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SURVEY METHODOLOGY REPORT

**Topographic, Bathymetric,
Magnetometer Surveys, and
Marsh Elevation Survey**

Project:

**East Delacroix Marsh
Creation and Terracing
Project (BS-0037)**

St. Bernard Parish, Louisiana

Prepared for:

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Coastal Protection and
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SURVEY METHODOLOGY REPORT

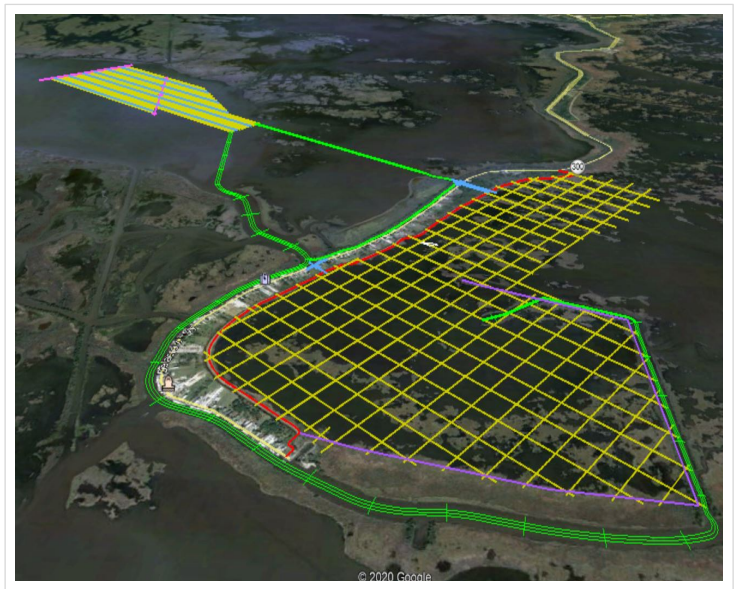
Prepared for the
Coastal Protection and Restoration Authority
in Support of
East Delacroix Marsh Creation and Terracing Project (BS-0037)
St. Bernard Parish, Louisiana

August 2020

Introduction

The East Delacroix Marsh Creation and Terracing Project (BS-0037) is funded by the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) under Priority Project List 28 in partnership with the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS). The Coastal Protection and Restoration Authority (CPRA) is serving as the local sponsor and has been authorized to execute Phase 1 (Engineering and Design) of BS-0037. APPENDIX A contains the CWPPRA PPL 28 Project Fact Sheet as well as other graphical information representing BS-0037.

The overall goal of the project is to create wetlands and terraces on the east and southeast sides of the community of Delacroix. Delacroix has had an increased exposure to flooding since Hurricanes Katrina and Rita, which caused wind erosion and saltwater intrusion causing the majority of wetland loss in the project area.



Topographic, bathymetric and magnetometer surveys are required to facilitate the project design and accurately estimate the quantities required for the fill area, the quantities available to be dredged in the borrow sites, construction access, and to determine the average marsh elevation within the project site..

Proposed Features

The project goal is to create and nourish approximately 406 acres of marsh and construct approximately 12,950 linear feet of terraces (approximately 8 acres) utilizing a layout to help protect the community of Delacroix.

Sediment would be hydraulically dredged from Lake Lery and placed in two confined disposal areas creating 353 acres of marsh and nourishing 53 acres of existing marsh. Two creation cells allow a channel for the existing pump station. Approximately 12,950 ft of earthen terraces would be constructed. The side and crown of the terraces would be planted with appropriate bare root plants in one row per side and crown.

Two additional areas of deteriorating marsh south and east of the proposed project will be investigated should the project be considered for further evaluation. Therefore, data acquisition for Engineering & Design will include an additional 114 acres to allow flexibility for analysis of these alternate features

Location

The project site is located in Region 2, Breton Basin, Saint Bernard Parish, Louisiana, and east of and adjacent to the community of Delacroix, LA. The approximate coordinates of the center of the project areas are: 29° 46' 1.110"N and 89° 46' 59.380"W.

Proposed Survey Work Plan

On November 21, 2019, Fenstermaker submitted a Survey Cost Estimate to the CPRA Project Manager that included the following Survey Work Plan designated as Attachment A of the submittal.

Attachment A - Proposed Survey Work Plan

Prior to mobilization, the Fenstermaker Team will participate in a review meeting with CPRA Project Manager and staff associated with the BS-0037 project to review tasks to be performed, Cost Estimate, Proposed Survey Work Plan, and Proposed Schedule. Any modifications to the Plan, Schedule, and Cost Estimate during the review meeting will be resubmitted to CPRA for approval. Upon receiving the Notice to Proceed, Fenstermaker will commence the following tasks.

- 1.0 Installation of Staff Gages and Marsh Elevation Survey** – Prior to commencement of surveys, Notice will be sent to all landowners where data collection efforts will be taking place. CPRA Biologist, Bryan Gossman, will be contacted ten days prior to scheduling the assisting of the survey crew during the Marsh Elevation Survey. Once determined, a survey crew will be mobilized to Delacroix to commence the installation of two Staff Gages, one located in Bayou Terre-Aux-Bouefs and one within the Marsh Creation Area. The gages will be calibrated using a Realtime Kinematic (RTK) rover receiving GPS corrections from the project benchmark. The following day, the survey crew will meet with a biologist from CPRA to direct the survey crew on the locations for performing the Marsh Elevation Survey within the Marsh Creation Area. The survey crew will consist of a 2-man survey crew and an airboat operator.
- 2.0 Topographic Survey at Marsh Creation/Terrace Area, Spoil Bank, Pump Station Outfall** – The 2-man survey crew will perform topographic surveys from an airboat utilizing RTK along Transects T-01 through T-41 at 500-foot grid intervals. Survey limits on the west and south sides will be to the marsh edge along the Tidal Levee to the west and south, and to the proposed containment dike to the east and south. While surveying Transect T-04, the survey crew will obtain pipe invert elevations at the pump station outfall. Marsh elevations and water bottoms will be recorded using an RTK rover pole with a 6" flatfoot attached to the bottom at a maximum distance of 25 feet along each transect, and where the change in elevation is greater than 0.5 feet, such as the marsh to water transition, spoil banks, etc. Topographic surveys will also be performed along the proposed containment dike (SB-1) and along the oilfield canal (SB-2).
- 3.0 Magnetometer Survey of Marsh Creation Area** - A 2-man survey crew will perform the magnetometer surveys from an airboat utilizing RTK along Transects T-01 through T-41 at 500-foot grid intervals. Survey limits on the west and south will be to the marsh edge along the Tidal Levee to the west and south, and the proposed containment dike to the east and south. Magnetic anomalies will be determined using a Cesium 882 marine magnetometer with positions recorded using RTK and integrated into HyPack.
- 4.0 Topographic Survey of Tidal Levee Profile and Cross-Sections** – The Tidal Levee Profile (TL-1) will be surveyed using a 3-man crew, RTK, and a utility terrain vehicle (UTV). Cross-Sections will be performed across TL-1 centerline from the marsh edge on the flood side to the bottom of the drainage canal on the protected side of the levee. A 14-foot skiff will be used to survey water bottoms within the drainage canal.
- 5.0 Topographic Survey of North and South Sediment Pipeline Crossings** – Prior to performing the topographic surveys along La Highway 300, LA One Call will be notified to mark all existing utilities within the pipeline crossings' footprint. Topographic surveys will be performed by the survey crew along Transects CL-1 through CL-10 and RC1 through RC-3. Surveys will be performed at 10-foot intervals or changes in elevation over 0.5 feet. Water levels will be recorded at the beginning and end of each day. All marked underground utilities and those visible above ground will be located. Note that Transects CL-5, CL-6, RC-1, and RC-2 will require clearing prior to the survey being performed due to thick scrub brush. Costs associated with clearing and grubbing are not included in this proposal. Bathymetric Surveys within the bayou will be performed when surveying the Proposed Access Routes below.
- 6.0 Topographic, Bathymetric and Magnetometer Surveys along Proposed Access Routes** – Proposed Access Routes identified at AR-1, AR-2, and AR-3 will be surveyed by a 3-man survey crew from a 28-foot shallow-draft marine vessel.

Equipment will include RTK for positioning and a Cesium-882 marine magnetometer integrated into HyPack to record anomalies and positions. A total of three lines will be surveyed within each Proposed Access Route, one along the centerline and 50 offset either side of the centerline. Single-beam bathymetry will be performed on Cross-sections along the access routes at 1000-foot intervals up to the 3-foot water depth. A 3-man survey crew utilizing a smaller marine vessel will perform topographic surveys from the 5-foot water depth to the bankline on either side of the access route to facilitate with each cross-section being completely captured.

- 7.0 Bathymetry, Magnetometer, Side-Scan Sonar, Sub-bottom Profile Surveys within the Proposed Borrow Area and Cultural Resource Investigation** – A 3-man survey crew from Fenstermaker will perform the Single-beam Bathymetric Surveys, Magnetometer Survey, and Side-Scan Sonar Surveys within the Proposed Borrow Area Transects BA-01 through BA-27. TerraSond, a subcontractor to Fenstermaker, will be assisting the survey crew with Sub-bottom Profile Surveys and Cultural Resource Investigations. All information will be collected and recorded onboard using HyPack. During the data collection, a Marine Archaeologist will be onboard reviewing the survey data, real-time, and documenting any information that will require further investigations and will compare with information obtained from SHPO. Pipelines located within or adjacent to the proposed Borrow Area will be crossed during the survey to determine their locations.
- 8.0 Pipeline Probing and Marking** – Upon completion of all surveys, magnetic anomalies will be mapped in AutoCAD and will include the anomaly number, durations, gammas, and geodetic positions. This information will be provided to the survey crew to facilitate in the location of existing pipelines to be marked and probed for depth of cover, and depth of water, if submerged. Flagged cane poles will be used to mark the existing pipelines at 200-foot intervals. Where two or more pipelines exist within the same area, cane poles will be marked with a different color scheme.
- 9.0 Deliverables:** Fenstermaker anticipates that deliverables will be completed 4 weeks upon completion of all Field Surveys. All deliverables will be provided as specified in the Scope of Work.

On January 14, 2020, Fenstermaker received a Notice to Proceed to commence surveys in support East Delacroix Marsh Creation Project. After completing the desktop research for permitted pipelines and Landowner Notification, Fenstermaker scheduled a survey crew to commence the data collection process in the field.

Static GPS Survey at Reference Control Monuments

Prior to the mobilization, all transects and coordinates for the reference monuments were setup in the Trimble Business Center (TBC) project file, and then uploaded to the surveyor's positioning device datalogger. On Monday, February 17, 2020, the survey crew mobilized and traveled from the Lafayette office to the project site to perform the required survey tasks.



Monument BS32-SM-01

Upon arriving at the project site, the survey crew navigated to an existing monument located south of the project site. After locating monument BS23-SM-01, the GPS base receiver was installed and initialized to begin logging static GPS. A GPS rover unit was then initialized to receive base corrections using Real-time Kinematic (RTK) for sub-centimeter positioning. The survey crew performed a quality control check at a nearby monument USACE 15055S DEL to validate correct positioning of the GPS system. The survey crew then navigated along pre-plotted transect lines and profile of the Tidal Levee to obtain natural ground and water bottom elevations.

Static GPS was collected on benchmarks for each day that survey crews performed on topographic, magnetometer, and bathymetric surveys. Additional temporary benchmarks (TBM's) were installed at various locations for efficiency. Initially, the TBM's were located using RTK to determine the positions and facilitated as a quality control check point. Afterward, the TBM's were used as reference base points and static GPS was collected and post-processed. A total of three TBM's were set throughout the project footprint. Static GPS surveys in support of the topographic, bathymetric, and magnetometer surveys were completed on June 19, 2020.

Upon completing the static GPS surveys each day, GPS raw data files were downloaded, then uploaded to Fenstermaker's ftp site for post-processing and adjustment.

Static GPS survey activities performed are in conformance with CPRA survey standards as specified in "A Contractor's Guide to the Standards of Practice Required by Louisiana Department of Natural Resources, Coastal Restoration Division for Contractor's Performing GPS Surveys and Establishing GPS Derived Orthometric Heights Within the Louisiana Coastal Zone Primary GPS Network" dated January 2019.

Static GPS Downloading, Processing & Adjustments

Upon completing the static GPS survey, GPS log sheets were checked and compared to the data files on the receivers. The raw GPS data was then downloaded into the project file created in Trimble Business Center (TBC) software. The IGS Precise Ephemeris was also downloaded from the NOAA/NGS Internet website for each day that GPS data was collected. All CORS¹ stations which were located nearest to or within the project area were also downloaded from the National Geodetic Survey (NGS) website and processed with the static GPS data. CORS Stations that were incorporated into the GPS network included "MARY", "SBCH", "BVHS", "GRIS", "LMCN", "HOUM", and "DSTR".

After post-processing the GPS Network, a report was then generated in the TBC program and reviewed to determine satellite cycle slips to avoid baseline float solutions in the processed data. If a baseline float solution existed, the elevation mask was raised 5 degrees and the baseline was re-processed to eliminate satellite noise that may have existed close to the horizon.

Upon completing the processing phase, the data was loaded into the adjustment program and adjusted. All necessary adjustments were performed using the TBC Network Adjustment software.

The initial adjustment for the GPS network was minimally constrained to the published adjusted NAD83 (2011) Epoch 2010.00 and the published ellipsoid height at the antenna reference point (ARP) for CORS Station "MARY". A re-adjustment was performed to identify potential outliers to be disabled from the adjustment. A scale factor was determined from the Statistics Summary and applied to the network and re-adjusted until the Chi-Square Test passed with a 95% confidence level.



Monument BS32-SM-01

The final fully constrained adjustment was performed by holding to the published values for the CORS Stations antenna reference points (ARP) at "MARY", "LMCN", and "BVHS". Orthometric heights (elevations) were calculated using the Geoid12B model. The adjusted ellipsoid heights for the remainder of the CORS Stations were compared with their published NAD83 (2011) values as a quality control check. All GPS files were submitted to the NGS Online Positioning User Service (OPUS) Program² for an independent solution and comparisons made with the final adjustment results.

¹ The National Geodetic Survey (NGS) coordinates two networks of continuously operating reference stations (CORS): the National CORS network and the Cooperative CORS network. Each CORS site provides Global Positioning System (GPS) carrier phase and code range measurements in support of 3-dimensional positioning activities throughout the United States and its territories. Surveyors, GIS/LIS professionals, engineers, scientists, and others can apply CORS data to position points at which GPS data have been collected. The CORS system enables positioning accuracies that approach a few centimeters relative to the National Spatial Reference System, both horizontally and vertically.

² The National Geodetic Survey operates the On-line Positioning User Service (OPUS) as a means to provide GPS users easier access to the National Spatial Reference System (NSRS). OPUS allows users to submit their GPS data files to NGS, where the data will be processed to determine a position using NGS computers and software. Each data file that is submitted will be processed with respect to 3 CORS sites.

Figure 1: Tabulation of Final GPS Adjustment Results at Reference Control

**East Delacroix Marsh Creation and Terracing Project
Static GPS Adjustment Results**

NAD83 (2011) Louisiana South Zone (1702) - NAVD88 (2009.55) Geoid12B

Name	Latitude	Longitude	Ellipsoid Hgt	Northing	Easting	Elevation	Description
BS32-SM-01	29d45'29.24786"	-89d47'02.06588"	-80.713	460,856.71	3,772,450.51	2.59	MON
TBM-1	29d46'05.05619"	-89d47'18.58732"	-79.163	464,453.88	3,770,945.70	4.25	CP
TBM-2	29d45'46.11876"	-89d47'21.20011"	-84.574	462,538.00	3,770,741.23	-1.22	CP
TBM-3	29d46'20.92590"	-89d47'09.36423"	-79.365	466,067.77	3,771,736.81	4.10	CP

RTK Survey of Topographic Features

Upon mobilization and travel to the project on Monday, February 17, 2020, the RTK base unit was initialized at reference monument BS32-SM-01. A quality control shot was measured at USACE 15055S DEL with the roving unit to verify that the system was operational and delivering corrected positions. Topographic surveys commenced along the Tidal Levee centerline profile and cross-sections. Invert shots were also captured at the discharge pipes located at the Pump Station. The Tidal Levee survey was completed on February 21st.

On March 4th, surveys commenced along transects within the proposed marsh creation site and proposed spoil bank. Once the GPS base was setup and initialized, the survey crew navigated by airboat to capture topographic features along pre-plotted transects within the Marsh Creation Area that included existing natural ground shots, spoil banks, shorelines, and water bottoms using a 2-meter pole with the RTK rover unit attached. Topographic surveys within marsh creation site were completed on March 18th.



Flap Gates on Flood Side of Pump Station

Topographic Surveys of North and South Sediment Pipeline Crossings were performed on March 5th to document existing ground elevations along the crossings and existing roadway of Delacroix Highway. After contacting LA One Call April 18th, the survey crew returned to the crossing locations to tie-in existing utilities which included power poles, fire hydrant, sewer hookups, water meters, and water valves.

RTK was used to perform topographic cross-sections within waterway channels, canals, bayous, and access routes using an extended pole to capture water bottoms. This data was used to validate bathymetric survey data collected with the single-beam echo sounder.

Topographic features were collected along transects as specified in the Section above titled "Proposed Survey Work Plan" using RTK. A flatfoot was attached to the bottom of the rover rod to prevent penetration into the water bottom. In addition, water surface shots were acquired daily to facilitate in determining a relationship to any nearby gauges.

Static GPS was collected at the base station concurrent with the RTK topographic survey for each day of

data collection. All topographic surveys conducted to capture existing features, including magnetometer surveys and pipeline probing, were completed on June 19, 2020.

Marsh Elevation Survey

On April 23, 2020, a survey crew met with an environmental specialist from Fenstermaker to direct the survey crew on the locations for performing the Marsh Elevation Survey within the Marsh Creation Area.

A total of three (3) sites were selected by the Fenstermaker environmental specialist. RTK surveys to determine marsh elevations were taken at twenty (20) locations within each selected site, separated by 20 to 40 feet. Elevations were recorded on datalogger at the top of the marsh root mass and top of the mudline adjacent to the root mass. The results were tabulated in a spreadsheet to determine average elevations for root mass and mudline for each site surveyed.

GPS and RTK Survey Equipment

The equipment used for the static GPS survey consisted of a Trimble® Navigation's dual-frequency GNSS GPS receiver with integrated GPS antenna, also called base stations. A two-meter fixed height tripod was used to eliminate human error that could be introduced by miss-measurement of the GPS antenna heights. The GPS data was downloaded, processed and adjusted using Trimble Business Center (TBC) Software, Version 5.20. The Geoid12B model was used to determine the geoid separation and applied to the ellipsoid heights to determine elevation as specified in the scope.

To perform the RTK survey, a rover consisting of a Trimble® Navigation's dual-frequency GNSS GPS receivers with an integrated GPS antenna and a radio link was employed to transmit corrections to the rover from the base setup. A fixed height rod with attached flatfoot was used at the rover. The data was collected and stored on a Trimble® TSC3 datalogger and downloaded using TBC, Version 5.20.

Bathymetric Surveys within the Access Routes, Bayous and Borrow Area

Prior to commencing the single-beam bathymetric surveys, coordinates and line files for the proposed transect lines within the Bayou Terre Bouefs, Bayou Lery, Access Routes, and Proposed Borrow Area in Lake Lery were provided to the survey crew.

On March 4, 2020, the bathymetric survey crew commenced single-beam surveys in Bayou Terre Bouefs south and west of the marsh creation and terracing site. With the installation of a GPS base station at monument BS32-SM-01 and performing a QC check at the TBM, the survey crew mounted the RTK rover system on the marine vessel and integrated the positioning system with the onboard single-beam echo-sounder using HyPack. This allowed the survey crew to navigate along pre-plotted transect lines to obtain corrected water bottom elevations. Positioning was accomplished using Real-time kinematic (RTK) with the base station delivering GPS corrections from the reference marks located within the project site.

Prior to commencing bathymetric surveys within the Proposed Borrow Area, Fenstermaker survey technicians met with TerraSond technicians to install and calibrate GPS with single-beam Echotrac, side-scan, and sub-bottom profile devices through HyPack on the Fenstermaker marine vessel at the Lafayette office. Once all equipment was successfully communicating through the onboard computer software, Fenstermaker and TerraSond survey crews mobilized to the project site in Delacroix.

On Tuesday, June 2, 2020, bathymetric surveys commenced within the Proposed Borrow Area which included a single-beam fathometer, side-sonar, sub-bottom profiler, and marine magnetometer. Data acquisition for the single-beam survey was accomplished using HYPACK® digital data acquisition and navigation software. An Echotrac CV100 fathometer was used to determine the water depths along the pre-plotted transect lines. The fathometer was integrated with RTK to accurately position in three dimensions.

Water surface shots were taken in the morning and afternoon by the bathymetric survey crew using RTK to obtain the water surface elevations relative to NAVD88 using Geoid12B. Sound velocities were performed to determine the speed of sound in the water column using an Odom DigiBar Sound Velocity Sensor. Once the sound of velocity was determined and applied to the software, bar checks were performed at the beginning of the day to measure the actual depths relative to the recorded depths on the echo sounder with the average sound velocity, draft and index applied. Once the sound of velocity was determined and applied to the software, a steel plate was lowered beneath the transducer head at 5-foot intervals to validate correct depth readings delivered from the echosounder.

Once all checks were completed and the system initialized, the bathymetric crew navigated along the pre-plotted transects within the borrow area to collect water depths, water bottom features with the side-scan system, sub-bottom features with the profiler, and anomalies with the magnetometer. A Marine Archaeologist from TerraSond was also aboard the marine vessel during data collection to interpret the information that was collected in real-time. Bathymetric Surveys within the Borrow Area continued each day, as described above, and was completed on June 4th.

Back at the office, the raw data was imported into HYPACK® program, which includes the raw bathymetry data and corrected tide file. A graphic image was generated so that the digital sounder data could be swath edited to remove outliers. The final adjusted and edited file was exported in ascii format and vertically adjusted using NAVD88 using Geoid12B.

Prior to performing Bathymetric surveys within the Borrow Area and Access Routes, a staff gauge was installed at the boat launch located in Bayou Terre Boeufs to facilitate with recording water levels during the surveys. The gauge datum was calibrated to NAVD88, Geoid12B, using RTK.



Staff Gauge Installed at Boat Launch in Bayou Terre Aux Boeufs

Bathymetric Survey Equipment

Horizontal positioning was logged real-time using a Trimble R8 GNSS GPS Receiver integrated with RTK for GPS corrections resulting in a 5cm horizontal accuracy or better. Pitch and roll was recorded with the CDL MiniTilt Motion Sensor to correct for motion changes. Odom Echotrac CV100 was also used to determine water depths along all transect lines. Bathymetry data was corrected for velocity and adjusted to NAVD88 using Geoid12B.

Sub-bottom Profiler and Side-Scan Sonar equipment that was owned and operated by TerraSond is described in a separate report included with these deliverables.

Magnetometer Hazard Surveys within the Marsh Creation and Terracing Area

Prior to performing the magnetometer surveys, a search was made using the National Pipeline Mapping System (NPMS) database and RexTag within Fenstermaker's Map Analyst GIS Mapping System (See Attachment A). The database revealed that one pipeline existed within the Proposed Marsh Creation and Terracing Area. Additional pipelines were shown to exist within and adjacent to the Proposed Borrow Area.



Abandoned Pipeline Located in Marsh Creation Area

Commencing on March 6, 2020, the magnetometer surveys were performed from an airboat along the 500-foot interval gridded transects to locate potential hazards and existing pipelines within the Proposed Marsh Creation and Terracing Area. The topographic survey crew located existing anomalies using a magnetometer towed behind the airboat to record positions. Magnetometer surveys were completed on March 19th. Anomalies determined from the processed magnetometer survey indicated that two potential pipelines existed within the marsh creation site.

On March 24th, survey crews returned to the field to investigate the apparent pipeline locations by probing the pipeline alignment at approximately 400-foot intervals. Once the pipeline was located, depth of cover, water depth, elevation, and position was recorded on the RTK datalogger and the location was marked with a flagged cane pole. A total of two pipelines running east/west were located within the proposed Marsh Creation Area. Due to the corrosion and deterioration of the northern pipeline, it was apparent that it was abandoned.

Instruments utilized for the surveys included a Trimble® R7 GNSS RTK system providing centimeter accuracy positioning and a Geometrics® 882 Cesium Marine Magnetometer.

The magnetometer on the airboat was operated in a towed configuration with the tow point at the stern of the vessel. The magnetometer dataset was collected through HYPACK® at a sampling rate of 10 Hz and a very high sensitivity of less than 0.1 gammas. Chesapeake Technology, Inc.'s SonarWiz.SBP software was used to interpret the magnetometer dataset.

For the Proposed Borrow Area, unidentified anomalies were located from the marine vessel using a Geometrics 882 Marine Magnetometer. Single-beam bathymetry surveys were performed in conjunction with the magnetometer survey to locate water bottoms along the planned track lines within the Proposed Borrow Area. Contacts, or mag hits, were presumed to represent articles of ferrous debris which are either buried below the mudline or too small to be acoustically detected and probably associated with debris, such as crab traps. A table of the recorded magnetic anomalies, identified and unidentified, is presented in a table. The table listing includes Anomaly Number, Coordinates, Duration, Frequency, Amplitude, Ground Elevation, Depth of Cover (if probed), and Water Depth.

A nomogram (See Figure 2) provides a visual reference of the relationship between a ferrous object and magnetic deflection generated by the object. The amplitude and signature width of a magnetic deflection are dependent on a variety of factors that include object size and configuration, ferrous content, and distance from the sensor (Breiner, 1973). Since all the variables involved in anomaly classification are not readily available, the nomogram provides only a rough estimate for anomalies and source size. The positions of the unidentified anomalies were recorded using the onboard Differential GPS system. Water surface shots were taken occasionally by the crew using RTK to obtain the water surface elevations relative to NAVD88 using Geoid12B.

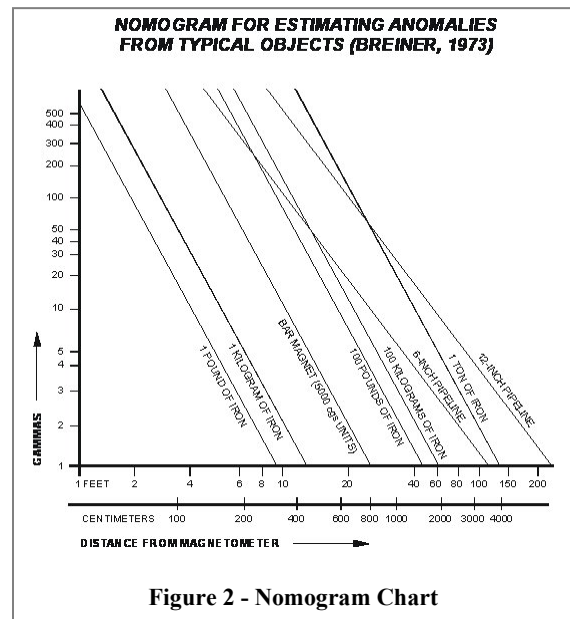


Figure 2 - Nomogram Chart

Back at the office, all raw data was imported into SonarWiz, which includes the raw magnetometer data and Magnetometer tow point position on the vessel. The magnetometer data is then laid back using the recorded laid-back values. A hydrographic survey specialist analyzed each file picking all magnetometer anomalies. The specialist then exported a file with all anomaly positions and amplitudes to be mapped.

Significant anomalies that were located and identified on this survey are associated with existing pipelines and ferrous debris, all of which are located within the project footprint. The remainder of these anomalies are determined to be consistent with targets usually associated with minor debris such as crab traps, steel cans and buckets, anchors, etc. Upon further investigations of the anomalies, crab traps seemed to be the most common debris source.

Conclusion

While reasonable efforts are made to locate all pipelines and magnetic anomalies, the equipment used and the characteristics of pipelines themselves make it impossible to guarantee total success. Accordingly, it is incumbent upon the owners, operators and/or contractors conducting operations, to do so with extreme caution, and recognize that hazards, in addition to those detected and reported by Fenstermaker, may exist within the areas of operation, regardless of Fenstermaker's most diligent efforts.

The presence of debris can have an adverse impact on the success of construction activities. The knowledge of the presence of magnetic anomalies will be factored in the alternatives analysis state of engineering and design for this project.

Louisiana (Louisiana One Call™ www.laonecall.com) maintains an information center and link between those who dig (excavators) and those who own and operate underground facilities (operators). It is advisable, and in most States, it is the law for the contractor to contact the center for assistance in locating and marking underground utilities.

FINAL NOTE

Please be advised that the data, which was collected during the survey of this project, represents an epoch, a snapshot at the time that the survey was performed. Due to the effects of crustal motion, subsidence, upheaval, drought and other conditions which influence the physical position and stability of surface monuments, topographic features, and other structures within the Louisiana Coastal Zone, it is recommended that GPS monuments used for this project be re-observed and reprocessed on future surveys using the same reference control, if possible, for the purpose of updating the three dimensional position of the reference monuments.

The GPS/RTK Survey protocols performed in support of this project were in accordance with the Coastal Protection and Restoration Authority of Louisiana requirements as described in "A Contractor's Guide to the Standards of Practice Required by Louisiana Department of Natural Resources, Coastal Restoration Division for Contractor's Performing GPS Surveys and Establishing GPS Derived Orthometric Heights Within the Louisiana Coastal Zone Primary GPS Network" dated January 2019. All Static GPS were adjusted using Trimble Business Center software to determine the final positions for all reference control monuments.



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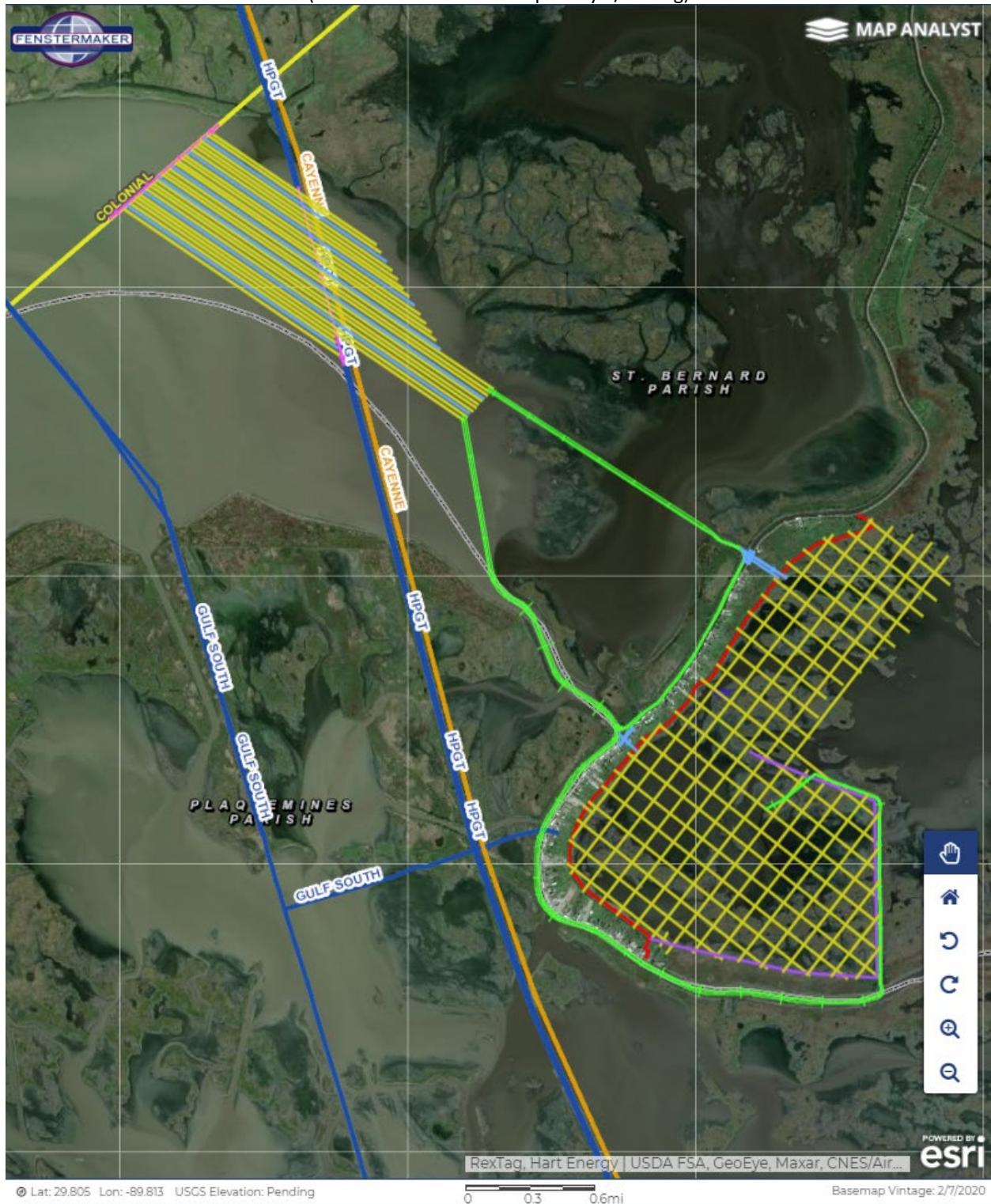
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ATTACHMENT A – PIPELINE DATABASE RESEARCH

(Source: Fenstermaker Map Analyst/RexTag)



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