W00435

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service

# DESCRIPTIVE REPORT

| | |
|---|---|
| Type of Survey: | Field Examination |
| Registry Number: | W00435 |

## LOCALITY

| | |
|---|---|
| State(s): | Mississippi |
| General Locality: | Mississippi Coastline |
| Sub-locality: | St. Louis Bay |

**2014**

CHIEF OF PARTY
Alberto Neves

LIBRARY & ARCHIVES

Date:

| U.S. DEPARTMENT OF COMMERCE<br>NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION | REGISTRY NUMBER: |
|---|---|
| **HYDROGRAPHIC TITLE SHEET** | **W00435** |

INSTRUCTIONS: The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

| | |
|---|---|
| State(s): | **Mississippi** |
| General Locality: | **Mississippi Coastline** |
| Sub-Locality: | **St. Louis Bay** |
| Scale: | **20000** |
| Dates of Survey: | **06/09/2014 to 06/19/2014** |
| Instructions Dated: | **11/05/2021** |
| Project Number: | **ESD-PHB-18** |
| Field Unit: | **University of Southern Mississippi** |
| Chief of Party: | **Alberto Neves** |
| Soundings by: | **ODIM Brooke Ocean MB1** (**MBES**)<br>**EdgeTech 4600** (**Interferometric**) |
| Imagery by: | **EdgeTech 4600** (**SSS**) |
| Verification by: | **Pacific Hydrographic Branch** |
| Soundings Acquired in: | **meters at Mean Lower Low Water** |

Remarks:

***Any revisions to the Descriptive Report (DR) applied during office processing are shown in red italic text. The DR is maintained as a field unit product, therefore all information and recommendations within this report are considered preliminary unless otherwise noted. The final disposition of survey data is represented in the NOAA nautical chart products. All pertinent records for this survey are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via https://www.ncei.noaa.gov/. Products created during office processing were generated in NAD83 UTM 16N, MLLW. All references to other horizontal or vertical datums in this report are applicable to the processed hydrographic data provided by the field unit.***

# DESCRIPTIVE REPORT MEMO

November 05, 2021

**MEMORANDUM FOR:** Pacific Hydrographic Branch

**FROM:** Report prepared by PHB on behalf of field unit
Alberto Neves
Hydrographic Science Program Coordinator, University of Southern Mississippi

**SUBJECT:** Submission of Survey W00435

The primary objective of conducting a hydrographic survey in this area was to provide the Bay-Waveland Yacht Club (BWYC), as well as the City of Bay St. Louis, information about their respective marinas with regards to silting and access to deep water. This was accomplished with a high resolution Multi-Beam Echo-Sounder (MBES) and Side Scan Sonar (SSS) System.

A MBES surface, gridded at 50cm, was produced from this survey.

All soundings were reduced to Mean Lower Low Water using Constant Separation. The horizontal datum for this project is North American Datum of 1983 (NAD 83). The projection used for this project is Universal Transverse Mercator (UTM) Zone 16.

All survey systems and methods utilized during this survey were as described in ESD-PHB-21_DAPR.

All data were reviewed for DTONs and none were identified in this survey.

University of Southern Mississippi acquired the data outlined in this report. Additional documentation from the data provider may be attached to this report.

See attached report for details on acquisition, processing, and results.

This survey does meet charting specifications and is adequate to supersede prior data. The survey meets charting quality CATZOC B.

THE UNIVERSITY OF SOUTHERN MISSISSIPPI.

**Bay St Louis, MS**
**New Marina and Bay Waveland Yacht Club**

# 14USM02 Descriptive Report

**Date:** July 15, 2014

**Prepared By:**
Kira Fargo
Matthew Niles
Monica Price
Hembal Teckmun
William Tubbs
Mohammad Uddin
Antonio Williams

**Acknowledgement**

The Bay St. Louis team has put a lot of effort in undertaking this hydrographic project. However, without some help from others, our efforts would not have been sufficient to complete this project successfully. We are very grateful to the following people:

- All of the faculty members of the Hydrographic Department for their continuous and invaluable help and support throughout the entire project.
- Harold Olsen, director of the Community Development Department of Bay St. Louis City for accepting our project to survey the Bay St. Louis Municipal Harbor and Pier
- Claude H. Dannemann , Commodore of Bay-Waveland Yacht Club for providing a secure place to dock our boat.
- Steve Cutcomb and John Gann, Chesapeake Technology for support in SonarWiz 5
- Geoffrey Gomez and Andrea Lindblad of ESRI for support in ArcGIS
- Lisa Brisson, Product Engineer from Edgetech for support in processing Edgetech Bathymetry
- Matthew Gudger and Marc Thibodeau from CARIS for advice on multibeam processing.
- Evan Martzial and Scott Nesbitt from QPS for support in processing in QINSy.
- A special thanks to Teledyne-Odom Hydrographic for lending us a MB1 multibeam echosounder. Without the assistance of Kim Dailey in getting us permission and to Michael Redmayne and Marvin Story for training us on the MB1 and helping us to set it up, this survey would lack a bathymetric reference surface.

| | |
|---|---|
| **Title** | New Marina and Bay Waveland Yacht Club |
| **Registry Number** | 14USM02 |
| **Team Members** | Kira Fargo<br>Matthew Niles<br>Monica Price<br>Hembal Teckmun<br>William Tubbs<br>Mohammad Uddin<br>Antonio Williams |
| **Locality** | United States - Gulf Coast - Mississippi |
| **Chart No. and Scale** | NOAA Chart 11372, Scale 1:40,000 |
| **Product Scale** | 1:500<br>1:750<br>1:5000 |
| **Positional Accuracy** | IHO Order 1a<br>NOAA 1m Object Detection Survey |
| **Horizontal Datum** | NAD83 (print charts), WGS84 (ENC) |
| **Vertical Datum** | MLLW |
| **Charts Affected** | NOAA Charts 11372, 11371 |
| **ENC Affected** | US5MS11M, US4MS10M, US3GC04M, US2GC09M, US1GC09M |
| **Prior Surveys** | H11617 (2007), 11USM01 (2011) |

# Contents

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# A Area Surveyed

This object detection survey was conducted to the specifications outlined in the University of Southern Mississippi Hydrographic Survey Specification 14USM02, New Marina and Bay Waveland Yacht Club. The survey extends from the Bay Waveland Yacht Club to the Bay St. Louis Municipal Harbor (new marina). The New Marina was under construction during the survey but has since been finished. The new marina, sea walls, as well as ATONS are added to the updated chart. The survey was required to meet the National Oceanic and Atmospheric Administration (NOAA) 1m object detection standards. The International Hydrographic Organization (IHO) order 1a standard was used and met in over 99% of the area surveyed.

## A.1 Purpose and Description

The purpose of the survey was to provide the Bay-Waveland Yacht Club (BWYC) as well as the City of Bay St. Louis information about their respective marinas with regards to silting and access to deep water. This was accomplished with a high resolution Multi-Beam Echo-Sounder (MBES) and Side Scan Sonar (SSS) System to check existing chart information as well as historical data. In addition, a Phase-Differencing Bathymetric Sonar (PDBS) was used to verify functionality and compare to the MBES for accuracy.

The survey area was divided into three sub-areas denoted 1, 2 and 3 which correspond to the priority. Area 1 is the BWYC and is principally concerned with silting in and around the immediate area. Area 2 is the new marina and city officials are concerned with boat draft clearance and the effectiveness of dredging. Area 3 is the area and channel between the two marinas, identifying the depths out to the 2 m contour.

SSS coverage for areas 1, 2, and 3 is shown in figure 1. MBES coverage with the Odom MB1 for areas 1, 2, and 3 are shown in figure 2 and the coverage with the EdgeTech 4600 can be seen in figure 3.

The survey was conducted to the NOAA 1m object detection survey requirements. No objects of 1m or greater size were identified and therefore a smaller object detection standard was used. If an object was found with a length or width of 1m or greater and/or the object protruded from the bottom by 0.3m or greater, it was included in the report. The survey was done to IHO Order 1a standards as required.

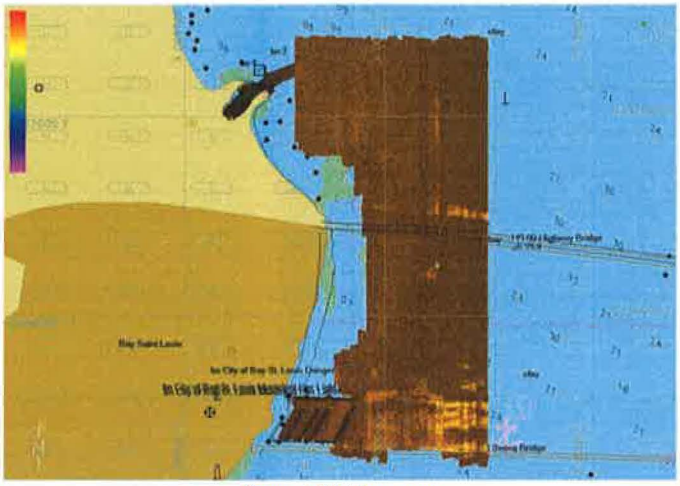

Figure 1 SSS Coverage

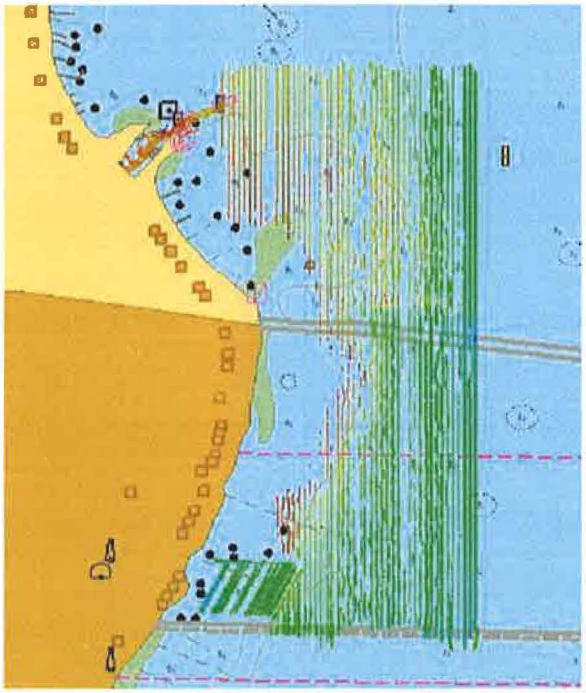

Figure 2 MB1 Coverage

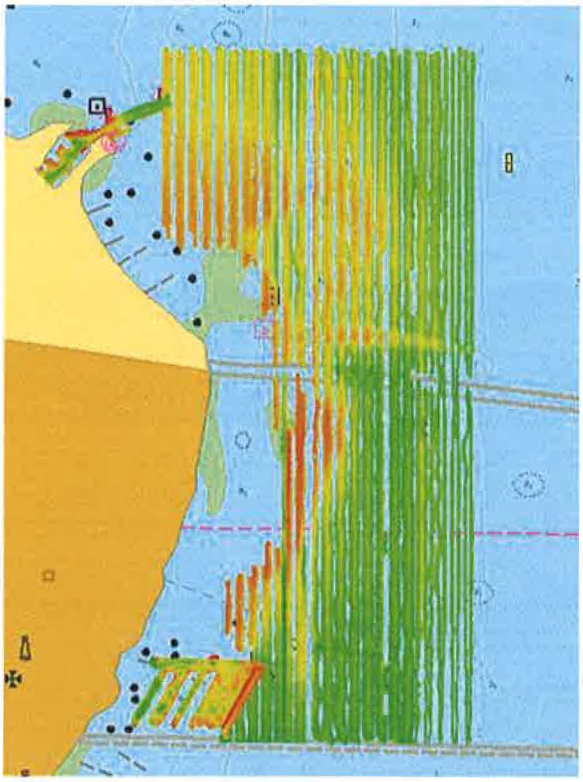

Figure 3 EdgeTech MB Coverage

## A.2 Survey Statistics

| Area | Mainlines Linear NM | Crosslines Linear NM | SSS Lines Linear NM | Seabed Samples | ATONs Positioned | DTONs |
|---|---|---|---|---|---|---|
| 1 | 1.43 | 0.10 | 1.43 | 1 | 6 | 1 |
| 2 | 3.20 | 0.47 | 3.20 | 1 | 2 | 0 |
| 3 | 39.38 | 3.81 | 39.38 | 2 | 20 | 1 |

Table 1 Survey Statistics

## A.3 Chronology

| Date | Julian Day | Activity |
|---|---|---|
| 21-May | 141 | Tide gauge calibration |
| 22-May | 142 | Installed tide gauge at Jimmy Rutherford Pier<br>3 hours of simultaneous observations between the tide gauge and tide staff |
| week of 2-6-Jun | 153-158 | Vessel prepartation |
| 2-Jun | 153 | Configure equipment on the vessel |
| 3-6 Jun | 154-158 | Troubleshooting and hardware issues |
| 4-Jun | 155 | Vessel configuration survey |
| 5-Jun | 156 | Installed new primary benchmark<br>Level in tide gauge<br>Completed static GNSS observation of primary benchmark<br>Begin shorelining |
| 6-Jun | 157 | Shorelining<br>Equipment testing in the Pearl River |
| 9-Jun | 160 | Discussion with Teledyne Odom represenative concerning MB1 operations.<br>Complete shorelining<br>Equipment Testing and Side Scan Sonar calibration check<br>First day of Hydrographic Survey Operations, Area 1, Bay Waveland Yacht Club<br>Attempted first Patch Test in Area 1 |
| 10-Jun | 161 | Bad Weather Day, secured the boat |
| 11-Jun | 162 | Second Patch Test attempt, performed in Pass Christian, bad weather<br>Side Scan Sonar calibration check<br>New Marina Survey |
| 12-Jun | 163 | Third Patch Test in Pass Christian with better weather<br>Side Scan Sonar calibration check<br>Start eastern section of Area 3<br>Redo Area 1, Bay Waveland Yacht Club |
| 15-Jun | 164 | Bad Weather Day, secured the boat |
| 16-Jun | 167 | Continuing with Area 3<br>Side Scan Sonar calibration check |
| 17-Jun | 168 | Finish Development lines in Area 3<br>Side Scan Sonar calibration check<br>Survey Navaids around Area 2<br>Complete cross check lines in Area 3 |
| 18-Jun | 169 | Continue with navaid surveying<br>Side Scan Sonar calibration check<br>Completed Patch Test Lines in Pass Christian<br>Target Investigations |
| 19-Jun | 170 | Target Investigations<br>Side Scan Sonar calibration check<br>Complete navaids survey<br>Complete survey collection and equipment breakdown |
| 20-Jun | 171 | Return R/V Frying Pan back to USM Stennis Space Center |
| 1-Jul | 182 | Level out tide gauge<br>3 hours of simultaneous observations between the tide gauge and tide staff<br>Calibrate tide gauge. |

Table 2 Chronology

# B Data Acquisition and Processing

This section contains an overview of the equipment, processes and results of the data acquisition and processing conducted during the survey. For more detailed information, refer to the supplementary 14USM02 Data Acquisition and Processing Report.

## B.1 Equipment

### B.1.1 Survey Vessel Aluminum Skiff Equipment

The new USM Aluminum skiff, was used for data collection during the summer project. This skiff has a flat bottom hull constructed of aluminum. It is 6.3 m in length, has a beam of 2.5m and a draft of 0.2 m. It was equipped with over-the-side pole mounts for the MB1 and the EdgeTech together with supporting ancillary equipment, all of which is shown in table 3.

| Task | Equipment | Model | Serial Number | Use |
|---|---|---|---|---|
| Vessel Configuration Survey | Total station | Leica TS02 | 216915 | Angular and distance measurements |
| | Tripods | Seco Tri-Max | N/A | |
| | Tribrach | Leica GDF112 | 180 | |
| | Prisms and rod | GPM111 | 187 | |
| | Prism | GPR111 | 185 | |
| | Reflective sheet | N/A | N/A | |
| | Measuring tape | Fiberglass 60m | N/A | |
| Shorelining | Topcon GNSS receiver | TopCon GR-3 | 433-0511 | Shoreline positioning |
| | Rover Rod wheel | TopCon GPS Milimeter | 22-050908-01 | Shoreline positioning |
| Leveling Operations | Three wire automatic level | Leica NA 2002 | USM 182874 | Benchmark leveling |
| | Leveling rods | Leica NA 2002 | N/A | Benchmark leveling |
| | Topcon GNSS receiver | TopCon GR-3 | 433-0511 | Benchmark positioning |
| On Water Operations | | | | |
| Motion Reference | IMU | Applanix | 623067054 | Heave/pitch/row measuremant |
| | POS computer system | POS MV V4 | 2791 | Motion processor and interface |
| | Trimble GNSS antenna | Zephyr model 2 | 1440912441 | Primary POS GNSS antenna |
| | Trimble GNSS antenna | Zephyr model 2 | 30939221 | Secondary POS GNSS antenna |
| Positioning | CNAV GNSS antenna | ANT3001R | 5906 | Primary navigation |
| | CNAV GNSS receiver | CNAV 3050 | 12462 | Primary navigation |
| | Trimble GNSS antenna | Zephyr geodetic | 12681297 | Backup navigation |
| | Trimble GNSS receiver | Trimble NetRS | 4440239259 | Backup navigation |
| Data Acquisition | "Field 2" laptop | Dell Latitude E6510 | 214471 | CNAV logging, MB1 Controller and HYPACK data acquisition |
| | MB1 multibeam sonar | Teledyne Odom Demo 2 | 100126 | Bathymetry |
| | MB1 multibeam processor | Teledyne Odom MB1 | 220047 | Bathymetry |
| | Edgetech 4600 sonar | Edgetech 4600 | 215070 | Phase differencing bathymetry and SSS |
| | Edgetech 4600 sonar Interface | Edgetech 4600 | 40282 | Controls sonar |
| | Edgetech 4600 processor | Edgetech 4600 | 40182 | Edgetech 4600 computer , QINSy and POS MV Controller |
| | Edgetech 4600 casing | Edgetech 4600 | 40283 | |
| | Sound velocimeter | Odom Digibar Pro 1200 probe and handheld unit | 214819 | Sound speed determination |
| | Tide Staff x2 | | | Graduated rod for measuring water level |
| | Tide Gauge | In-Situ Level Troll 700 | 144380 | Automatic tidal measurement and recording |
| | Seabed sampler | Wildco Petite Ponar Grab | N/A | Analysis of seabed samples |
| Miscellaneous | LAN Hub | Netgear | 2362155G0222E | Networking |
| | UPS | ACP | JB0638033009 | Uninterrupted power supply |
| | Monitor | Dell | KR-006HRM-47602-17R-ARXS | display |
| | Monitor | Dell | MX-07R477-48323-38K-OFD7 | display |
| | External Hard Disk | Lacie | N/A | Backup |
| | Measuring Tape | Fiberglass 60m | N/A | Measure draft |

Table 3 Skiff Al Equipment

### B.1.2 Geodetic and Tidal Equipment

Benchmark leveling, geodetic observations and tidal observations were conducted using the equipment detailed in table 4.

| Task | Equipment | Model | Serial Number | Use |
|---|---|---|---|---|
| **Leveling Operations** | Three wire automatic level | Leica NA 2002 | USM 182874 | Benchmark leveling |
| | Leveling rods | Leica NA 2002 | N/A | Benchmark leveling |
| | Topcon GNSS receiver | TopCon GR-3 | 433-0511 | Benchmark positioning |

Table 4 Geodetic and Tidal Equipment

Prior to each use, the Leica NA2002 level was checked for collimation error by performing a C-Check.

The Level Troll 700 tide gauge was user calibrated in the 1.5m test tank against a graduated staff in building 1029 prior to deployment. The results of the calibration can be seen in table 5.

| Calibration Results | RMS |
|---|---|
| Pre Survey | 0.0007 |
| Post Survey | 0.0009 |
| Average | 0.0008 |

Table 5 Calibration Results

### B.1.3 Data Processing Software

Data collection and processing software versions utilized throughout the survey are shown in table 6.

| Task | Software | Version | Use |
|---|---|---|---|
| Data Collection | Win-Situ 5 | 5.6.21.0 | Automatic tidal measurement and recording |
| | Edgetech Discover Bathymetric | 33.0.1.112 | Edgetech 4600 side scan logging |
| | QINSy Console | 8.10 | Edgetech 4600 bathymetry logging |
| | HYPACK | 13.0 13.0.0.6 | MB1 bathymetry logging |
| | Applanix MV-POS Controller | 6.05 | Motion control and logging |
| | C-NAV C-Setup | 7.0.5 | CNAV control and logging |
| | Internet Explorer | 11.0.960.17107 | Trimble NetRS Control and logging |
| | Image | 1.1.13 | MB1 bathymetry Controller and real time processing |
| Data Processing | PC-CDU | 7.12 | Configuring and downloading TOPCON GNSS data |
| | RINEX Utility | 3.6 | Converting CNAV GNSS data to RINEX format |
| | Convert to RINEX - TBC utility | 2.1.4.0 | Converting Trimble GNSS data to RINEX format |
| | GrafNav | 8.30.2105 | Kinematic and static GNSS post processing |
| | CARIS HIPS and SIPS | 8.1.7 and 8.1.8 | Multibeam processing |
| | SonarWiz 5 | 5.05.0023 | Side Scan Sonar processing |
| | MATLAB R2013b | 8.2.0.701 | Data manipulation |
| | ARCGIS | 10.2.2 | Chart and ENC production |
| | NAVOTAS | 4.2.5.0 | Tide zoning calculation |
| | Tide Analyst | 4.2.0.0 | Analysis of tide |

Table 6 Data Processing Software Versions

## B.2 Quality Control

### B.2.1 Data Consistency

#### *EdgeTech*

The EdgeTech PDBS is considered a dual-headed system. Prior to recording any data, a discrepancy was noticed between the port and starboard sides. This problem was reported to EdgeTech Support, but went unresolved in the time allotted for this survey and may have played a role in the condition of the data.


Figure 4 Discover Signal Meter

Data acquired from the EdgeTech required a lot of processing. Larger angles from nadir were extremely inaccurate. A 70 degree angle from nadir filter was used initially to all lines. There was a lot of noise in the yacht club, marina and near the bridges. When entering and exiting the yacht club, the beams closest to nadir indicated depths in excess of 75m as shown in the figure below.

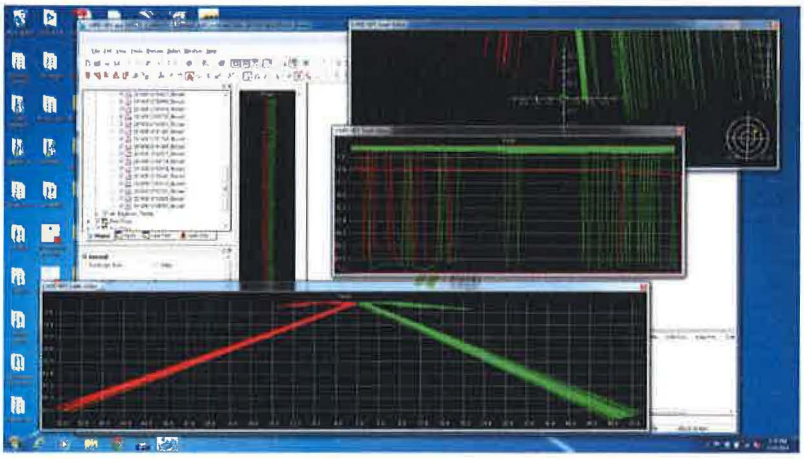

Figure 5 Swath Angle Editor (BWYC)

### *MB1*

The internal consistency of data was generally good up to ±45° Port and Starboard. Therefore, the outer beams between 45-60° on both side (Port and starboard) were filtered during processing using HIPS &SIPS software.

### B.2.2 Crossline Comparison

Crosslines were run perpendicular to the survey lines with a spacing of 15 times the main lines spacing in area 3. Due to the limited space in the yacht club and marina, survey lines were used as cross-check lines. The lines used in the yacht club were perpendicular to each other and the lines chosen at the marina were no less than 45 degrees of an angle to each other. The comparisons were conducted using the QC Report tool in Caris HIPS by selecting the crosslines and the associated base surface.

QC reports were generated after cleaning all the surveyed lines to analyze the quality of the data. In the QC report, it was revealed that on 17 June 14 (Julian day 168) 5-product lines failed to meet the survey specification requirement (Order 1a). Further investigation revealed from Grafnav software ( Used to obtain PPK solution) that though value of HDOP (horizontal Dilution of Precision) met the survey requirement but the PDOP (Position Dilution of Precision) for both Trimble and CNAV exceed the limit thereby failed to meet the required survey standard of IHO order IA for the period 1347-1444 UTC on (17 Jun 14). Following figure shows the HDOP and PDOP values for the mentioned time:

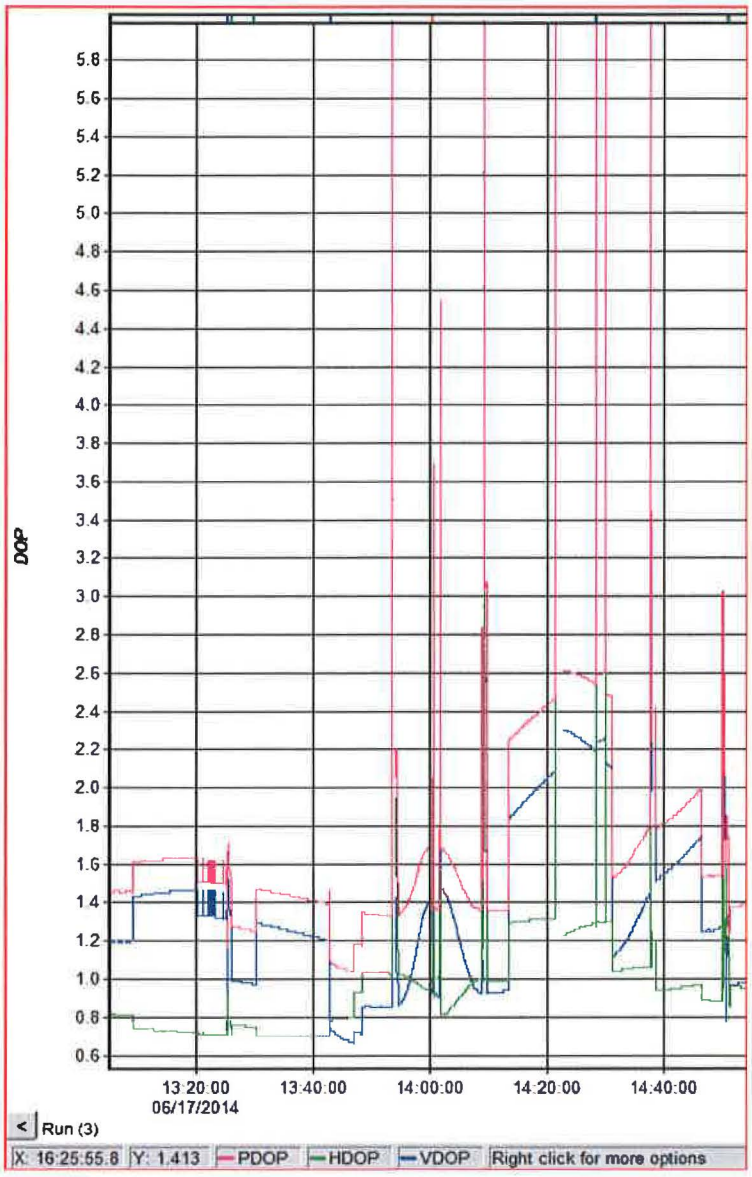


Figure 6 HDOP and VDOP value between the time period 1347-1444 UTC on (17 Jun 14)

Hence, for those five lines (Julian day 168 Hypack line no 288_1347, 289_1401, 290_1415, 291_1429 and 292_144) traditional tide was applied to compare the quality of the data. This time quality of the data improved remarkably and met the survey specification (order 1a). The QC report generated for both ERS and traditional survey lines to compare their result are shown in table 7 and 8:

| QC Report_ERS (Before applying traditional tide) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Beam Number | Count | Max (+) | Min (-) | Mean | Std Dev | Special Order (%) | Order 1a (%) | Order 1b (%) | Order 2 (%) |
| 01 - 11 | 150 | 0.852 | 1.089 | 0.144 | 0.492 | 25.333 | 56.667 | 56.667 | 95.333 |
| 11 - 20 | 4,308 | 0.944 | 1.204 | -0.133 | 0.477 | 36.769 | 68.709 | 68.709 | 92.874 |
| 21 - 31 | 16,024 | 1.055 | 1.293 | -0.148 | 0.419 | 44.652 | 78.152 | 78.152 | 94.415 |
| 31 - 41 | 18,846 | 1.041 | 1.27 | -0.101 | 0.407 | 48.907 | 80.181 | 80.181 | 96.413 |
| 41 - 51 | 19,122 | 1.025 | 1.154 | -0.078 | 0.402 | 48.975 | 79.626 | 79.626 | 97.584 |
| 51 - 61 | 19,062 | 0.89 | 1.122 | -0.066 | 0.399 | 49.397 | 79.042 | 79.042 | 98.19 |
| 61 - 71 | 18,988 | 0.971 | 1.129 | -0.045 | 0.406 | 50.427 | 78.36 | 78.36 | 98.399 |
| 71 - 81 | 18,848 | 1.129 | 1.078 | -0.018 | 0.408 | 50.568 | 78.539 | 78.539 | 98.764 |
| 81 - 91 | 16,856 | 1.12 | 1.098 | -0.033 | 0.38 | 54.675 | 83.045 | 83.045 | 99.075 |
| 91 - 101 | 12,846 | 1.009 | 1.032 | -0.079 | 0.337 | 64.113 | 87.249 | 87.249 | 99.642 |
| 101 - 111 | 2,848 | 0.471 | 1.012 | -0.119 | 0.254 | 78.301 | 90.871 | 90.871 | 99.93 |
| 111 - 121 | 3 | 0 | 0.035 | -0.019 | 0.014 | 100 | 100 | 100 | 100 |

Table 7 QC Reports ERS (Before applying traditional tide

| QC REPORT_After Applying traditionla tide | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Beam Number | Count | Max (+) | Min (-) | Mean | Std Dev | Special Order (%) | Order 1a (%) | Order 1b (%) | Order 2 (%) |
| 01- 10 | 164 | 0.368 | 0.29 | -0.06 | 0.11 | 96.341 | 100 | 100 | 100 |
| 11-20 | 3,655 | 0.406 | 0.303 | -0.011 | 0.094 | 98.988 | 100 | 100 | 100 |
| 21 - 31 | 12,941 | 0.394 | 0.268 | 0.002 | 0.082 | 99.838 | 100 | 100 | 100 |
| 31 - 41 | 15,280 | 0.429 | 0.268 | 0.01 | 0.085 | 99.777 | 100 | 100 | 100 |
| 41 - 51 | 15,172 | 0.399 | 0.24 | 0.032 | 0.084 | 99.69 | 100 | 100 | 100 |
| 51 - 61 | 15,154 | 0.528 | 0.223 | 0.047 | 0.081 | 99.479 | 99.987 | 99.987 | 100 |
| 61 - 71 | 15,105 | 0.519 | 0.217 | 0.07 | 0.08 | 98.974 | 99.987 | 99.987 | 100 |
| 71 - 81 | 14,832 | 0.488 | 0.186 | 0.092 | 0.076 | 97.984 | 100 | 100 | 100 |
| 81 - 91 | 13,267 | 0.406 | 0.162 | 0.099 | 0.076 | 97.92 | 100 | 100 | 100 |
| 91 - 101 | 10,251 | 0.365 | 0.102 | 0.117 | 0.072 | 97.298 | 100 | 100 | 100 |
| 101 - 111 | 2,328 | 0.323 | 0.112 | 0.151 | 0.066 | 94.674 | 100 | 100 | 100 |
| 111 - 121 | 8 | 0.181 | 0 | 0.121 | 0.058 | 100 | 100 | 100 | 100 |

Table 8 QC Report after applying traditional Tide

*EdgeTech*

BWYC: IHO Order 1a was accomplished

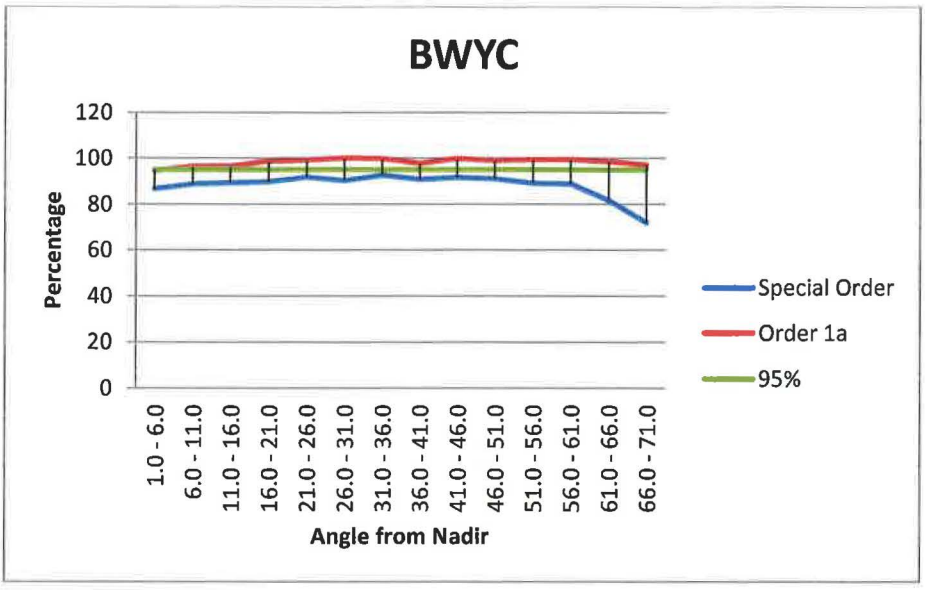


Figure 7 BWYC QC Report

Marina: IHO Order 1a was accomplished after applying a 45 degree filter from nadir

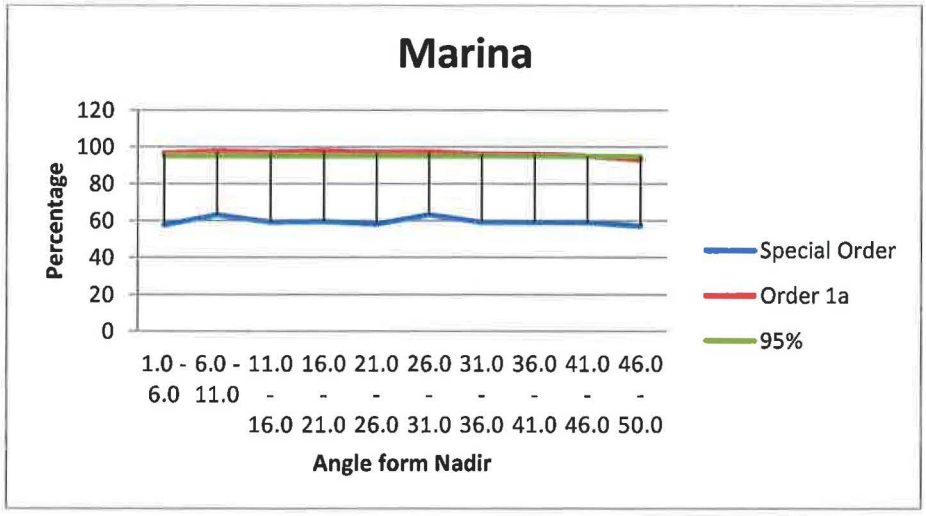


Figure 8 Marina QC Report

Area3: IHO Order 1a was accomplished after applying a 40 degree filter from nadir

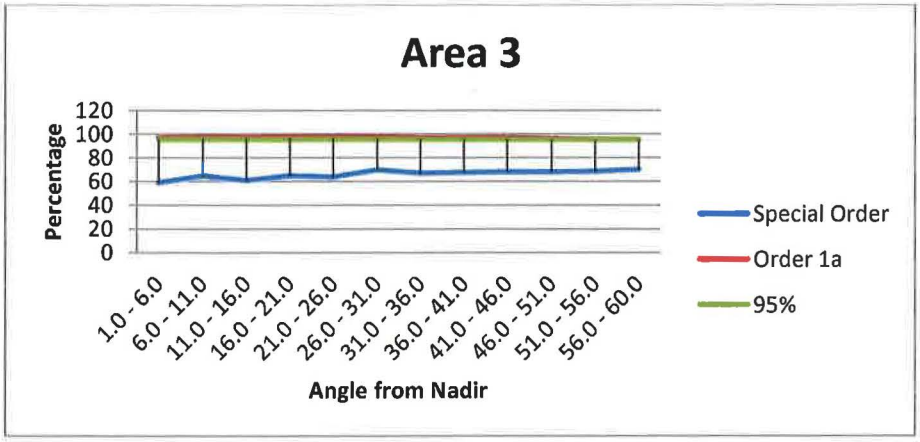


Figure 9 Area 3

## *MB1*

| Area | No. Beams Order 1a | No. Beams Special Order | Order 1a Met? | Special Order Met? | Highest Mean Difference (m) (Included beams only) |
|---|---|---|---|---|---|
| BWYC | 120 (100%) | 120 (99.97%) | Yes | Yes | 0.058 |
| New Marina | 120 (100%) | 120 (99.3%) | Yes | Yes | 0.071 |
| Area 3 | 120 (100%) | 120 (96.40%) | Yes | Yes | 0.105 |

Table 9 Crossline Comparison Results

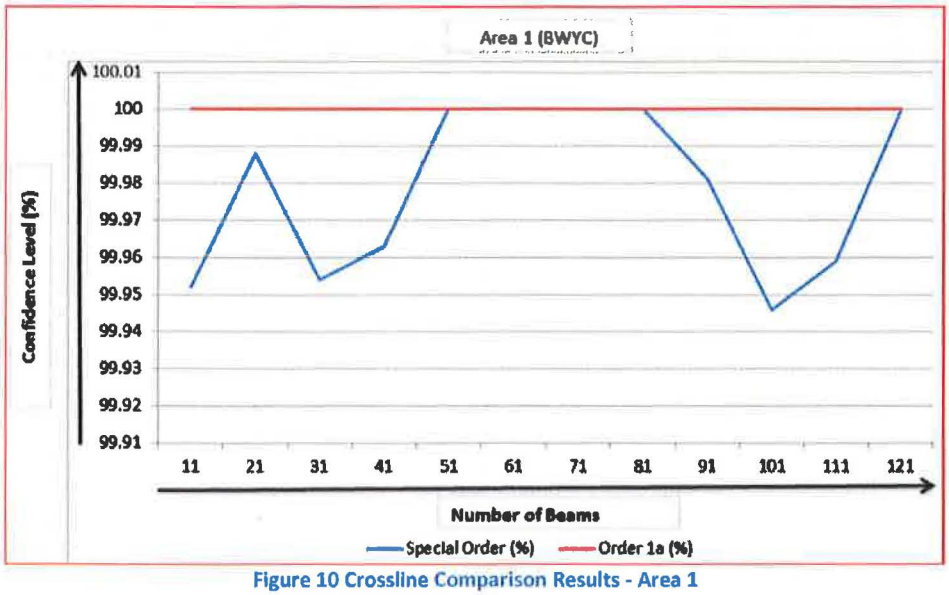


Figure 10 Crossline Comparison Results - Area 1

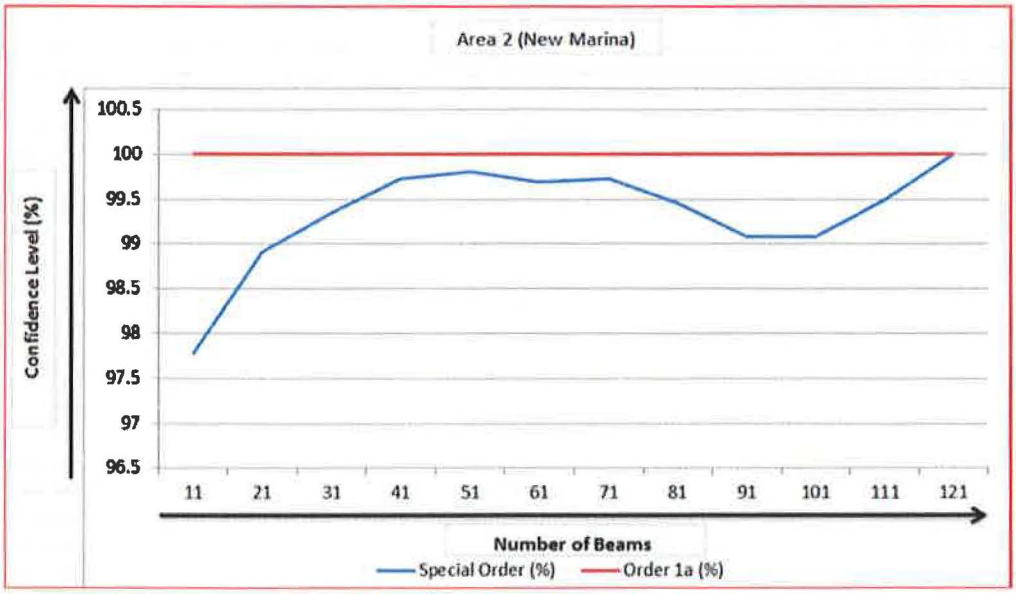


Figure 11 Crossline Comparison Results - Area 2

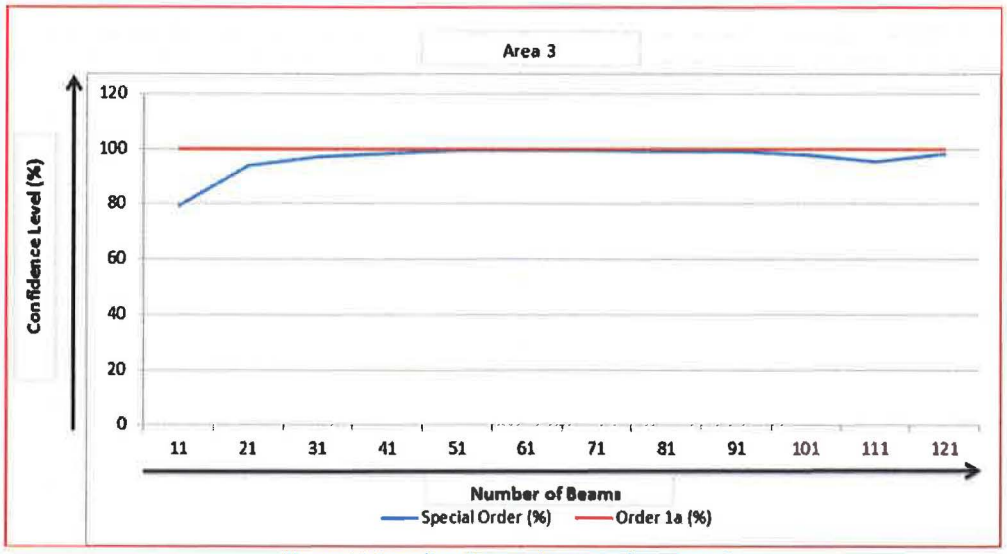


Figure 12 Crossline Comparison Results – Area 3

### B.2.3 Coverage and Junctions

#### *EdgeTech*

The multibeam coverage did not cover 100% of the sea floor as the depths were shallow and therefore this was a skunk stripe survey. Side scan coverage for the overall survey area was 100% at 100% coverage and 86% at 200% coverage. The survey fell short of the 200% due to pier infrastructure and various boats blocking access to areas not covered. In addition, the model created by SonarWiz to generate these percentages does not take into account the boundaries of the survey. Although the entire survey area was ensonified in area3, the outlining areas around the survey area were added to the calculations.

| Area | Total Area (m^2) | Coverage Area (m^2) | Percentage |
|---|---|---|---|
| BWYC | 35207 | 20184 | 57 |
| Marina | 70669 | 51464 | 73 |
| Area 3 | 1584927 | 1044699 | 66 |

Table 10 EdgeTech Coverage

Two junctions were identified using the EdgeTech data. The first is between the marina and area 3 and the second is between the yacht club and area 3. A differencing surface was created between two depth surfaces, either the yacht club or marina and area 3.

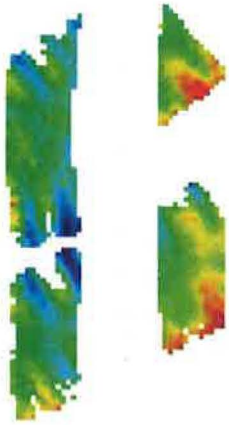

Figure 13 Difference Surface Between BWYC and Area 3

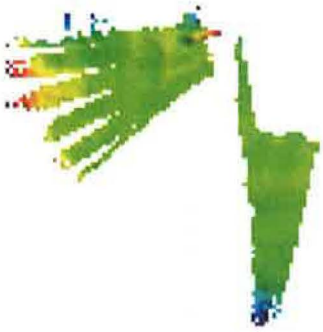

Figure 14 Difference Surface Between Marina and Area 3

| | Max Diff | Min Diff | Mean Diff | Std Dev | Total Counts |
|---|---|---|---|---|---|
| BWYC Junction | -0.01m | -0.63m | -0.31m | 0.09m | 1625 |
| Marina Junction | 0.15m | -0.86m | -0.35 | 0.14 | 1504 |

Table 11 Junction Differences (EdgeTech)

The mean vertical difference at each location was most likely caused by processing with different navigation sources. Each area was surveyed on different days. Due to configuration errors the yacht club and marina data were processed using navigation data from different GNSS units. The Trimble GNSS was the primary source of navigation data for the yacht club and marina, while the CNAV was the primary source of navigation data for area 3. In addition, the GPS collected in area 3 in the vicinity of the junction was degraded as explained in B.2.2.

BWYC junction indicates a roll artifact. The vessel was susceptible to small sea surface changes and when heading east/west, the vessel was taken seas on the beam. The north/south lines did not have the same artifact. This difference was plainly apparent in Figure 12.

Marina junction indicates a turn. The location is at the entrance which has 2 large concrete entrance markers and the end of the fishing pier. The turn is in between the markers and pier. The noise from the interaction of the sonars and the objects created a location of increased uncertainty. In addition, the GPS issue that was explained in B.2.2 distorted increased the difference.

*MB1*

| | Total Area (m^2) | Coverage Area (m^2) | Percentage |
|---|---|---|---|
| BWYC | 35207 | 9311 | 26 |
| Marina | 70669 | 24048 | 34 |
| Area 3 | 1584927 | 412976 | 26 |

**Table 12 MB1 Coverage by Area**

All features identified by the SSS were investigated. Not all features were located in MBES or PDBS to verify the least depths. Due to time constraints and issues with processing the PDBS data, no features were found. The MBES surfaces did verify the least depth of two features in area three.

Two junctions exist within the survey area. The two areas can be seen in table 13.

| | Max Diff | Min Diff | Mean Diff | Std Dev | Total Counts |
|---|---|---|---|---|---|
| BWYC Junction | 0.24 m | -0.30 m | 0.02 m | 0.07 m | 1175 |
| Marina Junction | 0.45 m | -0.23 m | 0.04 m | 0.10 m | 235 |

**Table 13 Junction Differences (MB1)**

### B.2.5 EdgeTech 4600 vs. MB1

The two sonars were used simultaneously in each area of the survey. Unfortunately due to delays in processing the EdgeTech data, the marina and area 3 data was not cleaned to the extent of the yacht club. The below comparison is the difference surface between EdgeTech BWYC and MB1 BWYC.

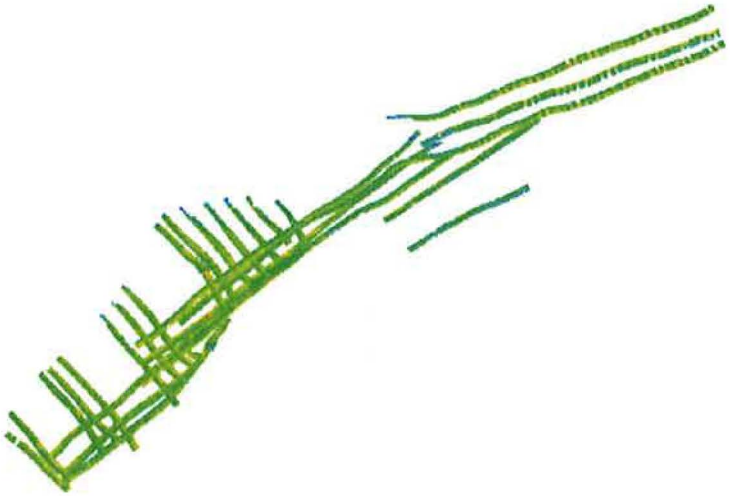

Figure 15 EdgeTech vs. MB1 BWYC Difference

The surface was created with bin sizes of 1m. The green color indicates the area around the mean depth difference, -0.37m, at standard deviation of 0.07m. The bias between the two surfaces is theorized to be caused by the configuration settings of the PDBS. According to QC reports, crossline and surface, generated by the QC report feature in Caris HIPS both surfaces met both IHO order 1a and Special Order surveys. The actual difference is less than 0.2% as indicated in the reports. The PDBS, may be more susceptible to human error in configuration, but it offered a 70 degree swath from nadir, where MB1 MBES was limited to 45 degrees from nadir.

### B.2.6 Sonar Confidence Checks

The SSS performance was checked on multiple occasions during the survey. Checks were conducted using objects including crab traps and other objects with less than a 0.5 m diameter, at or near the full 25 m range scale. These confidence checks proved that the EdgeTech 4600 was capable of resolving objects much smaller than the 1 m requirement at the edge of the range scale. This allowed detection and classification of targets that were much smaller than the required size.

### B.2.7 Other Factors Affecting Quality

The winds in the afternoon came up from the Gulf of Mexico which increased the sea state on the bay. The flat-bottom, small survey vessel was very susceptible to minor variations in the waves. Surveying area 3 was typically not possible as the boat would heave and splash water into the boat.

This boat configuration was never used in previous surveys. The boat was recently purchased and the mounts for the transducers and antennas needed to be constructed in a limited period of time. A small amount of wobble was noticed in the antenna mounts and the EdgeTech mount.

The team was unfamiliar with the equipment. The EdgeTech was not available during the year as it required repairs and little time was available to properly test it. The Odom MB1 was never used by USM and with the exception of a brief introduction, there was no MB1 experience. Lastly a factor that cannot

be overlooked is the inexperience of the team. In most cases, members had little to no survey experience.

### B.2.8 Specification Deviations

The team achieved 186% SSS coverage, falling 14% short of the 200% requirement. The 14% that was not covered was mainly in the yacht club where boats were preventing the survey boat from covering the area. According to figure 2.1 in the HSS area 3 was to extend to the area just above the yacht club. The depth of the water was too shallow to safely survey without the possibility of running aground with the EdgeTech transducer.

The survey for area 3 did not extend pass the CSX Train Bridge or east to the drawbridge. There were only 4 obstructions east of the yacht club. As per instruction, the dangers to navigation found were investigated but not reported to the USCG. A Danger to Navigation report would be sent to ocs.nbd@noaa.gov.

Chart corrections found during the survey were not reported to NOAA's Nautical Chart Product discrepancy Report Webpage, as per instruction. However corrections have been made and identified in the chart comparison report.

According to appendix L in the HSS CUBE surfaces were to be created with the data. Unfortunately, during processing, it was identified that the Caris software is unable to read the required uncertainty values in the EdgeTech data. Due to the nature of the skunk stripe survey, a CUBE surface could not be created for the MB1. However Swath Angle surfaces at 0.5m resolution were created for the EdgeTech data and 0.25m resolution Swath Angle surfaces were created for the MB1.

The HSS calls for sound velocity casts at the beginning, middle, and the end of the survey day; if the surface sound velocity varied by more than 2m/s then addition casts were to be done. Three casts were done a day but additional casts were not completed when the SV varied by 2m/s.

Hypack was originally to be used for all data collection, but due to configuration problems the discover software was used to log EdgeTech data. We were unable to connect to both sonars in Hypack.

## B.3 Corrections to Echo Soundings

### B.3.1 Vessel Configuration

On June 4, 2014 a vessel configuration survey was completed for the aluminum skiff using a Leica TS02 TotalStation, standard Leica prisms, and Leica reflective tapes. Due to time constraints and poor weather the pre-installed bolt network was unavailable. The aluminum skiff was positioned in between two set benchmarks inside building 1029. Using the TotalStation, the horizontal distance, horizontal angles and vertical angles between each benchmark, and each prism were measured.

The GNSS and IMU positions were all observed from multiple stations, additional points on the vessel were observed to aid in the building of the vessel file as well as for the crude (tape) measurements.

Forward and reverse measurements were taken for each point and the measurements were adjusted using a least-squares 3 dimensional adjustment. The adjusted observation points were plotted in AutoCAD Civil 3D. All of the vessel observations where moved in the AutoCAD program so that the reference point (RP), which is also the IMU, becomes (0, 0, 0). The vessel was then rotated so that the X and Y axis are orientated properly in the X, Y, and Z directions.

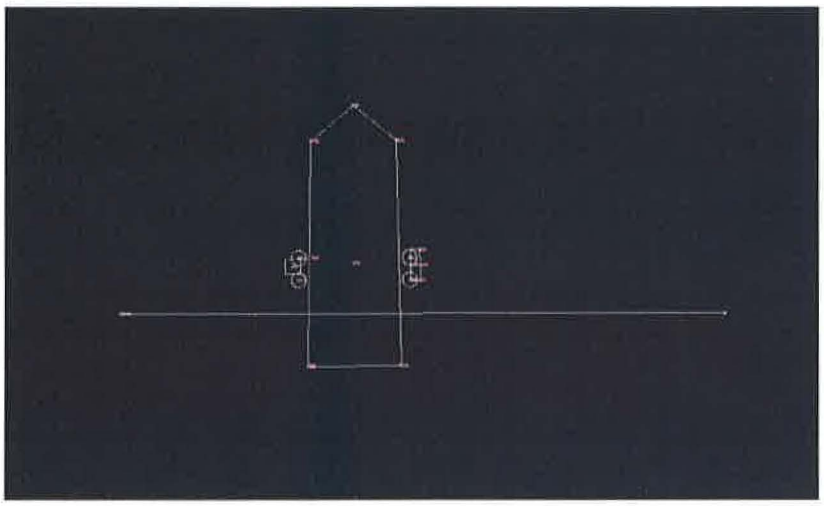

Figure 16 AutoCad VCS

The position of the SSS points and MBES acoustic center were determined using the schematic of the systems and using taped offsets in AutoCAD Civil 3D.

Figure 17 Survey Vessel

### B.3.2 Initial Calibration

Multiple patch test calibrations line sets were conducted but because of non-ideal conditions and lack of targets, the one conducted on June 18, 2014, (JD 169) in front of Pass Christian was used. This set of

lines was determined to be the best because of a slope in the area however, actual targets on the sea floor were lacking. Calibration values were obtained via the Caris calibration tool. The calibration values were applied to the Caris HIPS vessel file for data collected on June 8-19, 2014 (Julian days 159-170). Roll lines from JD 163 were used. Patch test lines and descriptions can be seen in table 14 and calibration values are shown in table 15.

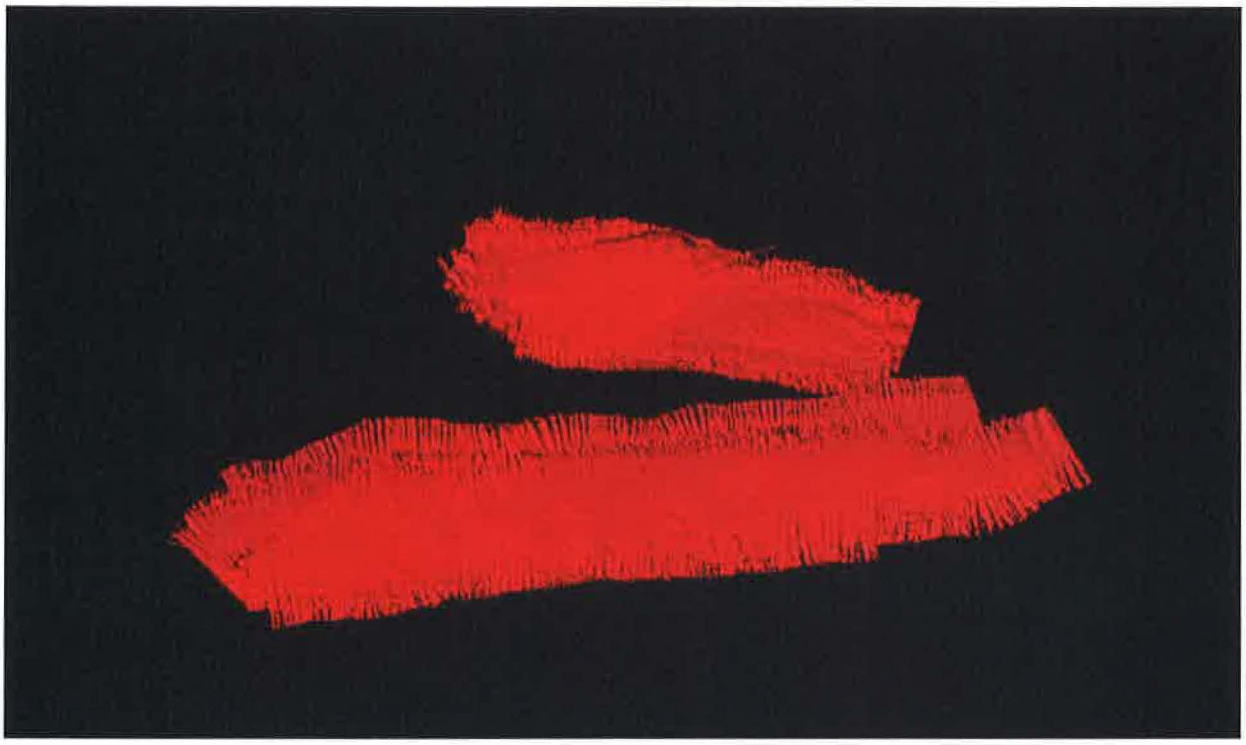

Figure 18 EdgeTech Patch Test Lines

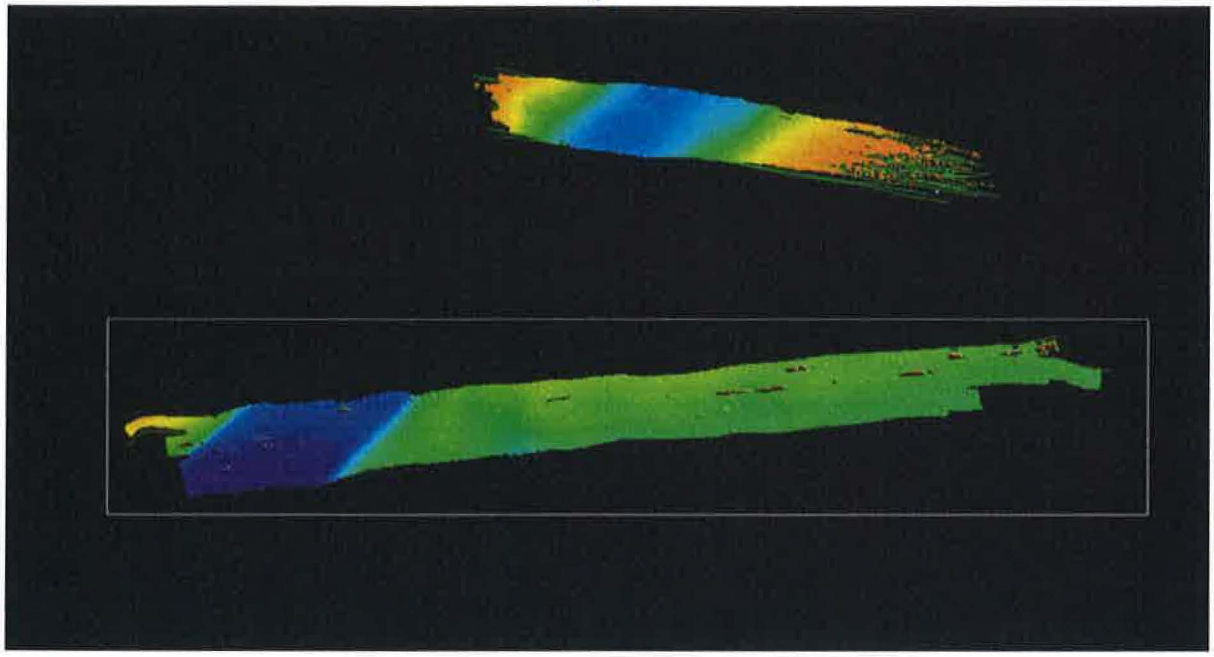

Figure 19 MB1 Patch Test Lines

| Test | Criteria | Lines Used | Speed (knots) | Course (deg) |
|---|---|---|---|---|
| Latency | 2 lines running in same direction and having 2 different speeds on a sloppy bottom (ideally 10-20 deg) | 003_1649 | 3 | 96 |
| | | 003_1723 | 6 | 95 |
| Pitch | 2 lines running in opposite directions and having the same speed on a sloppy bottom (ideally 10-20 deg) | 008_1831 | 1.8 | 264 |
| | | 007_1826 | 1.7 | 84 |
| Yaw | 2 separate lines running in the same direction and with same speed having a target ideally centered between the 2 lines. | 008_1833 | 1.9 | 84 |
| | | 007_1826 | 1.7 | 84 |
| Roll | 2 lines with same speed but in opposite directions on a flat bottom. | 003_1840 | 3.8 | 84 |
| | | 007_1837 | 3.8 | 264 |

Table 14 Patch Test Lines

| System | Side | Date | Roll (°) | Pitch (°) | Yaw (°) | Timing (s) |
|---|---|---|---|---|---|---|
| Edgetech | Port | June 8-19, 2014 | -2.713 | 0.5 | 1.5 | 0 |
| Edgetech | Starboard | June 8-19, 2015 | -3.9 | 0.5 | 1.5 | 0 |
| MB1 | | June 8-19, 2014 | 1.6 | -2 | -1.5 | 0 |

Table 15 Vessel Calibration Data

### B.3.3 Navigation Data

All navigation data in the final survey data set is sourced from PPK GNSS solutions, positions were reported with standard deviations less than 0.075m (horizontal) and 0.09m (vertical). The average position standard deviations during MBES sounding after PPK processing of GNSS data can be seen in the table below.

| Date (JD) | Source | Horizontal (m) | Vertical (m) |
|---|---|---|---|
| 162 | Trimble | 0.0283 | 0.0452 |
| 163 | Trimble | 0.0218 | 0.0321 |
| 167 | Trimble | 0.0524 | 0.0636 |
| 168 | CNAV | 0.0686 | 0.0858 |
| 169 | Trimble | 0.0297 | 0.0462 |
| 170 | CNAV | 0.0732 | 0.0882 |

Table 16 Average Observed Position Standard Deviations during MBES Sounding

The GPS system used varies by day based upon settings and accuracy of the systems. Both systems were logged at 1 Hz and the data was post-processed in GrafNav software using the GCGC CORS located near the Bay-Waveland Yacht Club (designation: "MSWV") (GCGC, 2014). The base station data was sourced at 1Hz in the NAD83 (2011) epoch 2010.0 datum.

### B.3.4 Attitude

The POSMV data was logged at 50 Hz, this data included raw dual frequency positioning data from both GNSS antennas and heave data. This data was applied for heave to all lines in all three of the areas using the Caris HIPS delayed heave function.

### B.3.5 Tide and Water Level Corrections

The majority of the data was reduced to MLLW NTDE 1983-2001 using Ellipsoid Reference Survey (ERS) techniques. A single separation value between ellipsoid and MLLW was derived using several components including: tidal data collected from a gauge established before the survey, a tidal datum transfer linking the new gauge to a nearby established NOAA gauge (station ID: 8747437), dual frequency static GNSS survey, as well as three-wire level runs connecting the tide gauge to a primary bench mark. ERS could not be used for the entire survey. Tides published by NOAA from station 8747437 were applied to approximately one hour of bathymetry data. For more details please see the *Horizontal and Vertical Control Report*.

| BM1 | |
|---|---|
| Latitude | 30° 18' 42.1" N |

| Longitude | 089° 19' 27.3" W |
|---|---|
| MLLW wrt BM 1 | -2.6786 |
| NAD 83 wrt to BM 1 | -24.984 |
| SEP | -27.6626 |

Table 17 Separation Summary

### B.3.6 Sound Velocity Correction

Sound velocity casts were conducted at multiple times each day, generally at the beginning, middle, and end of the day and whenever areas were changed. These SVP files were compiled into a single Caris HIPS SVP file. When a cast was taken the collection time, date and position were recorded. The nearest in time technique was used because the survey area was small and the sound velocity would be most accurate based on time not distance.

### B.3.7 TPU Calculation

#### B.3.7.1 CARIS vessel file

The uncertainty values (at 1 σ) as observed, reported by the manufacturers and/or obtained in guidance with other agencies (such as CARIS web site) were entered into the Caris HIPS Vessel File.

These uncertainty estimates, which describe the accuracy of each sensor, are later used in the calculation of the Total Propagated Uncertainty (TPU).

| | Entry | Edgetech 162-167,169 | Edgetech 168, 170 | MB1 162-167,169 | MB1 168, 170 | Manual Tides 168(% Lines) | |
|---|---|---|---|---|---|---|---|
| Caris Website | Motion Gyro (°) | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | |
| | Heave % Amplitude | 5 | 5 | 5 | 5 | 5 | |
| | Heave (m) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | |
| | Roll (°) | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | |
| | Pitch (°) | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | |
| Observed 2D GNSS | Position Navigation (m) | 0.033 | 0.071 | 0.033 | 0.071 | 0.071 | |
| Standard Deviations | Timing Transducer (s) | 0.005 | 0.005 | 0.001 | 0.001 | 0.001 | Manufacturer's Specs |
| | Navigation Timing (s) | 0.005 | 0.005 | 0.001 | 0.001 | 0.001 | |
| | Gyro Timing (s) | 0.005 | 0.005 | 0.001 | 0.001 | 0.001 | |
| | Heave Timing (s) | 0.005 | 0.005 | 0.001 | 0.001 | 0.001 | |
| | Pitch Timing (s) | 0.005 | 0.005 | 0.001 | 0.001 | 0.001 | |
| | Roll Timing (s) | 0.005 | 0.005 | 0.001 | 0.001 | 0.001 | |
| Observed | Offset X (m) | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | |
| | Offset Y (m) | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | |
| | Offset Z (m) | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | |
| | Vessel Speed (m/s) | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | |
| | Loading (m) | 0 | 0 | 0 | 0 | 0.044 | Caris |
| | Draft (m) | 0 | 0 | 0 | 0 | 0.044 | |
| | MRU Gyro Alignment | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | |
| | MRU Roll/Pitch Alignment | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | |

Table 18 Caris HIPS Vessel File TPU Entries

#### B.3.7.2 CARIS TPU controller

Furthermore, the value of the uncertainty for the Ellipsoid to chart separation (at 1σ) and the sound speed uncertainty were entered in the TPU Controller in Caris for computing the TPU for ERS.

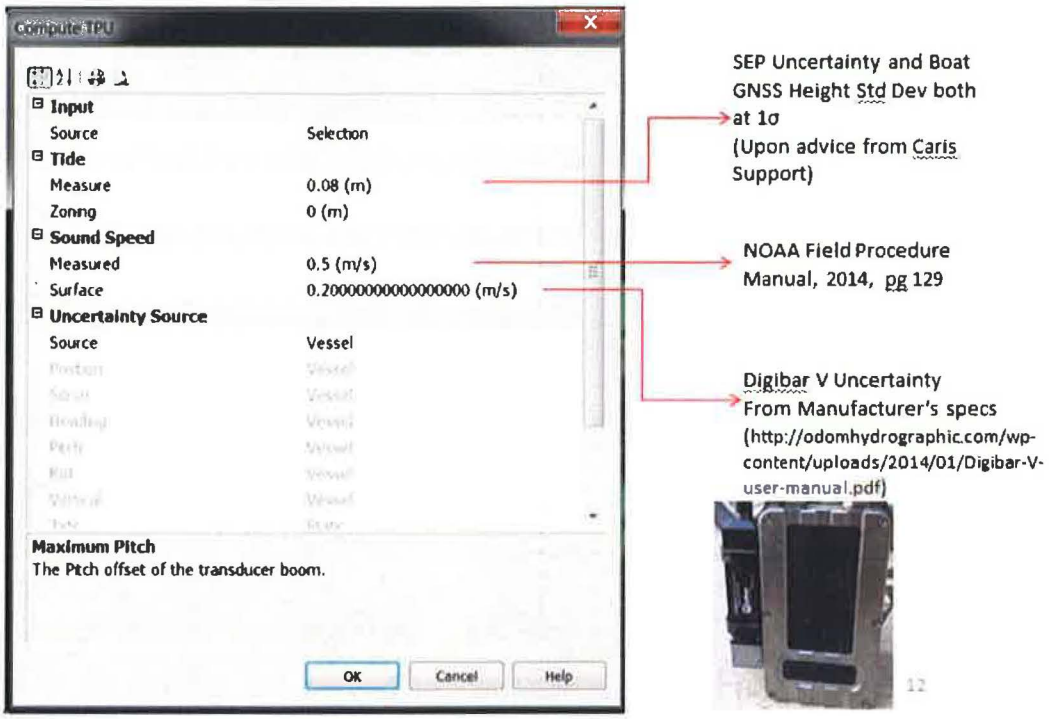


Figure 20 TPU controller

### B.3.7.3 Cross Check analysis in CARIS

Cross check analysis revealed that 5 survey lines in area 3 (288_1347, 289_1401, 290_1415, 291_1429, 292_1444) did not meet order 1a, see table 28. This was due to bad GNSS.

| Beam Nu... | Count | Max (+) | Min (-) | Mean | Std Dev | Special Order (%) | Order 1a (%) | Order 1b (%) | Order 2 (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1 - 11 | 150 | 0.852 | 1.089 | 0.144 | 0.492 | 25.333 | 56.667 | 56.667 | 95.333 |
| 11 - 21 | 4,308 | 0.944 | 1.204 | -0.133 | 0.477 | 36.769 | 68.709 | 68.709 | 92.874 |
| 21 - 31 | 16,024 | 1.055 | 1.293 | -0.148 | 0.419 | 44.652 | 78.152 | 78.152 | 94.415 |
| 31 - 41 | 18,846 | 1.041 | 1.270 | -0.101 | 0.407 | 48.907 | 80.181 | 80.181 | 96.413 |
| 41 - 51 | 19,122 | 1.025 | 1.154 | -0.078 | 0.402 | 48.975 | 79.626 | 79.626 | 97.584 |
| 51 - 61 | 19,062 | 0.890 | 1.122 | -0.066 | 0.399 | 49.397 | 79.042 | 79.042 | 98.190 |
| 61 - 71 | 18,988 | 0.971 | 1.129 | -0.045 | 0.406 | 50.427 | 78.360 | 78.360 | 98.399 |
| 71 - 81 | 18,848 | 1.129 | 1.078 | -0.018 | 0.408 | 50.568 | 78.539 | 78.539 | 98.764 |
| 81 - 91 | 16,856 | 1.120 | 1.098 | -0.033 | 0.380 | 54.675 | 83.045 | 83.045 | 99.075 |
| 91 - 101 | 12,846 | 1.009 | 1.032 | -0.079 | 0.337 | 64.113 | 87.249 | 87.249 | 99.642 |
| 101 - 111 | 2,848 | 0.471 | 1.012 | -0.119 | 0.254 | 78.301 | 90.871 | 90.871 | 99.930 |
| 111 - 121 | 3 | 0.000 | 0.035 | -0.019 | 0.014 | 100.000 | 100.000 | 100.000 | 100.000 |

Table 19 Cross Check analysis of Bad GPS lines

Changes were needed in order to meet the required standard and it was proposed to use traditional tide values from BWYC Tide station (NOAA 8474347).

### B.3.7.4 Assessing Tide station Uncertainty

It was determined from NOAA website (http://tidesandcurrents.noaa.gov/inundation/userguide?a=l) that the measurement error and datum error combined in the tide values obtained from NOAA tide stations are less than 0.01m at 95% CI.

### B.3.7.5 Additional Vertical uncertainty on Boat using Traditional Tides

Since traditional tides were proposed to be used, such factors as Heave, Draft and Loading needed to be included in the CARIS vessel file for a proper assessment of the uncertainty involved. Table 26 gives an assessment of the additional uncertainty involved. A new boat file was created for this purpose.

| Factors | 1 $\sigma$ value (m) | |
|---|---|---|
| Delta Draft | 0.05 | From Caris |
| Draft | 0.044 | |
| Loading | 0.044 | |
| $\sum\sqrt{\sigma^2}$ | 0.080 | |
| $1.96*\sum\sqrt{\sigma^2}$ | | |
| 95% Confidence | 0.156 | |

Table 20 Boat uncertainty

### B.3.7.6 Horizontal Uncertainty

Figure 28 Shows the Standard deviation obtained from the PPK solution for that particular time (13:47:34 to 14:44:24 on Jd 168_14)

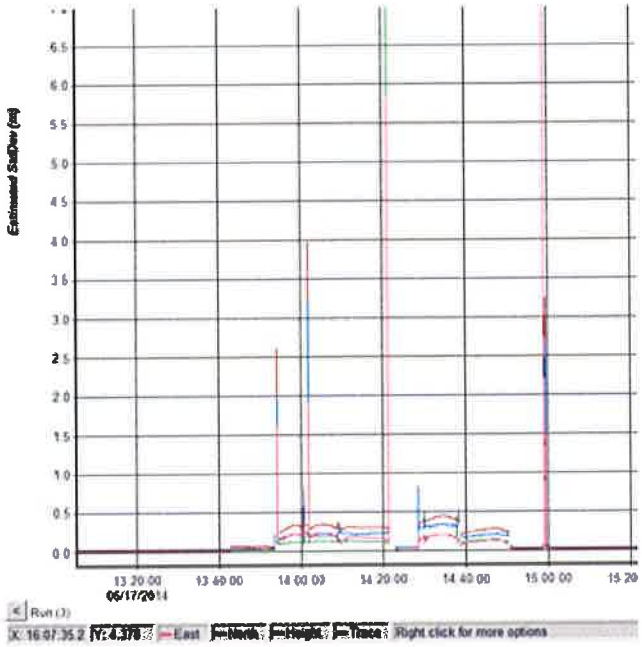


Figure 21 Standard Deviation during bad GPS period

This figure shows that the horizontal standard deviation for that particular time was generally lower than 0.5m. Since the THU requirement for the survey ranged from 5.02 to 5.21 m, it was decided to use the horizontal GNSS data after cleaning "spikes" in the Navigation Editor of CARIS. The horizontal standard deviation was 0.194m before cleaning of the data.

### B.3.7.7 TPU Results

#### B.3.7.7.1 *Application of Traditional Tides*

After applying the Traditional tides together with the relevant uncertainties to the 5 lines mentioned above, it was found that these lines now net the IHO Order 1a specifications, see table30 below.

| Beam Nu... | Count | Max (+) | Min (-) | Mean | Std Dev | Special Order (%) | Order 1a (%) | Order 1b (%) | Order 2 (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1 - 11 | 164 | 0.368 | 0.290 | -0.060 | 0.110 | 96.341 | 100.000 | 100.000 | 100.000 |
| 11 - 21 | 3,655 | 0.406 | 0.303 | -0.011 | 0.094 | 98.988 | 100.000 | 100.000 | 100.000 |
| 21 - 31 | 12,941 | 0.394 | 0.268 | 0.002 | 0.082 | 99.838 | 100.000 | 100.000 | 100.000 |
| 31 - 41 | 15,280 | 0.429 | 0.268 | 0.010 | 0.085 | 99.777 | 100.000 | 100.000 | 100.000 |
| 41 - 51 | 15,172 | 0.399 | 0.240 | 0.032 | 0.084 | 99.690 | 100.000 | 100.000 | 100.000 |
| 51 - 61 | 15,154 | 0.528 | 0.223 | 0.047 | 0.081 | 99.479 | 99.987 | 99.987 | 100.000 |
| 61 - 71 | 15,105 | 0.519 | 0.217 | 0.070 | 0.080 | 98.974 | 99.987 | 99.987 | 100.000 |
| 71 - 81 | 14,832 | 0.488 | 0.186 | 0.092 | 0.076 | 97.984 | 100.000 | 100.000 | 100.000 |
| 81 - 91 | 13,267 | 0.406 | 0.162 | 0.099 | 0.076 | 97.920 | 100.000 | 100.000 | 100.000 |
| 91 - 101 | 10,251 | 0.365 | 0.102 | 0.117 | 0.072 | 97.298 | 100.000 | 100.000 | 100.000 |
| 101 - 111 | 2,328 | 0.323 | 0.112 | 0.151 | 0.066 | 94.674 | 100.000 | 100.000 | 100.000 |
| 111 - 121 | 8 | 0.181 | 0.000 | 0.121 | 0.058 | 100.000 | 100.000 | 100.000 | 100.000 |

Table 21 Cross check result after applying Traditional tides

### B.3.7.7.2 Cross Check Lines Results.

The results of the cross check lines within the 3 areas are shown below.

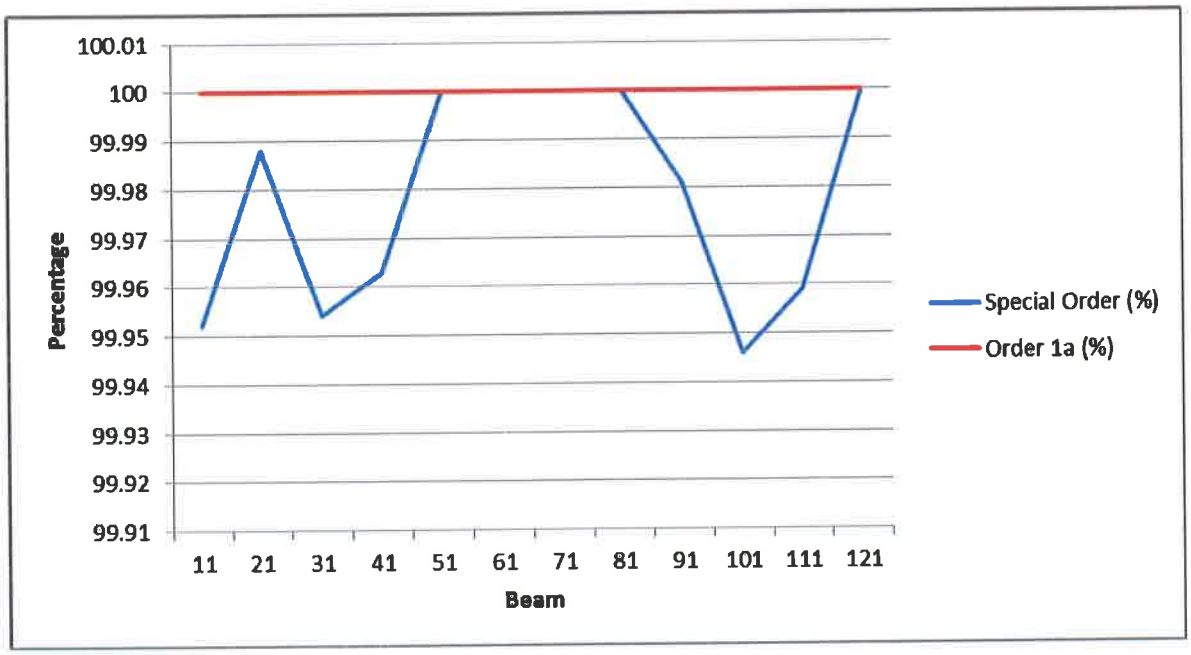


Figure 22 Site 1 (BWYC)

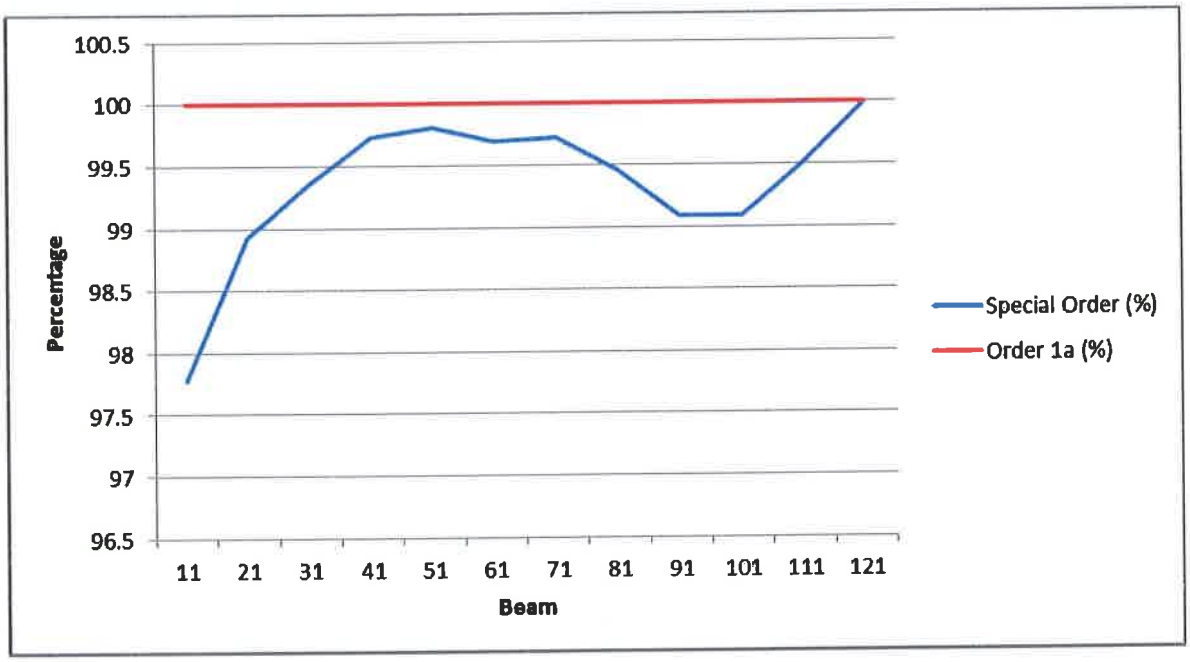


Figure 23 Site 2 (New Marina)

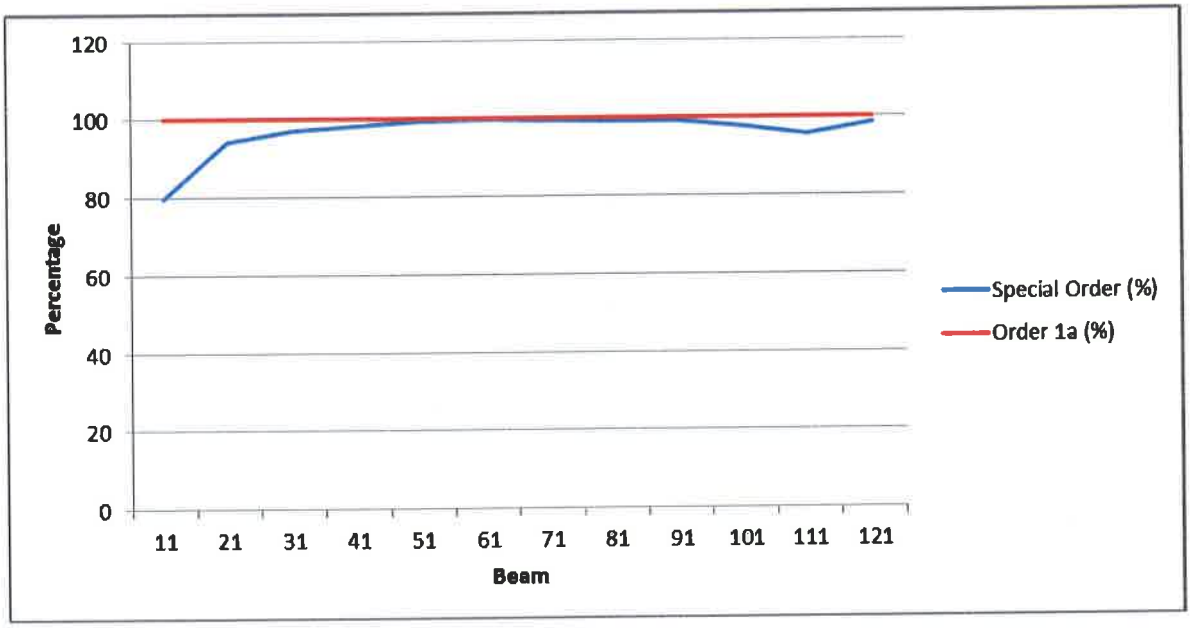


Figure 24 Site 3

It can be seen that all the lines in the 3 areas meet IHO Order 1A. Table 31 Gives a summary of the result.

| Area | No. Beams Order 1a | No. Beams Special Order | Order 1a Met? | Special Order Met? |
|---|---|---|---|---|
| Area 1 | 120 (100%) | 120(99.97%) | Yes | Yes |
| Area 2 | 120 (100%) | 120 (99.3%) | Yes | Yes |
| Area 3 | 120 (100%) | 120(96.40%) | Yes | Yes |

Table 22 Summary of Cross line Results

#### B.3.7.7.3 *TVU and TPU obtained from CARIS*

Using CARIS Subset Editor, different parts of the surveyed area was queried and the results are shown in the table below.

| Area | THU (m) | TVU (m) | Order 1a Met? | Special Order Met? |
|---|---|---|---|---|
| Area 1 | 0.07 | 0.18 | Yes | Yes |
| Area 2 | 0.14 | 0.18 | Yes | Yes |
| Area 3 | 0.14 | 0.18 | Yes | Yes |

Table 23 THU and TPU values

## B.4 Backscatter

Backscatter was not required for this survey.

## B.5 Data Processing

### B.5.1 Preliminary Surfaces

The EdgeTech and MB1 data was imported into Caris HIPS and each line was individually cleaned using the swath editor. A Swath Angle surface was created for each area with 0.5 m resolution for the EdgeTech and 0.25m for the MB1. The following NOAA and IHO Order 1a standards were used.

| | |
|---|---|
| Object detection size | 1m x 1m x 1m |
| Grid resolution | 0.5m |
| 95% Node density | Minimum of 5 soundings |
| Max. propagation distance | $\frac{Grid\ Resolution}{\sqrt{2}} = 0.35$ |

| | |
|---|---|
| Order 1a TVU | for a given depth d, TVU = $\sqrt{a^2 + (b\ x\ d)^2}$, where a = 0.5m and b = 0.13 |
| Order 1a THU | 2m |

### B.5.2 Subset Editing

All Swath Angle surfaces created for the EdgeTech and MB1 lines were cleaned using Caris HIPS subset editor in multiple projects in order to shorten processing time. All projects used the same vessel file and patch test settings. All significant bathymetric features identified were inspected to determine the least depth above the object.

### B.5.3 Filtering

Prior to creating the surface, all the EdgeTech lines were filtered to 70 degrees while the MB1 was filtered to 45 degrees from nadir due to the poor quality of the data. After the Subset editing was completed, another filter was run in order to remove soundings greater than 7 m. The filtering removed erroneous soundings missed during the subset editing.

### B.5.4 Finalization

Each Swath Angle surface was finalized after the all the filtering and editing. Based off the projected depth from the each surface, a minimum and maximum depth was entered in order to remove any missed outliers.

### B.5.5 SSS Mosaics

The JSF files were imported into SonarWiz 5 using a value of 60 dB for the time variable gain (TVG). Auto JSF Scalar and ADC Gain from the JSF sonar packet were also applied upon import. User gain control (UGC), Automatic Gain Control (AGC), and Beam Angle Correction (BAC) settings were applied to each line individually in an attempt to create three consistent mosaics (one for each of the three survey areas). The final corrected lines were displayed using the Cover Up SSS Overlap Mode as it displayed the mosaic best. The mosaic was finally exported to GeoTIFF mosaics at 0.5 meters/pixel resolution. Mosaic coverage is shown in figure 1.

### B.5.6 SSS Targets

SSS feature selection began with the manual inspecting of each gain corrected line. Each feature was then digitized to show the measured shadow lengths, feature dimensions, and estimated least depth. There were several thresholds that each contact had to reach to be considered significant. If any dimension of the target was greater than 1 m, or had a target height of greater than 0.5 m, it was put into the generated reports. Contact reports can be found in the appendices of the supplementary 14USM02 Data Acquisition and Processing Report. An S-57 final feature file was generated using the standard NOAA descriptors listed in the Specifications and Deliverables [NOAA,2014].

# C Vertical and Horizontal Control

This section is an overview of the methods to acquire and employ horizontal and vertical control for the survey conducted in St. Louis Bay. For a more detailed account refer to supplementary 14USM02 Horizontal and Vertical Control Report.

## C.1 Vertical Control

### C.1.1 Vertical Datum

The vertical datum calculated to correct bathymetry was MLLW NTDE 1983-2001. Ellipsoid reference techniques were used to correct the majority of the data, except five survey lines in Area 3. These lines were affected by the GPS issue as described in B.2.2 The separation between MLLW to GRS80 was calculated using:

- Tides collected from a USM gauge and NOAA CO-OPS gauge 8747437
- GNSS static survey over the primary benchmark
- 3-wire leveling connecting the USM gauge to secondary tidal staff and three benchmarks.
- Range ratio tidal datum transfer from USM tide gauge to CO-OPS gauge 8747437.

### C.1.2 Existing Tidal Infrastructure

NOAA operates a tidal station outside the Bay Waveland Yacht Club in the northern section of the survey area, station 8747437. This gauge has been in continuous operation since 1978 and therefore was designated the primary gauge and used for the tidal datum transfer. Tides from this gauge were also used to correct soundings where GPS tides could not be applied.

| Station 8747437 | |
|---|---|
| Latitude | 30° 19.5' N |
| Longitude | 089° 19.5' W |
| MHW | 1.225 |
| MSL | 0.994 |
| DTL | 0.993 |
| NAVD88 | 0.728 |
| MLLW | 0.822 |
| GT | 0.529 |
| MN | 0.462 |
| STND | 0 |

Table 24 NOAA tide station 8747437 station location and datums


Figure 25 USM Installed Tide Gauge


Figure 26 NOAA Tide Gauge

### C.1.3 Tide Zoning

NOAA requires tide zone delineation for phase differences greater than 18 minutes and amplitude differences greater than 6 cm between tidal stations. Ellipsoid referencing techniques eliminates the need for tide zoning. However, five survey lines in area 3 require tide measurements for vertical correction. Pre-survey, tides from Station 8747437 and Pascagoula NOAA Lab Station 8741533 were used to determine one tide zone can be used to survey Saint Louis Bay.


Figure 27 Showing the Span Between the Bay St. Louis Station and the Pascagoula Station.

| | Station ID | GT | HWI in minutes | Distance in KM |
|---|---|---|---|---|
| Bay St. Louis | 8747437 | 0.529 | 90 | 75 |
| Pascagoula | 8741533 | 0.468 | | |

Table 21 Showing Tidal Characteristics Between Bay St. Louis and Pascagoula for Zoning Purposes.

Looking at Table 18, the difference between the great diurnal range at Pascagoula and Bay St. Louis is 0.06 cm. The amplitude between the two stations changes only 6 cm, falling within NOAA specifications for one tidal zone. The high water interval (HWI) between Pascagoula and Bay St. Louis is 90 minutes, and using a ratio, it was determined the HWI between the top of the survey area to bottom of the survey area to be less than 3 minutes, and therefore only on tide zone is required for the entire survey area.

The requirement for only one tide zone was also verified using NAVOTAS. Two tide stations within Bay St. Louis were selected and harmonic constituents were derived from each one, see Figure 21. Using those harmonic constituents, tides were generated from five points within the survey area to determine if the differences between phase and amplitude were small enough to justify one tide zone. There was little phase offset, and the largest amplitude offset was 4 cm. See Figures 21– 24.

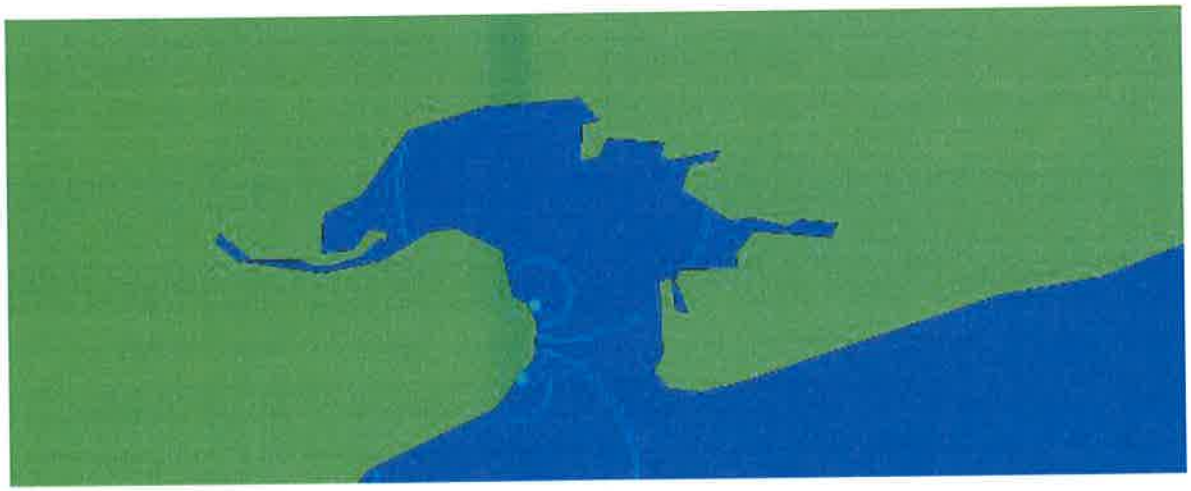

Figure 27 Tide Stations Selected in Bay St. Louis.

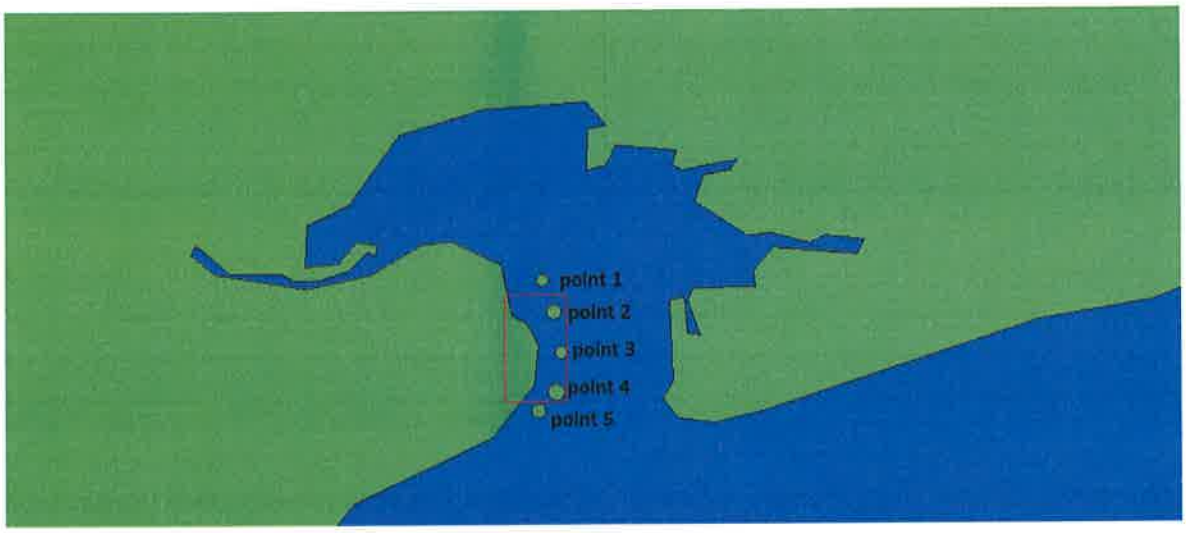


Figure 28 Points Chosen in Tide Analyst for Tide Generation in NAVOTAS.

The red box falls within our survey area.

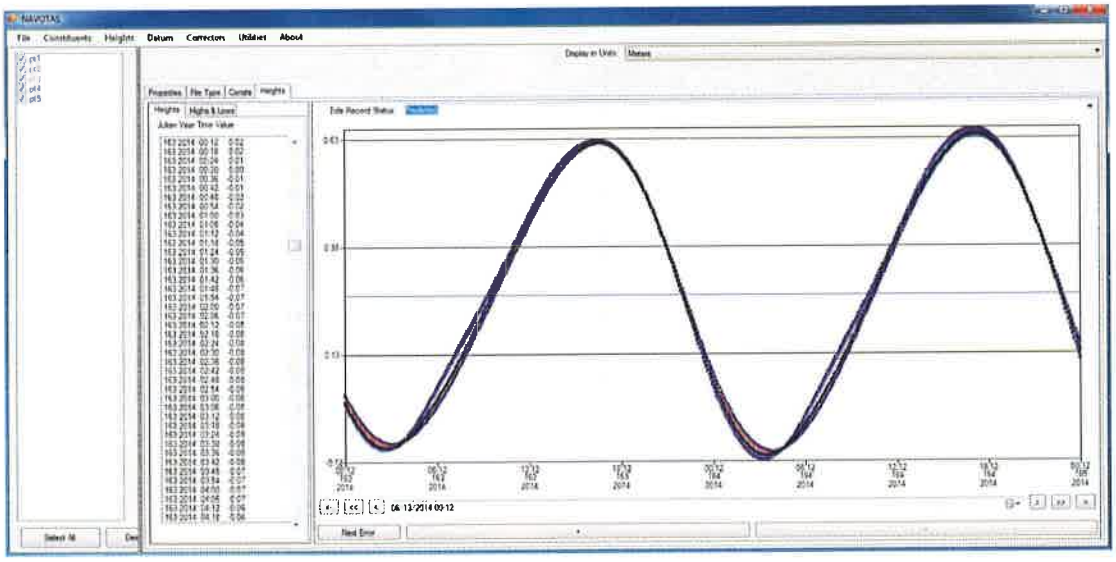

Figure 30 Two Days of Data from the Five Points Chosen in NAVOTAS

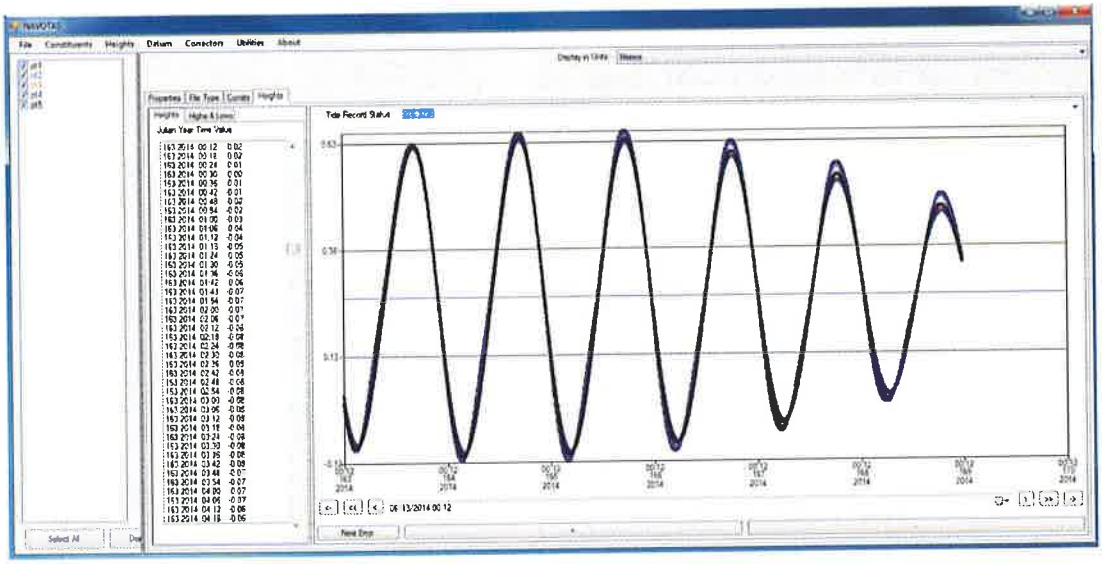

Figure 31 Seven Days of Data from the Five Points Chosen in NAVOTAS

Figure 25 shows the tides collected from the USM tide gauge and the tides collected by the NOAA gauge during the survey. The tides line up, showing no difference in phase or peak to peak amplitude values.

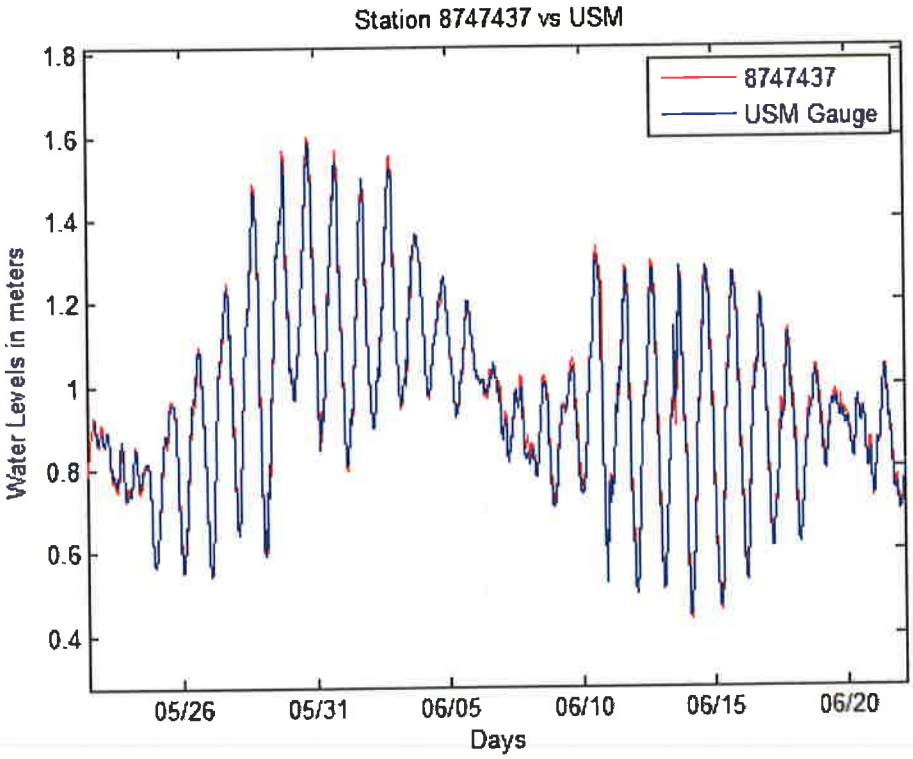


Figure 32 USM Gauge and NOAA Gauge

### C.1.4 SEP Value

There are several calculations required in order to determine the separation between ellipsoid and MLLW NTDE 1983-2001. A leveling line between the tide gauge and BMs establishes the heights of BMs relative to the tide gauge. A four hour GNSS static survey over the primary BM gives the ellipsoid to BM heights, and a minimum of 30 days of tidal data along with a tidal datum transfer gives MLLW NTDE 1983-2001. The ellipsoid to BM1 distance comes from the opus solution. A summary of the results are in Table 21.

| BM1 | |
|---|---|
| Latitude | 30° 18' 42.1" N |
| Longitude | 089° 19' 27.3" W |
| MLLW wrt BM 1 | -2.6786 |
| NAD 83 wrt to BM 1 | -24.984 |
| SEP | -27.6626 |

Table 22 Separation Summary

NOAA's Geoid 12A model was used to justify using one separation value within the survey area. Five points within the survey area shows very little difference. The difference between the extremes was only 0.047 m, please see Table 22 for the model's values.

| Geoid 12A | | |
|---|---|---|
| Point 1 | 30 19 30.99 N<br>089 19 26.76 W | -27.477 |
| Point 2 | 30 19 16.39 N<br>089 19 12.72 W | -27.469 |
| Point 3 | 30 18 56.70 N<br>089 19 6.82 W | -27.453 |
| Point 4 | 30 18 45.22 N<br>089 19 9.4 W | -27.441 |
| BM 1 | 30 18 42.14 N<br>089 19 27.29 W | -27.43 |
| Differences | | 0.047 |

Table 23 Geoid12a Ranges

The Tide Zoning section proved insignificant tidal variation between the top and bottom of the survey area, and Geoid12a shows miniscule differences between the ellipsoid and NAVD88 within the survey area. All of these statistics verify the need for only one separation value within the survey area.

| | BM1 |
|---|---|
| Ellipsoid to NAVD88 | -27.43 |
| Geoid12a | -27.43 |

Table 24 BM1

## C.2 Horizontal Control

### C.2.1 Positioning Methodology

The survey vessel was fitted with a Trimble NetRS,NAV 3050, and an Applanix Position and Orientation System for Marine Vehicles (POSMV) v4 Wavemaster. Both the Trimble NetRS GNSS and the CNAV 3050 were configured to log dual frequency raw positioning data at a rate of 1Hz. The POSMV unit logged all raw Ethernet data, including dual frequency positioning data at 50Hz. Real-time positioning for data collection was obtained from the POSMV system supported by Real-Time gypsy (RTG) via the CNAV GNSS. Moreover, to increase the accuracy of the survey, the raw data from the CNAV and Trimble GNSS receivers were post-processed to generate a Post Processed Kinematic (PPK) solution. The most accurate system varied by day and the one chosen by day can be seen in Table 25.

| Date | Julian Day | Source |
|---|---|---|
| 11 June 14 | 162 | Trimble PPK |
| 12 June 14 | 163 | Trimble PPK |
| 16 June 14 | 167 | Trimble PPK |
| 17 June 14 | 168 | CNAV PPK |
| 18 June 14 | 169 | Trimble PPK |
| 19 June 14 | 170 | CNAV PPK |

Table 25 GNSS by Day

The CNAV 3050 and Trimble NetRs GNSS data were processed against the Gulf Coast Geospatial Consortium (GCGC) Continuously Operating Reference Station (CORS), which is stationed at BWYC (Station ID MSWV). This is a 1Hz reference station. All navigation coordinates were generated using the North American Datum of 1983 (NAD83) (2011/PA11/MA11) epoch 2010.0 datum. This was sourced from the GCGC website [GCGC, 2014]. The base station was located within the survey area and the furthest extent of the survey area is 2.5 km from the base station. This is in accordance with the NOAA 2014 requirement for a maximum PPK baseline length less than 30km.

### C.2.2 Navigation Validation

Navigation was validated by using a junction area between survey areas 1 and 3 as well as 2 and 3. Area 1 and 2 were processed using the Trimble NetRS PPK data. Area 3 was processed using the CNAV 3050 data. The mean vertical difference between each surface, for the MB1 and EdgeTech can be seen in the tables below.

| | Max Diff | Min Diff | Mean Diff | Std Dev | Total Counts |
|---|---|---|---|---|---|
| BWYC Junction | 0.15 m | -0.86 m | -0.35 m | 0.14 m | 3468 |
| Marina Junction | 1.87 m | -1.31 m | 0.04 m | 0.27 m | 1504 |

Table 30 Junction Differences (EdgeTech)

| | Max Diff | Min Diff | Mean Diff | Std Dev | Total Counts |
|---|---|---|---|---|---|
| BWYC Junction | 0.24 m | -0.30 m | 0.02 m | 0.07 m | 1175 |
| Marina Junction | 0.45 m | -0.23 m | 0.04 m | 0.10 m | 235 |

Table 31 Junction Differences (MB1)

# D Results and Recommendations

## D.1 Chart Comparison

Comparisons of soundings obtained during this survey with those published on NOAA chart 11372 were similar.

Area 1
Depths in the BWYC were typically 3 feet with some small variations, the coastline as well as the shape of the BWYC changed significantly from the chart. Two uncharted dangers to navigation inside the BWYC were found. They can be seen in table 27 below:

| Latitude | Longitude | Depth (m) | Description |
|---|---|---|---|
| 30° 19' 31.21" N | 89° 19' 34.92" W | 1.28 | Object reaching 0.61 m in height. |
| 30° 19' 30.91" N | 89° 19' 36.00" W | 1.05 | Object with 0.62 m height. |

Table 32

Area 2
Depths in the New Marina were as expected. Due to recent dredging the depths are greater than were posted on previous charts. There are no dangers to navigation inside the New Marina.

Area 3
Depths in area 3 were as expected. The contours followed the same general path and the charted sandbars were in the general location, except north of the Highway 90 bridge where they were noticeable differences. Two uncharted dangers to navigation inside area 3 were found. One was not significant because it was probably sunken in the mud, the other can be seen in table 29 below:

| Latitude | Longitude | Depth (m) | Description |
|---|---|---|---|
| 30° 19' 15.398" N | 89° 19' 14.21" W | - | Old channel marker. Was awash at high tide. Protrudes about 5 cm at low tide. |

Table 33 DTONs Area 3

## D.2 Additional Results

### D.2.1 Seabed Samples

The seabed sampling of all three areas was conducted on 18 June 2014. A Petite Ponar Grab was used to sample four different locations in the three areas. The sediment grab obtained samples from the top ~10 cm of the seabed sediment. The locations that were sampled were selected by assessing possible texture boundaries from return intensity variation that had been observed in the gain correct SSS

mosaics. The team also made sure to grab at least one sample from each survey area. The full list of samples is shown in table 30.

| Time (UTC) | Latitude | Longitude | NATSUR | NATQUA | Color |
|---|---|---|---|---|---|
| 21:06 | 30° 19' 45.6" N | 89° 18' 49.4" E | Clay (2) | Sticky, Fine (5,1) | Grey (7) |
| 15:31 | 30° 18' 41.3" N | 89° 18' 41.6" E | Clay (2) | Fine (1) | Grey (7) |
| 19:55 | 30° 18' 38.8" N | 89° 19' 17.5" E | Clay, Sand (2,4) | Sticky, Medium (5,2) | Grey, Grey (7,7) |
| 21:20 | 30° 19' 30.9" N | 89° 19' 34.7" E | Clay (2) | Fine (1) | Grey (7) |

Table 34 Seabed Samples Collected 19 June 2013 with S-57 Encoding Values

### D.2.2 Seabed Texture

Beam averaged backscatter data was not recorded during this survey. SSS mosaics were processed in place of multibeam backscatter to gather the seabed texture distribution. The general intensity variation that was used across all mosaics was minimal, except in Area 3. This suggests little variation in the seabed texture across the first two areas. In Area 3, the most prominent variation occurred at the southern end where the sediment seemed to contain more sand than clay (which was most common in the other two areas and most of Area 3). This area is at the junction between the Gulf and the entrance to the Bay. It is also the area leading up to the Bay St. Louis Municipal Harbor & Pier. Seabed sample data is recorded in the S57 Final Feature File that is submitted with this dataset.

### D.2.3 Aids to Navigation

While there were only a few aids to navigation (ATONs) in the vicinity of the survey area, there were many that were not of use anymore. The older ATONs were in more shallow water than most of the survey area. In order to verify these, the transducers were removed after the survey portion was complete.

All of the ATONs that were within the survey area were positioned using PPK GNSS data from the TopCon GR3. CNAV and Trimble data was recorded as a backup.

| Timestamp & Imagery | Area | Name | Feature No. | Verified Position | Charted Position | Distance off station (m) | Bearing from station (°) | Light Characteristics |
|---|---|---|---|---|---|---|---|---|
| 1725  | 1 | NOAA Bay Waveland Tide Monitoring Platform Light | 10270 | 30° 19' 34.76" N 89° 19' 32.92" W | 30° 19' 34.51" N 89° 19' 33.39" W | 14.59 | 240 | Flashing Yellow at 3 Seconds |
| 2129 | 1 | Bay Waveland Yacht Club | - | 30° 19' 32.30" N 89° 19' 31.11" W | - | - | - | Flashing Green at 5 Seconds |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
|  | | Entrance Light | | | | | | | |
| 1746  | 1 | Bay Waveland Yacht Club Entrance Marker | - | 30° 19' 32.46" N 89° 19' 30.57" W | - | - | - | - | |
| 1711  | 1 | Bay Waveland Yacht Club Entrance Marker | - | 30° 19' 33.38" N 89° 19' 29.25" W | - | - | - | - | |
| 1715  | 1 | Saint Louis Bay Beacon 4 | - | 30° 19' 33.18" N 89° 19' 31.98" W | 30° 19' 33.48" N 89° 19' 32.12" W | 8.62 | 335 | Flashing Red at 5 Seconds | |
| 1917  | 1 | Saint Louis Bay Beacon 2 | - | 30° 19' 37.85" N 89° 19' 25.12" W | 30° 19' 35.39" N 89° 19' 26.41" W | 82.94 | 206 | Flashing Red at 5 Seconds | |
| 1803  | 2 | City of Bay St. Louis Municipal Pier Light 1 | 10357.01 | 30° 18' 40.39"N 89° 19' 14.04" W | 30° 18' 40.37" N 89° 19' 14.36" W | 7.73 | 268 | N/A | |
| 1805  | 2 | City of Bay St. Louis Municipal Pier Light 2 | 10357.02 | 30° 18' 41.26" N 89° 19' 14.05" W | 30° 18' 41.15" N 89° 19' 14.61" W | 15.68 | 259 | Flashing Red at 1 Second | |
| 1819 | 3 | City of Bay St. Louis Danger | 10357 | 30° 18' 43.90" N 89° 19' 11.24" W | 30° 18' 43.9" N 89° 19' 11.20" W | 0.98 | 90 | Flashing White at 1 Second | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
|  | | Lights | | | | | | |
| 1821  | 3 | City of Bay St. Louis Danger Lights | - | 30° 18' 44.98" N<br>89° 19' 10.41" W | - | - | - | Flashing White at 2 Seconds |
| 1811  | 3 | City of Bay St. Louis Danger Lights | - | 30° 18' 45.73" N<br>89° 19' 16.94" W | - | - | - | N/A |
| 1814  | 3 | City of Bay St. Louis Danger Lights | - | 30° 18' 46.66" N<br>89° 19' 16.59" W | - | - | - | Flashing White at 1s |
| 1426  | 3 | Old Channel Marker | - | 30° 19' 13.73" N<br>89° 19' 14.98" W | - | - | - | - |
| 1428  | 3 | Old Channel Marker | - | 30° 19' 13.78" N<br>89° 19' 12.88" W | - | - | - | - |
| 1430  | 3 | Old Channel Marker | - | 30° 19' 15.398" N<br>89° 19' 14.21" W | - | - | - | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1432  | 3 | Old Channel Marker | - | 30° 19' 15.21" N 89° 19' 16.27" W | - | - | - | - |
| 1434  | 3 | Old Channel Marker | - | 30° 19' 16.86" N 89° 19' 15.27" W | - | - | - | - |
| 1436  | 3 | Old Channel Marker | - | 30° 19' 16.81" N 89° 19' 17.598" W | - | - | - | - |
| 1438  | 3 | Old Channel Marker | - | 30° 19' 18.48" N 89° 19' 16.88" W | - | - | - | - |
| 1440  | 3 | Old Channel Marker | - | 30° 19' 18.397" N 89° 19' 18.95" W | - | - | - | - |
| 1442  | 3 | Old Channel Marker | - | 30° 19' 20.08" N 89° 19' 18.23" W | - | - | - | - |
| 1444-  | 3 | Old Channel Marker | - | 30° 19' 20" N 89° 19' 20.27" W | - | - | - | - |
| 1446  | 3 | Old Channel Marker | - | 30° 19' 21.66" N 89° 19' 19.55" W | - | - | - | - |
| 1448  | 3 | Old Channel Marker | - | 30° 19' 21.61" N 89° 19' 21.65" W | - | - | - | - |
| 1450 | 3 | Old Channel Marker | - | 30° 19' 23.22" N 89° 19' 20.87" W | - | - | - | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
|  | | | | | | | | |
| 1452  | 3 | Old Channel Marker | - | 30° 19' 23.196" N 89° 19' 22.98" W | - | - | - | - |
| 1454  | 3 | Old Channel Marker | - | 30° 19' 24.82" N 89° 19' 22.22" W | - | - | - | - |
| 1458  | 3 | Old Channel Marker | - | 30° 19' 28.46" N 89° 19' 25.78" W | - | - | - | - |

Table 26 Aids to Navigation Positioned on 18-19 June 2014

### D.2.4 Dangers to Navigation

Three different DTONs were found during data processing, and one was found during the actual survey. The one found during the survey is awash at high tide, however protrudes above the surface at low tide. Table 30 below displays positioning and depth information for each of the discovered DTONs. The least depths for these DTONs were also set as designated soundings in the accompanying surfaces for each area. The full reports can be found in appendix II.

| Area | Latitude | Longitude | Depth (m) | Description |
|---|---|---|---|---|
| 1 | 30° 19' 31.21" N | 89° 19' 34.92" W | 1.28 | Object reaching 0.61 m in height. |
| 1 | 30° 19' 30.91" N | 89° 19' 36.00" W | 1.05 | Object with 0.62 m height. |
| 3 | 30° 19' 15.398" N | 89° 19' 14.21" W | - | Old channel marker. Was awash at high tide. Protrudes about 5 cm at low tide. |

Table 27 Summary of Dangers to Navigation

### D.2.5 Construction

Construction of the new Bay St. Louis Municipal Harbor & Pier was finishing up as the survey began. This was found at the most southern west area of our survey. This included the building of many boat slips and a long fishing pier. The survey vessel was unable to reach certain parts of this marina due to large tug boats and other construction equipment being in the way. Unfortunately the tug boat captain was not available to relocate the tug and barges in order for us to complete the small portion missed. The western portion of this marina will require future survey attention to adequately collect depth soundings in those vessel slips.

### D.2.6 Dredging

Dredging had been conducted at the new Bay St. Louis Municipal Harbor & Pier prior to this survey, and BWYC will be using the results of this survey in order to plan a future dredging activity.

### D.2.7 Amendments to Sailing Directions/Coast Pilot

The entire survey area was covered in the NOAA Coast Pilot 5, chapter 7 [NOAA, 2014]. The team looked over this section before the survey began to learn more about the area. Additions to the publication should be made to include the newly constructed Bay St. Louis Municipal Harbor & Pier. It is located approximately 0.56 miles South of U.S. Route 90 Highway bridge. The depth leading into the harbor is approximately 6 feet. The harbor facilities are open for public use

# E Approval Sheet

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# Appendices

# I Tides and Water Levels

The majority of bathymetry data has been corrected using a single separation value, MLLW NTDE 1983-2001 to the ellipsoid GRS-80, using ellipsoid referencing techniques. Five lines in Area 3 required the application of traditional techniques for tidal datum reduction due to insufficient raw GNSS data. NOAA CO-OPS tides from station 8747437 were used for the corrections. Lines in Table 33 have tides applied to them. Please see section C or *14USM02 Vertical and Horizontal Control Report* for more details concerning vertical control.

| | Start Time | End Time |
|---|---|---|
| JD 168 | 13:47 | 14:00 |
| | 14:01 | 14:15 |
| | 14:15 | 14:28 |
| | 14:29 | 14:43 |
| | 14:44 | 14:51 |

Table 28 Start and End Times for the Data with Tides Applied.

## I.1Abstract of times of Hydrography

If smoothed tides need to be applied to all of the survey data in the future, the bathymetry collection times are listed in Table 34.

| Date | Julian Day | Time UTC |
|---|---|---|
| 11-Jun | 162 | 18:47 - 22:10 |
| 12-Jun | 163 | 15:41 - 19:57 |
| 16-Jun | 167 | 15:17 - 20:50 |
| 17-Jun | 168 | 13:46 - 19:45 |
| 18-Jun | 169 | 13:00 - 18:59 |
| 19-Jun | 170 | 14:45 - 15:14 |

Table 29 Bathymetry Collection Times for Each Day.

## II.i Dangers to Navigation Submitted

The following reports were submitted to NOAA in support of the project S-57 DTON file.

### 1) 1637

**DANGER TO NAVIGATION**

**Survey Summary**

**Survey Position:** 30° 19' 30.91" N; 89° 19' 36.00" W
**Least Depth:** 0.67m
**TPU (±0.159)** **THU (TaPEh):** 0.065m ; **TVU (TPEv):** 0.145m
**Timestamp:** 2014-06-12 18:32:05
**Dataset:** 14USM02_DTONs.000
**FOID:** 1637

**Charts Affected:** RNC 11372, ENC US5MS11M

**Remarks:**

Feature sits approximately 0.61m above the surrounding seabed and is located inside the Bay Waveland Yacht Club. The water depth in this area is only 1.28m, and this feature lies in the main entry way to the Yacht Club. Due to the significant variation from the surrounding seabed, the feature may present a hazard to navigation.

**Feature Correlation**

| Source | Feature | Range | Azimuth | Status |
|---|---|---|---|---|
| 14USM02_DTONs.000 | 1637 | 0.00 | 000.0 | Primary |

Table 30

**Hydrographer Recommendations**

Mark feature as an obstruction.

**Cartographically-Rounded Depth (Affected Charts):**

Chart 11372: 2 Feet

**S-57 Data**

**Geo Object 1:** OBSTRN (Obstruction)

**Attributes:**
QUASOU - 6: Least depth known
SORDAT - 20140619
SORIND - US,US,graph,14USM02
TECSOU - 2,3: Found by side scan sonar, found by multi-beam echo sounder
VALSOU - 0.67 m
WATLEV - 3: Always under water/submerged

**Office Notes**

The submission for this danger is preliminary. None of the data has been provided to the AHB for verification at this time. The feature will be reviewed and verified once the survey data has been submitted. The horizontal datum is in NAD83, with depths corrected to chart datum of MLLW.

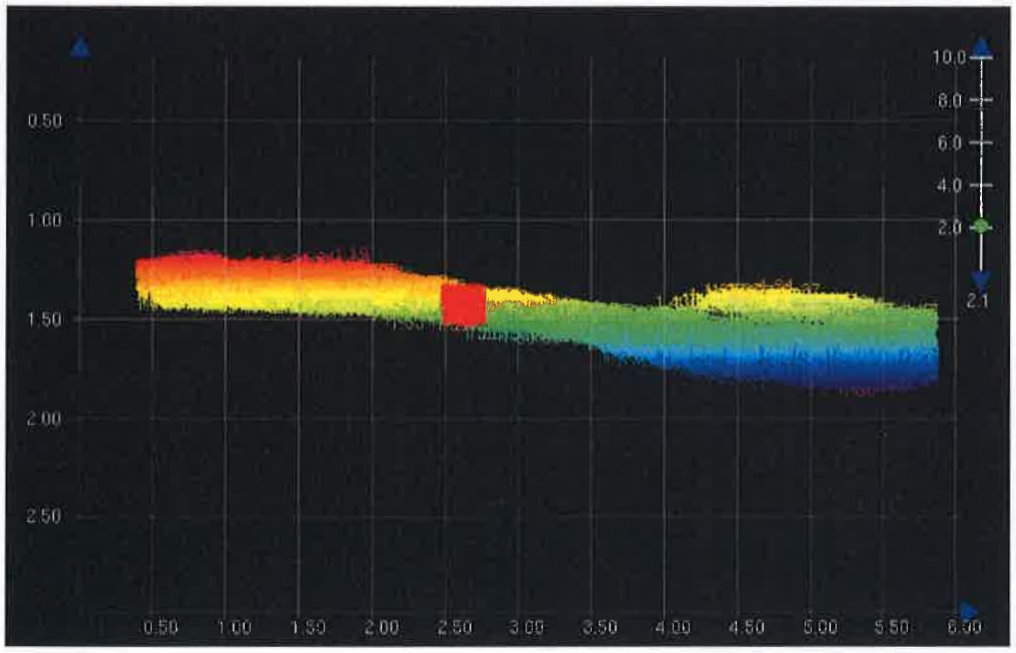



Figure 29 CARIS HIPS subset over feature at 2.0× exaggeration

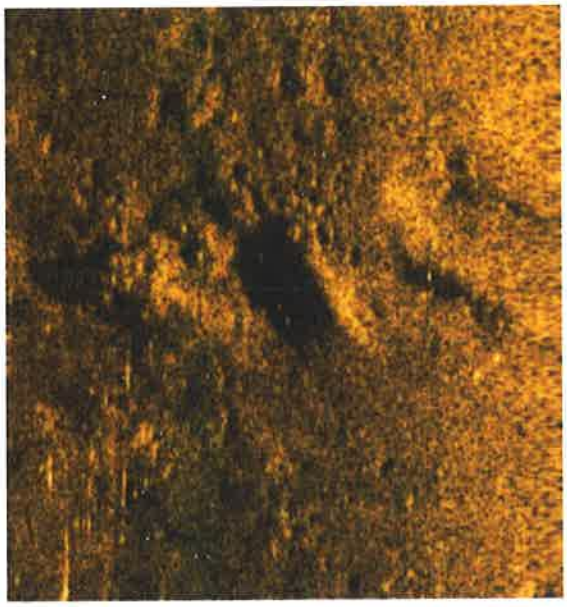


Figure 30 View of feature (25m range scale)

**2) 1639**

**DANGER TO NAVIGATION**

**Survey Summary**

**Survey Position:** 30° 19' 31.21" N; 89° 19' 34.92" W
**Least Depth:** 0.43m
**TPU (±0.159)** **THU (TPEh):** 0.065m ; **TVU (TPEv):** 0.145m
**Timestamp:** 2014-06-12 19:18:06
**Dataset:** 14USM02_DTONs.000
**FOID:** 1639

**Charts Affected:** RNC 11372, ENC US5MS11M

**Remarks:**

Feature sits approximately 0.62m above the surrounding seabed and is located inside the Bay Waveland Yacht Club. The water depth in this area is only 1.05m. This object is off of the main passage and by a slip. Due to the significant variation from the surrounding seabed, the feature may present a hazard to navigation. However, the feature was not picked up in multibeam data.

**Feature Correlation**

| Source | Feature | Range | Azimuth | Status |
|---|---|---|---|---|
| 14USM02_DTONs.000 | 1639 | 0.00 | 000.0 | Primary |

Table 31

**Hydrographer Recommendations**

Mark feature as an obstruction.

**Cartographically-Rounded Depth (Affected Charts):**

Chart 11372: 1 Foot

**S-57 Data**

**Geo Object 1:** OBSTRN (Obstruction)

**Attributes:**
QUASOU - 6: Least depth known
SORDAT - 20140619
SORIND - US,US,graph,14USM02
TECSOU - 2: Found by side scan sonar
VALSOU - 0.43 m
WATLEV - 3: Always under water/submerged

**Office Notes**

The submission for this danger is preliminary. None of the data has been provided to the AHB for verification at this time. The feature will be reviewed and verified once the survey data has been submitted. The horizontal datum is in NAD83, with depths corrected to chart datum of MLLW.

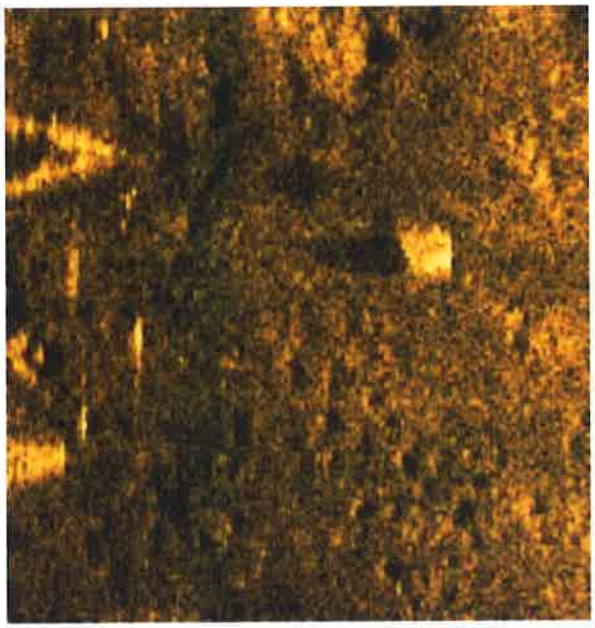


Figure 31 SSS view of feature (25m range scale)

**3) 1238**

**DANGER TO NAVIGATION**

**Survey Summary**

**Survey Position:** 30° 19' 15.398" N; 89° 19' 14.21" W
**Least Depth:** 0.00m
**TPU (N/A)** **THU (TPEh):** 0.04m ; **TVU (TPEv):** N/A
**Timestamp:** 2014-06-19 14:25:30
**Dataset:** 14USM02_DTONs.000
**FOID:** 1238

**Charts Affected:** RNC 11372, ENC US5MS11M

**Remarks:**

Object appears to be an old channel marker that is awash at high tide. It protrudes about 5 cm out of the water at low tide. It is located south of the Bay Waveland Yacht Club near the shore. The water depth in this area is approximately 0.59m. Due to the lack of visibility, the feature may present a hazard to navigation.

**Feature Correlation**

| Source | Feature | Range | Azimuth | Status |
|---|---|---|---|---|
| 14USM02_DTONs.000 | 1238 | 0.00 | 000.0 | Primary |

Table 32

**Hydrographer Recommendations**

Mark feature as an obstruction.

**Cartographically-Rounded Depth (Affected Charts):**

Chart 11372: 2 Feet

**S-57 Data**

**Geo Object 1:** OBSTRN (Obstruction)

**Attributes:** QUASOU - 2: Depth Unknown
SORDAT - 20140619

SORIND - US,US,graph,14USM02
STATUS - 4: Not in use
WATLEV - 4: Covers and uncovers

**Office Notes**

The submission for this danger is preliminary. None of the data has been provided to the AHB for verification at this time. The feature will be reviewed and verified once the survey data has been submitted. The horizontal datum is in NAD83, with depths corrected to chart datum of MLLW.

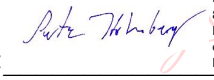
Figure 32 Image of Obstruction Protruding from Water at Low Tide

APPROVAL PAGE

W00435

The survey data meet or exceed the current requirements of the Office of Coast Survey hydrographic data review process and may be used to update NOAA products. The following survey products will be archived at the National Centers for Environmental Information:

- Descriptive Report
- Collection of Bathymetric Attributed Grids (BAGs)
- Geospatial PDF of survey products

Approved: 


**Peter Holmberg**
Acting Chief, Pacific Hydrographic Branch