SURVEY METHODOLOGY REPORT

November 21, 2019

STATE OF LOUISIANA
COASTAL PROTECTION AND RESTORATION AUTHORITY (CPRA)

RACCOON ISLAND SHORELINE PROTECTION /
MARSH CREATION (TE-48) PROJECT

TERREBONNE PARISH, LOUISIANA

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Section 1: General Project Description

Project Overview

The Raccoon Island Shoreline Protection/Marsh Creation (TE-48) project is located within the Louisiana Department of Wildlife and Fisheries (LDWF) administered Isle Dernieres Barrier Islands Refuge, which is positioned southwest of Cocodrie in Terrebonne Parish, Louisiana. (See Figure 1). The TE-48 project area occupies 502 acres and includes the entire subaerial extent of Raccoon Island. Figure 1 also depicts the location of highway and boat access in the vicinity of this project.

Vicinity Map

(Figure 1)
The purpose of the project is to provide topographic and bathymetric orthometric height surveys of the littoral, beach, washover, marsh, and bay environments for the Raccoon Island Shoreline Protection/Marsh Creation (TE-48) project. Specifically, previously established cross-sectional breakwater field (T1-T10; T2A), spit (S1-S7), and marsh (M1-M10) transects were reoccupied and surveyed using Real Time Kinematic (RTK) methods and the Louisiana Coastal Zone (LCZ) GPS Network. Elevation data collected as part of this scope will be used to evaluate coastal structures and detect shoreface and island migration trends. This survey is the first post-construction survey for the marsh creation area.
## Project Timeline

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<th>Project #</th>
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Section 2: Project Planning

Reference Systems and Project Control

Horizontal Datum (Epoch): NAD 83 Louisiana South Zone (LA-1702) US feet.
Vertical Datum (Epoch): NAVD 88 GEOID 12A US feet.

All elevation related surveys performed were adjusted and calibrated to the specified monument that is part of the CPRA – Louisiana Coastal Zone (LCZ) GPS Network. The monument is labeled as TE48-SM-01 (COON) (See Appendix A for Data Sheet) using industry accepted RTK GPS equipment and methodologies as outlined in this document.

Vertical Conversion Factor

The NAVD88 Geoid 12A elevation for the TE48-SM-01 (COON) monument is 1.488 feet, and the NAVD88 Geoid 99 elevation for the TE48-SM-01 (COON) monument is 2.132 feet. The conversion factor from Geoid 12A to Geoid 99 for the TE48-SM-01 (COON) monument is 0.644 feet.

Preparation of Survey Transects

All survey transects described in this “Report” were converted using AutoCAD Civil 3D© and HYPACK© to a digital format that is compatible with the surveyor(s) task-specific data collection equipment for the use of navigation and preparation. See Figures 2-5 for locations and positions of survey transects.
Figure 2
<table>
<thead>
<tr>
<th></th>
<th>BeginX_LSZ NAD 83 (ft)</th>
<th>BeginY_LSZ NAD 83 (ft)</th>
<th>EndX_LSZ NAD 83 (ft)</th>
<th>EndY_LSZ NAD 83 (ft)</th>
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(Figure 3)
(Figure 4)
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</table>

(Figure 5)
Section 3: Topographic/Bathymetric Transect Survey

Equipment

Equipment utilized during survey:

- One (1) Trimble Survey Grade RTK System including but not limited to 5700, R7, R8-2, R8-3 and R-10 Receivers (Includes Base and Rover and accessories) and/or C4G Net. Calibrated to the project control.
- One (1) Teledyne Odom MK III Fathometer with 200kHz Transducer
- One (1) YSI Cast Away CTD Probe (Velocimeter)
- One (1) Desktop Computer with Hypack© Navigation Software.
- One (1) 8’ pole with 6” diameter plate on bottom
- One (1) Closed Cabin Survey Vessel.

The manufacturer’s specification sheets for each item can be found in Appendix B at the end of this document.

Methodology

Survey Control

Before the survey commenced the location and verification of the project monument TE48-SM-01 was completed. Once the project monument was located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver was set on the monument and static surveys were performed to check the validity of the elevation for the monument being used.

Data Acquisition for Breakwater Field & Spit Transects

Surveys were performed along the cross-sectional transects in the project area using the real-time kinematic (RTK) method. The project area consists of eleven (11) breakwater field, seven (7) spit, and ten (10) marsh transects. Ten of the breakwater field transects (T1-T10) are separated by 750 feet intervals (Figure 2), and transect T2A was established using the coordinates provided in Figure 3. The spit transects (S1-S7) are separated at 1,500 feet intervals (Figure 2). Nine of the marsh transects (M1-M9) are separated by 500 feet intervals, while M10 is separated from M9 by approximately 170 feet. The average length of the marsh transects is 566 feet (Figure 4). The points along the cross sections were taken no more than twenty-five (25) feet apart unless there was an abrupt change in elevation along the transect. Abrupt changes in elevation are considered to be greater than or equal to 0.5 feet. Survey points were also acquired where there was a change in project features. Breakwater field and spit transect lines were surveyed beginning at the -9 foot NAVD88 contour on the gulf side of the island for all transects except T2A. The beginning points provided in Figure 3 served as guidelines for transects T3-T10. The breakwater field transects T1, T2, and T2A terminated at the end points listed in Figure 3, while transects T3-T10 merged with the topographic survey at the land/water interface. The spit transects (S1-S7) ended at the -4 foot NAVD88 contour of the bay. The end points provided in Figure 3 for the spit transects were also only guidelines. Therefore, the spit transects extend from the -9 foot NAVD88 contour of the Gulf of Mexico to the -4 foot NAVD88 contour of Caillou Bay. Approximately 25-50 feet of overlap between topographic and bathymetric data was obtained. Although several of the breakwater field and spit transects intersect coastal structures, no elevations were established on the rock structure.
**Data Acquisition for Marsh Transects**

Surveys were performed along the cross-sectional transects in the project area using the real-time kinematic (RTK) method. The marsh transects consist of ten (10) transects (M1-M10) (Figure 4). The marsh transects begin and end at the coordinates listed in Figure 5. All topographic points were collected at the significant breaks in the slope (i.e., containment dikes; shoreline edges; and at all changes in elevation of 0.5 feet or greater, etc.) so that the resulting data accurately depicts the island morphology. Survey points were no more than 25 feet apart.

**Data Processing**

All topographic data was processed using Trimble Business Center (TBC) software version 4.00.

All bathymetric data was processed using Hypack© software version 2018.

All processed data was represented visually using an AutoCAD Civil 3D software version specified in the specifications for analysis.

**Equipment Calibration for Bathymetric Surveys**

Once the survey control is verified, the RTK system and the echo sounder transducer will be hard mounted to the survey vessel using specially designed mounts welded to the hull on the bow or stern of the vessel.

The RTK antenna and transducer positional offsets are then measured and entered into the Hypack© Navigation Software for the tide and draft corrections to be applied.

A “Bar Check” of this system is then performed. A velocity probe is lowered into the water within the project site down to the sea floor to obtain velocities throughout the water column and determine an average. The average water velocity is then entered into the echo sounder and set. Then, a minimum 1’x1’ plate is lowered below the transducer at 5’ increments down to the deepest survey depth to obtain the correct draft and index of the transducer and to calibrate the water velocities at each 5’ increment. The “Bar Check” is recorded electronically in the Odom E-chart Software.
Section 4: Deliverables

Preliminary Submittals
In addition to the deliverables requested in this scope of services, an electronic set of 11” x 17” preliminary drawings shall be delivered to the Project Engineer, for technical review and comment.

Final Submittals
Two electronic copies of final deliverables that include half size (11” x 17”) plan view drawings showing all survey lines and hazard survey results as well as cross section plots. Final deliverables should include:

• Drawing files in AutoCAD 2010 (.dwg) or later format Copy of the field notebook records
• Excel file of survey transects, including point number, northing, easting, elevation, and description
• Field Notebook Records
• Methodology Report
• GPS Survey Report

Drawing Files
The drawing files shall conform to CPRA AutoCAD Standards. The plan views shall be plotted over aerial photograph. Also, a table will be included with benchmark names and horizontal and vertical datums on which the survey is based. The state project name and number shall be shown on all drawings.

Certification
All deliverables shall be certified by a professional land surveyor licensed by the State of Louisiana.

The deliverables described above shall be submitted to the following CPRA representative:
Glen Curole
1440 Tiger Drive, Suite B
Thibodeaux, LA 70301
glen.curole@la.gov
(985) 447-0991
**APPENDIX A SURVEY CONTROL**

**VICINITY MAP**

Scale: 1" = 2,000'  
Reproduced from 2013 GOOGLE Earth Aerial Image

**Station Name:** "TE48-SM-01"

**Monument Location:** Located in Terrebonne Parish, Louisiana, on the north side of Raccoon Island in Isles Dernieres, and is approximately 24 miles southwesterly of Cocodrie, Louisiana.

**Monument Description:** NGS style floating sleeve monument; datum point set on 9/16" stainless steel sectional rods driven 88 feet to refusal, set in sand filled 6" PVC pipe with access cover set flush with the ground.

*Stamping: "COON"*

**Installation Date:** January 2005

**Monument Established By:** John Chance Land Surveys, Inc.

**For:** La. Dept. of Natural Resources, CRD

**Date of Survey Update:** March 10-12, 2015

**Monument Updated By:** T. Baker Smith, LLC

**Adjusted NAD 83 (2011-Epoch 2010) Geodetic Position**

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<tbody>
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**Adjusted NAD 83 Datum LSZ (1702) Feet**

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</tr>
</thead>
<tbody>
<tr>
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</table>

**Adjusted NAVD88 (2011-Epoch 2010.0) Height**

Elevation = 1.488 feet (0.454 mtrs.) (Geoid12A)

Ellipsoid Height = -23.624 mtrs.
Geoid12A Height = -24.078 mtrs.

*Adjusted position determined by T. Baker Smith, LLC for Coastal Protection and Restoration Authority*
TRIMBLE R8
GNSS SYSTEM

THE INDUSTRY LEADING TOTAL GNSS SOLUTION

The Trimble R8 GNSS system has long set the bar for advanced GNSS surveying systems. Through advanced Trimble® survey technology and a comprehensive set of communication options integrated into a flexible system design, this integrated GNSS system delivers industry-leading performance. For surveyors facing demanding RTK applications, the Trimble R8 is an invaluable GNSS partner.

TRIMBLE 360 RECEIVER TECHNOLOGY

Future-proof your investment

Powerful Trimble 360 receiver technology integrated in the Trimble R8 supports signals from all existing and planned GNSS constellations and augmentation systems providing unmatched GNSS tracking performance. With this leading-edge technology, it is now possible for surveyors to expand the reach of their GNSS rovers into areas that were previously too obscured, such as under trees and in dense urban areas.

With two integrated Trimble Maxwell™-6 chips, the Trimble R8 offers an unparalleled 440 GNSS channels. Also capable of tracking carrier signals from a wide range of satellite systems, including GPS, GLONASS, Galileo, BeiDou (COMPASS), and QZSS, the Trimble R8 provides a robust solution for surveyors.

The CMR communications protocol in the Trimble R8 provides unprecedented compression for optimized bandwidth and full utilization all of the satellites in view, giving you the most reliable positioning performance.

Designed with the future in mind, Trimble 360 technology is optimized to receive future planned signals as the number of available satellites continues to grow. With Trimble 360 technology, the Trimble R8 delivers business confidence with a sound GNSS investment for today and long into the future.

FLEXIBLE SYSTEM DESIGN

The Trimble R8 combines the most comprehensive feature set into an integrated and flexible system design for demanding surveying applications. Connect directly to the controller to receive RTK network corrections, and connect to the Internet via comprehensive communication options. With a built-in transmit/receive UHF radio, the Trimble R8 enables ultimate flexibility for rover or base operation. As a base station, the internal INTRP™ carrier provides you customized access to base station corrections via the Internet.

Trimble’s exclusive Web UI™ eliminates travel requirements for routine monitoring of base station receivers. Now you can assess the health and status of base receivers and perform remote configurations from the office. Likewise, you can download post-processing data through Web UI and save additional trips out to the field.

AN INDUSTRY LEADING FIELD SOLUTION

If you’re seeking the industry leading field solution, pair the Trimble R8 GNSS receiver with one of our powerful Trimble controllers, such as the Trimble TSC3, Trimble CU3 or Trimble Tablet Rugged PC featuring Trimble Access™ field software. These rugged controllers bring the power of the office to the field through an intuitive Windows-based interface.

Trimble Access field software offers numerous features and capabilities to streamline the flow of everyday surveying work. Streamlined workflows such as Route, Monitoring, Mins, and Turns—guide crew through common project types and allow crews to get the job done faster with less distractions. Survey companies can also implement their unique workflows by taking advantage of the customization capabilities available in the Trimble Access Software Development Kit (SDK).

Need to get data back to the office immediately? Benefit from real-time data streaming via Trimble Access Services, now available with any valid Trimble Access maintenance agreement.

Back in the office, seamlessly transfer your field data using Trimble Business Center, edit, process, and archive collected data with confidence.

The Trimble R8 GNSS system—the industry leader for GNSS surveying applications.
The Trimble® R8 GNSS VRS™ Rover is a multi-channel, multi-frequency GNSS (Global Navigation Satellite System) receiver, antenna, and data-link radio combined in one compact unit. The VRS rover combines advanced receiver technology with a proven system design to provide maximum accuracy and productivity.

TRIMBLE R-TRACK TECHNOLOGY FOR COMPREHENSIVE GNSS SUPPORT

Powered by an enhanced RTK engine, Trimble R-Track™ technology in the Trimble R8 GNSS VRS Rover supports the modernized GPS L2C and L5 signals as well as GLONASS L1&L2 signals. This extensive GNSS support is capable of providing surveying professionals with real field benefits.

With the world’s GNSS in constant development, surveying businesses small and large can be confident that investment in a Trimble GNSS system is protected. Trimble, already proven in GPS technology will continue to lead the industry in GNSS support.

PROVEN SYSTEM DESIGN

From its powerful Trimble field software and controller to the receiver itself, the Trimble R8 GNSS VRS Rover’s overall design has been tried, tested, and proven. It’s rugged, lightweight and cable free for unsurpassed ergonomics and productivity in the field. Additionally, the Trimble R8 GNSS VRS rover consumes very little power and includes internal memory. These features also assist you in the field, enabling you to work longer without changing batteries or transferring data.

The Trimble R8 GNSS VRS Rover works optimally with Trimble controllers such as the Trimble CU or Trimble® TSC™ controllers. Both controllers run industry-standard Microsoft® Windows™ operating systems, which are familiar and easy to use. They are also flexible for running both Trimble field software and other specialized applications.

The VRS rover includes an internal GSM/GPRS cell modem for wireless connection to the Internet via NTRIP (Networked Transport of RTCM via Internet Protocol). Quickly and easily access GNSS data from a Trimble GNSS infrastructure solution over the Internet. No additional cellphone or external modem is required.

AN IMPORTANT COMPONENT OF A Trimble GNSS INFRASTRUCTURE SOLUTION

Trimble® GNSS Infrastructure is the most established and widely used GNSS infrastructure solution available. Additionally, all components of Trimble GNSS infrastructure—including the Trimble R8 GNSS VRS Rover—are designed to work together.

This means the solution is scalable, that is, it will grow with you as your business needs change. And the solution is part of Trimble’s Connected Site model, where products, techniques, services, and relationships combine to take your business to all-new levels of achievement.

With numerous fully modeled networks all over the world and dedicated GNSS infrastructure engineers on hand to support your unique needs, Trimble GNSS infrastructure solutions are always a wise investment. Surveying professionals like you can rely on Trimble's experience and expertise in this field, and be confident that choosing a Trimble GNSS Infrastructure solution is the right decision.
The CastAway™-CTD
with profiling and analysis software

The YSI CastAway-CTD is a lightweight, easy to use hydrographic instrument designed for quick and accurate conductivity, temperature, and depth profiles. Starting with a unique six-electrode array and a flow-through cell, the CastAway makes use of commercial Bluetooth and GPS technology to make an instrument that is as usable as it is accurate.

The palm-sized CastAway-CTD can easily be deployed by hand. Each cast is referenced with both time and location using its built-in GPS receiver. Latitude and longitude are acquired both before and after each profile. Plots of conductivity, temperature, salinity and sound speed versus depth can be viewed immediately on the CastAway’s integrated color LCD screen in the field.

Raw data can be easily downloaded via Bluetooth to a Windows computer for detailed analysis and/or export at any time. Rugged, non-corrosive housing, AA battery power and tool free operation reflect the technician friendly pedigree of the CastAway-CTD. So do the simple, intuitive features – everything an operator needs to know about deploying the CastAway-CTD, viewing data and downloading the files fits in the lunchbox-sized carrying case.

Best used in:
- Coastal Oceanography
- Hydrology
- Aquaculture/Fisheries

When needed for:
- Saltwater Intrusion
- Surveying/Hydrography
- Sound Velocity Profiles
- Field Sensor Verification
- Estuarine Research

- GPS position, date and time
- Fast sampling and sensor response
- Waterproof interface works in and out of the water
- Bluetooth wireless communication
- No user calibration required
- No tools, computers or cables required!

www.ysi.com/castaway
Raccoon Island Shoreline Protection/Marsh Creation (TE-48) Project – Terrebonne Parish, Louisiana

20

219-008
CPRA
RACCOON ISLAND PROTECTION

BASE @ TVE-5 8.91 1.5M

SHOTS 1-101 NO 8.00
102-1014 WATER TOP
1015-1023 ARC 
1004-1053 WATER TOP 9.6

PERFORMED UPLAND TOPO
AND HYDRO SURVEY OF LINES

INDEX 0.0
DRAFT 1.1
VELOCITY 49.0

GULF OF MEXICO

RACCOON ISLAND

SIGHTS

SECTIONS