

# **SURVEY SERVICES METHODOLOGY REPORT**

Prepared for

**Louisiana Department of Natural Resources, CED  
& Sellers & Associates, Inc.**

in Support of

## **FRESHWATER BAYOU SHORELINE PROTECTION PROJECT (TV-11b) & FRESHWATER BAYOU MARSH CREATION PROJECT (ME-25SF)**

**Monumentation, Static GPS Survey,  
Bathymetric, Topographic & Hazards Survey  
DNR RSIQ No. 2514-08-01**

May 2009

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### **Project Description**

The Freshwater Bayou Marsh Creation Project (ME-25SF) is a 2007 State Surplus Funds project. The proposed project will create approximately 100 acres of marsh adjacent to Freshwater Bayou in Vermilion Parish near the Acadiana Canal. This area has undergone marsh reduction due to erosion, salt water intrusion, and, most recently, due to Hurricane Rita. If restored, this area would help the integrity of the Mermentau Basin to function as a freshwater marsh habitat. Approximately 100 acres of marsh will be created by hydraulically dredging material from Freshwater Bayou Canal and pumping it to a designated fill area within the adjacent interior marsh ponds. The fill area will be formed by constructing earthen dikes around the boundaries of the pond. This scope of services involves the completion of topographic, bathymetric, and magnetometer surveys of the proposed fill and borrow sites.

The goal of the Freshwater Bayou Shoreline Protection Project (TV-11b) is to stop erosion along the bank of Freshwater Bayou Canal, and to protect the interior wetlands from increased tidal exchange and wake-induced erosion. This objective will be achieved by constructing a rock dike along the shoreline of Freshwater Bayou Canal in a manner that will effectively reduce wave energies and thereby preventing further shoreline erosion. The proposed project area consists of four sections totaling approximately 35,600 linear feet of shoreline along the east and west banks of the canal.

### **Kick-off Meeting**

The project kick off meeting was held at 10:00 A.M. on October 29, 2008 in the LaSalle Building in Baton Rouge, Louisiana to discuss project details and tasks to be performed. Among those present were representatives from Louisiana Department of Natural Resources, Coastal Restoration Division and Coastal Engineering Division, Sellers & Associates, Inc., Shaw Coastal, Inc., Louis Capozzoli & Associates, Inc., and John Chance Land Surveys, Inc. After the introductions, each team member provided the group with their role on the project along with questions and answers. Discussions included land rights, topographic and bathymetric surveys, and geotechnical investigations. The meeting adjourned approximately 3pm.

The Notice to Proceed from LDNR was issued to Sellers & Associates, Inc. and a verbal given to John Chance Land Surveys, Inc. on Wednesday, October 29th to commence the required survey services.

### **Geotechnical Boring Locations Survey**

On Friday, November 7<sup>th</sup>, JCLS received the "go ahead" from Sellers & Associates at the request of Capozzoli & Associates to stakeout a total of sixteen boring locations. Upon securing Right-of-Entry with Vermilion Corporation and providing Certificate of Insurance, a JCLS crew traveled to the project site on Tuesday, November 11<sup>th</sup> to commence the survey. The crew set out in an airboat and navigated to each of sixteen preplanned locations as provided to JCLS using StarFIX DGPS sub-meter positioning system. All locations

were marked with a cane pole and tagged with the boring number and proposed boring depth. A magnetometer survey was performed at each boring site to clear it of any potential hazards such as pipelines.

### **Pre-Planning the Survey**

Monday, November 17, 2008 commenced with topographic and hydrographic survey crews mobilizing all necessary equipment for the project from the Lafayette office of John Chance Land Surveys, Inc. (JCLS). Coordinates for the pre-plotted transect lines, reference monuments, proposed boring locations and existing pipelines from the GIS database were all setup in a Trimble Geomatics Office (TGO) project file, and then uploaded to the GPS positioning devices for the topographic and hydrographic survey crews. The Hydro and Topographic survey crews traveled to the project site to commence the survey on the following day.

### **Static GPS and RTK Survey of Topographic Features at Transects**

Upon arriving at the project site, the topographic crew located an existing GPS monument to be used as the project reference control. The survey crews commenced work on Tuesday, November 18<sup>th</sup> at the northern reach of Freshwater Bayou near Intracoastal City. To begin, the RTK base unit was installed at a monument stamped “57 V 96” at the intersection of LA Highway 333 and Oyster Lane in Intracoastal City. It should be noted that this monument was recently adjusted, validated and published by NGS (Louisiana Height Modernization Program 2006.81)<sup>1</sup>. Once all necessary equipment was installed, the base unit was initialized with its coordinates and elevation. A quality control shot was measured near the base monument with the roving unit to verify that the system was operational and delivering corrected positions. The base unit was then activated to begin static data collection while simultaneously transmitting DGPS corrections to the RTK rover. The crew then navigated to pre-plotted transects locations to survey the topographic features which consisted of measuring the 3-D position of each point and storing it on the collector.

RTK Surveys to collect the topographic features on transects for the Shoreline Protection Project (TV-11b) and the Marsh Creation Project (ME-25SF) continued, off and on, through December 15<sup>th</sup>, 2008. Surveys of the Marsh Creation Project (ME-25SF) took place on November 21<sup>st</sup>.

During each daily session, a raw data file was created on the RTK base receiver. The monument name, Julian date, session number and antenna height was keyed into each receiver. The survey technician completed a GPS logsheet, while in the field, to document information about the survey as well as other pertinent monument details. Information on the log sheets included the monument stamping, actual survey start and stop times, the GPS antenna height measurements, weather conditions, satellite information as well as any problems that may be encountered during the survey. The log sheets also serve as a quality control check by the data processor when the data is downloaded from the GPS receiver, confirming that the monument names and antenna heights were keyed in correctly.



As an additional quality control check, static GPS was collected at the base station concurrent with the RTK survey so that post processing could be performed utilizing the NGS Online Positioning User Service (OPUS) Program as an independent check. Upon completion of the RTK survey, the data logger was downloaded and the information checked.

<sup>1</sup> The current Height Modernization project for South Louisiana is a partnership between FEMA, the Louisiana Spatial Reference Center (LSRC) at Louisiana State University (LSU), and NOAA'S National Geodetic Survey (NGS). The project includes a number of different components such as the re-observing of the control marks updated last Fall (99–2004.65 marks), the update or establishment of additional control points in all 27 parishes (approx. 225 marks), a small amount of leveling, GPS observations, gravity observations, additional LSU / NGS established CORS, a pilot multi-base RTK network in the SE portion of the state, and the establishment of several new NOAA tide stations. There are a total of 330 control marks (not counting CORS) that were observed and now have updated coordinate values and ellipsoid heights.

### **Average Marsh Elevations - Vegetative Benchmark Samples**

On Wednesday, December 10th, the survey crews begin the task of taking vegetative samples. Upon setting up the RTK base station at GPS monument "COE 08-003C-2" and initializing the rover unit, the survey crew then set out by boat to "tie-in" vegetative benchmarks at the direction of Brad Segura, Ecological Scientist with JCLS. At the direction of Mr. Segura, the survey was performed by recording the horizontal position and elevation of each vegetative species on the Trimble TSC2 datalogger. The base of the fixed height pole with GPS antenna was held at the precise location of the sample shot, among the living stems or on the soil containing the living roots, then storing that fixed position. Among the species sampled were *Spartina patens*, *Distichlis spicata*, *Typha sp.*, *Baccharis sp.*, and *Schoenoplectus americanus*. A total of 30 benchmark samples were recorded at each of three sample sites and stored on the RTK datalogger.

Upon completion of the vegetative benchmark sampling survey, the TSC2 data logger was downloaded and the information then checked. The GPS positions for the RTK survey were based on the adjusted NAD83 horizontal and NAVD88-2006.81 vertical position for the monuments occupied.

### **GPS Data Downloading, Processing & Adjustments**

Upon completing the static GPS survey at the end of each day, GPS log sheets and GPS raw data files were sent back the Lafayette office via e-mail, then checked into the project file. All GPS raw data files were converted to RINEX format then submitted to the NGS Online Positioning User Service (OPUS) Program<sup>2</sup> for an independent solution. Comparisons were made between the OPUS results at each GPS base station control point and the final adjustment results. The final tabulated OPUS adjustment results can be located in this report.

### **GPS and RTK Survey Equipment**

The equipment used for the static GPS survey consisted of Trimble® Navigation's 5700 and R7-GNSS GPS receivers along with external Zephyr Geodetic and Zephyr Model 2 GPS antennas with ground plates. Two meter fixed height tripods were used to eliminate human error that could be introduced by mis-measurement of the GPS antenna heights. The GPS data was downloaded, processed and adjusted using Trimble® Geomatics Office Software. Geoid03-2004.61 model was used to determine the geoid separation and applied to the ellipsoid heights for elevation determination.

The Real-time Kinematic (RTK) survey consists of two Trimble® Navigation's dual-frequency 5700 and R7 GNSS GPS receivers (base and rover) along with external Zephyr Geodetic and Zephyr Geodetic Model 2 antennas and a Pacific Crest PDL radios to transmit corrections to the rover from the base setup. A two-meter fixed height tripod was used at the base and a two meter fixed height rod at the rover, except for shots taken in deeper water which required an extended pole. Geoid03-2004.61 was used to determine the geoid separation and applied to the ellipsoid heights for elevation determination. The data was collected and stored on a Trimble® TSC2 datalogger, version 12.22 and downloaded using Trimble® Geomatics Office (TGO), version 1.64.

The Land survey crew also utilized a Geometrics 858 cesium magnetometer to clear core sample sites of potential hazards.

### **Bathymetric Survey of Water Bottoms & Hazard Surveys**

Bathymetry survey to locate water bottoms along the transect lines was performed by keying-in the transect end point coordinates to generate the pre-plot transect lines as well as existing pipeline locations from previous surveys into the onboard navigation program. Bathymetric Survey was performed on November 18<sup>th</sup> and was completed on November 19<sup>th</sup>.

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<sup>2</sup> 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.

## Unidentified Magnetic Anomalies

Existing buried pipelines were located from the marine vessel as well using a SeaSpy Mini Marine magnetometer. The anomalies range in amplitude from 1 to 1131 gammas and durations from 9 to 376 feet. The contacts are 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 prior construction or passing ship traffic. A table of the recorded magnetic anomalies, identified and unidentified, is listed in the base map report. The unidentified anomalies are also numerically listed in a table located on maps included in this report.



A nomogram (see Figure 1) 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 of 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 anomalies were recorded using the onboard DGPS system. Water surface shots were taken occasionally using RTK to obtain the elevation relative to NAVD88. These water shots were time tagged to correlate with real-time tide gage readings for determination of a correction factor in the post processing stage.

Prior to processing the bathymetric survey transect data, actual tide gage readings were downloaded via the Internet for the real-time NOAA gage "876-6072" located at the Freshwater Bayou Lock. Staff gages were also installed at the various locations along Freshwater Bayou and calibrated to NAVD88 vertical datum. The staff gages were read periodically and recorded in the field book along with time read. A correction factor to convert the data to from MLLW to NAVD88 was determined by matching staff gage readings to the time coded NOAA gage readings. A mean correction factor was calculated and applied to the MLLW values, and then the NAVD88 values were output to a text file. This file was used to tide correct the raw bathymetry data in JCLS's StarFix.nav program.

Back at the office, all the raw data was imported into Starfix.nav program, which includes the raw bathymetry data, the corrected tide file, and the CRP/transducer offset file. The tide files were applied to the sounder data to correct the water depths. A graphic file was generated so that the digital sounder data could be "despiked" to remove outliers. The final adjusted and edited file will be exported in ascii format, then imported into MicroStation to generate digital drawings.

## Bathymetric Survey Equipment

Sub-meter horizontal positioning was logged real-time using a Trimble AG132 GPS Receiver integrated with OmniStar for DGPS corrections. The 24-foot marine vessel was equipped with a Hydrotrac portable echo sounder with heave input from a TSS DMS-05 Motion Sensor for vertical motion corrections. Using JCLS proprietary software called StarFix.nav, all data was digitally logged real-time, while Hydrotrac simultaneous charted the water depths on a paper scroll. Existing buried pipelines were located using a SeaSpy Mini Marine magnetometer.

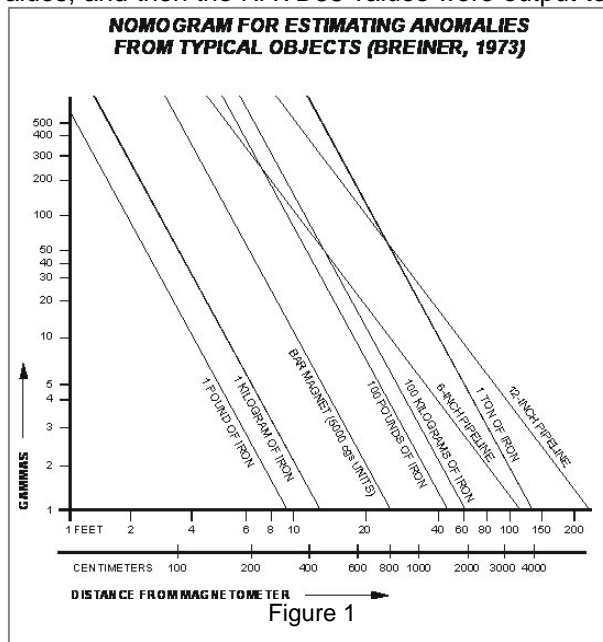


Figure 1

## FINAL NOTE

Please be advised that the static GPS network survey, which was created to determine the three-dimensional positions of deep rod monument to a specific vertical datum within this project, and all other surveys related to and referenced from this monument, only represent an epoch, a snapshot at the time that the survey was performed. Due to the effects of crustal motion, subsidence, upheaval, drought, hurricanes and other conditions which influence the physical position and stability of surface monuments and other structures within the Louisiana Coastal Zone, it is recommended that GPS monuments within this network be periodically re-surveyed for the purpose of verifying the three dimensional position of the reference monuments included in this survey. Therefore, by duplicating the same methods and procedures used in this GPS survey, positional changes such as local subsidence can be monitored. Also be aware that differences in the adjusted results may be noticeable with the advent of new CORS Stations being used in the adjustment and revisions to the Geoid model becoming available.

The GPS Survey protocols performed in support of this project was in accordance with the Louisiana Department of Natural Resources (LDNR) requirements described in *"A Contractor's Guide to Minimum Standards 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 May 2007.

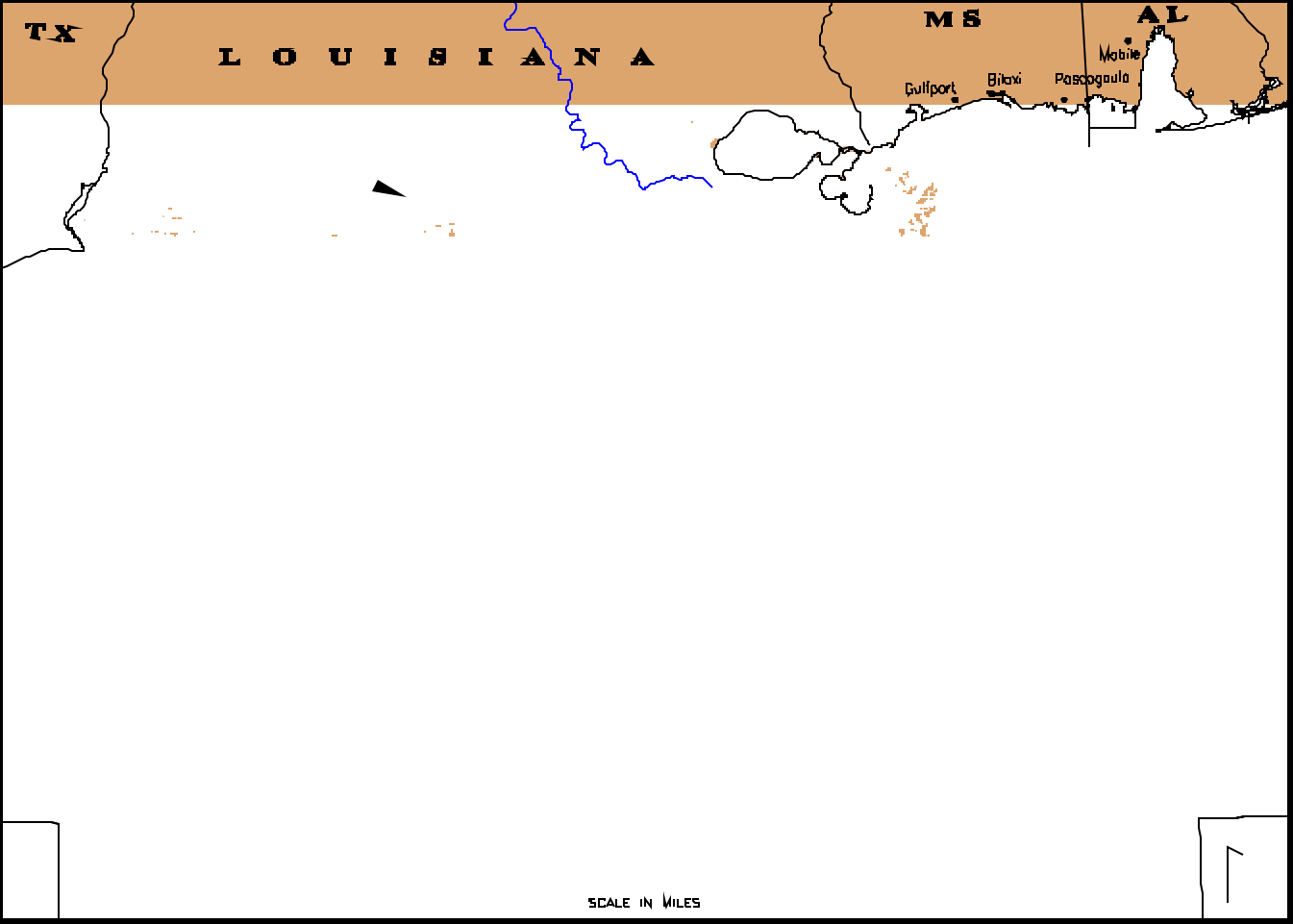
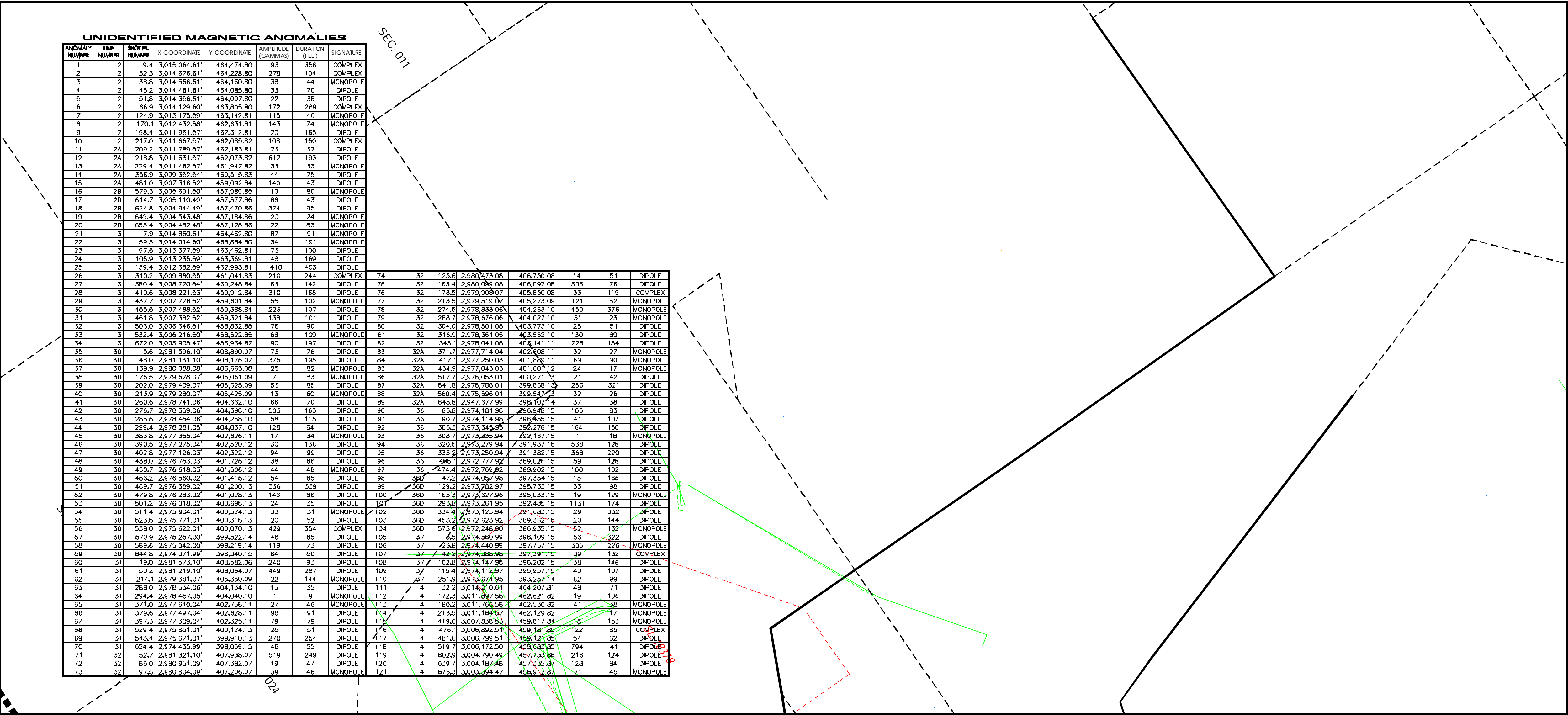
**JOHN CHANCE LAND SURVEYS, INC.**



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LEGEND:

▲ 81 DENOTES MAGNETIC ANOMOLY

— POSSIBLE PIPELINES