the east and southeast. Orleans Parish was founded in 1807 and is one of the state's original nineteen parishes. The parish seat is the city of New Orleans. The parish is primarily urban, except for the coastal marshes in the eastern portion and an area of woodlands on the western bank of the Mississippi River that is known as the Lower Coast. Due to rapid urban expansion the areas containing marshes and swamps is decreasing. The total area of the parish is 223,686 acres; of which 127,360 acres is land and 96,326 acres is water. Elevation ranges from 20 feet on the man-made levees to about 6.5 feet below sea level. Many of the former marshes and swamps have been drained. The marshes and swamps range from sea level to about 1 foot above sea level.

Illustration 1. – Orleans Parish (Source: *Soil Survey of Orleans Parish, Louisiana*.)

The recorded population at the time of the 2010 census was 233,740. (Trahan *et al*. 1990; U.S. Census Bureau). Orleans Parish was the most populous parish in Louisiana prior to Hurricane Katrina in 2005. As of 2015, it ranks third in population, trailing neighboring Jefferson Parish and East Baton Rouge Parish.

The Lake Pontchartrain Basin watershed stretches from the State of Mississippi on the north and east to the Mississippi River on the west and south, and to Breton Sound at the Gulf of Mexico. The basin encompasses approximately 12,170 square kilometers (4,700 square miles) in area. Lake Pontchartrain, Lake St. Catherine, Lake Maurepas and Lake Borgne cover the southern portion of the basin. Lake Pontchartrain and its adjacent lakes form one of the largest estuaries in the United States. Nearly 1.5 million people (one-third of Louisiana's entire population) live in the fourteen parishes in the Lake Pontchartrain Basisn (Kindinger 1997).

Climate:

Orleans Parish has a humid, semi-tropical climate. The average temperature is 81 degrees during the summer. The warmest month is July with an average high temperature of 90 degrees. The hottest temperature on record is 98 degrees, which occurred at New Orleans on June 27, 1967. The coolest month is January, when the average temperature is 54 degrees and the average daily minimum temperature is 44 degrees. The lowest temperature ever documented is 14 degrees, recorded at New Orleans on January 24, 1963. The average precipitation is 59 inches per year with the majority of rainfall (33 inches or approximately 56%) occurring between April and September (Trahan *et al*. 1990).

Soil:

The primary soil type found within the project area is classified Maurepas Muck. This very poorly—drained soil is very fluid and mucky throughout. It is an organic soil encountered in swamps. Typically, the surface layer is very dark grayish brown, slightly acid, very fluid muck about 10 inches thick. The underlying subsoil to a depth of approximately 84 inches is a darker brown and/or darker reddish brown material, slightly acid, very fluid muck. Logs, stumps, and fragments of wood are common in the underlying material (Trahan *et al*. 1990).

Maurepas soils are often accompanied with smaller amounts of Barbary and Kenner soils. Barbary soils are very poorly drained soils found at slightly higher elevations. Kenner soils are encountered in freshwater marshes. These soils are not suited to crops, pasture, woodland or urban uses as they are highly susceptible to flooding (Trahan *et al*. 1990).

The bottom sediments of Lake Pontchartrain and Lake St. Catherine represent accumulations of particulate matter transferred to the estuaries over time. Sediment sources include mineral particles from soils and eroded sediments from rivers, streams and shores. They also include dust and contaminants from the air, canals, roadways (causeway), and other sources. Particulate matter also originates from biological organisms found in the water column (plankton) and carbonate shells that are secreted by bottom dwelling organisms like *Rangia* clams and the eastern oyster (*Crassostrea virginica*) (Manheim et al. 2002).

Geology and Biology:

Lake Pontchartrain was created from the Gulf of Mexico (GOM) when a delta finger of the Mississippi River merged with the mainland and enclosed a portion of the gulf between the finger and the mainland. However, even after its isolation, the connection between the lake and the GOM was, and still is, maintained through tidal channels. Thus the lake originated from a mixed marine and continental environment and is slowly transforming into a continental environment as the waters within have changed over time from saltwater, to brackish, to freshwater. This environmental change has not been progressively uniform at all times and in all places. As a result, there are noticeable variations in the character and distribution of the sediments and associated flora and fauna (Steinmayer 1939).

Generally speaking, wave action, littoral currents, and inflowing streams are the mitigating factors in the textural distribution of the sediments, which are coarse along the outer margin where water activity is the greatest and fine in the deep and still waters of the lake. The textural distribution of bottom sediments is mostly affected by those factors and bottom topography does not exert as important an influence. Although there are exceptions, the organic content is usually highest where the texture is fine and low where the texture is coarse. The organic matter in Lakes Pontchartrain and Lake St. Catherine appear to be primarily vegetative in origin (Steinmayer 1939).

The north shore of Lake Pontchartrain contains vast beds of submerged aquatic vegetation (SAV). Common species include beaked tasselweed or widgeon grass (*Ruppia maritima*), water celery, tape grass or eelgrass (*Vallisneria Americana*), and the invasive Eurasian watermilfoil (*Myriophyllum spicatum*). SAV beds have been documented in Lake Pontchartrain to extend from the shoreline to a depth of approximately 6.5 feet (Cho and Poirrier 2001).

The most significant and important natural hard substrate habitats in the Pontchartrain Basin are the oyster reefs found in the higher salinity portions of Lake Pontchartrain and Lake Borgne, accumulations of *rangia* clam shells in other parts of the ecosystem, and the cypress stumps, natural logs and other wooden debris washed into the lakes. There are also many other sources of artificial substrate associated with human activities now present in the lakes, such as crab traps, glass bottles, metal cans, and other junk, that if not buried in the sediment can become the foundation to support a small colony of hard substrate organisms. Concrete pilings used for bridges, wooden posts used for dock and piers usually quickly become encrusted with algae, barnacles, and other benthic communities. Bulkheads and seawalls, as well as the numerous rock piles and other shoreline protection materials placed around the lakes also provide substrate to which marine organisms can attach and colonize. An estimated 36-40% of the shoreline contains potential hard substrate (Lopez 2003). The concrete pilings supporting the Pontchartrain Causeway and I-10 bridges, as well as other bridges and powerline supports, provide extensive artificial hard substrate (Hastings 2009).

The Lake Pontchartrain ecosystem also supports a large number of migratory and non-migratory waterfowl. The American Bird Conservatory has designated the unique estuarine habitat the Lake Pontchartrain Important Bird Area (IBA). The IBA is over 400,000 acres, of which nearly all is open water (http://www.audubon.org/important-bird-areas/lake-pontchartrain.)

Seagulls, terns, egrets, herons, and rails frequent the habitats associated with Lake Pontchartrain. The Lake Pontchartrain IBA also supports relatively large numbers of wintering waterfowl, including Horned Grebe and Common Loon. Lesser Scaup (*Aythya affinis*) populations declined in the lake from 1978 to 2002 during a time which they also declined nationwide. However, despite changes in the lake's water quality, salinity and changes to the surrounding habitat, tens to hundreds of thousands of the small North American ducks have perservered at this shallow, estuarine lake. In fact, the highest count in two decades, more than 1 million birds, arrived during the winter following Hurricane Katrina.

Raptors such as bald eagles and ospreys nest and forage in the habitats that surround the lake.

Another important species found along the lake is the brown pelican (*Pelecanus occidentalis*). A drive across the Lake Pontchrtrain Causeway bridge often provides a front-row seat to witness pelicans in action. Known for its nurturing qualities and its awkward grace, the brown pelican had endeared itself to people living along the Gulf Coast for centuries, even being honored as Louisiana's state bird. However, the brown pelican's local existence nearly came to an tragic end as the species was driven to the brink of extinction in Louisiana in the 1960's. One of the primary contributing factors was the widespread use of DDT and other pesticides that entered the Mississippi River from agricultural runoff and chemical spills.

DDT (dichloro-diphenyl-trichloroethane) was developed as the first of the modern synthetic insecticides in the 1940's. An unintended consequence of its use was the adverse side effects it had on brown pelicans, bald eagles and many other bird species. The chemical weakened egg shells which caused breeding failure.[1]

The United States banned the use of DDT in 1972. By this time much of the damage had already been done. The number of brown pelicans had declined to the point that is was put on the endangered species list in 1970; it would remain there for the next thirty-nine years. The Louisiana Department of Wildlife & Fisheries initiated a vigorous restocking program in 1968. The success of that program has restored the population to the point that the pelican was removed from the list in 2009. The population of brown pelicans rebounded to around 650,000. The creation and enhancement of breeding islands has helped maintain the population in the face of habitat loss (http://www.audubon.org/important-bird-areas/lake-pontchartrain).

The brown pelican continues to thrive. It has remained off the endangered species list despite a few major challenges, most notably the 2010 BP oil spill. Despite dramatic images of oil-covered pelicans that visually illustrated the ecological damage of the massive spill, pelican populations were declared stable just two years later, the birds were nesting, and they could be observed throughout the state's southernmost wildlife refuge areas (*Times-Picayune*, May 26, 2017). While brown pelicans do not generally feed on inland lakes, they commonly feed on Lake Pontchartrain in the winter months.

[1] Today, nearly 50 years after DDT was banned in the U.S., we continue to live with its long-lasting effects.

4.0 PREHISTORIC BACKGROUND

The Wisconsin Glacial episode was the last major advance of continental glaciers in North America. During the Wisconsin period, between 60,000 and 50,000 years ago and again between 24,000 and 20,000 years ago, the massive Laurentide ice sheet blanketed much of the North American continent. Canada was almost completely covered by ice, as were large areas that now make up the northern regions of the United States. At the height of the ice age, the Bering land bridge permitted humans and other mammals to migrate from Siberia to North America. During the Wisconsin period, the advance of glaciers trapped large amounts of the Earth's water as polar ice (Coleman and Roberts, 1991; Neuman, 1984). As the glaciers advanced across the land, ocean levels around the world were lowered by as much as 400 feet (Fisk and McFarlan, 1955). Large expanses of continental shelf were exposed as sea levels fell. In the northern Gulf of Mexico, the seas receded to nearly the edge of the continental shelf (Fisk, 1944). Vegetation began to cover this newly exposed land as sea level lowered. Between 20,000 and 12, 000 years ago, much of the continental shelf would have been heavily forested and could have supported human occupation. The exposed Pleistocene surface was subject to sub-aerial erosion and water from melting glaciers cut channels into the continental shelf. As bands of Paleo-Indians migrated towards the coast, they most likely settled along these ancient rivers and streams (Fisk and McFarlan, 1955). Paleo-Indian sites are commonly found where streams empty into river valleys, on natural levees and point bars, and along river and coastal terraces (Pearson, *et. al*,. 1986). Around 17,000 years ago, warmer temperatures caused the glaciers to melt. Sea level began to rise as the glaciers melted and receded, inundating Paleo-Indian occupation sites located on the continental shelf. As sea level rose, delta systems and estuarine sediment covered many prehistoric sites possibly protecting them from erosion during the Holocene transgression (Belknap, 1983).

Several of these preserved occupation sites have been located off the coast of Texas and Louisiana. A Coastal Environments, Inc. study (Pearson *et al*., 1986) revealed suspected archaeological remains in the now submerged Sabine River Valley. The remains consisted of subaerial-formed shell middens and pollen deposits, which closely resembled material from known terrestrial archaeological sites. Researchers located the pollen deposits 54 to 60 feet below the modern sea level, approximately 15 to 20 feet beneath the present seafloor. Radiocarbon analysis indicated a date of approximately 8,100 $\pm$ 95 years ago. Gagliano (1967) discusses various Paleo-sites located in the coastal marshes of Avery Island in south-central Louisiana. These coastal estuary deposits on Avery Island contained artifacts in association with extinct faunal remains dated between 12,000 and 10,950 years ago (CEI, 1977). In Southern Texas, Aten (1983) documented "tool like" materials found in the dredge spoil from Galveston Bay. These cultural remains date to the late Pleistocene period, approximately 13,000 to 10,000 years ago. In addition to the aforementioned sites, numerous other submerged or coastal prehistoric activity areas have been located by researchers along the Gulf Coast between Texas and Florida (Aten and Good, 1985; Stright, 1990; and Johnson and Stright, 1992).

5.0 CULTURAL SUMMARY

Paleo-Indian Period (10,500 – 6,500 BC)

The earliest human activities in Louisiana occurred during the Paleo-Indian Period. The Paleo-Indian Period is believed to have begun around 10,500 B.C., although no radiocarbon dates have been established for this early occupation. Nomadic hunter-gather groups roamed the region. These groups exploited native plants and animal resources including Pleistocene mega fauna such as mastodon, mammoth, and giant bison. The nomadic existence of these groups has left only a minimal archaeological record and little *in situ* evidence has been discovered in Louisiana (Girand 2001; Lee *et al*. 2002; Lehmann and Mayer 2002).

The main source of information on the Paleo-Indian period in Louisiana has come from, as in many states, surface finds. Additionally, excavations at Avery Island have also located artifacts that are thought to be from the Paleo-Indian Period. The material culture remains associated with the Paleo-Indian peoples suggest a focus on big-game hunting (McGimsey 2004; Smith *et al.* 1983). The diet of Paleo-Indian people would have also been supplemented by foraging for plant materials and small game (Meltzer and Smith, 1986). The lithic tool kit, which is amazingly homogenous throughout North America, consists mainly of fluted lanceolate points (Chance, *et al.* 1997). These long, thin, bifacial blade-like points were sometime hafted to bone or ivory foreshafts, which were in turn attached to wooden spear shafts (Milanich, 1994). Projective point varieties recovered in Louisiana include Clovis, Plainview, Dalton, Meserve, Quad, Pelican, San Patrice, and Scottsbluff (Hunter *et al*. 1995; Lee *et al*. 2002; Saunders 1994; Yakubik *et al*. 1985). Other lithics associated with this period include gravers, end and side scrapers, and flake tools (Harcourt 2000).

The majority of artifacts associated with this period have been discovered in northern Louisiana. In southern Louisiana, few Paleo-Indian sites have been identified. Sites that do have such a component include 161B23 on Avery Island in Iberia Parish, the Beverly Picard site (16VM124) in Vermilion Parish, and the Vatican (16SL171) in St. Landry Parish. The scarcity of Paleo-Indian cultural material in the coastal region of Louisiana may be due to coastal erosion (Gibson 1975; Yakubik *et al*. 1985; Shuman *et al.* 1995). Sites once along the Mississippi River have been washed away or deeply buried as the river shifted its course and deposited silt. In southern Louisiana, the lack of Paleo-Indian sites may also be attributed to rising sea levels that have inundated many occupation sites from this period. During the Paleo-Indian period, sea levels and the inland water table were much lower than they are today because the continental ice sheets were holding massive quantities of moisture within them. Prehistoric water levels were as much as twenty-six meters below present-day levels. According to Milanich (1994:183) "about half of the land exposed 12,000 years ago is now inundated continental shelf."

Archaic Period (ca. 6500-1700 B.C.)

The Archaic Period, also referred to as the Meso-Indian Period, is characterized by changes in social organization and subsistence. Population during this period appears to be slowly increasing. Cultural groups were still nomadic hunter-gathers but had begun to occupy sites for longer intervals. Additionally, the territorial range of these groups may have become smaller than they had been during the Paleo-Indian Period. While their Paleo-Indian ancestors might have roamed from

Mississippi to Texas in their lifetime, rarely returning to the same place twice, an Archaic Indian might spend his entire life within a six-parish area, returning each season to regular camp sites (Neuman and Hawkins, 1993). Subsistence patterns were also undergoing change during the Archaic Period. Aquatic and floral resources were exploited more than ever before. The major technological development from this period was the atl-atl or spear thrower. Evidence suggests that the atl-atl, along with the decline and eventual extinction of the mega fauna, led to a switch in hunting practices from group to individual strategies. Large game hunting was replaced by the seasonal hunting of smaller mammals such as deer, and the seasonal gathering of plant materials such as seeds and nuts. The artifact tool kit reflected the changes in subsistence patterns. During the Archaic Period, the tool kit becomes more generalized. Grinding and nutting stones are common. Projectile points tend to be heavier stemmed and notched varieties. The early Archaic Period is not well documented in Louisiana. The presence of non-local raw materials does suggest an active interaction with groups outside of Louisiana. Another significant attribute of the Archaic period is mound construction that begins to appear as early as 4,000 BC (McGimsey 2004; Smith *et al*. 1983).

Poverty Point (1700-800 B.C.)

Poverty Point is a unique culture that developed from the Middle Archaic period. The Poverty Point Culture flourished from approximately 1700 B.C. to 800 B.C. The culture is named for the famous Poverty Point Site located in the northeastern corner of Louisiana. Around 1500 B.C., it was the commercial and governmental center of the entire region. During this time, the Poverty Point Site had the largest and most intricate earthworks anywhere in the western hemisphere (Gibson, 2002). The emergence of the Poverty Point Culture saw a shift from small isolated settlements to large ceremonial centers. Artifacts similar to those found on sites in neighboring regions to the east imply that there was an extensive trade network in place during this period. The construction of large earthworks also suggests a developed social hierarchy with a defined class structure. The artifact toolkit is almost the same as the early Archaic. Bifacial knives and ground stone artifacts were common. Large stemmed and notched projectile points were prevalent, and there is development of a blade-core industry in the region. Unique to this period is a type of artifact that has become known as the “Poverty Point Object”. These polymorphous clay objects are usually associated with hearths and it is speculated that they are related to food production (McGimsey 2004; Smith *et al*. 1983).

Tchula Period (ca. 800 B.C. – 1 A.D.)

The Tchula period gets its name from site 16ST2 in St. Tammany Parish, Louisiana. During this period, people lived in small, scattered settlements. Although long-distance trade was much less significant, people in Louisiana remained in contact with their neighbors living in western Mississippi, coastal Alabama, Arkansas, eastern Texas, and southeastern Missouri (Louisiana Prehistory, 1993). This period also saw the introduction and first widespread use of ceramics in the Lower Mississippi Valley. The Tchefuncte culture is recognized as the main culture within Louisiana during the Tchula period. Tchefuncte wares tended to be crude ceramics. Tchefuncte vessels tended to be utilitarian and often had feet or base supports. The lithics are typical of the early Archaic periods with bone and antler becoming prevalent tool materials due to the scarcity of chert (McGimsey 2004; Smith *et al.* 1983). Tchefuncte ceramics display a wide range of decorative treatments including incised, punctuated, finger-pinched, stamped, notch, and brush design elements. Other artifacts associated with Tchefuncte sites are similar to those found related to the preceding Late Archaic and Poverty Point periods. Projectile point types include Pontchartrain, Gary, Epps, Ellis, and Maçon (Hays and Weinstein 2010; CEI 2014).

Marksville (ca. 100 B.C. – 400 A.D.)

Named for the Marksville Site (16AV1) in Avoyelles Parish, the Marksville Culture is considered the equivalent of the Hopewell Cultural Tradition of the Midwest. Similarities in mound construction and material culture suggest a well-developed sphere of interaction and that the Hopewell Culture greatly influenced the Louisiana Marksville Culture. The majority of archaeological information regarding the Marksville Culture comes from the excavation of burial mounds. Burials during this period tend to be similar to Hopewell burials farther north. There appears to have been an involved mortuary practice and the graves often include a variety of offerings. Medium to large stemmed projectile points were common and a blade core technology similar to that in the Hopewell area is also evident. Subsistence is still mainly from hunting, fishing, and gathering although large midden deposits from this period suggest the development of a more sedentary lifestyle (McGimsey 2004; Smith *et al*. 1983).

Troyville-Coles Creek (400 A.D. – 1100 A.D.)

The Troyville-Coles Creek Cultures have been combined in Louisiana, although there are arguments that the two should be separate. The Troyville period is also often referred to as the Baytown period. It tends to be the earlier culture of the two (400 A.D. - 700 A.D.) and is considered a transitional period between the end of the Marksville and the beginning of the more developed Coles Creek Culture. The Troyville Culture is not well defined in the coastal areas. It is often assimilated with the subsequent Cole Creek period because of the lack of diagnostic markers for the period in southeastern Louisiana (Neuman, 1984). The subsistence patterns are comparable to those of the earlier Tchefuncte and Marksville cultures. During this period the beginnings of plant domestication is first seen as plants begin to become the main food source. Pottery characteristics during the Troyville resemble Marksville Period wares but are somewhat larger. These larger ceramics, thought to be storage vessels, may indicate a food surplus in this period. The bow and arrow also came into use during this period (McGimsey 2004; Smith *et al*. 1983).

The Coles Creek Culture (700 A.D. - 1100 A.D.) is better known than the Troyville. This period saw a significant increase in the number of sites and the culture's sphere of influence. Cultivation of plants continues to increase as hunting and gathering take on a secondary subsistence role. During the Coles Creek Period, mounds are constructed as temples rather than burial mounds. These structures are usually truncated pyramids arranged around a plaza. Burial practices are less elaborate and the first evidence of group burials occurs. Pottery is the main diagnostic attribute from this period. During this period, a wide range of decorative techniques began to appear. The decorations are more consistent and easier to identify than in earlier periods (McGimsey 2004; Smith *et al*.1983).

The Greenhouse Site in Avoyelles Parish is the most extensively excavated Troyville-Coles Creek period site. The site consists of an open plaza surrounded by seven earthen mounds. Archaeologists have concluded that the mound group was used only for ceremonial activities since no remains from a village or campsite were found either in the plaza or in the vicinity outside the mound area (Neuman and Hawkins, 1993).

Plaquemine (1000 A.D. – 1500 A.D.)

The Plaquemine Culture developed in southeastern Louisiana around 1000 A.D. The Plaquemines were descendants of the Troysville-Coles Creek Indians. They built large ceremonial centers with two or more large mounds facing an open plaza. During the early part of the period, some hunters continued to use the atl-atl, but the bow and arrow soon replaced it as the weapon of choice. Plaquemine Indians hunted deer, rabbits, bear, raccoons, squirrels, turkeys, and ducks; fished for gar and drum; and collected mussels. Although these people tended gardens of corn, squash, pumpkins, and beans, they continued to collect many wild seeds, nuts, fruits, and roots as well (Neuman and Hawkins, 1993).

The Plaquemine Period is differentiated from the Coles Creek Period primarily on ceramic attributes. Brushing and shell tempering become prominent although some decorative techniques such as punctuating and incising are carried over from the previous period. Evidence from material culture remains and studies of mound construction indicate that the Plaquemine Culture may be a later prehistoric development of the Coles Creek Period. During the Plaquemine Culture, there is an increase in mound building around central plazas. Village sites become more widespread although the larger mound centers are found mainly in the riverine areas. The Plaquemine Culture reached its peak before the European intrusion into the region. The period is considered to end at the time of European Contact (McGimsey 2004; Smith *et al.* 1983).

Mississippian (1200 A.D. - 1700 A.D.)

The beginning of the Mississippi period is marked by the emergence of Mississippian Culture in the northern part of the Lower Mississippi River Valley and developed concurrently with the Plaquemine culture in the southern part (Phillips, 1970). The Mississippian Culture is best known for its extensive earthworks and mound groups, widespread trade networks, and unique ceramic styles and decorations. Mississippian ceramics are distinctive because they use shell tempering to add strength to the clay. This allowed larger, more complex vessels to be produced. Decorative techniques such as incising, punctuation, and engraving become widespread during this period. The increased use of the bow and arrow is reflected in the small arrow points that dominate the lithic toolkit. There are relatively few identified Mississippian sites in Louisiana. The main influence is in southeastern coastal Louisiana. This is likely the result of interaction with Mississippian societies in Alabama and Mississippi (McGimsey 2004; Harcourt 2000; Smith *et al*. 1983).

Native American Historical Period (1692 -1840)

Louisiana has an extensive history that extends back to the late 1600's. The area within present-day Orleans Parish was originally inhabited by numerous Native American Indian tribes, including the Colapissas, Bayou Goulas, Chickasaw, Biloxi, Choctaw and Pensacola nations (although Frederick S. Ellis, in his book *St. Tammany Parish: L'autre Côté du Lac*, claims that the regionally prominent Choctaw tribe did not arrive in the area until after it had begun to be settled by Europeans). The Choctaws were descendants of the peoples of the Hopewell and Mississippian cultures, who lived throughout the eastern Mississippi River valley and its tributaries (Ellis 1981; Cushman 2013).

The Choctaw settled along the banks of the Tangipahoa, Tchefuncte, and Natalbany rivers. The early Choctaw were peaceful farmers who relied on the cultivation of corn. They dried their corn and grounded it into meal or flour with mortar and pestles made of cypress. They also grew beans, pumpkins, and melons, and gathered nuts, seeds, and roots. They augmented their diet with hunting and fishing. The men hunted deer and black bear with bows and arrows, while young boys used blowguns to kill smaller game. They fished with spears and arrows until the Europeans introduced them to the fishhook (Woolfolk 1979).

The Choctaw women produced baskets made from palmetto fronds, which grew abundantly in the surrounding marshes and swamps. The baskets came in many shapes and sizes. They were colored with red, yellow, and black dye to contrast the natural tan color of the palmetto fiber. These baskets displayed beautiful decorative patterns in sharp contrast to their rather plain pottery. Choctaw pottery did not match the beauty or the technical excellence of those produced by other tribes. Nevertheless, they produced such an abundance of agricultural products that they acquired these pots from other tribes eager to trade them in exchange for corn and other agricultural produce (Woolfolk 1979).

The Choctaw were allies of the French and participated in the French campaign against the Natchez in 1730-1731. Throughout the French period in Louisiana history, the Frenchmen relied upon their support and military assistance against such enemies as the Natchez, the Yazoo, and the Chickasaws. Most Choctaws supported the colonists struggle for independence from Great Britain during the American Revolution. During the War of 1812, Choctaw, Cherokee and Lower Creek warriors fought alongside American troops under the command of General Andrew Jackson against the Red Stick Creek at the Battle of Horseshoe Bend in central Alabama on March 27, 1814. The Americans and their Indian allies routed the Red Sticks, effectively ending the Creek Uprising (de Kay 1967).

After becoming President, Jackson seized land ceded to his former allies, the Choctaw and Cherokees, together with other Cherokee lands. The exiled Choctaw became the model of forced Indian removal. The Choctaw were the first Native Americans to walk the "Trail of Tears" to the Oklahoma Territory, other tribes soon followed. Chief Junaluska, a Cherokee Chief who saved Jackson's life at the Battle of Horseshoe Bend remarked "If I had known that Jackson would drive us from our homes, I would have killed him at Horseshoe." (Reeves 1985; www.cherokee-nc.com.). Most Native Americans east of the Mississippi River were relocated to Oklahoma and other points further west between 1820 and the 1840's.

French Colonial Period (1682-1763)

The French explorer René Robert Cavalier, Sieur de La Salle departed Fort Crevecoeur (near present-day Peoria, Illinois) with a group of Frenchman and eighteen Indians and descended the Mississippi River to the Gulf of Mexico in the spring of 1682. A few leagues below the junction of the Mississippi and Red Rivers, La Salle and his companions discovered an Indian village that appeared deserted. The men investigated and found three of the lodges were filled with the corpses of the "Tangiboa." They had apparently been killed by members of the neighboring Houma tribe. La Salle continued his journey and reached the Gulf on April 9, 1682. He claimed all the land drained by the Mississippi River and its tributaries for King Louis XIV. He named the new territory La Louisiane after the monarch (Woolfolk 1979; Johnson 2002).

In 1699, the French sent Pierre le Moyne, Sieur d'Iberville to colonize the lower Mississippi Valley. After establishing a small fort at Biloxi, he embarked on an expedition to relocate the Mississippi River, as described by La Salle. Iberville's party travelled westward along the Gulf Coast through the barriers islands of Mississippi Sound and then to Lake Borgne. From there the Frenchmen proceeded west through the Rigolets (a narrow strait) and into Lake Pontchartrain. They surveyed Bayou St. John on the southern side of the lake and its access to the Mississippi River. The Frenchmen passed down Bayou Manchac to the Amite River and then traveled from Lake Maurepas through Pass Manchac on their way to the Mississippi River (French *et al.* 1853;Gayarré 1866;).

Iberville named the two lakes Pontchartrain and Maurepas, for Louis Phelypaux, Count Ponchartrain, the French Minister of Marine, and his son. The pass connecting the two lakes was called Manchac by the Indians, which means, "rear entrance." On their return trip they re-entered Lake Pontchartrain and followed the northern shore eastward. Iberville recorded such landmarks as the Tangipahoa and Tchefuncte Rivers, as well as Bayou Castein. They crossed Lake Pontchartrain on the way to Ship Island in the Gulf (Gayarré; 1866).

That same year, Iberville's younger brother, Jean Baptiste le Moyne, Sieur d'Bienville was informed that there were a number of Acolapissa villages north of Lake Pontchartrain. Pierre Iberville later established a French settlement at Biloxi Bay in 1699. After 1701, the settlement was moved to Mobile Bay (French *et al.* 1853; Higginbotham 1977).

In 1702, Iberville and Bienville founded a settlement at Twenty-Seven Mile Bluff on the Mobile River. The settlement became the first capital of the French colony of Louisiana. The outbreak of disease and a series of floods prompted Bienville to relocate the town several miles downriver to its present location at the confluence of the Mobile River and Mobile Bay in 1711. By the time Antoine Crozat took over administration of the colony by royal appointment in 1712, it boasted a population of 400 people. In 1720, the capital of Louisiana was moved from Mobile to Biloxi (Higginbotham 1977; Woolfolk 1979).

In 1718, Jean Baptiste le Moyne, Sieur d'Bienville established a colony at New Orleans. Four years later, the seat of French government was transferred from Biloxi to New Orleans. French settlement continued through the 1700s. Then in 1762, the Treaty of Fontainebleau ceded French interests west of the Mississippi to Spain. The French settlers were joined by others from Spain and a large contingent of immigrants from the Canary Islands. Throughout the 1700s, this area continued to prosper and grow. Agriculture was a major industry due to the rich soils that allowed a variety of crops such as sugar cane, indigo, and numerous vegetables to be grown (Pearson *et al*. 1989).

Although the Lake Pontchartrain area was first explored in 1699 and transportation on the local waterways began as early as 1705, no settlement became apparent until after 1720 when Leon Michel Durvergci, the director/oronnateur of the Colony of Louisiana, was instructed by the Company of the Indies to transfer colonists by boat from Biloxi to the upper parts of Lakes Maurepas and Manchac (also known as the Iberville River.) Settlement began almost immediately and in time the Maurepas Basin was settled by Spanish, French, English, Acadian, Dutch, and German settlers. The north shore of Lake Pontchartrain was first settled by French and Germans who were later joined by Americans and Englishmen during the British-period of administration, 1763-1779 (Saltus 1988).

British and Spanish Colonial Period (1763-1800)

The Treaty of Paris was signed by Great Britain and France on February 10, 1763. The agreement ended the Seven Years War (known in North America as the French & Indian War. Under the terms of the treaty, France formally ceded most of her North American land possession to Great Britain with the exception of St. Pierre and Miquelon. The newly acquired lands between Mobile Bay and the Mississippi River became the British colony of West Florida.

The British province of West Florida included the present-day area of St. Tammany Parish. By 1763 most of the inhabitants of the region clustered around the Bayou Bonfouca/Bayou Liberty area, the Mandeville/Bayou Lacombe area, or in the vicinity of the town of Cocquille and the Tchefuncte River. (Cocquille was founded by Jean Baptiste Baham in 1800. It was renamed Madisionville in honor of President James Madison in 1810.) (Parrish *et al.* 2010)

During this period, the boundary between West Florida and Spanish Isle d' Orleans ran down the centers of Bayou Manchac, the Amite River, Lake Mauerpas, Pass Manchac, Lake Pontchartrain, and the Ringolets to Mississippi Sound" (Ellis 1981).

The two colonies of British East Florida and British West Florida remained loyal to Great Britain throughout the American Revolutionary War (1776-83). Spain entered the war on the American side and as an ally of France in June 1779.

On September 10, 1779, the American schooner *Morris* (also known as *Morris's Tender*), Captain William Pickles, captured the British sloop H.M.S. *West Florida*, commanded by Lieutenant John Payne, during the Battle of Lake Pontchartrain. The seizure of the *West Florida* eliminated the British naval presence on Lake Pontchartrain and further weakened the already unstable British control of West Florida. In 1783, the Treaty of Paris that ended the American Revolution formally ceded control of Florida back to Spain.

Nineteenth Century

In 1800, Spain returned the Louisiana Territory to France through the Treaty of San Ildefonso. President Thomas Jefferson feared Napoleon's control of the Mississippi outlet could mean serious trouble for American shipping in the Gulf of Mexico. Jefferson dispatched Robert Livingston and James Monroe to Paris, where in April 1803 they negotiated the sale of the Louisiana Territory to the United States. During negotiations for the purchase of the Louisiana Territories, the territorial boundaries were only vaguely defined. When Livingston asked the French foreign minister about the boundaries, the minister replied that Livingston had "made a noble bargain" and America would no doubt "make the most of it." The vague boundaries gave the United States a strong claim to parts of Texas and Florida in addition to Louisiana. The Spanish were furious when the sale was made public, claiming that Napoleon had no right to agree to sell the territory before he actually took possession of it. By 1806, clashes between Spain and America over disputed territory led to a lawless no-mans-land referred to as the Sabine Free State, which stretched for several miles east of the Sabine River becoming a haven for thieves, smugglers, and pirates (Tindall 1988; Bradshaw 2002).

A large number of ships were lost at New Orleans and on Lake Pontchartrain during a hurricane on August 19, 1812. Nearly all the buildings suffered some degree of damage, even those made of brick. The storm demolished the market house in New Orleans. The levee was breached and fifteen feet of water covered the city; forty-five people drowned, The *National Intelligencer* of September 22, 1812 reported the U.S. Naval base also sustained significant damage. The American brig *Enterprise* was driven ashore. The *Viper* lost her main mast and at least ten people aboard the *Harlequin* were lost. Following the storm, the shores of Lake Pontchartrain were littered with wreckage from vessels and their assorted cargoes. The deadly storm claimed nearly 100 lives (Marx 1983; Roth 2010).

On January 8, 1815, soldiers under the command of Andrew Jackson - accompanied by frontier militiamen from Kentucky and Tennessee, local Louisiana Creoles, Choctaw Indians and a band of pirates under the command of Jean Lafitte – fought the British at the Battle of New Orleans. The British suffered 2,037 casualties, including 291 killed, 1,262 wounded and 489 captured or missing, while the American losses included 13 killed, 39 wounded and 19 missing.

Ironically, the Battle of New Orleans was fought after the War of 1812 was already over. The Treaty of Ghent that officially ended hostilities was signed in Belgium on Christmas Eve, 1814. News of the peace treaty, however, did not reach New Orleans until the following February. Jackson became a national hero, entered politics and due in large part to his popularity gained at his victory at New Orleans, was elected President of the United States in 1828 (Lawson 1966).

The New Basin Canal was dug by the New Orleans Canal and Banking Company from 1831-1838. Yellow Fever ravaged workers in the swamp and the loss of slaves was considered too expensive. Thus most of the work was done by German and Irish immigrants. Although a large numbers of workers died while excavating the canal, they were readily replaced by others willing to endure backbreaking work and risk their lives in dangerous conditions for a chance to earn $1.00 a day. The finished canal served as a transport route between downtown New Orleans and

Lake Pontchartrain. The 3.17-mile long canal remained a commercially important waterway for regional commerce through the 19th century.

Lake Pontchartrain was a strategically important waterway during the American Civil War. Shortly after the fall of Fort Sumter, in April 1861, President Abraham Lincoln proclaimed a blockade of the southern states from South Carolina to Texas. The following week the blockade was extended to include Virginia and North Carolina (Wise 1989). At first the Union naval blockade of the Confederacy existed in name only. The United States Navy began the war with only 90 vessels, of which only 46 were in commission. Of those in active service, only 24 were steamers. The Secretary of the Navy, Gideon Welles, responded to this critical shortage of ships by authorizing the purchase of 136 vessels, the construction of 52 and the repair and recommission of another 96. (Watts 1988) By the end of 1861, the number of vessels in the U.S. Navy had increased to 588 and by December 1864 that number had risen to 671 (Foster 1991).

Blockade runners became a fairly common sight on Lake Pontchartrain. The Confederates fortifications at the Ringolets (Fort Pike) and Chef Menteur Pass (Fort Macombe) guarded the entrance into Lake Pontchartrain. However, they saw little action and after the city of New Orleans fell to Union forces on April 24, 1862, the Rebels abandoned the forts and moved across the lake to Madisonville. The Confederates later moved up to Covington, Louisiana located at a fork of Bouge Falaya and the Tchefuncte River (Hastings 2009).

Three Confederate steamers were intentionally burned and destroyed on Lake Pontchartrain by retreating Confederate forces on April 21, 1862. These vessels included the gunboat C.S.S. Carondelet and the side-wheel steamers C.S.S. *Oregon* and C.S.S. Pamlico. A fourth gunboat, the C.S.S. *Bienville*, was also intentionally sunk before her completion on the Bouge Falaya River by Confederate soldiers to prevent capture (Hemphill 1998; Gaines 2008).

The Confederate gunboat C.S.S. *Corypheus* patrolled Lake Borgne and Lake Pontchartrain (Campanella 2007). The 82-ton schooner was originally built as a yacht at Brook Haven, New York in 1859. The *Corypheus* was seized under orders of General M. Lovell and armed with a 30-pounder rifled gun and a howitzer and converted into a gunboat. The *Corypheus* was captured by the U.S.S. *Calhoun* at Bayou Bonfouca on May 13, 1862 (Silverstone 1989).

New Orleans was occupied by Union troops under the command of General Benjamin F. Butler. The Union gunboat U.S.S. *New London*, commanded by Captain Abner Read, represented the most significant naval presence on Lake Pontchartrain (Rush *et al.* 1894). Union forces controlled Lake Pontchartrain and New Orleans for the remainder of the war. Meanwhile the adjacent north shore of Lake Pontchartrain remained under Confederate control. Illegal smuggling continued on the lake on a smaller scale and brought lucrative profits to those involved. Union soldiers occasionally crossed the lake to raid Madisonville and other north-shore communities and seize cotton, timber, lumber, tar, turpentine, bricks and other useful items.

Although no major naval engagements took place on Lake Pontchartrain during the Civil War, a series of significant historical events did occur on the lake, namely the testing of several innovative submarines (Hastings 2009).

The Confederate submarine *Pioneer* was built by James R. McClintock, Baxter Watson, John K. Scott and Robert F. Barrow in 1861-1862. McClintock and Watson would eventually partner up with Horace Lawson Hunley, a lawyer and assistant customs agent at the New Orleans Customs House, to build a submarine with a menacing streamlined appearance. The vessel was commissioned by the Confederacy to be used primarily against the *New London,* a Union gunboat patrolling Lake Pontchartrain. She was designed to carry three men. A stern propeller, cranked by hand, provided propulsion. Their initial testing included several apparently successful descents into the lake and the destruction of a small schooner and several rafts. During testing the *Pioneer* also reportedly succeeded in sinking a barge with a bomb towed behind the submarine.

In March 1862, the submarine's owners were issued a Letter of Marque by the Confederate government to "Cruise the high seas and rivers and destroy any vessels opposed to the Southern War for Independence." The *Pioneer*'s physical description is quoted here from that Letter of Marque: "Said vessel was built in New Orleans in the year 1862; is a propeller; is 34 feet in length; is 4 feet breadth; is 4 feet deep. She measures about 4 tons; has round, conical ends and is painted black."

However, a month later, New Orleans fell to the West Gulf Blockading Squadron commanded by Admiral David Glasgow Farragut, and the *Pioneer* was ordered destroyed. The 4-ton submarine was scuttled in Lake Pontchartrain's New Basin Channel (or Bayou St. John) when the Confederates evacuated New Orleans. Following the conclusion of the war, McClintock described the craft he and his partners had built as, "made of iron ¼-inch thick. The boat was of a cigar shape thirty feet long and four feet in diameter. This boat demonstrated to us that we could construct a boat that would move at will in any direction desired and at any distance from the surface. As we were unable to see objects passing under the water, the boat was steered by compass."

The submarine's disappearance remained a mystery for many years – until long after the conclusion of the war – and had been largely forgotten. According to William Morrison Robinson's *The Confederate Privateers*:

> Years afterwards, during some dredging operations to deepen the harbor, the dredge buckets one day got hold of something they could not lift. A diver was sent down to investigate, and he reported that there was some metal object buried in the mud which looked like a steam boiler. They set to work to raise this, and putting chains around it they lifted it on to the wharf.

One old Confederate veteran later claimed the *Pioneer* was used to attack Union warships. An article written in the *New Orleans Picayune* on June 29, 1902, refutes the implication that the submarine was ever dispatched against Admiral Farragut's fleet. The article stated that the *Pioneer* still lay "half submerged in the weeds and flowers growing on the bank of Bayou St. John."

Several years later, the *Picayune* ran another story, which concluded the *Pioneer* "was never used, for in a test made just before the Federals took this city, it sank in the Bayou St. John, three sailors losing their lives in trying the boat. It was not until many years after, when the bayou was dredged, that the boat was raised, and ever since has been lying at Spanish Fort."

The ultimate fate of the C.S.S. *Pioneer* is clouded by several conflicting reports. One version of the story claims Union sailors found the *Pioneer* and dragged it ashore where it was inspected and thoroughly diagramed by Union engineers. According to a newspaper article the *Pioneer* was lying on the bank of the canal near Claiborne Street and was raised and sold as scrap for $43 in 1868 (*The Daily Picayune*, February 15, 1868). Another article published in 1878 claims that a vessel, "similar to the *Pioneer*" was discovered by several boys swimming near Spanish Fort. They pointed it out to the crew aboard the dredge boat *Valentine*. The dredge crew raised the strange-looking craft they encountered during their dredging operations at Bayou St. John and Lake Pontchartrain (Lambousy 2006).

In 1895 the submarine was placed on display outside the bayou at Spanish Fort Amusement Park as a curiosity. At the time, the vessel was identified as the Confederate submarine *Pioneer*. Although no period documentation for the submarine is known to exist, and its original name and many details about it remain unknown, the location seemed to match historical accounts where the *Pioneer* was presumably scuttled to prevent from falling into Union hands after the fall of New Orleans (Serpas, 1975; *New Orleans Times Picayune*, June 29, 1902; *New Orleans Times Picayune*, April 2, 1909).

The "*Pioneer*" was donated it to Camp Nicholls, the Louisiana Home for Confederate Soldiers on Moss Street beside Bayou St. John in 1908. Around the same time the submarine's interior was filled with concrete in an attempt at preservation. (The ill-advised preservation method chosen is enough to make modern day conservators cringe.) That vessel was measured in 1926, but was found to be only twenty feet long. (The submarine's long spar may have been removed, thus making the vessel at least ten feet shorter than originally reported or the vessel in question may have been another variation of the missing submarine.) In 1942, the vessel was acquired by the Louisiana State Museum and transferred to Jackson Square. It was displayed at various locations around the Square. Subsequently it was moved inside the Lower Pontalba Building adjacent Jackson Square. In 1957 it was moved to the ground floor of the Presbytere Arcade, the Louisiana State Museum located in New Orleans (Hart 1928; Ragan 1999; Bak 2004).

In 1999, the submarine was transported to Baton Rouge, where the old concrete was professionally removed as part of a major restoration project (Lambousy 2006). Although the submarine was probably originally black, according to one author, it had been painted yellow by Tulane University students who "were obviously greater fans of the Beatles than of Civil War history (McCash 2001). After restoration was completed the craft was placed on display at the Baton Rouge branch of the Louisiana State Museum.

The identification of the submarine as the *Pioneer* was not called into serious question until historical research in the late 20th century determined that the *Pioneer* was designed differently than the submarine recovered from Bayou St. John. The Bayou submarine and the *Pioneer* may have undergone trials at about the same time and confusion between the two may date back to contemporary accounts; it is not clear which of the two was constructed first (Bak.

Hunley, McClintock and Watson went on to construct another three (or possibly more) man-powered, iron-hulled, submarines in Mobile including the C.S.S. *Pioneer II*, the *American Diver*, and the *H.L. Hunley*. The *Hunley* was built from steam boilers at Mobile in the spring of 1863 and then taken by rail to Charleston. The submarine arrived there on August 12, 1863.

The Confederate Army seized the *Hunley* from its private builders and owners shortly after her arrival at Charleston, although her inventor, Hunley and his partners continued to play an active role in further testing. Contemporary accounts often refer to the craft as the *Fish Boat*. However, following two fatal accidents during test dives, many people began to doubt her military value and began referring to the vessel as the “Peripatetic Coffin” or the “Iron Coffin.” (Kloeppel 1992).

On the night of February 17, 1864, the *Hunley*, under the command of Lieutenant George E. Dixon successfully embedded the barbed spar torpedo into the hull of the 12-gun steam-powered sloop-of-war U.S.S. *Housatonic*. The *Housatonic* was stationed at the entrance to Charleston Harbor, about five miles out to sea. The torpedo detonated as the submarine backed away, sinking the *Housatonic* in five minutes and killing five crewmen. The sinking of the *Housatonic* was the first recorded incident of a warship being sunk by a submarine in history and marked a new era in naval warfare. Exactly what happened next is unclear. The only thing that can be said with any degree of certainty is that the *Hunley* failed to return to port after the attack (Dunmore 2002).

In 1980, best-selling novelist and underwater explorer Clive Cussler became interested in finding the *Hunley*. He established a non-profit organization the National Underwater & Marine Agency (NUMA) to locate historic shipwrecks. NUMA organized a series of expeditions to find the *Hunley*. He spent fifteen years and a considerable amount of money searching for the elusive submarine.

In 1995, NUMA returned to the area to investigate some of the magnetometer targets that had been recorded earlier, but never properly identified. Target #1 proved to be the *Hunley*. The wreck was discovered by NUMA archaeologists Ralph Wilbanks, Wes Hall and Harry Pecorelli III on May 3, 1995. A week later, on May 11, Cussler publicly announced the discovery. The wreck was found several miles outside Charleston Harbor near the approach to Moffitt’s Channel lying in thirty feet of water (Cussler and Dirgo 1996; Ragan 1999).

On August 8, 2000, amid much fanfare, the *H.L. Hunley* was lifted out of the mud and raised to the surface. The South Carolina Institute of Archaeology and Anthropology, the U.S. National Park Service and the non-profit organization Friends of the *Hunley* were thrilled. The various groups had raised about seventeen million dollars in public donations to help recover and restore the Confederate submarine. The *Hunley* was then taken to the old Navy Yard and placed in a specially designed tank of fresh water to await conservation at the Warren Lasch Conservation Center in Charleston (Ragan 1999).

The north-shore area of Lake Pontchartrain flourished in the 19th century, and wealthy affluent citizens of New Orleans flocked to *'l'autre cote du lac* (the other side of the lake) for fresh air, spring water and a resort lifestyle. St. Tammany Parish boomed, especially during the summer months, as a healthful destination with numerous hotels, inns and restaurants. Daily steamboat excursions and later the railroad brought countless visitors who sometimes stayed months at a time (http://www.louisiananorthshore.com/cms/d/history.php).

The town of Slidell, Louisiana was founded on the north shore of Lake Pontchartrain in 1882 and 1883 during construction of the New Orleans & Northeastern Railroad (N.O.N.E.). The railroad line linked New Orleans with Meridian, Mississippi and from connected to Cincinnati, Ohio and eventually with the New York City. The railroad established a building camp at first high ground north of Lake Pontchartrain which eventually grew into a city. Slidell was chartered by the Louisiana Legislature as a town in 1888.

Twentieth Century

A 1901 article from the *St. Tammany Farmer*, a weekly newspaper printed at Covington, reported that "Slidell had six churches, three schools, a sawmill, five saloons, six stores, two brickyards, three barber shops, four fruit stands, and several other local favorites too numerous to mention" (*St. Tammany Farmer*, July 27, 1901).

During the first three decades or so after its founding, Slidell developed a creosote plant, one of the country's largest brick manufacturing facilities, a large lumber mill and a shipyard. The Slidell shipyard contributed significantly to the national effort in both World Wars (Parrish *et al.* 2010).

During World War II, numerous north-shore residents also travelled across the lake and worked at factories in New Orleans in ship, tank and airplane construction. Many worked at Higgins Industries, on land near Lake Pontchartrain, where the University of New Orleans stands today. Andrew Higgins had designed a shallow-draft boat designed to be operated in the marshes and swamps of Louisiana. The design was modified and improved to become the Landing Craft, Vehicle, Personnel (LCVP) or Higgins Boat. The landing craft was used extensively at Guadalcanal and other amphibious landings (Westrick and Comiskey 2014).

Higgins Industries expanded rapidly to meet the nation's military needs going from a single plant employing fewer than 75 people before the war to seven plants employing more than 20,000 workers by 1943 (D-Day Museum). Higgins also employed the first fully integrated working force of women and men, whites and blacks in New Orleans (Sidey 1944).

In February 1944, Dwight D. Eisenhower was designated Supreme Allied Commander of the Allied Expeditionary Force (SHAEF). General Eisenhower and his subordinates planned Operation Overload, the Allied invasion of Normandy. The D-Day landings on June 6, 1944, were costly but successful and led to the liberation of Europe. In 1964, Eisenhower told historian Stephen E. Ambrose, "Andrew Higgins is the man who won the war for us. If Higgins had not designed and built those landing craft, we never would have landed on an open beach." (Ambrose 1994; http://www.slidell.la.us/about_history.php).

At the turn of the century, Louisiana established the Board of Commissioners and the further expansion of port facilities contributed to New Orleans' accelerated growth rate. Urban flight from New Orleans began to have a transforming effect on the small towns located on the lake's north-shore in the 1960's. The completion of U.S. Interstates I-10/I-12 and the Causeway Bridge over Lake Pontchartrain greatly influenced this population shift. The transportation link stimulated the popularity of St. Tammany Parish as an important suburban within the New Orleans metropolis (Parrish *et al.* 2010).

In the 1960's, Slidell began to assume its modern identity. The National Aeronautic & Space Administration (NASA) selected the city as the site for a large computer facility in 1962. The NASA Slidell Computer Center was located on Gause Boulevard. Two nearby installations also supported NASA's Apollo lunar landing program. The Slidell Computer complex along with the Michoud Assembly Facility in New Orleans, and the John C. Stennis Space Center test facility in Hancock County, Mississippi, were instrumental in successfully putting American astronauts on the moon.

The NASA complex nearly tripled Slidell's population over a period of ten years, and the city became a major suburb of New Orleans. Slidell became one of the country's fastest growing cities. The complex brought new residents to the city, and in turn new businesses were created to serve the ever increasing population. This growth cycle still continuing today and Slidell ranks as the largest city of St. Tammany Parish.

Likewise NASA's aforementioned Michoud complex in New Orleans employed thousands of south Louisiana residents. The Saturn booster rockets that propelled the Apollo astronauts to the moon were built at the facility. Following the conclusion of the Apollo lunar missions in 1972, the Michoud plant converted to the construction of the external fuel tanks used in the Space Shuttle program, which began in 1981.

STS-1 was the first orbital spaceflight of NASA's Space Shuttle program. The first orbiter, *Columbia*, with astronauts John W. Young and Robert L. Crippen lifted off from Pad A, Launch Complex 39, at the Kennedy Space Center on April 12, 1981 and returned to Edwards Air Force Base in California 54.5 hours later, having orbited the Earth 37 times (Young and Crippen 1981).

New Orleans remains the largest city in Orleans Parish. Over the past 150 years, the singular event that has most affected the city was Hurricane Katrina. The storm triggered floods that inundated New Orleans. More than 1,800 people were killed as storm waters overwhelmed levees and broke through flood walls on August 29, 2005. Today, much of the city appears to have found its rhythm again, although some neighborhoods, such as the Lower Ninth Ward, remain works in progress.

Hurricane Katrina remains the costliest natural disaster and one of the five deadliest hurricanes in U.S. history. The storm caused an estimated $108 billion (2005 USD) in damage, roughly four times the damage inflicted by Hurricane Andrew across south Florida in 1992 (Knabb *et al.*, 2005; Rappaport, 1993).

6.0 PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

This section summarizes the results of a search of the Louisiana Division of Archaeology records for documentation related to previous cultural resource investigations within or near the project area. A review of the available records indicates no archaeological sites are located within the New Orleans Land Bridge Shoreline and Stabilization and Marsh Creation Project (PO-169) project area. Six archaeological sites are however, located in the immediate vicinity. These include sites 16OR31, 16OR34, 16OR57, 16OR60, 16OR569, and 16ST5. These sites are near the project area they are depicted within the chart bounds but are outside the Area of Potential Effect (APE).

Site Number 16OR31 – Lake St. Catherine (a.k.a. Orleans Landbridge #5)

The Lake St. Catherine site represents a prehistoric shell midden with Native American ceramics. The site is located about 1.75 miles southeast of Fort Pike on the Rigolets and approximately 0.6 miles northeast of Bay Jaune Point (Louisiana Site Record Form).

Sherwood Gagliano and Roger Saucier first recorded the prehistoric site located along the shores of Lake St. Catherine in 1957. At the time it was described as a subsided and elongated *Rangia* shell midden measuring approximately 250 feet (76.2 meters) long × 50 feet (15.2 meters) wide of unknown prehistoric cultural affiliation. The midden was raised 2 feet (0.6 m) above the marsh level. The site was noted as “totally disturbed” and not eligible for inclusion on the NRHP.

The site was visited by Roger Baudier in 1979. Bill Edwards of the Delta Chapter of the Louisiana Archaeological Society (LAS) revisited the site in 1982. Edwards noted the site was completely destroyed and the surface artifacts were heavily wave-washed.

Archaeologist Rob Mann (Louisiana State University Museum of Natural Science) visited the site in March 2010 (Mann 2010). While most of Mann’s time was spent along the shoreline, he did explore the site and collected thirteen sherds of Baytown Plain pottery and one sherd of unidentified punctated ware. The investigation revealed a much more extensive shell midden than previously recorded as being present at this location.

Mann felt it possible “that intact midden deposits from the site might be buried in the undisturbed portion of the marsh” and concluded that additional fieldwork should be undertaken to evaluate the NRHP eligibility of the site. He recommended further testing along the exposed shoreline and “until such testing is completed the NRHP status of the site should be undetermined.” Mann’s conclusion contradicted those of the earlier assessments.

On August 6, 2010, archaeologists from the CRM firm, HDR, Environmental, Operations, and Construction, Inc. revisited the site as part of the MC252 Oil Spill Response. They determined that the location was completely offshore. Furthermore, no cultural materials were observed along the adjacent shoreline. No oil cleanup activities occurred at or near the site.

The 16OR31 site was recorded by archaeologist Doug Wells (Coastal Environments, Inc.), on March 15, 2016. The survey revealed a shell scatter, largely hash that contained badly eroded materials. All the associated cultural materials were found at the surface, washed back into the marsh grass along the lakeshore, and underlain by marsh deposits. Shovel testing and probing failed to reveal any buried deposits, and even the thickest patches of hash and shell proved to be surficial.

The recent CEI survey called into question accuracy of the site's location as originally recorded.

> This appears to be the correct location of the shell midden reported by Rob Mann (2010) as 16OR31, approximately 150 meters northwest of his location, and approximately 380 meters northeast of the location recorded in the DOA GIS database. Probing at 10-meter intervals failed to reveal further deposits beyond what is exposed at the surface, and no further deposits were found by probing in the water to the west and south, nor in the marsh to the east.
>
> No other shell deposits were found on the shoreline (as it now exists) around the originally-recorded location of the site, so it is assumed that either the site was erroneously recorded by Gagliano and Saucier, as well as Mann, or that a significant amount of migration has occurred. The former seems most likely, at least for Mann's recording of the site, as aerial images suggest that the shell pile at the south end of the site was near the current location in 2009.

The CEI concluded that the 16OR31 site is entirely outside of the current Orleans Landbridge Marsh Restoration project area, and would not be impacted by activities currently planned for that project (LA Site Record Form).

Site Number 16OR34 – Garcia Site/Hospital Foundations:

The site is comprised of both prehistoric and historic elements. Variously known as the Garcia site, Fort Petite Coquilles and/or the Hospital Site, 16OR34 is unique for the many cultural components represented. The initial occupation of the Garcia site may date to Paleo-Indian times, as evidenced by finds of Clovis and Dalton points found in wave-washed log deposits situated along the shoreline. The Garcia site has a strong Poverty Point component. It should be pointed out however, that there are a number of problems concerning landform relationships at this site. The first is that there is good evidence for a Paleo-Indian component. This occurs in the form of both Dalton and unfluted Clovis points from beach deposits at the site.

If the initial occupation is indeed Paleo-Indian, what landform was the site situated on? The answer is that it was probably located on the edge of a Prairie Terrace headland which was partially exposed during Paleo-Indian times. Later, as sea levels fell and approached current levels this locale was probably situated on the shore of a bay or sound. The site is exceptionally unique since most of the Prairie Terrace deposits in the Pontchartrain Basin which were exposed during the Late Wisconsin period are now covered by a thick layer of later deposits (Gagliano *et al.* 1979).

The Spanish built a fort (Petite Coquilles) at the same location. Fort Petite Coquilles fort played a minor role in the War of 1812. General James Wilkinson, commander of the New Orleans district, believed that building a fort at this location was "a major factor in preventing the British from taking New Orleans." However, it was, in fact, criticized by General Andrew Jackson as being "of little service in protection of the pass" after American gunboats in Lake Borgne were captured on December 14, 1814.

Following the conclusion of the War of 1812, Brigadier General Simon Bernard was sent to evaluate the then existing military defenses of the "Gulf of Mexico Frontier" and to develop a report with recommendations for improvements.[2] His report was accompanied by a series of maps of the area and plans of existing fortifications. During the course of his survey, Bernard visited the study area and described the existing military defenses at both the Chef Menteur Pass and the Rigolets. He reconnoitered the fort located at Petite Coquilles, also referred to as the "Old Spanish Fort." General Bernard's report includes a description of the fort as it existed in 1817. "The Fort Coquille has a semicircular battery for 7 pieces of ordinance, framed with woods on the right and left side of that Barbet and otherwise 2 wood sides, but without platform nor parapet. South and East of this battery is a fr-t (*illegible*) made out of weak Palisades and of a ditch having a few feet of water" (Bernard 1817, Gagliano *et al*. 1979).

An army hospital associated with Fort Pike was built on the western side of Point Coquille along Lake Pontchartrain on the location of old Fort Coquilles (Girard 1870). The hospital existed between 1831 and 1865. It is shown on a surveyor's map of the Rigolets and the area made in April 7, 1846. The historic map also depicts a lighthouse on Pleasanton's Island, (present-day Rabbit Island) (Gagliano *et al.* 1979).

Site 16OR34 has a major Poverty Point component, a Tchula component, a Coles Creek component, in addition to several historic components including Spanish and American military. Historic burials from this interval have been recovered from the wave-washed banks, one of which was exhibited at the Fort Pike State Monument. Following the 1979 survey, Gagliano noted that "Even though the site has been badly degraded by wave erosion, there are remnant brickwork foundations and probably other *in situ* material." He recommended that 16OR34 should be nominated to the NRHP (Gagliano *et al.* 1979).

Although potentially eligible, Site 16OR34 is not currently listed on the NRHP.

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[2] Simon Bernard (1779-1839) was born in France and served as a General of Engineers in the French Army. Bernard was loyal to Napoleon Bonaparte and after the emperor's second abdication, Bernard was banished from France. He emigrated to the United States, where, he was made an assistant engineer in the U.S. Army with the rank and pay of a brigadier general of engineers on November 16, 1816. In addition to Fort Pike, Bernard designed a number of extensive fortifications for the Army, most notably Fort Monroe and Fort Wool in Virginia, Fort Adams, in Rhode Island and Fort Morgan in Alabama.

Site Number 16OR57 – Fort Pike:

Fort Pike is a decommissioned military fortification, named after the soldier and explorer Brigadier General Zebulon Montgomery Pike (1779-1813), whose name is also ascribed to Pike's Peak in the Rocky Mountains. Fort Pike was constructed shortly after the War of 1812 to guard the Rigolets pass, a vital and strategic waterway connecting the Gulf of Mexico, via Lake Borgne, to Lake Pontchartrain. The construction of the brick and masonry fortification began in 1819 and was completed in 1827 (Robinson 1977).

During the War of 1812 the strategic importance of the Rigolets and Chef Menteur became even more obvious. New Orleans could he attacked by one of these routes as well as others. On December 10, 1814, a British Royal Navy fleet anchored between Cat Island and Ship Island. Three days later they sailed into Lake Borgne and engaged an American naval squadron. By December 14, all the American ships were either captured or sunk. The British fleet then moved to New Orleans through Bayou Bienvenue (Davis 1959).

Although the fledgling United States had survived the War of 1812, the British destruction of Washington D.C. and their attack on New Orleans emphasized the weakness of the nation's defense. To prevent against any future foreign invasion, President James Monroe ordered the construction of an extensive coastal defense system. The new fortifications, together with existing ones, stretched along the entire Atlantic and Gulf coasts and protected strategic ports and rivers such as New Orleans and the Mississippi. Fort Pike and Fort Macomb were two of six new masonry forts built in coastal Louisiana at this time. Together with Fort Jackson and Fort St. Philip on the Mississippi River and Fort Livingston on Barataria Bay, these fortifications protected New Orleans from a potential seaborne invasion.

Fort Pike's role in the military affairs of the United States prior to the American Civil War varies considerably. During the Seminole Wars the fort served as a staging area for soldiers en route to Florida. It also served as a collection point for hundreds of Seminole prisoners and their black slaves who were being forcibly relocated to the Oklahoma Territory. Some of the fort's 24- and 32-pounder cannons were removed from the casemates in order to convert them to prison cells. At one point, a mere 66 soldiers guarded 253 prisoners.

Similarly, during the Mexican-American War (1846-1848), Fort Pike served as a stopover and rendezvous point for U.S. troops bound for Texas and Mexico. In between these hostilities, the fortification was largely abandoned and left in the care of a single ordnance sergeant.

In 1861, just weeks before Louisiana seceded from the Union and joined the Confederacy the Louisiana Continental Guard militia took control of the Fort Pike. Within a year, the small garrison stationed at Fort Pike had grown from fifty soldiers and a few officers to over 300 men. Confederate troops held it until Union forces captured New Orleans in 1862, whereupon the rebels evacuated the fort. Union forces took possession of the fort on May 4, 1862. The retreating Confederates had left the fort heavily damaged by spiking the guns and burning buildings (Groene 1988). The Union soldiers then reestablished control of the military instillation and used it as a base of operations to launch raids into enemy territory along the Gulf coast and shores of Lake Pontchartrain. Union officers also used Fort Pike as a training center, where former slaves were trained in the use of heavy artillery. These soldiers became part of the United States Colored Troops, and played an important role in several key battles, including the siege of Port Hudson.

American troops occupied and maintained the fortification until it closed permanently in 1871 (Groene 1988). By 1882 Fort Pike was placed on a list of forts to be abandoned (Casey 1983). Fort Pike was turned over to the U.S. Quartermaster Department for disposal and officially abandoned on October 10, 1890.

A portion of the former fort grounds was turned over to the State of Louisiana in 1921. On November 15, 1934, Governor O.K. Allen created the Fort Pike State Park out of the tract of approximately 125 acres (Casey 1983:160). A few years later the Works Program Administration (WPA) carried out repairs and restoration at the fort and it was opened to the public (Cramer 2014).

In spite of all the activity, not a single cannonball was ever fired in battle at Fort Pike. The fortification was placed on the National Register of Historic Places in 1972. The fort and grounds were maintained as part of a state park, known as the Fort Pike Historic Site.

Prior to 2005, the fort's brick-and-mortar structure and walls were badly decaying and in a state of disrepair. The storm surge generated by Hurricane Katrina greatly exacerbated the problems. The storm surge temporarily and completely submerged the entire fort and completely destroyed the adjacent state park buildings. The site reopened on May 2, 2008. In September 2008, the park was closed once again after it was damaged by Hurricane Gustav. The Fort Pike Historic Site underwent extensive repairs and restoration and was opened again in June 2009. It was again closed indefinitely for repairs and debris cleanup in the wake of Hurricane Isaac in 2012. Although it reopened to visitors afterwards, it closed again, in February 2015, this time however, the closure was not due to a natural disaster, but rather state budget cuts. The site is currently closed to the public.

Archaeological investigations have been conducted at Site 16OR57 on multiple occasions, including Gagliano (1979), Castille (1982) and Jones *et al.* (1997). The reports generated from these surveys contain historical information pertaining to the fort. More recent archaeological surveys have originated from projects associated with repairs and improvements.

In 2008, the University of New Orleans and the Louisiana Division of Archaeology entered into a two year agreement to fund a Regional Archaeologist in the greater New Orleans region. The Regional Program operated under the title of the Greater New Orleans Archaeology Program (GNOAP). In the winter of 2009, the GNOAP conducted monitoring activity for the replacement and stabilization of the brick wing walls at the entrance to Fort Pike. These walls were severely sloping inward and needed to be repaired. The areas of impact were the removal and replacement of the brick wing walls and concrete pathway leading toward the fort entrance. (White *et al.* 2009).

Hurricane Gustav made landfall on the coast of Louisiana on September 1, 2008. Fort Pike State Historic Site was heavily impacted by winds and storm surge and a large amount of hurricane debris was left scattered across the site. The Louisiana Facility Planning and Control received grant funding from the Federal Emergency Management Agency (FEMA) for debris removal. FEMA archaeologists conducted monitoring of debris removal from approximately 13 acres at the Fort Pike State Historic Site as required under Section 106 of the National Historic Preservation Act (Cramer 2014).

Site Number 16OR60 – West Rigolets Lighthouse:

The site is a historic lighthouse with associated keeper's dwelling dating the mid-19th to early 20th centuries. The site is located at the northernmost tip of the Marsh Island peninsula, directly north of the Fort Pike Historic Site. The structure was built in 1854, damaged by high winds in 1869, and renovated in 1879. The lighthouse was damaged by fire in 1887 and renovated once again in 1917.

The site was initially recorded by Fulgham (1978) and reported by Gagliano *et al*. (1978). Gulf South Research evaluated the site as part of a cultural resource study of the area in 1996. Both structures were reported as standing at the time, but in poor condition (Jones *et al*. 1996). The Federal Management Agency (FEMA) revisited the site following Hurricane Katrina in 2005. Only the foundation remained, along with "an associated historic and modern artifact scatter (LA site card update by Martinkovic [2007]).

On July 13, 2010, archaeologists from the CRM firm, HDR, Environmental, Operations, and Construction, Inc. revisited the site during a pedestrian surface inspection as part of the MC252 Response and found that the site was completely submerged. Similar to the 2007 survey, HDR recorded and collected wave-washed surface artifacts (including numerous brick fragments, which were not collected) along the shoreline.

Site Number 16OR569 – RW-1:

The site is a prehistoric shell midden. RW-1 was discovered by Coastal Environments, Inc. during a Phase I survey for the U.S. Army Corps of Engineers' Ecosystem Restoration Project in the spring of 2010. Shell fragments were observed within a marshy area on the southeastern shore of Lake Pontchartrain. The shell deposit consisted of a mixture of modern *rangia* clams and oyster shells and extended approximately 40 meters along the shoreline. Ceramic sherds were collected from the surface; however, no subsurface deposits were detected during probe testing. The ceramics indicated a Woodland/Coles Creek component, with Baytown Plain and Pontchartrain Check Stamped types collected (Weinstein 2010).

The site was heavily wave-washed. The negative results of the probing denoted an absence of any intact subsurface deposits indicating the site has limited research potential and is therefore not eligible for inclusion on the NRHP.

Site Number 16ST5 – Salt Bayou:

The site is comprised of both prehistoric and historic components. The multi-component site includes a previously recorded historic nineteenth-century ferry landing and a prehistoric village site of undetermined cultural affiliation. The site is located at the southernmost-tip of Treasure Island, west of the Treasure Island residential development. Salt Bayou as plotted by the Louisiana Cultural Resources Map encompasses 1.64 hectares at the peninsular southern tip of Treasure Island; only a small portion of the site extends offshore. The Salt Bayou site was first recorded by Kniffen (1939), where he recorded and observed over 250 prehistoric ceramic sherds and numerous lithic arrow points. Saucier and Gagliano briefly revisited the site in 1953. The site was re-surveyed by Fulgham and Castille in 1978. They reported the site as either destroyed or covered by recent residential improvements and development which included the addition of a bulkhead. HDR revisited the site on two occasions (July 13 and July 29, 2010) during pedestrian surface inspection surveys as part of the MC252 Oil Spill Response. No cultural resources were observed during any of the field visits. HDR archaeologists reported, however, that the site may have been impacted by recent land development, as it consisted of a manicured lawn with concrete rip rap barrier along the shoreline.

7.0 NRHP PROPERTIES AND STANDING STRUCTURES

NATIONAL REGISTER PROPERTIES NEAR THE PROJECT AREA

The National Register of Historic Places (NRHP) is the United States official list of districts, sites, buildings, structures, and objects deemed worthy of preservation. Currently there are 168 NRHP listed properties and districts, including twenty-five (25) National Historic Landmarks located in Orleans Parish. None of these properties or districts are located within the proposed project area; however, one property (Fort Pike) is situated near the project area.

STANDING STRUCTURES WITHIN THE PROJECT AREA

The Louisiana Division of Archaeology maintains a list of known standing structures, 50 years old or older within the state. No standing structures that are listed in the Louisiana Master Site File are within the proposed project area.

8.0 DATA ASSESSMENT

8.1 Subbottom Seismic Record

Fugro collected sub-bottom seismic profile data in support of the hazard survey and to describe the seismic stratigraphy of the proposed borrow areas. All sub-bottom data was collected using an Edgetech 3100 SB424 sub-bottom profiler operating at a swept frequency of 4-24 kHz, and was positioned using DGPS with proprietary Fugro corrections. The average depth penetration below the lake floor sediments recorded by the instrument during the survey was ~15 feet.

All subsurface geophysical data was processed and interpreted by Fugro using the SonarWiz geophysical software suite. Data was initially inspected to ensure no errors in navigation were recorded during the survey. All seismic files were then bottom tracked to establish the seafloor for the purposes of measuring facies thickness and eliminating water column noise. Acoustic gains were adjusted to optimize the seismic image for interpretation. Data was then examined for any contacts that may be interpreted to be hazardous or culturally significant. In each borrow area and respective dredge pipeline corridor, the deepest continuous reflector was identified and mapped. An isopach was then computed based on the thickness of the seismic sequence between the mapped reflector and the lake floor. An assumed velocity of 1500 m/s was used for all depth and thickness calculations. The seismic stratigraphy observable in the sub-bottom seismic data was also identified and described (Appendix D).

Relic submarine channels can often be detected in the subbottom profiler data, observed as dipping reflectors with an infill of high amplitude reflections. These high amplitude reflections suggest the channel fill is coarser sediment (e.g. silty-sandy mud) than the surrounding sediment and channel.

Several relict channels were identified and mapped within the survey area. No other specific landforms such as natural levees, point bars, or flood plains were identified that might indicate intact prehistoric sites.

8.2 Magnetometer Record

Fugro collected a marine magnetometer survey within the project areas to identify the locations of ferrous debris and plausible pipelines that may impact future construction and development activities. Magnetometer data was collected using a Geometrics G-882 marine magnetometer positioned using DGPS with proprietary Fugro corrections. All positioning and magnetometer data were recorded using the Hypack hydrographic and navigation software suite.

The magnetometer data was processed and interpreted using the SonarWiz geophysics software suite. Layback values were applied to all magnetometer data. Deflections from the ambient magnetic field within the survey area were identified and interpreted as anomalies. Interpretations recorded the position, duration, and amplitude of each anomaly. The geometry of each anomaly was also described in terms of monopole, dipole, or complex.

Many factors affect magnetic signatures. These include the distance of the sensor from the object, amount and configuration of ferrous material within the object, whether and to what depth the object is buried, etc. The possible combinations of existing conditions are innumerable and vary with the type and condition of the debris. Some signatures that could indicate the presence of buried archaeological remains are anomalies associated with sonar contacts, anomalies with high amplitude and/or long duration, anomalies that show up on more than one consecutive survey line, and/or clusters of anomalies (Anuskiewicz, 1992; Garrison *et al*., 1989a; Gearhart, 1988; Saltus, 1982).

The magnetometer detected 120 unidentified magnetic anomalies that could not be correlated to known features within the survey area. The unidentified magnetic anomalies have amplitudes ranging from 10 to 1,401 gammas, and durations ranging between 16 to 170 feet. None of the magnetic anomalies are associated with sonar contacts. The majority of the unidentified magnetic anomalies recorded are interpreted as small, buried ferrous debris. None of the unidentified magnetic anomalies display characteristics that would indicate the presence of significant submerged archaeological resources. Therefore, no areas are recommended for archaeological avoidance.

All identified anomalies were mapped, and may be viewed in Appendix A. A detailed table of the interpreted anomalies can be found in Appendix D. A table listing of all the unidentified magnetic anomalies is provided on Chart 7. The unidentified magnetic anomalies are also depicted on the Archaeological Assessment Maps.

The ferrous debris likely producing these anomalies may still pose a hazard to certain operations, and therefore caution is still advised when operating in their vicinity. The locations of all the magnetic anomalies should be considered during the planned dredging-related activities and investigated or avoided as deemed appropriate by CPRA.

8.3 Side Scan Sonar Record

The side scan sonar data exhibited primarily low to moderate acoustic reflectivity, which indicates fine to medium textured lake floor sediments (soft clay). There are also areas of increased acoustic reflectivity indicating the lake floor also consists of “rough” or “grainy” textured sediments (silty or sandy muds). Numerous areas of higher reflectivity were noted and could be indicative of oyster or other shell beds across the survey area.

A total of 101 unidentified sonar contacts that do not correlate to known infrastructure were recorded within the survey area.

The largest contact, Sonar Contact No. 32, measures 47.79 × 14.24 feet with no measurable height. It is located along the eastern edge of Borrow Area 1 in Lake Ponchartrain. The next largest contacts are Sonar Contact Nos. 9, 28, and 78. Sonar Contact No. 9 measures 39.51 × 8.70 feet with no measurable height. It is located in the northwestern corner of Borrow Area 1. Sonar Contact No. 28 is a linear target measuring 60.74 × 2.68 feet with no measurable height. It is located in the central portion of Borrow Area 1. Sonar Contact No. 78 measures 34.68 × 6.80 feet with no measurable height. It is located along the northern edge of Borrow Area 2 in Lake St. Catherine. The remaining unidentified sonar contacts are relatively smaller, measuring less than 25 feet in length.

All the sonar contacts recorded in the study area are interpreted as likely associated with modern activity, hurricane debris or are geological in origin. None of the contacts display characteristics suggestive of significant archaeological resources.

The Sonar Mosaic is depicted on Chart Nos. 12, 13, 14, and 15. Sonar Contact Nos. 1-69 are shown in Chart No. 1. Sonar Contact Nos. 70-89 are shown on Chart No. 13. Sonar Contact Nos. 90-101 are shown on Chart No 14. The locations of all the sonar contacts should be considered during the planned dredging-related activities and investigated or avoided as deemed appropriate by CPRA.

Data reproductions of each unidentified sonar contact are presented in the Sonar Contact Report located in Appendix C. All unidentified sonar contacts are listed in the Sonar Contact Table in Appendix C and depicted on the Archaeological Assessment Maps.

9.0 CONCLUSIONS AND RECOMMENDATIONS

No archaeological sites are recorded within the proposed (PO-169) survey area; however six known archaeological sites are located nearby. These sites include Lake St. Catherine (16OR31), Hospital Foundations/Garcia Site (16OR34), Fort Pike (16OR57), West Rigolets Lighthouse (16OR60), RW-1 (16OR569), and Salt Bayou (16ST5). No properties within the proposed survey areas are currently listed on the NRHP. No standing structures listed in the Louisiana Master Site File are within the proposed project area.

Table 1. Archaeological Avoidance Areas

Site No.	Description	LOUISIANA NORTH, UTM ZONE 15/16 NAD 83				Recommended Avoidance Area (Feet)
		X (ft)	Y (ft)	Lat. (°)	Long. (°)	
16OR31	Prehistoric Site	238015	3337868	30.144074	-8971987	100
16OR34	Prehistoric/Historic Site	---	---	30.167132	-89.746255	100
16OR57	Prehistoric/Historic Fort Ruin	236450	3340635	30.166189	-89.73662	100
16OR60	Historic Lighthouse	3336791	822270	30.174631	-89.743112	100
16OR569	Prehistoric Site	233514	3336270	30.128604	-89.765955	NONE
16ST5	Prehistoric Site	812650	3343012	30.178429	-89.75340	NONE

Although there are no known archaeological sites within the project area, several archaeological sites are in the nearby vicinity. Fort Pike (16OR57) is listed on the National Register of Historic Places and it should be avoided. No activities related to the marsh creation project should be allowed within this zone. Likewise the Garcia Site (16OR34) is significant and is eligible for inclusion on the NRHP. Since intact cultural deposits may exist immediately offshore the site should have an avoidance / no work zone around the area. The boundaries of the other known archaeological sites should be avoided by any disturbance activity by 100 feet. The areas for recommended avoidance are listed in Table 1. If in the event these no work zones cannot be avoided; further archaeological investigations within these areas may be required to mitigate any potential negative impact on these two sites.

Several relict channels were identified and mapped within the survey area. No other specific landforms such as natural levees, point bars, or flood plains were identified that might indicate intact prehistoric sites.

The Archaeological Assessment Survey revealed 101 unidentified sonar contacts and 127 unidentified magnetic anomalies within the archaeological assessment area. The majority of the unidentified magnetic anomalies recorded are interpreted as relatively small, buried ferrous debris measuring less than 100 gammas in amplitude. All of the sonar contacts appear to be insignificant modern debris or natural in origin. No sonar contacts or magnetic anomalies are recommended for avoidance or investigation on the basis of historic archaeological potential. There is, however, aways the possibility that shipwreck remains or other submerged cultural resources could be undetected or unidentified within the survey area. If any possible shipwreck material is encountered during dredging activities or other lakefloor disturbing activity, Dr. Charles “Chip” McGimsey, the state archaeologist and director of the Louisiana Division of Archaeology and the Division of Historic Preservation State Historic Preservation Office (SHPO) should be contacted within 48 hours for an assessment of any antiquities. Material indicating the presence of a historic shipwreck may include, but is not limited to, wooden ship beams, hull planking, rigging, anchors, ceramics, or other possible cultural material. Material indicative of a prehistoric site includes pottery, projectile points, stone and bone tools, ornaments, shell beads, or other possible cultural material. In this event, no activities should be conducted near the area of discovery until advised by the appropriate Louisiana Division of Archaeology and SHPO personnel.

Every reasonable effort has been made during this study to identify and evaluate possible locations of prehistoric and historic archaeological sites within the project area; however, the possibility exists that evidence can be overlooked. An archaeological field investigation may be necessary to verify the conditions at known sites and determine if additional cultural resources are present within the survey area. Likewise, should any evidence of prehistoric or historic resources be discovered during earthmoving activities, all work in that portion of the project area should be stopped immediately. This evidence includes aboriginal or historic pottery, prehistoric stone tools, bone or shell tools, historic trash pits and historic building foundations. Should questionable material be uncovered during the excavation of the project area, the Louisiana Division of Archaeology shall be notified.

In the event that human skeletal remains or associated burial artifacts are encountered on the project parcel, all work in that area must stop immediately. The consultant archaeologist and appropriate agencies should be notified. The discovery must be reported to local law enforcement, which will in turn contact the medical examiner. The medical examiner will determine whether the State Archaeologist should be found. If human remains are found, the provisions set forth in Chapter 10-A, Louisiana Unmarked Human Burial Sites Preservation Act.

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APPENDIX G: SUPPORTING DOCUMENTS FROM CPRA

Coastal Protection and Restoration Authority of Louisiana

STATE OF LOUISIANA
OFFICE OF COASTAL PROTECTION AND RESTORATION

SCOPE OF SERVICES FOR TOPOGRAPHIC, BATHYMETRIC, AND MAGNETOMETER SURVEYS

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION & MARSH CREATION PROJECT (PO-169)

March 2017

1.0 INTRODUCTION

The New Orleans Landbridge Shoreline Stabilization & Marsh Creation Project (PO-169) is funded under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) in Priority Project List 24. The Coastal Protection and Restoration Authority (CPRA), in partnership with US Fish and Wildlife Service (USFWS), have been authorized to execute Phase I (Engineering and Design) of PO-169. The objective of this project is to create, maintain, and nourish existing deteriorating wetlands through hydraulic dredging as well as provide additional protection to the lake shorelines with earthen berms.

2.0 PROPOSED FEATURES

Approximately 169 acres of marsh will be created and an additional 109 acres nourished using borrow material dredged from areas within Lakes St. Catherine and Pontchartrain. Containment dikes will be constructed around four marsh creation areas to retain sediment during pumping. The lake shorelines will be enhanced with an earthen berm to add additional protection from wind induced wave fetch.

3.0 LOCATION

The project is located in Region 1, Pontchartrain Basin, Orleans Parish, flanking U.S. Highway 90 along the east shore of Lake Pontchartrain and areas surrounding Lake St. Catherine as shown in **Appendix A**. Approximate coordinates for the center of the project are 30° 8'35.08"N and 89°44'1.16"WW (NAD 83).

4.0 SCOPE OF WORK

A survey of the project marsh fill and nourishment areas and potential pipelines was performed in the summer 2016. This scope of services is required to conduct additional surveying in the marsh fill and nourishment areas as well as a conduct a survey of the three project borrow areas. The surveying firm, hereinafter referred to as "Contracting Party", shall perform all surveying necessary for the New Orleans Landbridge Shoreline Stabilization & Marsh Creation Project (PO-169), as outlined in the following subsections. All coordinates will be provided to the Contracting Party in AutoCAD format.

4.1 Permission and Access

The Contracting Party shall be required to contact the landowners to secure access permission prior to performing surveys in any part of the project area. Rights of entry to privately owned property must be respected by all CPRA contractors. Failure to adhere to the above-stated CPRA policy will be considered grounds for termination of the contract. A map of the assessed landowners is shown in **Appendix C**.

As stated above, all landowner regulations shall be observed by the Contracting Party. The Contracting Party will be responsible for coordinating with the landowners during hunting season. The land owner contact information is listed below:

Danny Breaux
U.S. Fish and Wildlife Services
61389 HWY 434
Lacombe, LA 70445
(985)882-2030

Bryan Burch & George E. Burch
80 Villere Place
Destrehan, LA 70047

Park Investments LTD
3421 N. Causeway Blvd.
Suite 802
Metairie, LA 70002

Chef Menteur Land Company, LTD
PMB 135, 17515 Spring Cypress
Suite C
Cypress, TX 77429

EIP Chef Menteur LLC
2002 Clipper Park RD
Suite # 201
Baltimore, MD 21211

4.2 Navigable Waterway Hazard Notification

The Contracting Party shall be responsible for notification and coordination with the U.S. Army Corps of Engineers (USACE) and any Levee Board agencies if the work to be performed under this scope of services is within the jurisdictional footprint that requires any such coordination. Additionally, if any work under this scope of services is expected to interfere with navigation, the Contracting Party shall be responsible for notification, coordination, and addressing with appropriate actions of all such potential navigational interferences with the USACE and the U.S. Coast Guard in addition to the issuance of a Public Notice to Local Mariners. CPRA shall be kept abreast of any relevant communications and courses of action and shall be provided a copy of all official written documentation.

4.3 Horizontal and Vertical Control

Secondary monument “CRMSPO-SM-25” is within approximately 2.5 miles of the project area, and shall be used for horizontal and vertical control. The Contractor shall investigate the condition of this monument prior to the work commencing. If this monument is damaged or deemed otherwise unusable, CPRA shall be notified immediately. The data sheet for the monument is shown in **Appendix B.** Coordinates are listed in Table 1 below:

MONUMENT ID	Y NAD83 LA S 1702, FT	X NAD83 LA S 1702, FT	ELEVATION NAVD88, (2006.81) FT
CRMSPO-SM-25	618,174.14	3,792,271.06	6.34

Table 1: LCZ Secondary Monument Location

The State Plane Coordinate System, Louisiana South Zone, the North American Horizontal Datum of 1983 (NAD83) (2011-Epoch 2010), and the North American Vertical Datum of 1988 (NAVD 88) (Geoid 12A) shall be used for identification, as currently published by the National Geodetic Survey (NGS). All surveys conducted for the project shall utilize the established benchmark elevations using Geoid12A to determine NAVD88 elevation. If electronic data collectors are used, they shall be programmed to use the Geoid12A model that coincides with the monuments used for the surveys.

4.4 Borrow Area and Dredge Pipeline Alignment Bathymetric Survey

Bathymetric surveys shall be performed within the borrow area and proposed dredge pipeline alignment. Transects B1-1 thru B1-22, B2-1 thru B2-32 and B3-1 thru B3-8 shall be spaced at 98 foot intervals. Transects shall extend 25 feet beyond the limits of the proposed borrow areas. Additionally the proposed dredge pipeline alignment, Transects D-1 thru D-4, shall be surveyed. These transects are shown in **Appendix E.**

The bathymetric survey shall record the position and mud line elevation at a minimum of 50 feet along each transect line. Boat-based echo soundings data shall be corrected to compensate for water-level fluctuations caused by surface waves and astronomical tides. The water surface elevation shall be recorded at a minimum of 3 times per day during this survey.

Additionally, the Contracting Party shall identify any protruding structures above mean water level, or otherwise noted during the course of the work performed, within the limits of the borrow areas such as—but not limited to—wellheads, warning signs, crab traps, and abandoned boats or any object that may prevent or hinder dredging operations.

4.5 Geophysical Survey and Cultural Resource Investigation

The Contracting Party shall perform a high resolution (3.5 kHz or greater) seismic survey using side scan sonar and sub-bottom profile. A chirp sub-bottom profiler should preferably be used for proper depth-penetration and enhances resolution. Seismic stratigraphy shall then be developed on the basis of the sub-bottom profiles obtained. The seismic survey transects shall be run simultaneously with the borrow area survey and dredge pipeline alignment transect lines specified in **Section 4.4** and shown in **Appendix E**.

The Contracting Party shall have a marine archeologist present for all surveying efforts. The marine archeologist must be a Registered Professional Archeologist (RPA) as per LR 20:410 (April 1994).

4.6 Magnetometer Surveys

The Contracting Party shall perform a magnetometer survey along all proposed transects specified in **Section 4.4**, to locate any pipelines or obstructions in the project area. Additionally shoreline transects M1 thru M4 shall be surveyed as shown in **Appendix E.**

For each magnetic finding greater than or equal to fifty (50) gammas, the Contracting Party shall run a closed loop path with the magnetometer. This path shall completely enclose the original finding location, while maintaining a distance of approximately 25 feet from that location.

4.7 Magnetic Anomaly Probing Investigation

The Contracting Party shall utilize the provided pipeline information shown in **Appendix D** in addition to any resources available to the Contracting Party to estimate the anticipated level of effort required to perform the magnetic anomaly probing investigation. The Contracting party shall attempt to probe any anomalies found within the limits shown in **Appendix E.** Using the magnetometer survey results the Contracting Party may request an adjustment to the estimated level of effort to perform this task if applicable. Any alteration to this cost or scope shall be submitted to and approved by CPRA before any work is performed.

While performing the magnetic anomaly probing investigation the Contracting Party shall determine the anomaly source (e.g., pipeline, well, etc.) of each finding. If the anomaly represents a pipeline, the Contracting Party shall document the location, water level, depth of cover, mudline elevation, and top of anomaly elevation.

4.8 Aerial Photograph Overlay

All surveys lines shall be overlaid onto 2012 or newer geo-rectified Digital Orthophoto Quarter Quadrangle (DOQQ) aerial photographs. The Contracting Party is responsible for obtaining any additional information needed to reference the surveys required by this scope to the aerial photograph.

4.9 LASARD

Louisiana Sand Resources Database (LASARD): CPRA maintains the Louisiana Sand Resources Database (LASARD) Program to help facilitate the identification and management of nearshore, offshore and riverine sediment resources. The LASARD database is also used to manage, archive, and maintain geological, geophysical, topographic, bathymetric, geotechnical and other related data pertaining to the exploration of sand/sediment in various environments.

Where applicable, the Contracting Party shall follow the LASARD Standard Operating Procedures for Geo-scientific Data Management for the survey investigation and the data collection efforts. This Standard Operating Procedure, corresponding attribute specifications, and GIS templates shall be provided to the Contractor by CPRA. For all questions pertaining to the LASARD program, please contact Syed Khalil at 225-342-1641 or syed.khalil@la.gov.

5.0 DELIVERABLES

5.1 Cultural Resources

5.1.1 A separate cultural resource report shall be prepared. The cultural resources report shall be developed to meet SHPO requirements (http://www.crt.state.la.us/c ultural-development/archaeology/section-106/report-standards/phase-i-surveys/index) for archaeological field surveys. Two copies of the preliminary report shall be submitted to CPRA for technical review and comment and distribution to overseeing agencies.

5.1.1.1 The report shall document all background information pertinent to the project area;
5.1.1.2 Any findings;
5.1.1.3 An exhibit showing the location of all findings.

5.1.2 The Contracting Party shall assist CPRA and provide technical support to address comments from overseeing agencies.

5.1.3 Once the report is finalized, two (2) bound hard copies of the final cultural resource report shall be submitted to CPRA. Each bound copy shall include one (1) digital copy of the final cultural resource report (Adobe PDF) on compact disk or flash drive.

Please send all preliminary and final deliverables to the following address:

Devyani Kar
Coastal Protection and Restoration Authority
P.O. Box 44027
Baton Rouge, LA 70804-4027
phone: (225)-342-6412
email: Devyani.Kar@la.gov

5.2 Surveys

5.2.1 Two sets of 11” x 17” preliminary drawings shall be delivered to CPRA, for technical review and comment before the remaining deliverables are finalized.

5.2.2 Once the deliverables are finalized, two (2) bound hard copies of the final survey report, data, and drawings shall be submitted to CPRA. Each bound copy shall include one (1) digital copy of the final survey report (Adobe PDF), data (Microsoft Excel), and drawings (AutoCAD 2012 or later edition) on compact disk or flash drive.

5.2.2.1 The survey report shall document the survey methodology employed in the field, survey control, calibrations, field equipment, field records, and all other pertinent information.

5.2.2.2 All survey data shall be provided in tables which include separate columns for the associated transect as shown in **Appendix E**, point number, northing coordinate, easting coordinate, elevation, and description. Magnetometer survey data shall also include the amplitude, duration, and description for the probable cause of all magnetic anomalies.

5.2.2.3 The survey drawings shall conform to CPRA drafting standards, utilize half size (11”x17”) borders, and include the following information:

5.2.2.3.1 Project name and number shall appear on all sheets;
5.2.2.3.2 All elevations shall reference NAVD88;
5.2.2.3.3 All horizontal coordinates shall reference the Louisiana State Plane Coordinate System South Zone, NAD83;
5.2.2.3.4 The location of all secondary survey monuments and temporary benchmarks shall appear in plan view;
5.2.2.3.5 Transects shall be shown in plan and profile and include mean high and mean low water levels;
5.2.2.3.6 Spot elevations shall be shown or appropriately represented in plan view;
5.2.2.3.7 Topography shall be represented in plan view using +/-1.0 foot contours;
5.2.2.3.8 Bathymetry shall be represented in plan view using +/- 2.0 foot contours;
5.2.2.3.9 Magnetometer survey track lines and readings shall be shown in plan view;
5.2.2.3.10 Infrastructure and/or magnetic anomalies shall shown in plan and profile.

6.0 LASARD

6.1 LASARD shall be submitted to CPRA electronically or on compact disc in the data format following protocols defined in the LASARD SOP for acceptance before the survey report is finalized. **The deliverables and corresponding data reporting format outlined in this section is in addition to the deliverables and data reporting format outlined in Section 5.0 Engineering Deliverables.** Additional Attribute Specifications and LASARD GIS Templates will be provided to the Contracting Party by CPRA.

LASARD SOP:

Khalil, S. M., Haywood, E. and Forrest, B., 2015. Standard Operating Procedures for Geo-scientific Data Management, Louisiana Sand Resources Database (LASARD), Coastal Protection and Restoration Authority of Louisiana (CPRA), 30pp. http://cims.coastal.la.gov/DocLibrary/FileDownload.aspx?Root=0&id=14838

6.2 Two digital copies of the final LASARD deliverables on compact discs shall be submitted to CPRA after acceptance of the draft LASARD deliverables. Each compact disc shall include one (1) digital copy of the final LASARD deliverables as defined by the Attribute Specifications and LASARD GIS Templates provided to the Contracting Party by CPRA.

7.0 SCHEDULE

The estimated schedule necessary to perform all of the work under this scope of services is 45 calendar days. The Contracting Party shall submit any recommended modifications to the duration of the schedule in their proposal.

8.0 CERTIFICATION

All survey and LASARD deliverables shall be certified by a professional land surveyor licensed by the State of Louisiana. The cultural resource report shall be certified by a RPA.

Appendix A

Project Fact Sheet and Project Map

February 2015
Cost figures as of: November 2015

New Orleans Landbridge Shoreline Stabilization & Marsh Creation (PO-169)

Project Status

Approved Date: 2015 **Project Area:** 271 acres
Approved Funds: $1.94 M **Total Est. Cost:** $17.5 M
Net Benefit After 20 Years: 167 acres
Status: Engineering and Design
Project Type: Marsh Creation
PPL #: 24

Location

The project is located in Region 1, Pontchartrain Basin, Orleans Parish, flanking U.S. Highway 90 along the east shore of Lake Pontchartrain and areas surrounding Lake St. Catherine.

Problems

Since 1956, approximately 110 acres of marsh has been lost along the east shore of Lake Pontchartrain between Hospital Road and the Greens Ditch. One of the greatest influences of marsh loss in the area can be attributed to tropical storm impacts. Wetland losses were accelerated by winds and storm surge caused by Hurricane Katrina, which converted approximately 70 acres of interior marsh to open water. Stabilizing the shoreline and protecting the remaining marsh would protect natural coastal resources dependent on this important estuarine lake, communities that thrive on those resources, the Fort Pike State Historical Site, and infrastructure including U.S. Highway 90. USGS land change analysis determined a loss rate of -0.35% per year for the 1984 -2011 period of analysis. Subsidence in this unit is relatively low and is estimated at 0-1foot/century (Coast 2050).

Lake Pontchartrain supports a large number of wintering waterfowl. Various gulls, terns, herons, egrets, and rails can be found using habitats associated with Lake Pontchartrain, which has been designated as an Important Bird Area by the American Bird Conservancy. Restoring these marshes will protect the Orleans Landbridge and will help to protect fish and wildlife trust resources dependent on these marsh habitats, particularly at-risk species and species of conservation concern such as the black rail, reddish egret, brown pelican, mottled duck, seaside sparrow, king rail, and the Louisiana eyed silkmoth.

Restoration Strategy

Borrow material will be dredged from areas within Lakes St. Catherine and Pontchartrain to create 169 acres and nourish 102 acres of brackish marsh. Containment dikes will be constructed around four marsh creation areas to retain sediment during pumping. The lake shorelines will be enhanced with an earthen berm to add additional protection from wind induced wave fetch. Containment dikes that are not functioning as shoreline enhancement will be degraded and/or gapped. Vegetative plantings are proposed including five rows along the crown and two rows along the front slope of the shoreline protection berm, as well as within the marsh platform area.

As a result of marsh scoured by Hurricane Katrina, a remnant shoreline east of U.S. Highway 90 offers little protection from wave energy coming from Lake St. Catherine and Rigolets Pass.

Progress to Date

This project was approved for Phase I Engineering and Design in January 2015

This project is on Priority Project List (PPL) 24.

For more project information, please contact:

Federal Sponsor:
U.S. Fish and Wildlife Service
Lafayette, LA
(337) 291-3100

Local Sponsor:
Coastal Protection and Restoration Authority
Baton Rouge, LA
(225) 342-4736

New Orleans Landbridge Stabilization & Marsh Creation (PO-169)

Earthen Berm *

Marsh Creation *

Project Boundary

*denotes proposed features

0.2 0 0.2 0.4 Kilometers

0.2 0 0.2 0.4 Miles

Map Produced by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Coastal Restoration Assessment Branch
Baton Rouge, La.

Background Imagery:
2012 Digitial Orthophoto Quarter Quadrangle

Map Date: March 05, 2015
Map ID: USGS-NWRC 2015-11-0011
Data accurate as of: February 12, 2015

Appendix B

Secondary Monument Data Sheet

VICINITY MAP Not to Scale

Reproduced from NAIP Louisiana 2013 1m Aerial Imagery

Station Name: "CRMSPO SM 25"

Location: From the intersection of US Hwy 90 and LA Hwy 433 in St. Tammany Parish, proceed 1.0 mile northeast along US Hwy 90 to the station on the right.

Monument Description: CPRA MON

Stamping: CRMSPO SM 25

Installation Date: 2007 **Date of Survey:** 13-May-14

Monument Established By: Hydro Consultants

NAD83 (2011) Epoch 2010.00 Geodetic Position

Lat: 30°11'23.72430"N

Long: 89°42'51.99357"W

NAD83 (2011) Epoch 2010.00 Datum LSZ (1702) Ft

N= 618,174.14

E= 3,792,271.06

Adjusted NAVD88 Height

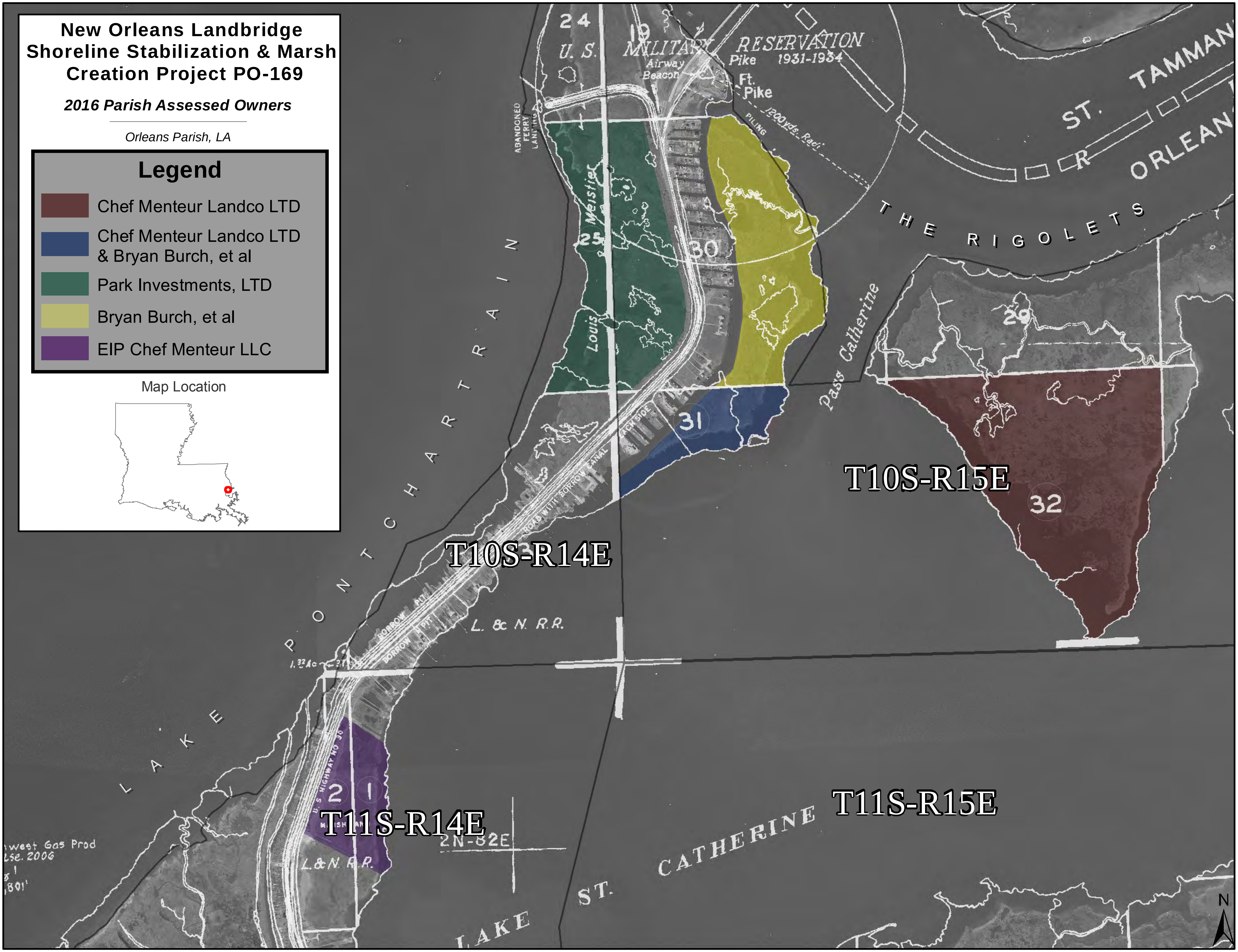
Elevation = 6.34 feet (1.933 mtrs)

Ellipsoid Height (2011) = -24.646 mtrs.

Geoid12A Height = -26.579 mtrs.

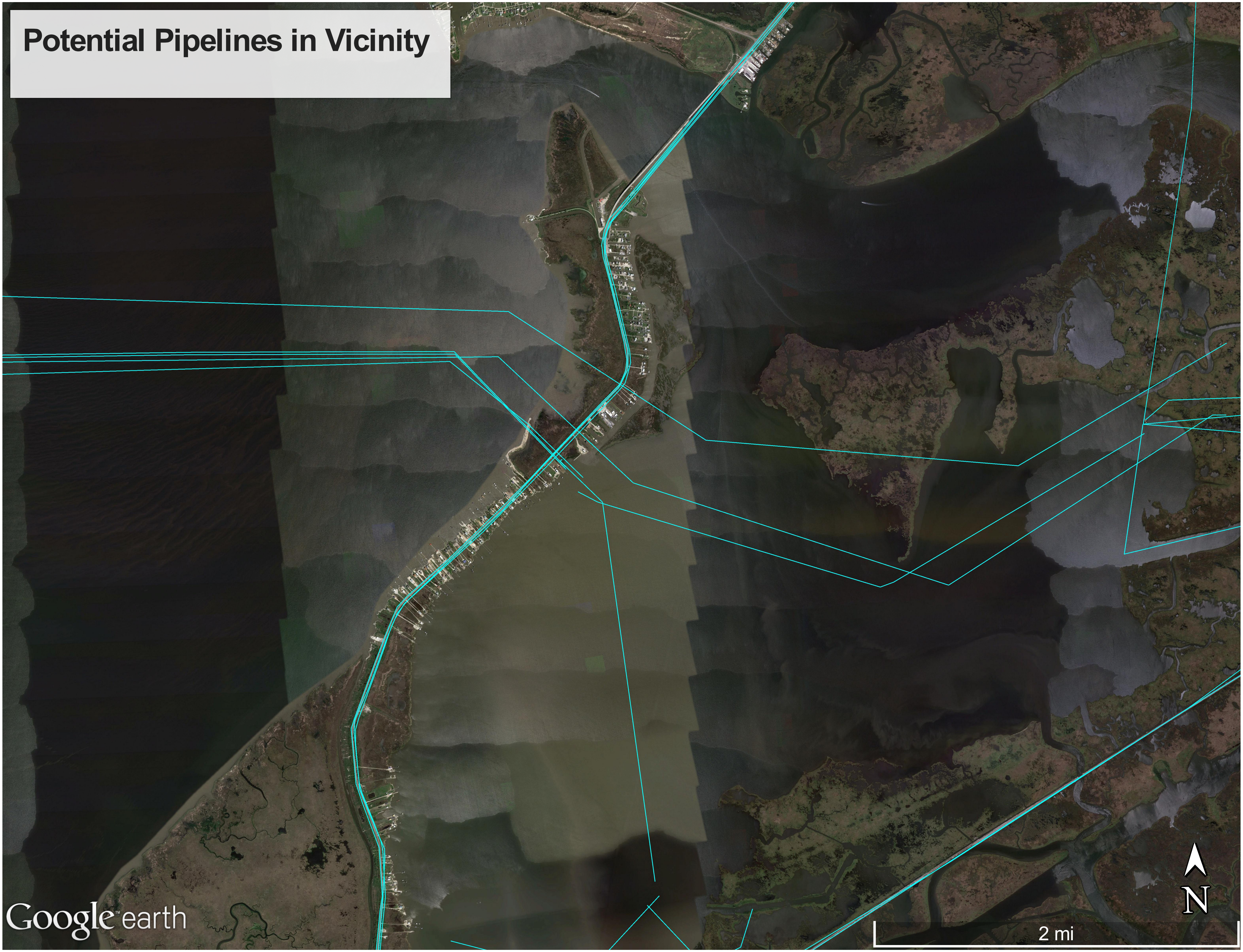
Appendix C

Assessed Landowner Map


New Orleans Landbridge Shoreline Stabilization & Marsh Creation Project PO-169
2016 Parish Assessed Owners
Orleans Parish, LA
Legend
Chef Menteur Landco LTD
Chef Menteur Landco LTD & Bryan Burch, et al
Park Investments, LTD
Bryan Burch, et al
EIP Chef Menteur LLC
Map Location
T10S-R14E
T10S-R15E
T11S-R14E
T11S-R15E
LAKE PONTCHARTRAIN
THE RIGOLETS
LAKE ST. CATHERINE
Pass Catherine
U. S. MILITARY RESERVATION 1931-1934
ST. TAMMANY
ORLEANS
Airway Beacon
Ft. Pike
L. & N. R.R.
24
19
25
30
29
31
32
2
1
N

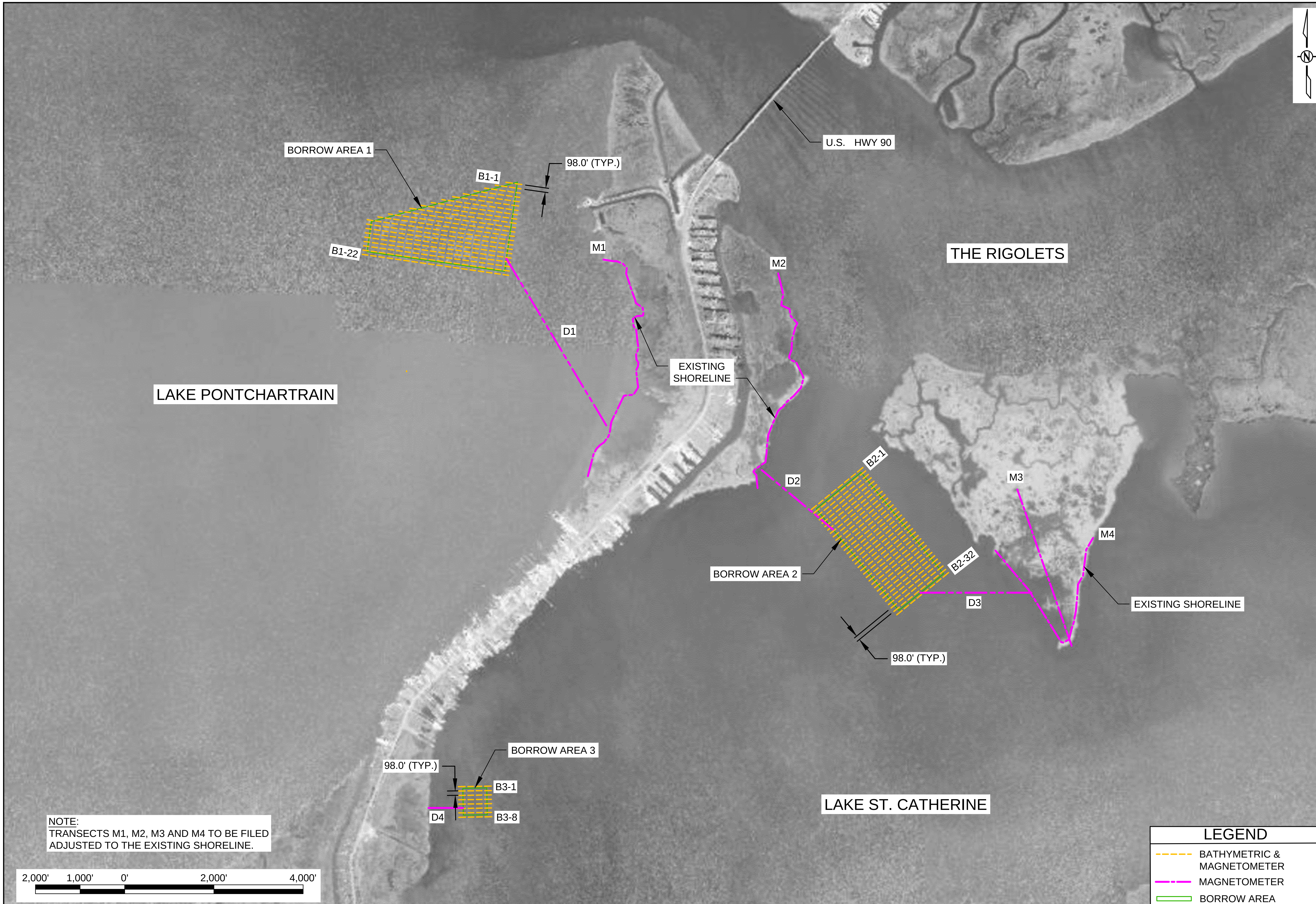
Appendix D
Potential Pipeline Map

Potential Pipelines in Vicinity



Appendix E

Survey Layout



REV.	DATE	DESCRIPTION	BY

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

MAGNETOMETER LAYOUT

DESIGNED BY: GREG MATTSON, E.I.

APPROVED BY: SHANNON HAYNES, P.E.

NEW ORLEANS LANDBRIDGE SHORELINE STABILIZATION & MARSH CREATION

STATE PROJECT NUMBER: PO-169

DRAWN BY: SHANE FAUST

DATE: March 2017

SHEET 1 OF 1