

Appendix D

Survey Methodology

SURVEY WORK PLAN REVISION 1

CAMINADA HEADLAND BACK BARRIER MARSH CREATION PROJECT (BA-0171)

**GLDD Project # 84768
LaFourche and Jefferson Parishes, Louisiana**

May 2020

The submittal herein complies with the Contract requirements with the following exception(s):

- 1. GLDD and HydroTerra LLC shall update this plan at a later date to include work related to: Temporary Bench Marks (TS-210.7.2), Temporary Aids to Navigation (TS-210.7.3), Grade Stakes (TS-210.7.6), Process Surveys (TS-210.8) and As-Built Surveys (TS-210.9) and Acceptance (TS-210.11)*

Signed:

Date: May 15, 2020

Name: Chris Ameika

Title: Project Sponsor



HYDROTERRA

PRE-CONSTRUCTION SURVEY METHODOLOGY REPORT

May 15th, 2020

STATE OF LOUISIANA
COASTAL PROTECTION AND RESTORATION AUTHORITY (CPRA)
CAMINADA HEADLAND BACK BARRIER MARSH CREATION PROJECT
(BA-0171)

LAFOURCHE AND JEFFERSON PARISHES, LOUISIANA

Prepared for;
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Section 1: General Project Description

Project Overview

The Caminada Headland has experienced some of the highest shoreline retreat rates in Louisiana. Historically the shoreline has migrated landward at about 40 feet per year. Between 2006 and 2011, shoreline migration increased dramatically, exceeding 80 feet per year near Bay Champagne and 110 feet per year in the Bayou Moreau area. The increased losses occurred in the wake of Hurricanes Katrina and Rita in 2005 as the breaches remained open for an extended length of time. The losses were exacerbated by Tropical Storm Fay and Hurricanes Gustav and Ike in 2008. Significant prolonged breaches greatly increase the net export of sediment from the headland.

In addition to the shoreline migration, the area is also experiencing high loss rates of interior marshes. As the beach and dune continue to migrate landward, overwashed sediment will be lost into newly formed open water and land loss rates will be exacerbated. The continued deterioration of Caminada headland threatens thousands of acres of wetland habitat as well as critical infrastructure, including Port Fourchon, LA Highway 1, and the lower Lafourche levee system.

This project would create 972 acres of back barrier intertidal marsh and nourish 198 acres of emergent marsh using material dredged from the Gulf of Mexico. The marsh creation and nourishment cells are designed to minimize impacts on existing marsh and mangroves.

Assuming some natural vegetative recruitment, vegetative plantings are planned at a 50% density, with half planned at project year one and half planned at project year 3. Containment dikes will be degraded or gapped by year three to allow access for estuarine organisms.

The project is located in Lafourche and Jefferson Parishes, Louisiana, east of Port Fourchon, adjacent to the Caminada Headland (See Figure 1).

Vicinity Map

CAMINADA HEADLAND BACK
BARRIER MARSH CREATION PROJECT
PROJECT NO. BA-0171
LAFOURCHE AND JEFFERSON PARISHES

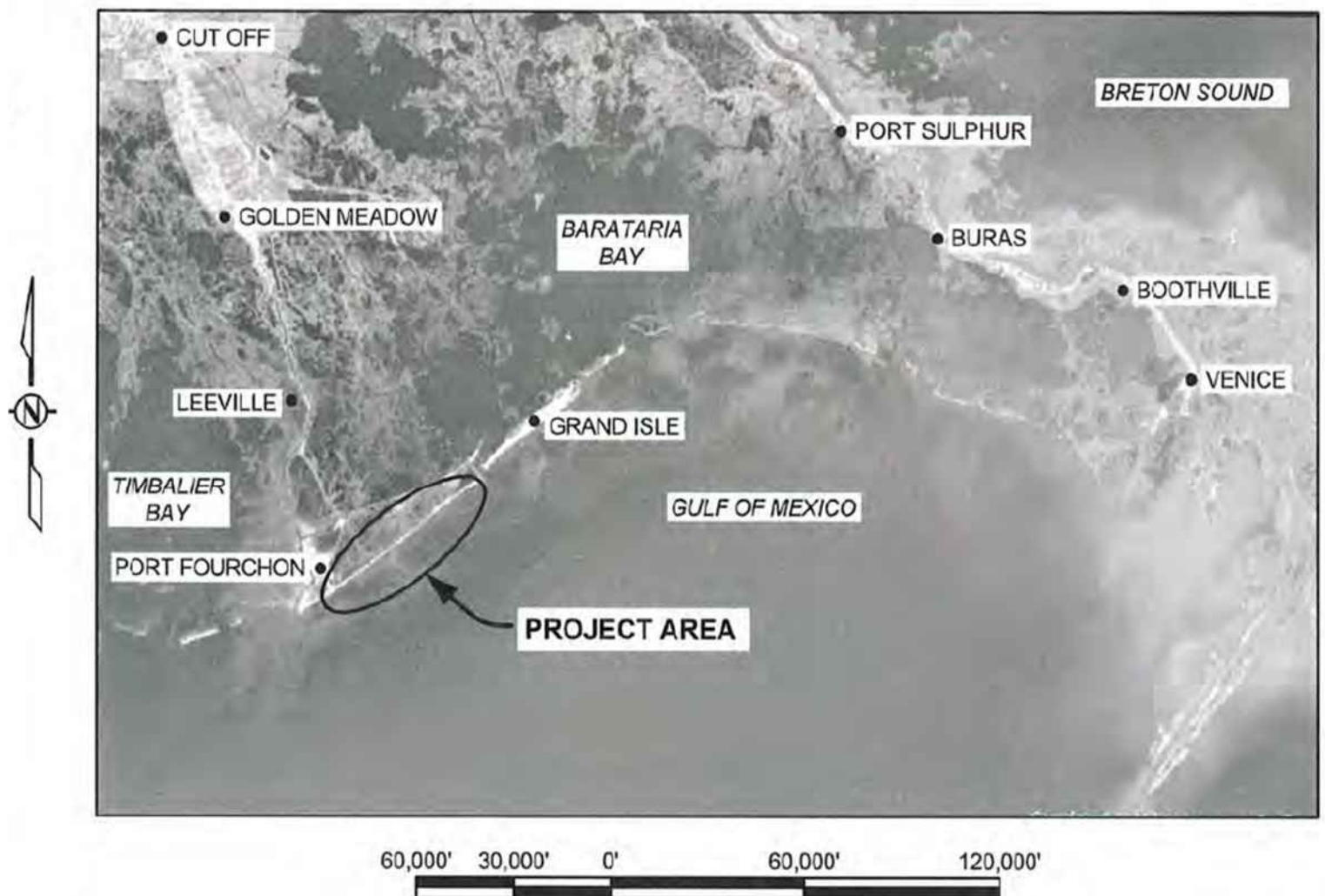


Figure 1

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 Epoch 2010.00 US feet.

All horizontal and vertical related surveys performed will be adjusted and calibrated to the specified secondary monument listed in the specifications and plans as “TE23 SM-01” (See Appendix A) using industry accepted RTK GNSS equipment and methodologies as outlined in this document. Hazard surveys may use Gulfnet VRS RTK for positioning.

The secondary monument “TE23-SM-01” is within approximately 1.0 miles of the project area and will be used for horizontal and vertical control. The condition of this monument will be investigated for damage prior to the work commencing. The station description is included in Appendix A of this report.

Preparation of Survey Transects

All survey transects described in this “Report” will be 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.

Contract Document

This survey methodology plan was created using the documents from change order #1.

Section 3: Bathymetric and Topographic Survey Dredge Pipeline Corridor (TS 210.7.7 and 210.7.7.1)

A topographic and bathymetric survey shall be performed within the entire proposed dredge pipeline corridor before installation as shown on the plans (Figure 2).

Offshore Portion TS 210.7.7 (To be performed by GLDD)

Survey transects shall be surveyed every one thousand (1000') feet perpendicular to the centerline of the proposed dredge pipeline corridor and shall be three hundred and fifty (350') feet long. In addition, a profile line shall be surveyed along the proposed centerline. The survey shall extend from the marsh creation borrow area to the shoreline.

Beach and Dune Portion TS 210.7.7.1 (To be performed by Hydroterra Technologies)

Survey transects shall be surveyed every fifty (50') feet perpendicular to the centerline of the proposed dredge pipeline corridor and shall be one hundred (100') feet long. In addition, a profile line shall be surveyed along the proposed centerline. The survey shall extend from the shoreline to the marsh creation area.

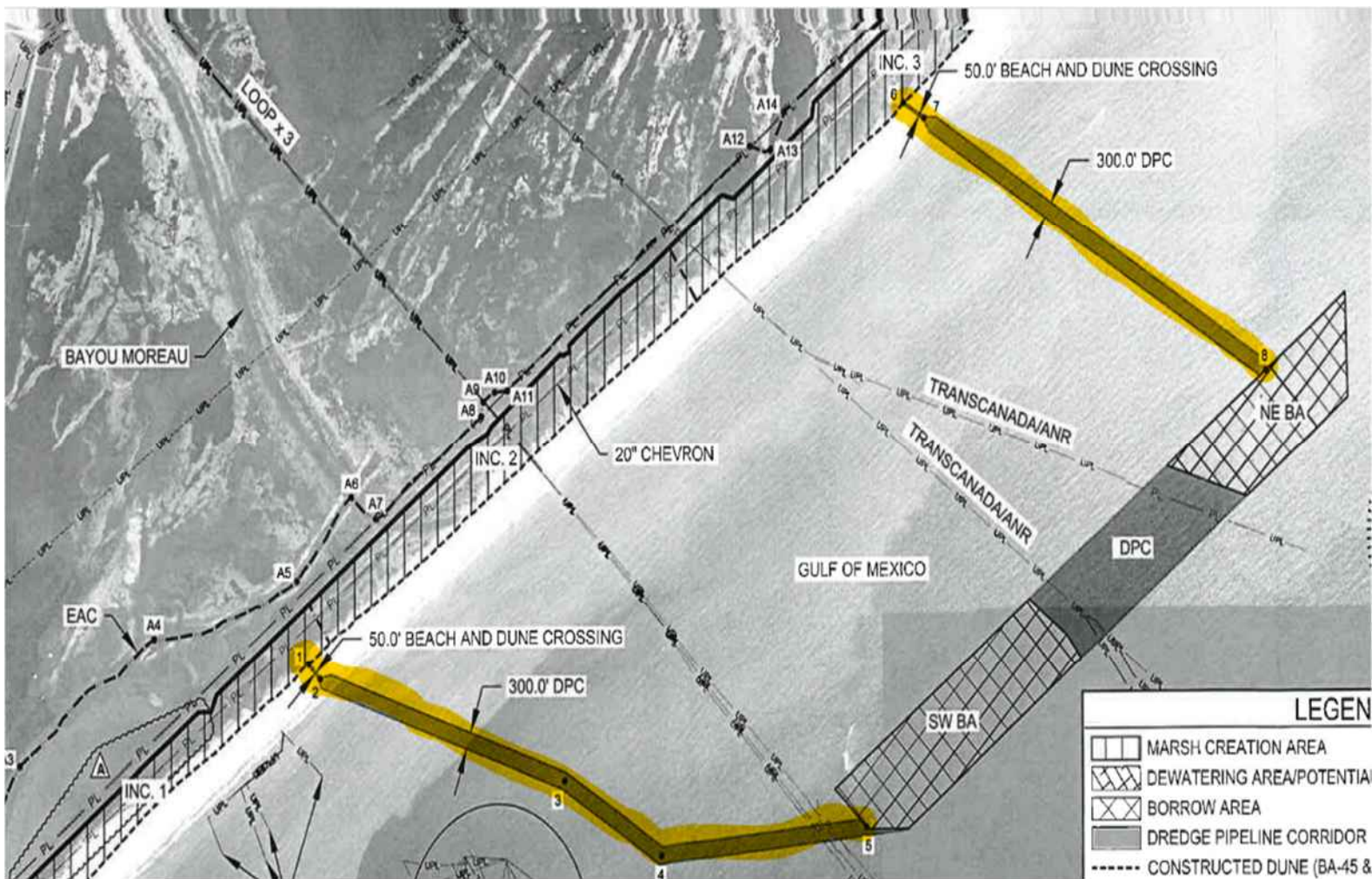


Figure 2

Equipment

Equipment to be utilized by GLDD 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) Odom MKIII Depth Sounder with Dual Frequency Transducer. (200khz/24kHz frequencies to be used during survey)
- One (1) YSI Cast Away CTD Probe (Velocimeter) or DigiBar
- One (1) Motion Sensor
- One (1) Desktop Computer with Hypack© Navigation Software Version 2018.
- One (1) Closed Cabin Survey Vessel.

Equipment to be utilized by Hydroterra Technologies 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) Fixed Height Aluminum Rod (8' or 10' in length) with a 6" diameter metal plate as the base of the rod.
- One (1) Airboat.

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

Methodology

Survey Control Offshore Portion

Before the survey will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

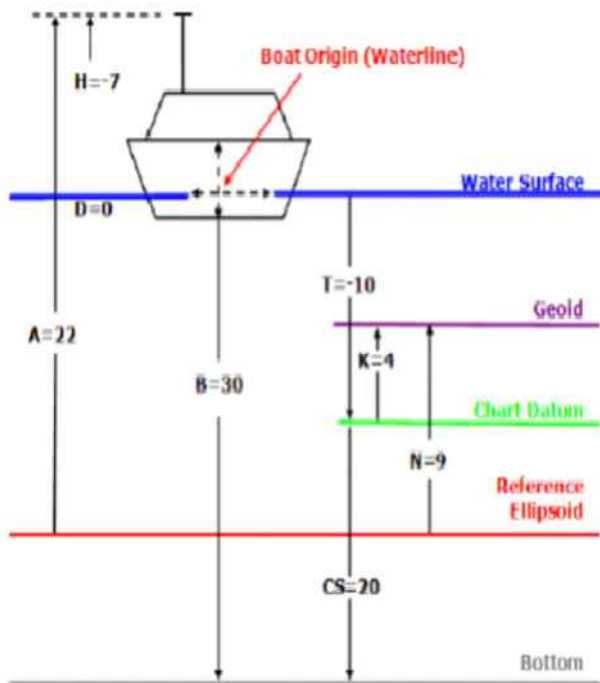
Survey Control Beach and Dune Portion

Before the survey will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

Equipment Calibration for Bathymetric Surveys

Once the survey control is verified, the RTK system and the echo sounder transducer are 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 measured and entered into the Hypack© Navigation Software for the tide and draft corrections to be applied (Fig. 6).



A “Bar Check” of this system is then performed. First, the 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 will be entered into the echo sounder and set. Then, a steel plate will be lowered below the transducer at 10’ 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 ten foot increment. The “Bar Check” will be recorded electronically in the Odom E-chart Software.

RTK tides will be checked daily against a tide board referenced to the site control noted above.

Data Acquisition

The proposed dredge pipeline corridor is shown Figure 2.

The Teledyne Odom Echotrac III has a vertical accuracy of 0.01m / 0.10 ft. +/- 0.1% of depth @ 200kHz as required is TS 210.4.2 (See specification sheet Appendix B).

The Trimble Survey Grade RTK system has a minimum horizontal and vertical accuracy of 0.01m / 0.10 ft. as required is TS 210.4.1 (See specification sheet Appendix B).

Real Time Kinematic surveying

Single Baseline <30 km

Horizontal - 8 mm + 1 ppm RMS

Vertical - 15 mm + 1 ppm RMS

Network RTK

Horizontal - 8 mm + 0.5 ppm RMS

Vertical - 15 mm + 0.5 ppm RMS

Initialization time - typically <8 seconds

Initialization reliability - typically >99.9%

The offshore portion bathymetric survey lines shall be no more than one thousand (1000') feet apart orientated perpendicular to the proposed dredge pipeline corridor and shall be three hundred and fifty (350') feet long. In addition a profile line will be surveyed along the proposed centerline of the dredge pipeline corridor. This survey is to be performed by GLDD.

The onshore portion topographic survey lines shall be no more than fifty (50') feet apart orientated perpendicular to the proposed dredge pipeline corridor and shall be one hundred (100') feet long. In addition a profile line will be surveyed along the proposed centerline of the dredge pipeline corridor. This survey is to be performed by Hydroterra Technologies. Bottom elevation and coordinates shall be recorded every ten (10') feet along the perpendicular transects

Survey transects will be provided digitally to the field surveyor(s) for acquisition of data along the transects.

Data Processing

All topographic data will be processed using the Trimble Geomatics Office (TGO) software version 1.62 or Trimble Business Center.

All bathymetric data will be processed using the Hypack® Single Beam Editor software.

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

Section 4: Equipment Access Corridor (TS 210.7.8)

A topographic and bathymetric survey shall be performed along the centerlines of the proposed equipment access corridors as shown on the plans (Figure 3 and 4).

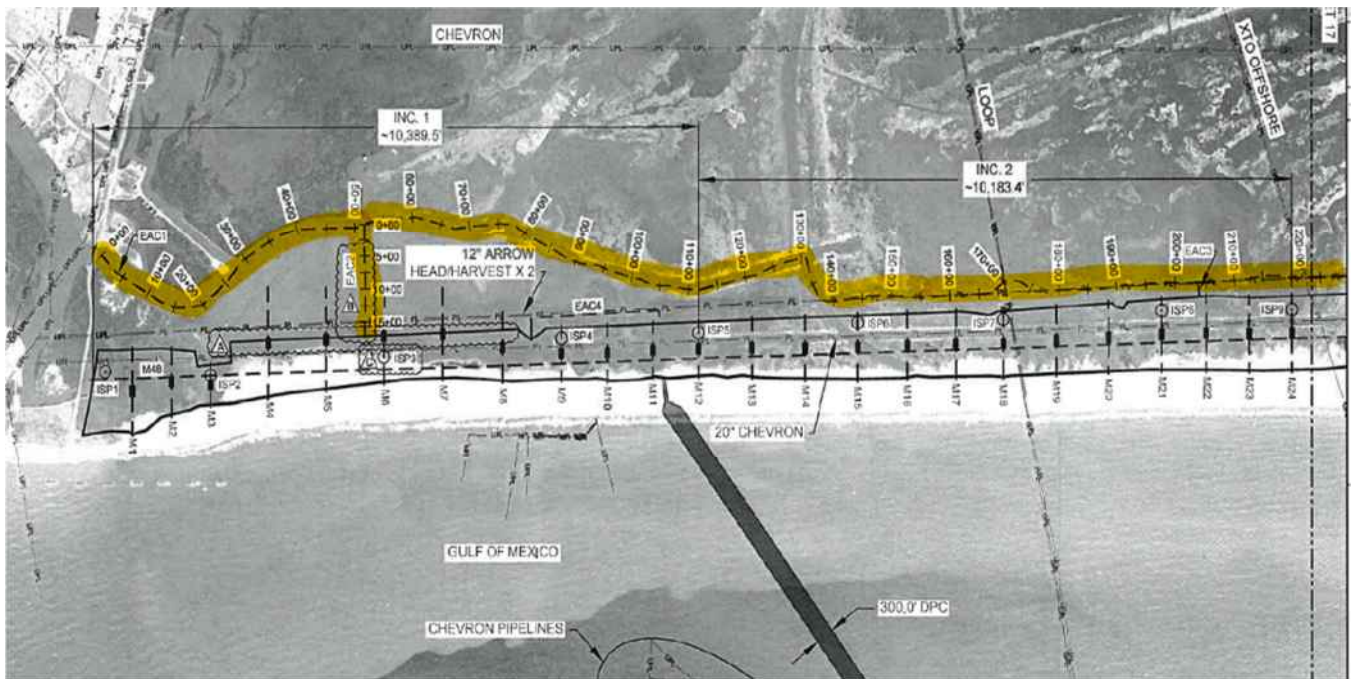


Figure 3

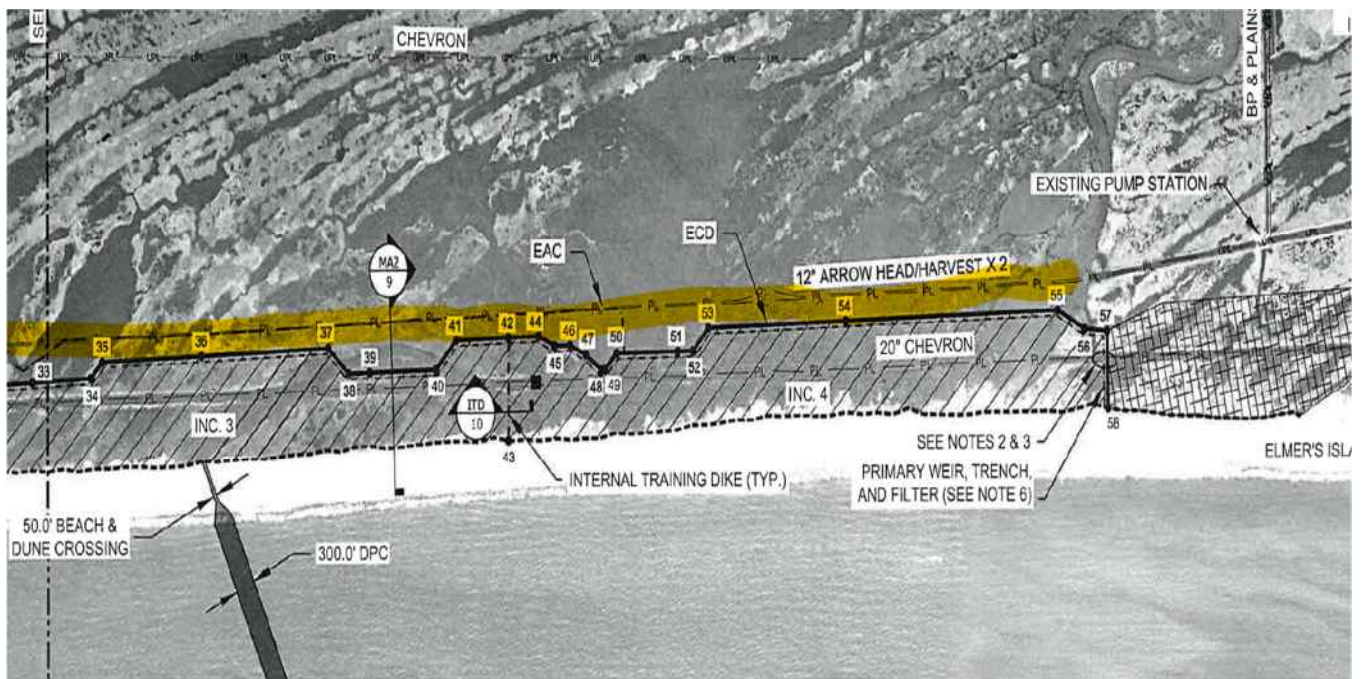


Figure 4

Equipment

Equipment to be 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) Fixed Height Aluminum Rod (8' or 10' in length) with a 6" diameter metal plate as the base of the rod.
- One (1) Airboat.

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 will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

Hazard surveys may use Gulfnet VRS RTK for positioning.

Data Acquisition

The proposed equipment access corridors are shown Figure 3 and 4.

The Trimble Survey Grade RTK system has a minimum horizontal and vertical accuracy of 0.01m / 0.10 ft. as required is TS 210.4.1 (See specification sheet Appendix B).

Real Time Kinematic surveying

Single Baseline <30 km

Horizontal - 8 mm + 1 ppm RMS

Vertical - 15 mm + 1 ppm RMS

Network RTK

Horizontal - 8 mm + 0.5 ppm RMS

Vertical - 15 mm + 0.5 ppm RMS

Initialization time - typically <8 seconds

Initialization reliability - typically >99.9%

The survey lines shall be no more than one thousand (1000') feet apart orientated perpendicular to the proposed equipment access corridors and shall be fifty (50') feet long. In addition a profile line will be surveyed along the proposed centerline of the dredge pipeline corridor. Bottom elevation and coordinates along the profile line shall be recorded every one hundred (100') feet and every PI and every twenty-five (25') feet and PI's along the perpendicular transects.

Survey transects will be provided digitally to the field surveyor(s) for acquisition of data along the transects.

Data Processing

All topographic data will be processed using the Trimble Geomatics Office (TGO) software version 1.62 or Trimble Business Center.

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

Section 5: Marsh Creation Borrow Area (TS 210.7.9)

A bathymetric survey shall be performed on the borrow areas (Figure 5). This survey is to be performed by GLDD. Pre-Construction, Process and As-Built hydrographic surveys will be observed by a HydtoTerra representative.

Equipment

Equipment to be utilized by GLDD 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) Odom MKIII Depth Sounder with Dual Frequency Transducer. (200khz/24kHz frequencies to be used during survey)
- One (1) YSI Cast Away CTD Probe (Velocimeter) or DigiBar
- One (1) Motion Sensor
- One (1) Desktop Computer with Hypack© Navigation Software Version 2018.
- One (1) Closed Cabin Survey Vessel.

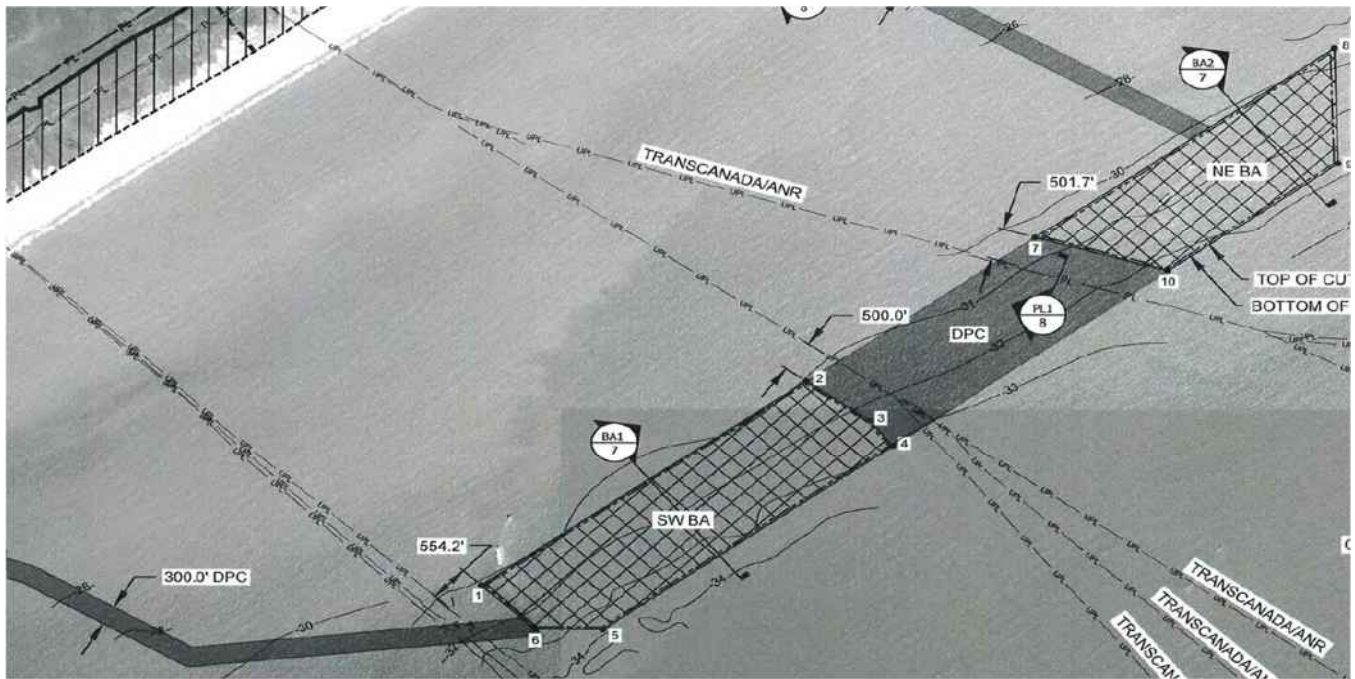


Figure 5

Methodology

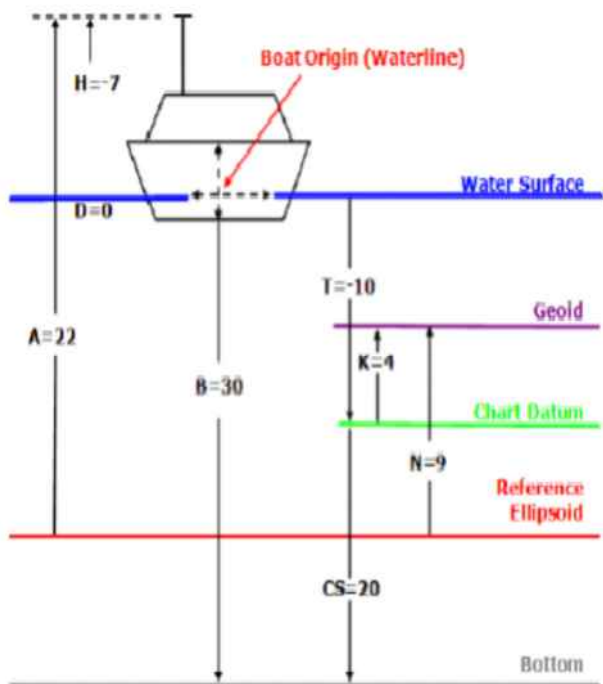
Survey Control

Before the survey will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

Equipment Calibration for Bathymetric Surveys

Once the survey control is verified, the RTK system and the echo sounder transducer are 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 measured and entered into the Hypack© Navigation Software for the tide and draft corrections to be applied (Fig. 6).



A “Bar Check” of this system is then performed. First, the 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 will be entered into the echo sounder and set. Then, a steel plate will be lowered below the transducer at 10’ 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 ten foot increment. The “Bar Check” will be recorded electronically in the Odom E-chart Software.

RTK tides will be checked daily against a tide board referenced to the site control noted above.

Data Acquisition

The borrow area is split into NE BA and SW BA, where transects will be spaced 200 feet apart perpendicular to the fill area. The area in between the two borrow areas, noted as DPC, will be spaced 600 feet apart, as shown in Figure 7. Ground elevations shall be recorder at twenty five (25') foot intervals along the transects and extend fifty (50') feet beyond the boundaries of the marsh creation borrow areas.

Bathymetric data will be corrected for roll, pitch, heave, and tide. Sound velocity corrections will be applied based on measurements made before and throughout the duration of the survey using either the Castaway CTD or the DigiBar to obtain water column sound velocities of the entire water column to the seafloor.

The Teledyne Odom Echotrac III has a vertical accuracy of 0.01m / 0.10 ft. +/- 0.1% of depth @ 200kHz as required is TS 210.4.2 (See specification sheet Appendix B).

Data Processing

Single beam data will be processed using Hypack Single Beam Editor.

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

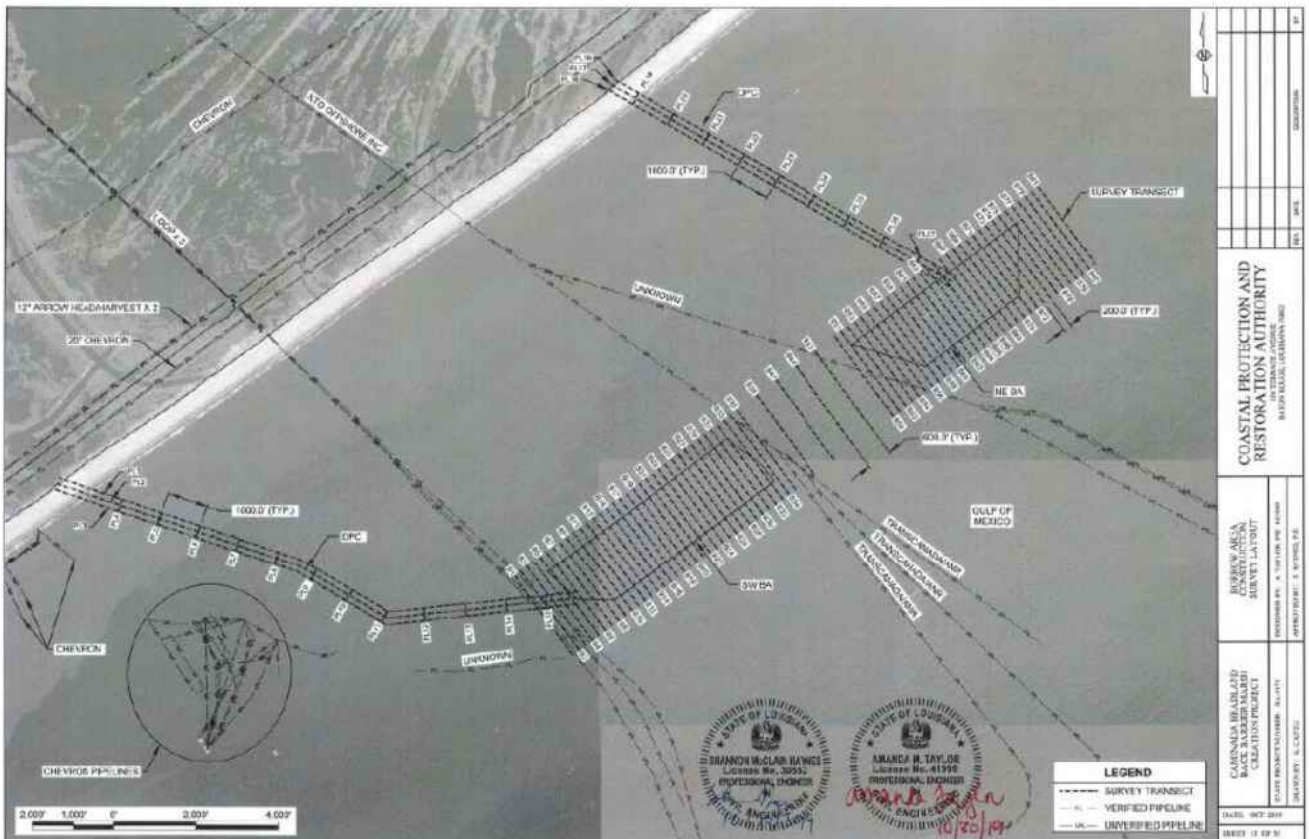


Figure 7

Section 6: Dewatering Weirs (TS 210.7.10, TS 210.8.4.1 and TS 210.9.6)

A topographic survey shall be performed on the weirs and outfall locations prior to installation. An after installation (TS 210.8.4.1) and after all equipment has been demobilized (TS 210.9.6) survey shall be performed. These surveys shall be consistent with the Pre-Construction Survey.

Equipment

Equipment planned to be 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) Fixed Height Aluminum Rod (8' or 10' in length) with a 6" diameter metal plate as the base of the rod.
- One (1) Airboat.

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 will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

Hazard surveys may use Gulfnet VRS RTK for positioning.

Data Acquisition

Transects shall extend along the centerline of each conduit for each dewatering weir to fifty (50') feet beyond the entrance and one hundred (100') feet beyond the outfall. Ground elevations and coordinates shall be recorded at twenty-five (25') foot intervals along the transects.

The Trimble Survey Grade RTK system has a minimum horizontal and vertical accuracy of 0.01m / 0.10 ft. as required is TS 210.4.1 (See specification sheet Appendix B).

Real Time Kinematic surveying

Single Baseline <30 km

Horizontal - 8 mm + 1 ppm RMS

Vertical - 15 mm + 1 ppm RMS

Network RTK

Horizontal - 8 mm + 0.5 ppm RMS

Vertical - 15 mm + 0.5 ppm RMS

Initialization time - typically <8 seconds

Initialization reliability - typically >99.9%

The transects will be provided digitally to the field surveyor(s) for acquisition of data along the transects.

Data Processing

All topographic data will be processed using the Trimble Geomatics Office (TGO) software version 1.62 or Trimble Business Center.

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

Section 7: Earthen Containment Dike (TS 210.7.11 & 210.7.11.1)

A topographic survey and stakeout shall be performed along the centerline of the dikes.

Equipment

Equipment planned to be 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) Fixed Height Aluminum Rod (8' or 10' in length) with a 6" diameter metal plate as the base of the rod.
- One (1) Air Boat.

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 will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

Hazard surveys may use Gulfnet VRS RTK for positioning.

Data Acquisition

Ground elevations and coordinates shall be recorded at one-hundred (100') foot intervals along the centerline or where there is a change in grade greater than plus or minus one-half (+/- 0.5') feet and at all points of inflection. In addition survey stakes shall be placed at one-hundred (100') foot intervals and at all points of inflection along the centerline of the dike, inside toe of the earthen containment dike, and outside toe of the associated borrow area. Stakes shall conform to TS 210.4.4

The Trimble Survey Grade RTK system has a minimum horizontal and vertical accuracy of 0.01m / 0.10 ft. as required is TS 210.4.1 (See specification sheet Appendix B).

Real Time Kinematic surveying

Single Baseline <30 km

Horizontal - 8 mm + 1 ppm RMS

Vertical - 15 mm + 1 ppm RMS

Network RTK

Horizontal - 8 mm + 0.5 ppm RMS

Vertical - 15 mm + 0.5 ppm RMS

Initialization time - typically <8 seconds

Initialization reliability - typically >99.9%

Data Processing

All topographic data will be processed using the Trimble Geomatics Office (TGO) software version 1.62 or Trimble Business Center.

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

Section 8: Existing Dune (TS 210.7.12)

A pre-construction topographic survey of the existing dune shall be surveyed along the centerline of the dune crest and extend from the eastern and western boundaries of the project site. An as-built survey of the existing dune (TS 210.9.3) This survey shall be consistent with the Pre-Construction Survey

Equipment

Equipment planned to be 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) Fixed Height Aluminum Rod (8' or 10' in length) with a 6" diameter metal plate as the base of the rod.
- One (1) Air Boat.

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 will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

Hazard surveys may use Gulfnet VRS RTK for positioning.

Data Acquisition

Ground elevations and coordinates shall be recorded at one-hundred (100') foot intervals along the centerline or where there is a change in grade greater than plus or minus one-half (+/- 0.5') feet and at all points of inflection.

The Trimble Survey Grade RTK system has a minimum horizontal and vertical accuracy of 0.01m / 0.10 ft. as required is TS 210.4.1 (See specification sheet Appendix B).

Real Time Kinematic surveying

Single Baseline <30 km

Horizontal - 8 mm + 1 ppm RMS

Vertical - 15 mm + 1 ppm RMS

Network RTK

Horizontal - 8 mm + 0.5 ppm RMS

Vertical - 15 mm + 0.5 ppm RMS

Initialization time - typically <8 seconds

Initialization reliability - typically >99.9%

Data Processing

All topographic data will be processed using the Trimble Geomatics Office (TGO) software version 1.62 or Trimble Business Center.

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

Section 9: Marsh Creation Area (TS 210.7.13)

A topographic survey shall be performed within the marsh creation area. Transects shall be consistent with the construction survey layout as shown on the plans.

Equipment

Equipment planned to be 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) Fixed Height Aluminum Rod (8' or 10' in length) with a 6" diameter metal plate as the base of the rod.
- One (1) Air Boat 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 will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

Hazard surveys may use Gulfnet VRS RTK for positioning.

Data Acquisition

Ground elevations and coordinates shall be recorded at twenty-five (25') foot intervals along the transects and where there is a change in grade greater than one-half (0.5') feet and at all points of inflection. Transects shall extend fifty (50') feet beyond the Arrowhead/Harvest pipeline canal. This survey shall not be performed until the earthen containment dike has been constructed and accepted by the engineer.

The Trimble Survey Grade RTK system has a minimum horizontal and vertical accuracy of 0.01m / 0.10 ft. as required is TS 210.4.1 (See specification sheet Appendix B).

Real Time Kinematic surveying

Single Baseline <30 km

Horizontal - 8 mm + 1 ppm RMS

Vertical - 15 mm + 1 ppm RMS

Network RTK

Horizontal - 8 mm + 0.5 ppm RMS

Vertical - 15 mm + 0.5 ppm RMS

Initialization time - typically <8 seconds

Initialization reliability - typically >99.9%

Data Processing

All topographic data will be processed using the Trimble Geomatics Office (TGO) software version 1.62 or Trimble Business Center.

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

Section 10: Magnetometer Survey Borrow Area (TS 210.7.9), Dredge Pipeline Corridor (TS 210.7.7 and TS 210-7.7.1), Equipment Access Corridors (TS 210.7.8), Earthen Containment Dike (TS 210.7.11), Marsh Creation Area (TS 210.7.13)

In an effort to verify locations and depths of pipelines and other underwater obstructions, a design magnetometer survey will be performed in preparation for this project. A magnetometer survey shall be performed within the marsh creation borrow area, dredge pipeline corridor, equipment access corridors, earthen containment dike and marsh creation area.

Equipment

Equipment planned to be 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.
- Geometrics G-882 Cesium Magnetometer
- Subsurface Instruments MUL-1 (Underwater Magnetic Locator) and ML-1 Metal locator.
- One (1) Desktop Computer with Hypack© Navigation Software Version 2016.
- One (1) Closed Cabin Survey Vessel.
- One (1) Air Boat Survey Vessel.
- Probe Rod

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 will begin the location and verification of the project secondary monument TE23 SM-01 will be completed. Once the project monument is located, visually inspected for integrity, and deemed undisturbed and suitable for use, a base receiver if utilized will be set on the monument. If a base station will not be utilized a National Geodetic Survey real-time network (C4G) calibrated to the project control points will be utilized.

Hazard surveys may use Gulfnet VRS RTK for positioning.

Data Acquisition

A magnetometer survey shall be performed after Louisiana One Call has been notified to identify any pipeline, utilities, and/or obstruction locations and ensure no unknown infrastructure exist within the Work Area. The excavation areas, conveyance corridor, submerged pipeline corridor, and Gulf of Mexico borrow area shall be surveyed. The survey shall be conducted using a Geometrics G-882 magnetometer.

The Geometrics G-882 Marine Magnetometer has a minimum accuracy of 3 gammas throughout its operational range as required is TS 210.4.3 (See specification sheet Appendix B).

The Trimble Survey Grade RTK system has a minimum horizontal and vertical accuracy of 0.01m / 0.10 ft. as required is TS 210.4.1 (See specification sheet Appendix B).

Real Time Kinematic surveying

Single Baseline <30 km

Horizontal - 8 mm + 1 ppm RMS

Vertical - 15 mm + 1 ppm RMS

Network RTK

Horizontal - 8 mm + 0.5 ppm RMS

Vertical - 15 mm + 0.5 ppm RMS

Initialization time - typically <8 seconds

Initialization reliability - typically >99.9%

Borrow Area (TS 210.7.9)

Magnetometer track lines shall be spaced every two hundred (200') feet oriented in an approximate NW-SE direction and extend fifty (50') beyond the boundaries of the marsh creation borrow areas. In addition five (5) cross lines orientated in an approximate SW-NE direction shall be surveyed.

Dredge Pipeline Corridor (TS 210.7.7 and TS 210-7.7.1).

Three (3) magnetometer track lines shall be surveyed, one along the proposed centerline of the dredge pipeline corridor and one on each side of the proposed centerline of the dredge pipeline corridor, in addition three-hundred and fifty (350') foot long perpendicular cross sections every one thousand (1000') feet along the centerline corridor will be surveyed.

Equipment Access Corridors (TS 210.7.8)

Three (3) magnetometer track lines shall be surveyed, one (1) along the proposed centerline of the equipment access corridors and one (1) on each side of the proposed centerline of the equipment access corridors, In addition fifty (50') foot long perpendicular cross sections every one thousand (1000') feet along the centerline of the equipment access corridor will be surveyed.

Earthen Containment Dike and Internal Training Dikes (TS 210.7.11)

One (1) magnetometer track lines shall be surveyed along the centerline of the earthen containment dike and internal training dike borrow areas.

Marsh Creation Area (TS 210.7.13)

Magnetometer Track lines as Shown on the Plans Shall be Surveyed.

Infrastructure (TS 210.7.4)

All infrastructure (pipelines, powerlines, etc.), that are located within one hundred fifty (150') feet of the marsh creation borrow area, earthen containment dikes, earthen containment dike borrow areas, marsh creation area, dredge pipeline corridors and equipment access corridors shall be surveyed and marked at fifty (50') intervals. Pipelines shall be probed for depth of cover and their locations marked prior to excavation, dredging, and installation of the sediment pipeline, for the duration of construction. For the offshore borrow area and offshore dredge pipeline corridors divers will be required to be probed for depth.

Data Processing

All Magnetometer data will be processed using the Hypack© 2019 Magnetometer Editor software.

All topographic data will be processed using the Trimble Geomatics Office (TGO) software version 1.62 or Trimble Business Center.

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

Section 11: Deliverables (TS 210.10)

Hydroterra Technologies shall submit all survey data and drawings to GLDD and Engineer for review and acceptance by the dates specified in SP-3 of the specifications.

Survey Data (TS 210.10.1):

Survey data shall be provided in Microsoft Excel, or approved equal using the file share platform specified in SP-20 of the specifications.

Bathymetric and Topographic Data (TS 210.10.1.1):

Bathymetric and topographic data shall be provided in tables and include separate columns for the transect number, point number, point description, northing coordinates, easting coordinate and elevation. Bathymetric survey data shall be corrected for tidal fluctuations and vessel pitch, roll and heave.

Magnetometer Data (TS 210.10.1.2):

Magnetometer detections shall be provided in tables and provide separate columns for transect number, point number, point description, northing coordinates, easting coordinate, sensor height, signature type, amplitude and duration. Elevation and depth of cover shall be provided for all pipelines and magnetic detections higher than fifty (50) gammas. Descriptions shall also be provided for the probable causes of all magnetic detections.

Elevation Data (TS 210.10.1.3):

Elevation data for the instrumented settlement plates, grade stakes, earthen containment dikes, slurry, and dewatering weirs shall be provided in separate tables.

Survey Drawings (TS 210.10.2):

Surveys shall be provided in the latest version of Autocad and Adobe Acrobat or approved equal. All survey drawings shall conform to CPRA drafting standards and be presented as follows.

TS 210.10.2.1 All sheets shall include the Project name number and seal of a professional engineer or surveyor licensed in the State of Louisiana.

TS 210.10.2.2 The locations of all earthen containment dikes, marsh fill, survey monuments, temporary benchmarks, grade stakes, instrumented settlement plates, dredge pipeline crossings and dewatering weirs shall appear in plan view.

TS 210.10.2.3 Transects and profiles shall be shown in plan and profile view and include spot elevations, contours in +/- 1.0 foot increments, and mean high and mean low water levels.

TS 210.10.2.4 Magnetometer anomalies and infrastructure (pipelines, power lines, etc.) shall be shown in plan view. Probed infrastructure and magnetic anomalies higher than fifty (50) gammas shall also be shown in profile.

TS 210.10.2.5 All plan views shall be overlaid onto the most recent geo-rectified Digital Orthophoto Quarter Quadrangle aerial color photographs.

TS 210.10.2.6 revisions such as field or change orders shall be noted, shown in red and be easily distinguishable from the original design.

APPENDIX A



VICINITY MAP Not to Scale

Reproduced from 2015 Google Earth

Station Name: "TE23 SM-01"

Monument Location:

This Station is located southeast of Port Fourchon, 40 feet east of the centerline of La Hwy. 3090 and 65 feet northeast of the bridge approach near Pass Fourchon, Louisiana.

Monument Description: NGS Style floating sleeve monument; 9/16" stainless steel rods driven 96 feet to refusal, set in a sand filled 6" PVC with access cover set flush with the ground.

Date of Survey: February 2015

Monument Established By: Morris P. Hebert, Inc.

NAD 83 Geodetic Position

Lat. 29° 06' 42.28594"N

Long. 90° 11' 26.96414"W

NAD 83 Datum LSZ (1702) Feet

N= 224,296.459

E= 3,645,688.765

Adjusted NAVD 88 Height (Geoid 12A)

+7.29 feet (2.22 meters)

Ellipsoid Hgt:-70.856

Ellipsoid Hgt:-21.597 meters



Adjusted Position Established by Morris P. Hebert, Inc. for the Coastal Protection & Restoration Authority of Louisiana

APPENDIX B

G-882

Cesium Marine Magnetometer



Geometrics' G-882 Marine Magnetometer is the leading marine system in the industry with over 1,000 systems sold! The G-882 is the only system that meets the standards for UXO clearance in the North Sea.

This very high-resolution Cesium vapor marine magnetometer is low in cost, small in size, and offers flexibility for professional surveys in shallow or deep water. Use your personal computer with our MagLog™ software to log, display and print GPS position and magnetic field data.

The system directly interfaces to all major side-scan manufacturers for tandem tow configurations. Being small and lightweight, it is easily deployed and operated by one person. But add several streamlined weight collars and the system can quickly weigh more than 100 lbs for deep-tow applications.

This marine magnetometer system is particularly well-suited for the detection and mapping of all sizes of ferrous objects. This includes anchors, chains, cables, pipelines, ballast stones and other scattered shipwreck debris, munitions of all sizes (UXO), aircraft, engines and any other object with a magnetic expression. The G-882 is also perfect for geological studies. Its high sensitivity and high sample rates are maintained for all applications.

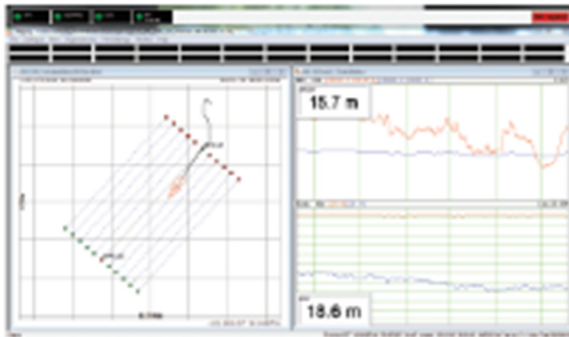
Objects as small as a 5-inch screwdriver are readily detected provided that the sensor is close to the seafloor and within practical detection range (refer to table on back).

FEATURES & BENEFITS

- **Cesium Vapor High Performance** – Highest detection range and high probability of detecting all sized ferrous targets.
- **Streamlined Design for Tow Safety** – Low probability of fouling in fishing lines or rocks. Rugged fiber-wound fiberglass housing.
- **Sample at up to 20Hz** – Unparalleled data density while also covering larger areas per day.
- **Sensor can be Rotated for Optimal Signal** – Can be used worldwide.
- **Easy Portability and Handling** – No winch required. Built-in easy-carry handle. Operable by a single man; only 44 lb with 200 ft cable.
- **Combine Multiple Systems for Increased Coverage** – Internal CM-221 Mini-counter provides multi-sensor sync and data concatenation, allowing side-by-side coverage which maximizes detection of small targets and reduces noise.
- **Export Version Available** – Use anywhere in the world without need for an export license (except embargoed countries). See specifications.



SPECIFICATIONS | G-882 Cesium Marine Magnetometer



MagLogLite™ Data Logging software is included with each magnetometer and allows recording and display of data and position with automatic anomaly detection. Additional software options include: MagLog Pro™, advanced logging software; MagMap™, a plotting and contouring package; and MagPick™ post-acquisition processing software.

MAGNETOMETER / ELECTRONICS

Operating Principle: Self-oscillating split-beam Cesium vapor (non-radioactive).

Operating Range: 20,000 to 100,000 nT.

Operating Zones: The earth's field vector should be at an angle greater than 10° from the sensor's equator and greater than 6° away from the sensor's long axis. Automatic hemisphere switching.

Noise: $<0.004 \text{ nT}/\sqrt{\text{Hz}}_{\text{ENC}}$ (5X (report) worse); $<0.02 \text{ nT}/\sqrt{\text{Hz}}_{\text{ENC}}$.

Max Sample Rate: 20 Hz.

Heading Error: $< 1 \text{ nT}$ (over entire 360° spin).

Output: RS-232 at 1,200 to 19,200 baud.

Power: 24 to 32 VDC, 0.75 A at power-on and 0.5 A thereafter.

MECHANICAL

Sensor Fish

DIA: 7 cm; L: 137 cm (275x54 in) (with fin assembly).

Weight: 18 kg (40 lb).

Includes sensor and electronics and 1 main weight. Additional collar weights are 6.4 kg (14 lb) each; total of 5 capable.

Tow Cable

DIA: 12 mm; L: 800 m (3,47 in x 2,625 ft).

Weight: 7.7 kg (17 lb) with terminations.

Break strength: 1,630 kg (3,600 lb).

Bend diameter: 30 cm (12 in).

Typical Detection Range for Common Objects

1. Ship: 1000 tons 0.5 to 1 nT at 800 ft (244 m)
2. Anchor: 20 tons 0.8 to 1.25 nT at 400 ft (120 m)
3. Automobile 1 to 2 nT at 100 ft (30 m)
4. Light Aircraft 0.5 to 2 nT at 40 ft (12 m)
5. Pipeline (1.2 inch) 1 to 2 nT at 200 ft (60 m)
6. Pipeline (6 inch) 1 to 2 nT at 100 ft (30 m)
7. Iron: 100 kg 1 to 2 nT at 50 ft (15 m)
8. Iron: 100 lb 0.5 to 1 nT at 30 ft (9 m)
9. Iron: 10 lb 0.5 to 1 nT at 20 ft (6 m)
10. Iron: 1 lb 0.5 to 1 nT at 10 ft (3 m)
11. Screwdriver: 5 inch 0.5 to 2 nT at 12 ft (4 m)
12. Bomb: 1000 lb 1 to 5 nT at 100 ft (30 m)
13. Bomb: 500 lb 0.5 to 5 nT at 50 ft (16 m)
14. Grenade 0.5 to 2 nT at 10 ft (3 m)
15. Shell: 20 mm 0.5 to 2 nT at 5 ft (1.8 m)

ENVIRONMENTAL

Operating Temperature: -35°C to +50°C (-30°F to +122°F).

Storage Temperature: -45°C to +70°C (-48°F to +158°F).

Altitudes: 9000 m (30,000 ft).

Depth: 4,000 psi (2,730 m; 8956 ft).

Water Tight: O-Ring sealed for up to 4,000 psi depth operation.

ACCESSORIES

Standard: Operation manual, shipping/storage container, ship kit with tools and hardware, power supply, MagLogLite™, MagMap™ and MagPick™ processing software, depth transducer, altimeter.

Optional: Steel tow cable to 6,000 m (19,600 ft) with telemetry, longitudinal or transverse gradiometers, plastic Pelican® case, MagLogPro™, collar weights.

Specifications subject to change without notice. G-882, v1 (07/00)



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Innovation • Experience • Results

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TRIMBLE R8 GNSS SYSTEM

KEY FEATURES

Advanced satellite tracking
with Trimble 360 receiver
technology

Includes Trimble Maxwell 6
chips with 440 channels

Unmatched GNSS tracking
performance

Web user interface and
remote configuration

Base and rover
communications options to
suit any application



THE INDUSTRY LEADING TOTAL GNSS SOLUTION

The Trimble® R8 GNSS system has long set the bar for advanced GNSS surveying systems. Through advanced Trimble 360 tracking 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 CMRx communications protocol in the Trimble R8 provides unprecedented correction compression for optimized bandwidth and full utilization of 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; 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 NTRIP caster provides you customized access¹ to base station corrections via the Internet.

¹ Cellular modem required.

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 CU 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 Roads, Monitoring, Mines, and Tunnels—guide crews through common project types and allows 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 sharing 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 adjust collected data with confidence.

The Trimble R8 GNSS system—the industry leader for GNSS surveying applications.



DATASHEET

TRIMBLE R8 GNSS VRS ROVER

KEY FEATURES

Proven GNSS technology from Trimble

Internal GSM/GPRS modem for fast Internet connection and data transfer

Lightweight, ergonomic, and cable free

Designed to optimally support the Trimble GNSS infrastructure solution



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® TSC2® controller. 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.



Trimble R8s GNSS SYSTEM

PERFORMANCE SPECIFICATIONS¹

Measurements

- Advanced Trimble Maxwell 6 Custom Survey GNSS chips with 440 channels
- Future-proof your investment with Trimble 360 tracking
- High precision multiple correlator for GNSS pseudorange measurements
- Unfiltered, un-smoothed pseudorange measurements data for low noise, low multipath error, low time domain correlation and high dynamic response
- Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
- Signal-to-Noise ratios reported in dB-Hz
- Proven Trimble low elevation tracking technology
- Satellite signals tracked simultaneously:
 - GPS: L1C/A, L1C, L2C, L2E, L5
 - GLONASS: L1C/A, L1P, L2C/A, L2P, L3
 - SBAS: L1C/A, L5 (for SBAS satellites that support L5)
 - Galileo: E1, E5A, E5B
 - BeiDou (COMPASS): B1, B2
- SBAS: QZSS, WAAS, EGNOS, GAGAN
- Positioning rates: 1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz

POSITIONING PERFORMANCE²

Code differential GNSS positioning	
Horizontal.....	0.25 m + 1 ppm RMS
Vertical.....	0.50 m + 1 ppm RMS
SBAS differential positioning accuracy ³	typically <5 m 3DRMS
Static GNSS surveying	
High-Precision Static	
Horizontal.....	3 mm + 0.1 ppm RMS
Vertical.....	3.5 mm + 0.4 ppm RMS
Static and Fast Static	
Horizontal.....	3 mm + 0.5 ppm RMS
Vertical.....	5 mm + 0.5 ppm RMS
Postprocessed Kinematic (PPK) GNSS surveying	
Horizontal.....	8 mm + 1 ppm RMS
Vertical.....	15 mm + 1 ppm RMS
Real Time Kinematic surveying	
Single Baseline <30 km	
Horizontal.....	8 mm + 1 ppm RMS
Vertical.....	15 mm + 1 ppm RMS
Network RTK⁴	
Horizontal.....	8 mm + 0.5 ppm RMS
Vertical.....	15 mm + 0.5 ppm RMS
Initialization time ⁵	typically <8 seconds
Initialization reliability ⁶	typically >99.9%

HARDWARE

Physical	
Dimensions.....	19 cm x 10.4 cm (7.5 in x 4.1 in), including connectors
Weight.....	1.52 kg (3.35 lb) with internal battery, internal radio and antenna 3.81 kg (8.40 lb) items above plus range pole, controller & internal radio
Operating Temperature ⁸	-40 °C to +65 °C (-40 °F to +149 °F)
Storage Temperature.....	-40 °C to +75 °C (-40 °F to +167 °F)
Humidity.....	100%, condensing
Ingress Protection.....	IP67 dustproof, protected from temporary immersion to depth of 1 m (3.28 ft)
Shock and vibration.....	Tested and meets the following environmental standards:
Shock.....	Non-operating: Designed to survive a 2 m (6.6 ft) pole drop onto concrete. Operating: to 40 g, 10 msec, sawtooth
Vibration.....	MIL-STD-810F, FIG.514.5C-1

ELECTRICAL

- Power: 10.5 V DC to 28 V DC external power input with over-voltage protection on Port 1 (7-pin Lemo)
- Rechargeable, removable 7.4 V, 2.8 Ah Lithium-ion smart battery
- Power consumption is <3.2 W in RTK rover mode with internal radio and Bluetooth[®] in use⁹
- Operating times on internal battery⁸:
 - 450 MHz receive only option..... 5.0 hours
 - 450 MHz receive/transmit option (0.5 W)..... 2.5 hours
 - Cellular receive option..... 4.0 hours

COMMUNICATIONS AND DATA STORAGE

- Serial: 3-wire serial (7-pin Lemo) on Port 1; full RS-232 serial (Dsub 9 pin) on Port 2
- Radio Modem¹⁰: fully integrated, sealed 450 MHz wide band receiver/transmitter with frequency range of 403 MHz to 473 MHz, support of Trimble, Pacific Crest, and SATEL radio protocols:
 - Transmit power: 0.5 W
 - Range: 3–5 km typical / 10 km optimal¹⁰
- Cellular¹¹: fully integrated, sealed internal GSM/GPRS/EDGE/UMTS/HSPA+ modem option. CSD (Circuit-Switched Data) and PSD (Packet-Switched Data) supported. Global Operation:
 - Penta-Band UMTS/HSPA+ (850/900, 900, 1900, and 2100 MHz)
 - Quad-Band GSM/CSD & GPRS/EDGE (850, 900, 1800, and 1900 MHz)
- Bluetooth[®]: fully integrated, fully sealed 2.4 GHz communications port (Bluetooth[®])¹²
- External communication devices for corrections supported on Serial and Bluetooth ports
- Data storage: 56 MB internal memory, 960 hours of raw observables (approx. 1.4 MB/day), based on recording every 15 sec from an average of 34 satellites

Data Formats

- CMR, CMR+, CMRr, RTCM 2.1, RTCM 2.3, RTCM 3.0, RTCM 3.1, RTCM 3.2 inputs and outputs
- 23 NMEA outputs, GSOF, RT17 and RT27 outputs, supports BINEX and smoothed carrier

WebUI

- Offers simple configuration, operation, status, and data transfer
- Accessible via Serial and Bluetooth

Supported Trimble Controllers¹

- Trimble TSC3, Trimble Slate, Trimble CU, Trimble Tablet Rugged PC

CERTIFICATIONS

IEC 60950-1 (Electrical Safety); FCC OET Bulletin 65 (RF Exposure Safety); FCC Part 15.105 (Class B), Part 15.247, Part 90; PTCRB (AT&T); Bluetooth SIG; IC ES-003 (Class B); Radio Equipment Directive 2014/53/EU, RoHS, WEEE; Australia & New Zealand RCM; Japan Radio and Telecom MIC

- Based on Trimble R8s GNSS receiver configuration. Radio frequency settings are country specific.
- Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, EM and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation time appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specifications.
- Depends on SBAS system performance.
- Network RTK RRM values are referenced to the closest physical reference station.
- May be affected by atmospheric conditions, signal multipath, obstructions and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
- Receiver will operate normally to -40 °C, internal batteries are rated to -20 °C, optional internal cellular modem operates to -40 °C.
- Tracking GPS, GLONASS and SBAS satellites.
- Varies with temperature and wireless data rate. When using a receiver and internal radio in the transmit mode, it is recommended that an external 6 Ah or higher battery is used. The specified operating times on an internal battery for the cellular receive option are in GSM CSD (Circuit-Switched Data) or GPRS PSD (Packet-Switched Data) mode.
- Varies with terrain and operating conditions.
- Bluetooth type approvals are country specific.

Specifications subject to change without notice.



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TRANSFORMING THE WAY THE WORLD WORKS



ML-1 & ML-1M MAGNETIC LOCATORS



KEY FEATURES

- 1 Low Battery Warning
- 2 Speaker
- 3 On/Off & Volume Control
- 4 Gain Up
- 5 Gain Down
- 6 - and + Signal Strength

FEATURES

- Easy & simple one-hand operation, built-in handle.
- Easy to learn — 3 keypad switches:
- ON/OFF & Volume, Sensitivity Up, Sensitivity Down.
- Volume built into the on/off key: just hold down the key while it cycles through settings.
- Microprocessor remembers the volume and gain settings from the last time the unit was on.
- Non-metered (ML-1), and Metered (ML-1M) versions designed to look, feel, and operate exactly the same, with the same life-time warranty.
- ML-1M version with LCD shows positive or negative polarity and signal strength. Detects edges of covers, pipe joints.
- The metered version (ML-1M) adds features without complexity. No learning curve between units.
- Strong aluminum "MonoTube" construction from the tip through the end of the handle and ABS injection-molded electronics case provides the best structural integrity in a hand-held locator.
- Lightweight, only about 2 pounds, including batteries.
- Uses 2 regular alkaline 9-volt batteries, parallel; and the unit is shipped with 2 spare batteries.
- Soft-pack carrying case included. Hard case optional.
- Over 5000 ML-1 units in Afghanistan used for detection of Improvised explosive devices (IEDs) and Unexploded Ordnance (UXOs)
- 7 year warranty.
- Battery compartment separated from electronic components and circuit board. No exposing electronics to replace the batteries.

SPECIFICATIONS

- **SIZE**
Length of the tube is approximately 1.25' x 38.75", tip to tip. The electronics compartment is ABS injection molded plastic approximately 3.25" tapered to 2.5" wide x 4.5" deep tapered to 2.5"
- **WEIGHT**
2lbs. including batteries
- **BATTERY LIFE**
40 hours minimum
- **POWER**
2 each, 9-volt alkaline batteries in custom molded bottom compartment.
- **FUNCTION**
Electronic keypad that clicks when a key is depressed. A real speaker is in the front panel providing outstanding volume.
- **CARRYING CASE**
Soft-pack custom case, instruction manual, and 2 sets of 9-volt batteries (1 set is a spare).
Optional hard case available.



- Includes:**
- Soft-pack custom case
 - Instruction manual
 - 2 sets of 9-volt batteries
 - (1 set is a spare).
- Optional hard case available.



SubSurface Instruments, Inc. | 1841-C Pine Park Drive, De Pere, WI. 54115
toll free: 855.422.6346 | Website: www.sillocators.com | email: info@sillocators.com



MUL-1 MAGNETIC UNDERWATER LOCATOR

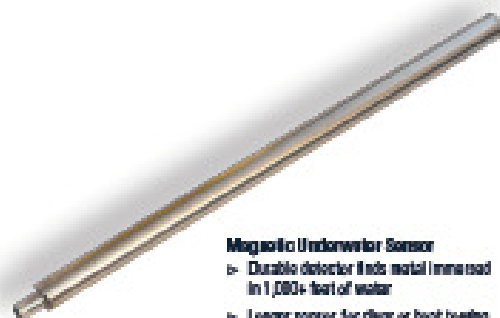


KEY FEATURES

- 1 LCD Display
- 2 Connectors/Panel
- 3 Connectivity Cables
- 4 Control Panel
- 5 Magnetic Underwater Locator
- 6 Audio Speakers

FEATURES

- Heavy-duty sensor cable acts as lanyard. 90', 50', 100' (non-standard lengths available)
- High-quality connectors and "Telltale Seal" cover over headset jack. "Seacon" connectors available.
- Alligator clips for 12-volt auxiliary power.
- Gel-cell auto-charges when auxiliary power connected.
- "Zero" to "Null" gradient.
- Permanent gel-cell battery-mounted under electronics panel.
- Bell-nosed and tapered sensor on BHS; longer sensor on MUL for diver or boat towing.
- 1 year warranty



Magnetic Underwater Sensor

- Durable detector finds metal immersed in 1,000+ feet of water
- Longer sensor for diver or boat towing.

SPECIFICATIONS

CONTROLS

- On, Off
- Volume Up and Down
- Range setting (Gain or Sensitivity) Up and Down
- Zero, Plus and Minus
- Auto Zero - Automatic self-adjusting

OUTPUTS

- Audio Frequency Pitch (speaker and jack for headset)
- Visual LCD Display
- Bar Graph - range (Gain setting - milligauss)
- RS-232 PC connection (cable included)
- Control all keypad functions data log range, keypad and signal settings works with hyper terminal or equivalent

POWER OPTIONS

- Internal Battery: 12-volt, 7.2Ah sealed lead acid
- Battery Life: 72 hours continuous use, charges to full overnight
- External Power: 12 to 15-volt, cable included
- Internal battery charging circuit is enabled when external power or AC charging cable is connected

DIMENSIONS

- Electronics: 16.9" w x 10" h x 6.5" d
- Sensor: 1.625" d x 34.375" L (4.13m x 47.3cm)



Included:

- ABS design case
- Connectivity cables
- Instruction manual



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NEW

The CastAway™-CTD with profiling and analysis software

CastAway
CTD



*The CastAway-CTD
Instant, reliable data in the
palm of your hand!*

Pure
Data for a
Healthy
Planet.®

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.



The CastAway is a multifunctional tool that incorporates the most modern technology available - yet is simple to use. It is designed for CTD profiling down to 100 m and is easy to deploy.



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



Teledyne Odom Hydrographic

Echotrac MK III

Dual-Frequency Echo Sounder

The Compact Unit that Does It All

Like to keep your options open? Then Teledyne Odom's ECHOTRAC MKIII is the echo sounder for you! It's the only sounder on the market offering you the choice of either a high-resolution thermal paper recorder.

When it comes from Teledyne Odom, you know it's durable, easy to use and backed by the best customer service in the industry. Both high and low channels feature frequency agility, enabling the operator to precisely match the transceiver to almost any existing transducer. This matching ability minimizes near-surface noise caused by transducer ringing while increasing echo return strength. The MKIII is capable of both shallow and deep-water operations, and it features unsurpassed interfacing flexibility with four serial ports and high speed Ethernet capability for maximum efficiency.

More than 30 years of technology enhancements, along with unparalleled performance and precision make TOH sounders the #1 choice for Hydrographic Offices around the world.



PRODUCT FEATURES

- | | | |
|--|--|---|
| <ul style="list-style-type: none">• Interchangeable paper chart• Frequency agile (both channels)• Internal data storage• Four serial ports and Ethernet interface | <ul style="list-style-type: none">• AC/DC power input• Selectable Receiver bandwidth for shallow/deep water echo sounding• Silas compatible output for sediment analysis | Options <ul style="list-style-type: none">• Remote Display• Side Scan Transducer 200kHz or 340kHz |
|--|--|---|

A Teledyne Marine Company



TELEDYNE
ODOM HYDROGRAPHIC
Everywhere you look™

Echotrac MK III

Dual-Frequency Echo Sounder

TECHNICAL SPECIFICATIONS

Frequency	High band: 100kHz-1MHz Low band: 3.5kHz-50kHz
Output Power	High: 100kHz-1kW RMS max 200kHz-900W RMS max, 750kHz-300W RMS max Low: 3.5kHz-2kW RMS max, 50kHz-2kW RMS max
Input Power	110 or 220VAC / 24 VDC 120 watts start/50 watts run
Resolution	0.01m / 0.10 ft.
Accuracy	0.01m / 0.10 ft. +/- 0.1% of depth @ 200kHz 0.10m / 0.30 ft. +/- 0.1% of depth @ 33kHz 0.18m / 0.60 ft. +/- 0.1% of depth @ 12kHz (corrected for sound velocity)
Depth Range	0.2-200m / 1.0-600 ft. @ 200kHz 0.5-1500m / 1.5-4500 ft. @ 33kHz 1.0-4000m / 3.0-13,123 ft. @ 12kHz
Phasing	Automatic scale change, 10%, 20%, 30% overlap or manual
Printer	High resolution 8 dot/mm (203 dpi); 16 gray shades; 216mm (8.5 in) wide thermal paper or film; External ON/OFF switch; Paper advance control
Paper Speed	1cm/min. (0.5 in/min.) to 22 cm/min. (8.5 in/min.); Auto = one dot row advance for each Ping
Sound Velocity	1370-1700m/s Resolution 1m/s
Transducer Draft Setting	0-15m (0-50 ft.)
Depth Display	On control PC and LCD display
Clock	Internal battery backed time, elapsed time and date clock
Annotation	Internal-date, time External-up to 80 ASCII characters from RS232 Serial or Ethernet port
Interfaces	4 X RS232 or 3 X RS232 and 1 X RS422 Inputs from external computer, motion sensor Outputs to external computer, remote display Ethernet interface Heave-TSS1 or sounder sentence
Blanking	0 to full scale
Installation	Desktop, optional rack mount or bulkhead mount
Help	The function of each parameter and its minimum and maximum values can be printed on the paper chart. The record of settings in tabular format is available on demand, and a continuous printout of parameters is available on thermal paper models. Log files are automatically created by Echotrac Control when that software is used to control the sounder.
Environmental Operating Temperature	0°-50°C, 5-90% relative humidity, non-condensing
Dimensions	450mm (17.7 in) H x 450mm (17.7 in) W x 300mm (12.8 in) D
Weight	16kg (35lbs.)
Options	3.5kHz 4-element sub-bottom array



Specifications subject to change without notice.
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