

H13511

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

**DESCRIPTIVE REPORT**

Type of Survey: Basic Hydrographic Survey

Registry Number: H13511

**LOCALITY**

State(s): Maryland

General Locality: Central Chesapeake Bay

Sub-locality: Chesapeake Beach to Horseshoe Point

**2023**

CHIEF OF PARTY  
Paul L. Donaldson

LIBRARY & ARCHIVES

Date:

**HYDROGRAPHIC TITLE SHEET**

**H13511**

**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): **Maryland**

General Locality: **Central Chesapeake Bay**

Sub-Locality: **Chesapeake Beach to Horseshoe Point**

Scale: **20000**

Dates of Survey: **10/13/2022 to 04/24/2023**

Instructions Dated: **08/23/2022**

Project Number: **OPR-E347-KR-22**

Field Unit: **Leidos**

Chief of Party: **Paul L. Donaldson**

Soundings by: **Multibeam Echo Sounder**

Imagery by: **Side Scan Sonar Multibeam Echo Sounder Backscatter**

Verification by: **Atlantic Hydrographic Branch**

Soundings Acquired in: **meters at Mean Lower Low Water**

**Remarks:**

Contract: 1305M220DNCNJ0056/TO-0003. Contractor: Leidos, 221 Third Street, Newport, RI 02840 USA. Subcontractors: Northstar Marine, Inc., 36 Clermont Drive, Clermont, NJ 08210; OARS, 8705 Shoal Creek Blvd, Suite 109, Austin, TX 78757. Leidos Doc. 22-TR-021. All times were recorded in UTC. Final data are corrected to North American Datum of 1983 (NAD83) 2011 realization 2010 (NAD83(2011)2010.0), UTM Zone 18N.

*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 18N, MLLW. All references to other horizontal or vertical datums in this report are applicable to the processed hydrographic data provided by the field unit.*

# Table of Contents

<b>A. Area Surveyed</b> .....	1
A.1 Survey Limits.....	1
A.2 Survey Purpose.....	3
A.3 Survey Quality.....	3
A.4 Survey Coverage.....	3
A.6 Survey Statistics.....	6
<b>B. Data Acquisition and Processing</b> .....	7
B.1 Equipment and Vessels.....	7
B.1.1 Vessels.....	8
B.1.2 Equipment.....	10
B.2 Quality Control.....	10
B.2.1 Crosslines.....	10
B.2.2 Uncertainty.....	16
B.2.3 Junctions.....	17
B.2.4 Sonar QC Checks.....	26
B.2.5 Equipment Effectiveness.....	26
B.2.6 Factors Affecting Soundings.....	26
B.2.7 Sound Speed Methods.....	27
B.2.8 Coverage Equipment and Methods.....	27
B.2.9 Multibeam Coverage Analysis.....	27
B.3 Echo Sounding Corrections.....	28
B.3.1 Corrections to Echo Soundings.....	28
B.3.2 Calibrations.....	28
B.4 Backscatter.....	28
B.5 Data Processing.....	29
B.5.1 Primary Data Processing Software.....	29
B.5.2 Surfaces.....	30
<b>C. Vertical and Horizontal Control</b> .....	31
C.1 Vertical Control.....	31
C.2 Horizontal Control.....	31
<b>D. Results and Recommendations</b> .....	32
D.1 Chart Comparison.....	32
D.1.1 Electronic Navigational Charts.....	32
D.1.2 Shoal and Hazardous Features.....	33
D.1.3 Charted Features.....	33
D.1.4 Uncharted Features.....	33
D.1.5 Channels.....	33
D.2 Additional Results.....	34
D.2.1 Aids to Navigation.....	34
D.2.2 Maritime Boundary Points.....	34
D.2.3 Bottom Samples.....	34
D.2.4 Overhead Features.....	34
D.2.5 Submarine Features.....	34

D.2.6 Platforms.....	34
D.2.7 Ferry Routes and Terminals.....	35
D.2.8 Abnormal Seafloor or Environmental Conditions.....	35
D.2.9 Construction and Dredging.....	35
D.2.10 New Survey Recommendations.....	35
D.2.11 ENC Scale Recommendations.....	35
<b>E. Approval Sheet.....</b>	<b>36</b>
<b>F. Table of Acronyms.....</b>	<b>37</b>

## List of Tables

Table 1: Survey Limits.....	1
Table 2: Survey Coverage.....	4
Table 3: Hydrographic Survey Statistics.....	6
Table 4: Dates of Hydrography.....	7
Table 5: Vessels Used.....	8
Table 6: Major Systems Used.....	10
Table 7: Survey Specific Tide TPU Values.....	16
Table 8: Survey Specific Sound Speed TPU Values.....	16
Table 9: Junctioning Surveys.....	19
Table 10: Primary bathymetric data processing software.....	29
Table 11: Primary imagery data processing software.....	29
Table 12: Submitted Surfaces.....	30
Table 13: ERS method and SEP file.....	31
Table 14: Largest Scale ENCs.....	32

## List of Figures

Figure 1: H13511 Survey Bounds.....	2
Figure 2: Final Bathymetry Coverage for H13511.....	5
Figure 3: R/V Sea Innovator I.....	8
Figure 4: R/V Oyster Bay II.....	9
Figure 5: Summary of Crossing Analysis.....	11
Figure 6: Summary of Vessel Comparison Repeatability Analysis.....	11
Figure 7: Tabular Results Crossing Analysis, Crosslines vs. Mainscheme Lines.....	12
Figure 8: Plot of Crossing Analysis Crosslines vs. Mainscheme Lines.....	12
Figure 9: Tabular Results Crossing Analysis, R/V Sea Innovator I Crosslines vs. Mainscheme Lines.....	13
Figure 10: Plot of Crossing Analysis R/V Sea Innovator I Crosslines vs. Mainscheme Lines.....	13
Figure 11: Tabular Results Crossing Analysis, R/V Oyster Bay II Crosslines vs. Mainscheme Lines.....	14
Figure 12: Plot of Crossing Analysis R/V Oyster Bay II Crosslines vs. Mainscheme Lines.....	14
Figure 13: Tabular Results Vessel Comparison Analysis, R/V Sea Innovator I vs. R/V Oyster Bay II.....	15
Figure 14: Plot of Vessel Comparison Analysis R/V Sea Innovator I vs. R/V Oyster Bay II.....	15
Figure 15: General Locality of H13511 with Junctioning Surveys.....	18
Figure 16: Tabular Results Junction Analysis H13511 vs. H13343.....	20

Figure 17: Plot of Junction Analysis H13511 vs. H13343.....	21
Figure 18: Tabular Results Junction Analysis H13511 vs. H13507.....	22
Figure 19: Plot of Junction Analysis H13511 vs. H13507.....	22
Figure 20: Tabular Results Junction Analysis H13511 vs. H13508.....	23
Figure 21: Plot of Junction Analysis H13511 vs. H13508.....	24
Figure 22: Tabular Results Junction Analysis H13511 vs. H13510.....	25
Figure 23: Plot of Junction Analysis H13511 vs. H13510.....	26
Figure 24: DTON Reports.....	33

## Descriptive Report to Accompany Survey H13511

Project: OPR-E347-KR-22

Locality: Central Chesapeake Bay

Sublocality: Chesapeake Beach to Horseshoe Point

Scale: 1:20000

October 2022 - April 2023

**Leidos**

Chief of Party: Paul L. Donaldson

### A. Area Surveyed

H13515 was located within the Central Chesapeake Bay, Maryland within Prospect Bay (Figure 1). The survey was conducted in accordance with coverage requirements listed in the Project Instructions (PI) OPR-E347-KR-22.

#### A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
38° 50' 43.74" N 76° 33' 12.98" W	38° 40' 57.14" N 76° 26' 53.75" W

*Table 1: Survey Limits*

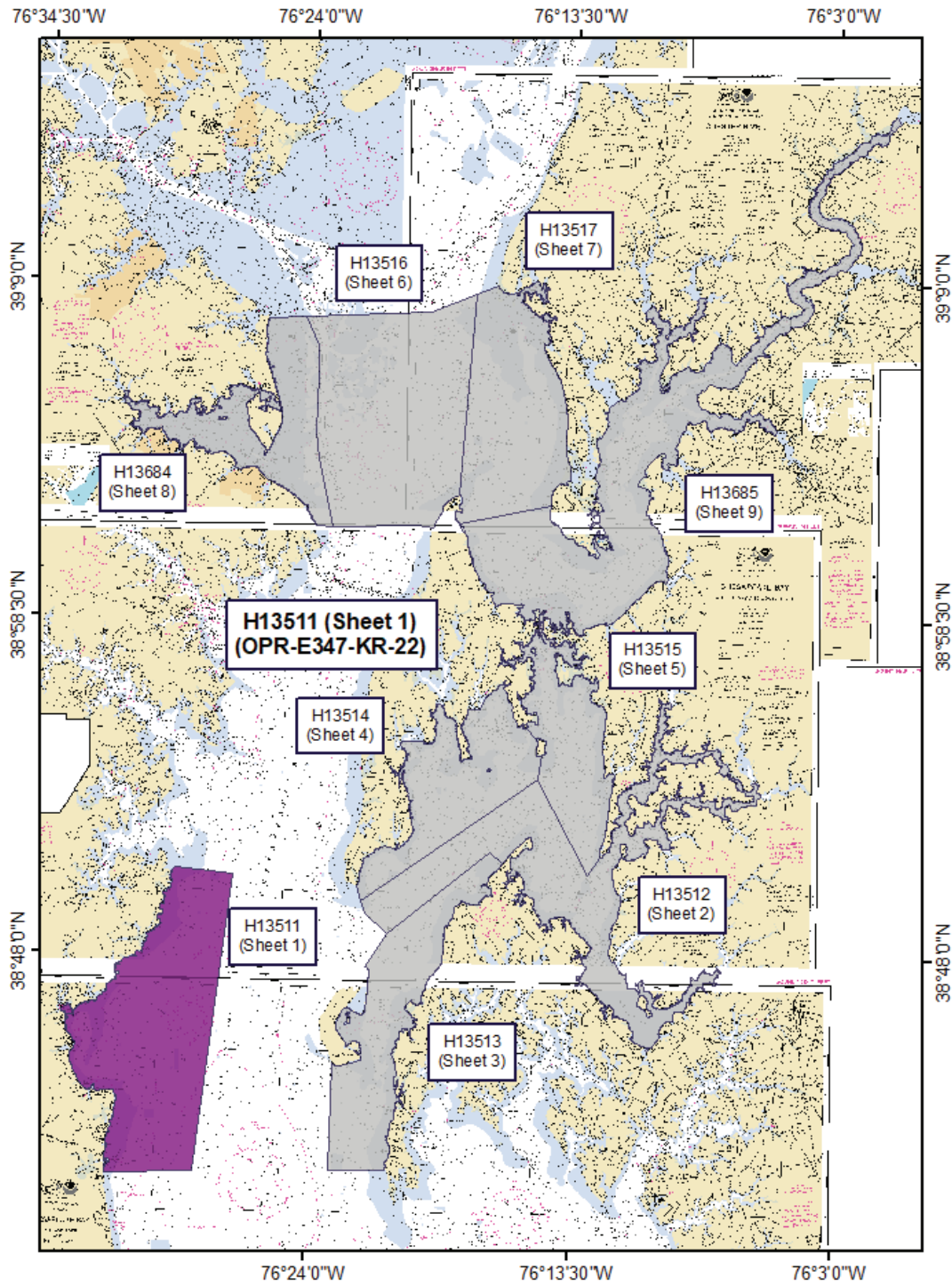


Figure 1: H13511 Survey Bounds

Survey limits were acquired in accordance with the requirements in the Project Instructions and the Hydrographic Survey Specifications and Deliverables (HSSD), March 2022.

## **A.2 Survey Purpose**

The Chesapeake Bay is the largest estuary in North America and heavily trafficked by commercial and recreational vessels as tourism, fishing, and marine commerce are economically vital for the region. In addition to fishing and tourism traffic, commercial vessels transit through the project area to reach the Port of Baltimore, which is ranked as a top 15 port in container and tonnage, and a top 10 port for dry bulk.

The majority of the prior data in the project area spans from the 1880s to 1940s. The bathymetric data vintage coupled with numerous storms and hurricanes having potentially changed the seabed over the last century raises a need to survey the area. In addition, the Ever Forward container ship ran aground near the Craighill Channel in March 2022, and was removed after 35 days. 206,230 cubic yards of material was dredged and taken to Poplar Island. The data from this project will provide modern bathymetry for updating National Ocean Service nautical charting products improving the safety of maritime traffic and commerce as well as supporting the Seabed 2030 global mapping initiative. Survey data from this project is intended to supersede all prior survey data in the common area.

## **A.3 Survey Quality**

The entire survey is adequate to supersede previous data.

Leidos warrants only that the survey data acquired by Leidos and delivered to NOAA under Contract 1305M220DNCNJ0056 reflects the state of the sea floor in existence on the day and at the time the survey was conducted.

H13511 was surveyed in accordance with the following documents:

- 1305M220DNCNJ0056 signed.pdf, received 23 August 2022
- Hydrographic Survey Specifications and Deliverables (HSSD), March 2022
- PRF.000, received 24 August 2022
- CSF.000, received 24 August 2022
- OPR-E347-KR-22 Project Brief, held 07 September 2022

## **A.4 Survey Coverage**

The following table lists the coverage requirements for this survey as assigned in the project instructions:

Water Depth	Coverage Required
Sheets 1, 3, 4, 5, 7, 8, and 9	Complete Coverage (Refer to HSSD Section 5.2.2.3)
Inshore limit to 8 meters water depth	Sidescan may be acquired at an altitude of 6-20% of the range scale.

*Table 2: Survey Coverage*

Leidos chose to achieve the coverage requirement using Complete Coverage, Option B (100% side scan sonar coverage with concurrent multibeam). Survey coverage achieved was in accordance with the requirements in the Project Instructions and the HSSD (Figure 2).

In many areas of H13511 the inshore limit of the Navigable Area Limit Line (NALL) was reached seaward of the assigned survey bounds. Leidos surveyed to the NALL as defined by HSSD Section 1.3.2; within the surveyed bounds. However, due to safety concerns for personnel and survey equipment, some areas were not fully covered with multibeam echo sounder (MBES) data to exactly the 3.5-meter depth contour. This was due limited vessel maneuverability around the shoal depth areas, at these discrete locations. In these areas the side scan sonar (SSS) swath extended shoreward of the MBES swath, and indicated that the seafloor continued to rise abruptly and in a manner that the vessel could not navigate over for further MBES coverage; while also indicating in the SSS data that there were no significant objects that would require individual cartographic representation.

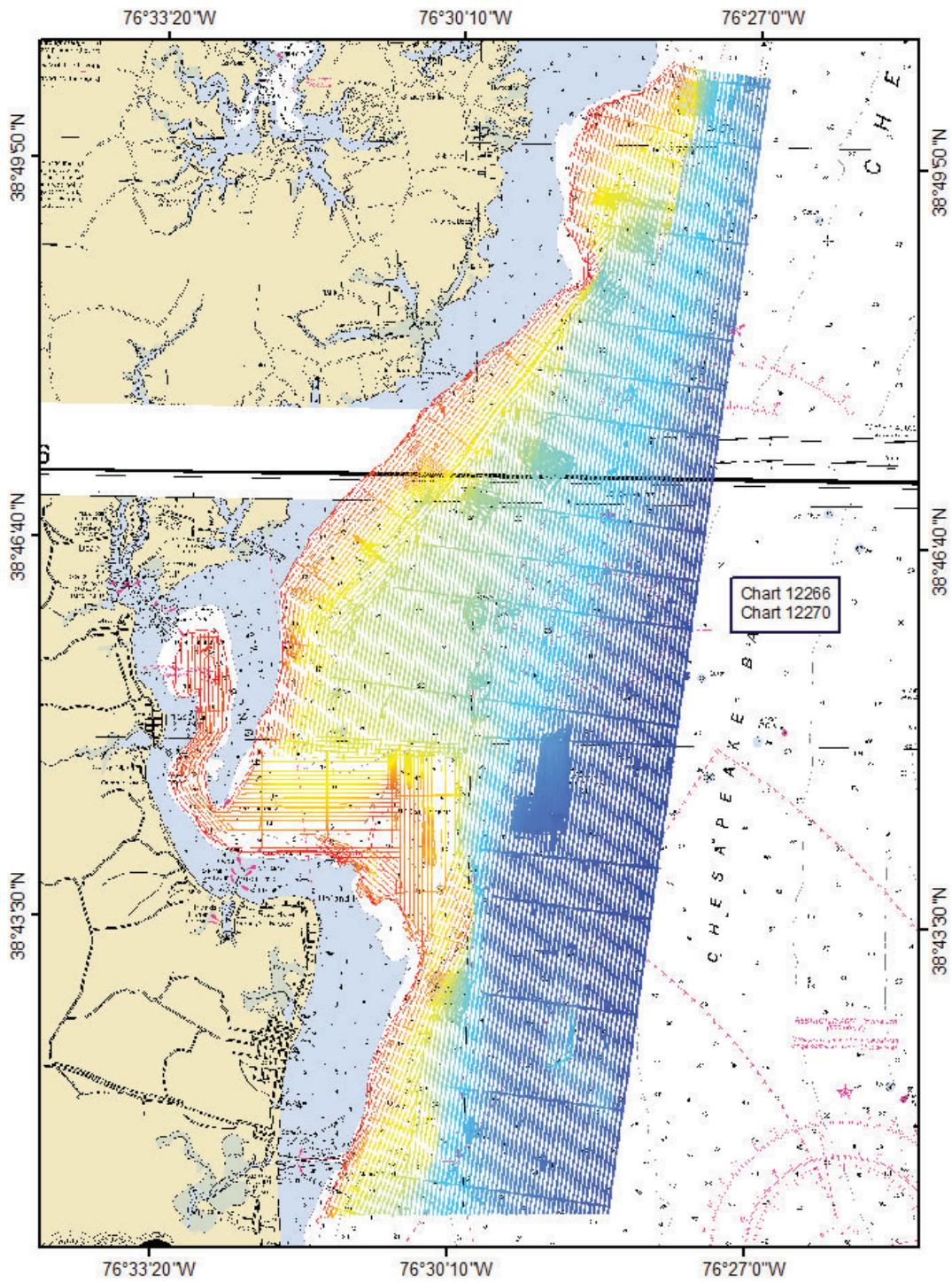


Figure 2: Final Bathymetry Coverage for H13511

## A.6 Survey Statistics

The following table lists the mainscheme and crossline acquisition mileage for this survey:

	<b>HULL ID</b>	<i>R/V Sea Innovator I</i>	<i>R/V Oyster Bay II</i>	<i>Total</i>
<b>LNM</b>	<b>SBES Mainscheme</b>	0.0	0.0	0.0
	<b>MBES Mainscheme</b>	0.0	0.0	0.0
	<b>Lidar Mainscheme</b>	0.0	0.0	0.0
	<b>SSS Mainscheme</b>	0.0	0.0	0.0
	<b>SBES/SSS Mainscheme</b>	0.0	0.0	0.0
	<b>MBES/SSS Mainscheme</b>	500.29	26.09	809.45
	<b>SBES/MBES Crosslines</b>	309.27	12.01	38.1
	<b>Lidar Crosslines</b>	0.0	0.0	0.0
<b>Number of Bottom Samples</b>			2	
<b>Number Maritime Boundary Points Investigated</b>			0	
<b>Number of DPs</b>			0	
<b>Number of Items Investigated by Dive Ops</b>			0	
<b>Total SNM</b>			24.49	

Table 3: Hydrographic Survey Statistics

The following table lists the specific dates of data acquisition for this survey:

<b>Survey Dates</b>	<b>Day of the Year</b>
10/13/2022	286
10/14/2022	287
10/15/2022	288
10/16/2022	289
10/17/2022	290
10/18/2022	291
10/19/2022	292
10/21/2022	294
11/03/2022	307
11/04/2022	308
11/05/2022	309
11/07/2022	311
11/09/2022	313
12/10/2022	344
12/11/2022	345
12/13/2022	347
12/16/2022	350
12/17/2022	351
04/10/2023	100
04/11/2023	101
04/24/2023	114

*Table 4: Dates of Hydrography*

## **B. Data Acquisition and Processing**

### **B.1 Equipment and Vessels**

Leidos used their ISS-2000 software on a Windows platform to acquire these survey data. Survey planning and data analysis were conducted using the Leidos SABER software on Linux platforms. Side scan sonar

(SSS) data were collected on a Windows platform using Klein's SonarPro software. Subsequent processing and review of the SSS data, including the generation of coverage mosaics, were accomplished using SABER.

A detailed description of the systems and vessel used to acquire and process these data is included in the Data Acquisition and Processing Report (DAPR) for OPR-E347-KR-22, delivered concurrently with H13511. There were no variations from the equipment configuration described in the DAPR.

### B.1.1 Vessels

The following vessels were used for data acquisition during this survey:

Hull ID	<i>R/V Sea Innovator I</i>	<i>R/V Oyster Bay II</i>
<b>LOA</b>	135.0 feet	30.0 meters
<b>Draft</b>	9.0 feet	3.0 meters

*Table 5: Vessels Used*



*Figure 3: R/V Sea Innovator I*



*Figure 4: R/V Oyster Bay II*

The R/V Sea Innovator I was used to collect multibeam echo sounder (MBES) (RESON SeaBat T50), side scan sonar (SSS) (Klein 4000), and sound speed data during twenty four hours per day survey operations. The R/V Oyster Bay II (Figure 4) was used to collect MBES (RESON SeaBat T50), SSS (Klein 4900), and sound speed data during twelve hours per day survey operations.

A detailed description of the vessels used is included in the DAPR.

## B.1.2 Equipment

The following major systems were used for data acquisition during this survey:

<b>Manufacturer</b>	<b>Model</b>	<b>Type</b>
Teledyne RESON	SeaBat T50-R	MBES
Klein Marine Systems	System 4000	SSS
Klein Marine Systems	System 4900	SSS
Applanix	POS MV 320 v5	Positioning and Attitude System
AML Oceanographic	BaseX	Sound Speed System
AML Oceanographic	MVP30	Conductivity, Temperature, and Depth Sensor
Teledyne RESON	SeaBat T50-R	MBES Backscatter

*Table 6: Major Systems Used*

A detailed description of the equipment installed is included in the DAPR.

## B.2 Quality Control

### B.2.1 Crosslines

Multibeam echo sounder crosslines acquired for this survey totaled 4.71% of mainscheme acquisition. The resulting crossline to mainscheme percentage met the requirement to achieve approximately four percent of mainscheme mileage for a complete coverage multibeam survey (Section 5.2.4.2 of the HSSD). H13511 requirements were for Complete Coverage, Option B, based on the classifications defined in Section 5.2.2.3 of the HSSD.

The mainscheme lines were spaced 70 meters apart, and crosslines were generally spaced 1500 meters apart. In the field, hydrographers conducted daily comparisons of mainscheme to near nadir crossline data to ensure that no systematic errors were introduced and to identify potential problems with the survey systems. After the application of all correctors and completion of final processing in the office, separate CUBE PFM grids were built at 1-meter resolution for all data. One grid contained the full valid swath ( $\pm 65^\circ$  from nadir, Class 2) of mainscheme multibeam and the other included only the near nadir swath ( $\pm 5^\circ$  from nadir, Class 1) crossline data. The difference grid was created by subtracting the 1-meter H13511 mainscheme CUBE depths from the 1-meter H13511 crossline CUBE depths. Additional comparisons were conducted of each vessels mainscheme to crossline depth data. These results are summarized in Figure 5.

The SABER Frequency Distribution Tool was used to analyze the difference grid created from the mainscheme and crossline PFM grids and the results of the analysis were compiled into the following section.

Section 5.2.4.2 of the HSSD states that the depth difference values are to be within the maximum allowable Total Vertical Uncertainty [TVU]. Of the three mainscheme to crossline analysis conducted the 100% of the comparisons were within TVU. Results for all crossing analysis are summarized in Figure 5.

As multiple vessels were used to survey H13511 repeatability analysis was performed between the data collected by both vessels where coincident. Of the vessel to vessel analysis, 99.99% of the comparisons were within TVU. Results are summarized in Figure 6. There were 51 comparisons which exceeded the maximum allowable TVU. In all instances, the differences were associated with features with the majority being associated with objects within the fish havens and fish weir piles.

Results for analysis conducted are presented in Figure 7 to Figure 14.

Crossing Analysis	Minimum and Maximum CUBE Depth (meters) of Crossline Grid	IHO Order 1A Maximum Allowable Uncertainty (meters) for the Range of Depths	Percentage of Depth Differences Within IHO Order 1A Maximum Allowable Uncertainty
R/V Sea Innovator I and R/V Oyster Bay II Multibeam 1-meter Crossline (Class 1) to R/V Sea Innovator I and R/V Oyster Bay II Multibeam 1-meter Mainscheme	2.538 – 11.644	0.501 – 0.522	100.00%
R/V Sea Innovator I Multibeam 1-meter Crossline (Class 1) to R/V Sea Innovator I Multibeam 1-meter Mainscheme	6.183 – 11.644	0.506 – 0.522	100.00%
R/V Oyster Bay II Multibeam 1-meter Crossline (Class 1) to R/V Oyster Bay II Multibeam 1-meter Mainscheme	2.538 – 7.783	0.501 – 0.510	100.00%

Figure 5: Summary of Crossing Analysis

Repeatability Analysis	Minimum and Maximum CUBE Depth (meters) of Comparison	IHO Order 1A Maximum Allowable Uncertainty (meters) for the Range of Depths	Percentage of Depth Differences Within IHO Order 1A Maximum Allowable Uncertainty
R/V Sea Innovator I 1-meter Multibeam Data to R/V Oyster Bay II 1-meter Multibeam Data	5.325 – 11.657	0.505 – 0.522	99.99%

Figure 6: Summary of Vessel Comparison Repeatability Analysis

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	15278	19.59	6903	8.85	7640	9.79	735	0.94
>0.01-0.02	12496	35.61	5396	15.77	7100	18.90		
>0.02-0.03	12794	52.01	4996	22.17	7798	28.90		
>0.03-0.04	10500	65.47	3821	27.07	6679	37.46		
>0.04-0.05	8690	76.61	3046	30.98	5644	44.69		
>0.05-0.06	5683	83.90	1899	33.41	3784	49.55		
>0.06-0.07	4345	89.47	1277	35.05	3068	53.48		
>0.07-0.08	2712	92.95	605	35.82	2107	56.18		
>0.08-0.09	2031	95.55	401	36.34	1630	58.27		
>0.09-0.1	1388	97.33	228	36.63	1160	59.76		
>0.1-0.11	961	98.56	111	36.77	850	60.85		
>0.11-0.12	607	99.34	53	36.84	554	61.56		
>0.12-0.13	238	99.65	18	36.86	220	61.84		
>0.13-0.14	108	99.78	5	36.87	103	61.97		
>0.14-0.15	57	99.86	3	36.87	54	62.04		
>0.15-0.2	7	99.99	0	36.88	7	62.16		
>0.2-0.25	1	99.99	1	36.88	0	62.17		
>0.25-0.264	1	100.00	0	36.88	1	62.17		
<b>Total</b>	<b>77999</b>	<b>100.00%</b>	<b>28769</b>	<b>36.88%</b>	<b>48495</b>	<b>62.17%</b>	<b>735</b>	<b>0.94%</b>

Reference Grid:  
H13511 OB SI CL1 cross MB 1m MLLW 20230614 pfm H13511 OB SI Main MB 1m MLLW 20230614 pfm.dif

Figure 7: Tabular Results Crossing Analysis, Crosslines vs. Mainscheme Lines

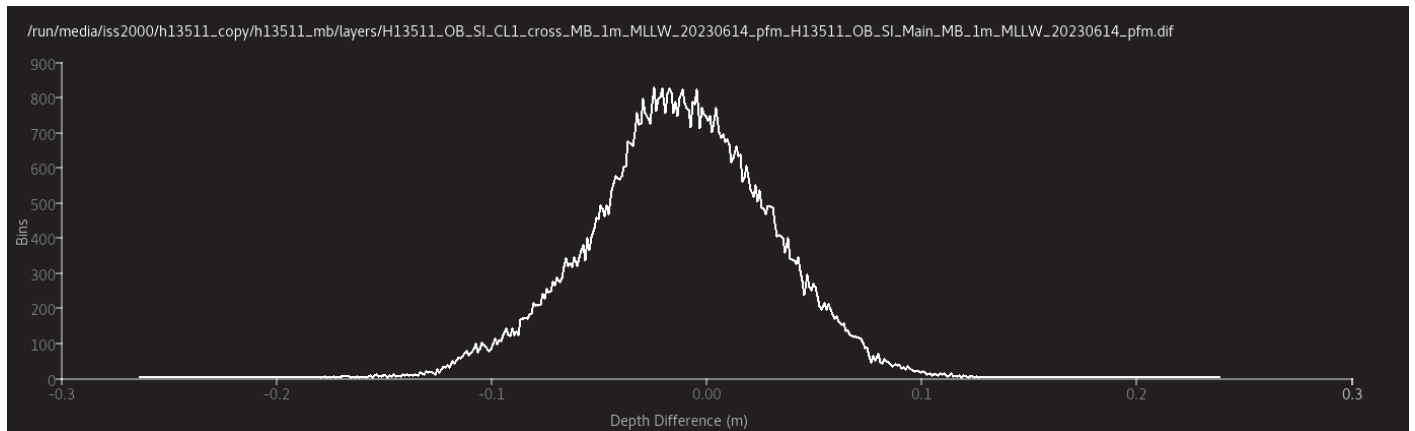


Figure 8: Plot of Crossing Analysis Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	11678	18.56	5366	8.53	5778	9.18	534	0.85
>0.01-0.02	10152	34.69	4480	15.65	5672	18.19		
>0.02-0.03	10622	51.57	4169	22.27	6453	28.45		
>0.03-0.04	8764	65.49	3284	27.49	5480	37.16		
>0.04-0.05	7130	76.82	2533	31.51	4597	44.46		
>0.05-0.06	4752	84.37	1549	33.97	3203	49.55		
>0.06-0.07	3550	90.01	1001	35.56	2549	53.60		
>0.07-0.08	2228	93.55	453	36.28	1775	56.42		
>0.08-0.09	1603	96.10	217	36.63	1386	58.62		
>0.09-0.1	1066	97.79	61	36.73	1005	60.22		
>0.1-0.11	773	99.02	14	36.75	759	61.43		
>0.11-0.12	441	99.72	1	36.75	440	62.12		
>0.12-0.13	125	99.92	0	36.75	125	62.32		
>0.13-0.14	33	99.97	0	36.75	33	62.38		
>0.14-0.15	8	99.99	0	36.75	8	62.39		
>0.15-0.192	8	100.00	0	36.75	8	62.40		
<b>Total</b>	<b>62933</b>	<b>100.00%</b>	<b>23128</b>	<b>36.75%</b>	<b>39271</b>	<b>62.40%</b>	<b>534</b>	<b>0.85%</b>

Reference Grid:  
H13511 SI CL1 cross MB 1m MLLW 20230614 pfm H13511 SI Main MB 1m MLLW 20230614 pfm.dif

Figure 9: Tabular Results Crossing Analysis, R/V Sea Innovator I Crosslines vs. Mainscheme Lines

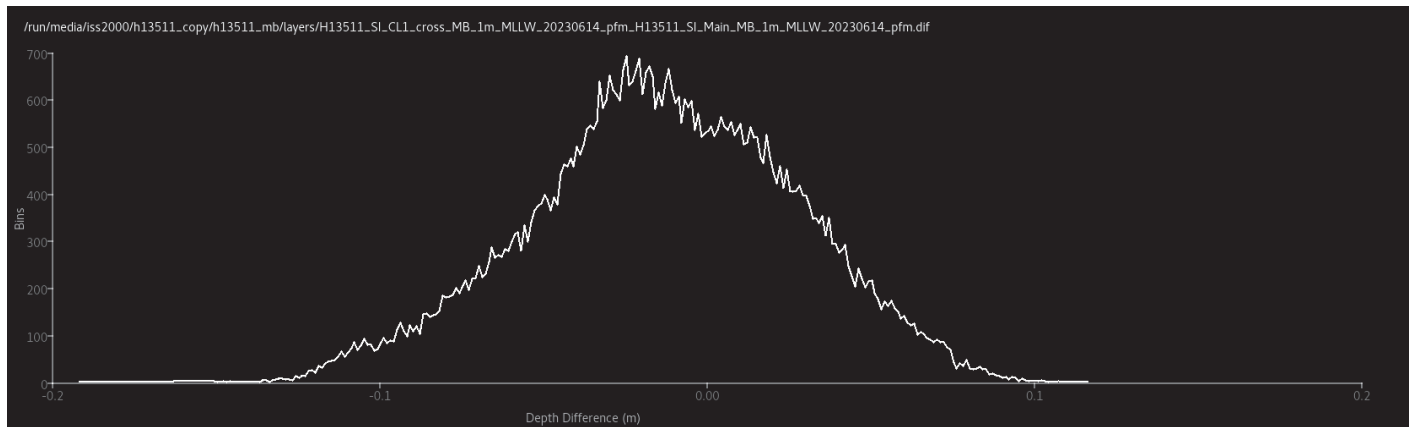


Figure 10: Plot of Crossing Analysis R/V Sea Innovator I Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	3409	29.50	1396	12.08	1815	15.71	198	1.71
>0.01-0.02	2289	49.32	836	19.32	1453	28.28		
>0.02-0.03	2052	67.08	712	25.48	1340	39.88		
>0.03-0.04	1430	79.45	353	28.54	1077	49.20		
>0.04-0.05	1118	89.13	278	30.94	840	56.47		
>0.05-0.06	581	94.16	147	32.21	434	60.23		
>0.06-0.07	375	97.40	70	32.82	305	62.87		
>0.07-0.08	163	98.81	35	33.12	128	63.98		
>0.08-0.09	71	99.43	22	33.31	49	64.40		
>0.09-0.1	33	99.71	19	33.48	14	64.52		
>0.1-0.11	10	99.80	0	33.48	10	64.61		
>0.11-0.12	10	99.89	0	33.48	10	64.70		
>0.12-0.13	7	99.95	0	33.48	7	64.76		
>0.13-0.14	0	99.95	0	33.48	0	64.76		
>0.14-0.15	0	99.95	0	33.48	0	64.76		
>0.15-0.2	2	99.97	2	33.49	0	64.76		
>0.2-0.25	3	99.99	3	33.52	0	64.76		
>0.25-0.264	4	100.00	3	33.52	1	64.77		
<b>Total</b>	<b>11554</b>	<b>100.00%</b>	<b>3873</b>	<b>33.52%</b>	<b>7483</b>	<b>64.77%</b>	<b>198</b>	<b>1.71%</b>

Reference Grid:  
H13511 OB CL1 cross MB 1m MLLW 20230614 pfm H13511 OB Main MB 1m MLLW 20230613 pfm.dif

Figure 11: Tabular Results Crossing Analysis, R/V Oyster Bay II Crosslines vs. Mainscheme Lines

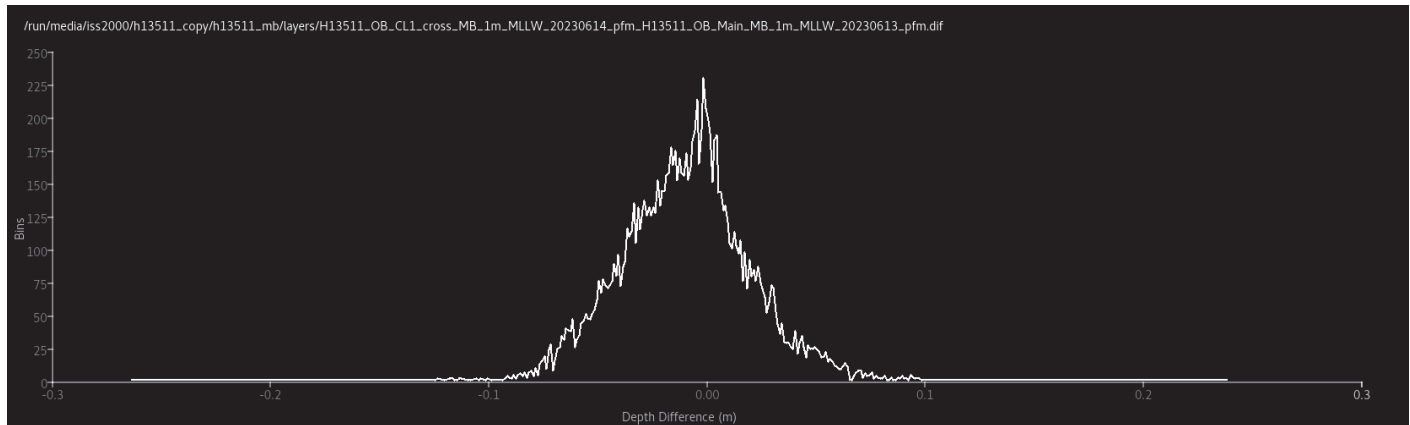


Figure 12: Plot of Crossing Analysis R/V Oyster Bay II Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	27636	2.46	8309	0.74	18128	1.61	1199	0.11
>0.01-0.02	31362	5.25	3746	1.07	27616	4.07		
>0.02-0.03	49006	9.62	1984	1.25	47022	8.26		
>0.03-0.04	73730	16.18	720	1.31	73010	14.76		
>0.04-0.05	108599	25.85	298	1.34	108301	24.41		
>0.05-0.06	122641	36.77	136	1.35	122505	35.32		
>0.06-0.07	135065	48.80	43	1.36	135022	47.34		
>0.07-0.08	113305	58.89	10	1.36	113295	57.43		
>0.08-0.09	118393	69.43	5	1.36	118388	67.97		
>0.09-0.1	98759	78.23	3	1.36	98756	76.76		
>0.1-0.11	77316	85.11	2	1.36	77314	83.65		
>0.11-0.12	59960	90.45	1	1.36	59959	88.99		
>0.12-0.13	41909	94.19	1	1.36	41908	92.72		
>0.13-0.14	25138	96.42	1	1.36	25137	94.96		
>0.14-0.15	14335	97.70	0	1.36	14335	96.23		
>0.15-0.35	25755	99.99	11	1.36	25744	98.53		
>0.35-0.55	20	99.99	6	1.36	14	98.53		
>0.55-0.75	8	99.99	2	1.36	6	98.53		
>0.75-0.95	13	99.99	2	1.36	11	98.53		
>0.95-1.15	5	99.99	0	1.36	5	98.53		
>1.15-1.35	5	99.99	1	1.36	4	98.53		
>1.35-1.55	5	99.99	0	1.36	5	98.53		
>1.55-1.75	3	99.99	0	1.36	3	98.53		
>1.75-1.95	3	99.99	1	1.36	2	98.53		
>1.95-2.15	1	99.99	0	1.36	1	98.53		
>2.15-3.15	2	99.99	0	1.36	2	98.53		
>3.15-4.15	3	99.99	1	1.36	2	98.53		
>4.15-5.16	2	100.00	0	1.36	2	98.53		
<b>Total</b>	<b>1122979</b>	<b>100.00%</b>	<b>15283</b>	<b>1.36%</b>	<b>1106497</b>	<b>98.53%</b>	<b>1199</b>	<b>0.11%</b>

Reference Grid:  
H13511 OB All MB 1m MLLW 20230619 pfm H13511 SI All MB 1m MLLW 20230619 pfm.tif

Figure 13: Tabular Results Vessel Comparison Analysis, R/V Sea Innovator I vs. R/V Oyster Bay II

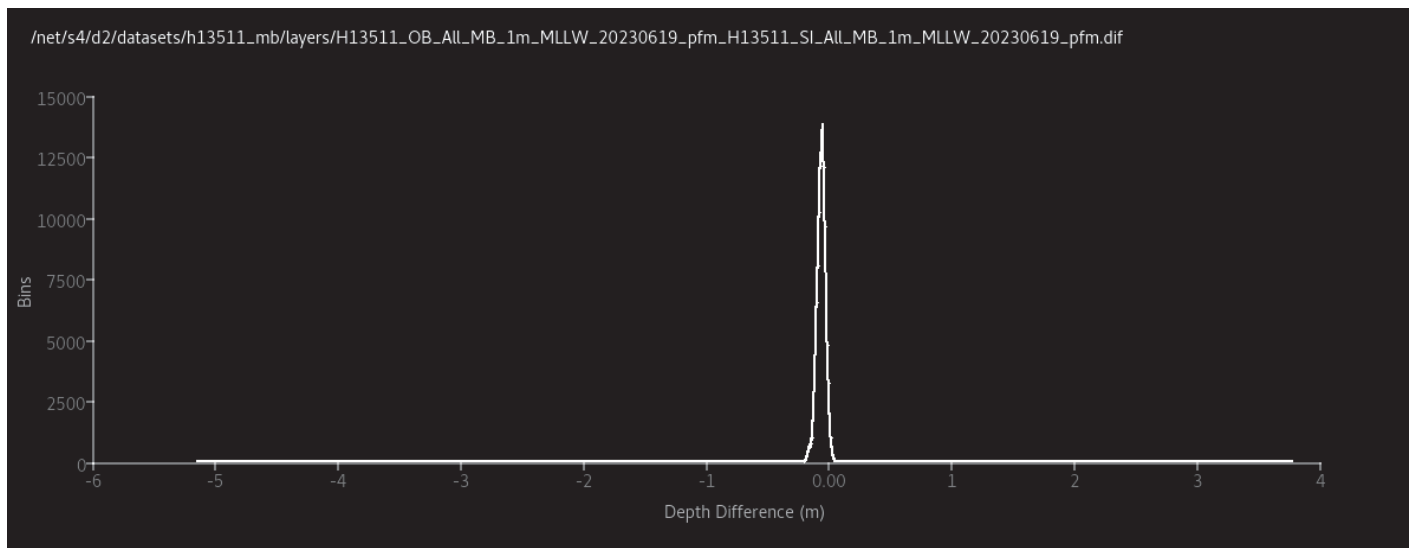


Figure 14: Plot of Vessel Comparison Analysis R/V Sea Innovator I vs. R/V Oyster Bay II

## B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.092 meters	0.2 meters

*Table 7: Survey Specific Tide TPU Values.*

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
R/V Sea Innovator I	1 meters/second	1 meters/second	1 meters/second	1 meters/second
R/V Oyster Bay II	1 meters/second	1 meters/second	1 meters/second	1 meters/second

*Table 8: Survey Specific Sound Speed TPU Values.*

For specific details on the use and application of the SABER Total Propagated Uncertainty (TPU) model, refer to the DAPR. Once the TPU model was applied to the GSF bathymetry data, each beam was attributed with the horizontal uncertainty and the vertical uncertainty at the 95% confidence level. The vertical and horizontal uncertainty values, estimated by the TPU model for individual multibeam soundings, varied little across the dataset, tending to be most affected by beam angle. Individual soundings that had vertical and horizontal uncertainty values above IHO S-44 6th Edition, Order 1a were flagged as invalid during the uncertainty attribution.

As discussed in the DAPR, SABER generates two vertical uncertainty surfaces; the Hypothesis Standard Deviation (Hyp. StdDev) and the Hypothesis Average Total Propagated Uncertainty (Hyp. AvgTPU). A third vertical uncertainty surface is generated from the larger value of these two uncertainties at each node and is referred to as the Hypothesis Final Uncertainty (Hyp. Final Uncertainty).

Per HSSD Section 5.2.2.3, H13511 depth data fell within one resolution surface (1-meter).

The final H13511 1-meter PFM CUBE surface contained final vertical uncertainties that ranged from 0.200 meters to 0.682 meters. The IHO Order 1a maximum allowable vertical uncertainty was calculated to range between 0.500 to 0.527 meters, based on the minimum CUBE depth (0.923 meters) and maximum CUBE depth (12.713 meters). Results from the SABER Check PFM Uncertainty function identified that there were nine nodes in the final H13511 1-meter PFM CUBE surface with final vertical uncertainties that exceeded IHO Order 1a allowable vertical uncertainty. Seven of the nodes were associated with scour around buoys, and the remaining two were associated with a steep ridge. A thorough review of the final gridded surface in post-processing showed no artifacts in the data and that all nodes which had an elevated CUBE uncertainty in the CUBE depth data agreed well with coincident data. The SABER Frequency Distribution Tool was also used to review the Hyp. Final Uncertainty surface within the final H13511 1-meter Main Area PFM grid.

Results showed that 99.99% of all nodes had final uncertainties less than or equal to maximum allowable vertical uncertainty of 0.527 meters

### **B.2.3 Junctions**

Per the Project Instructions, junction analysis was performed between H13511 and the surveys listed in the table below and illustrated in Figure 15. Results from the comparison to H13343, H13507, H13508, and H13510 are discussed below.

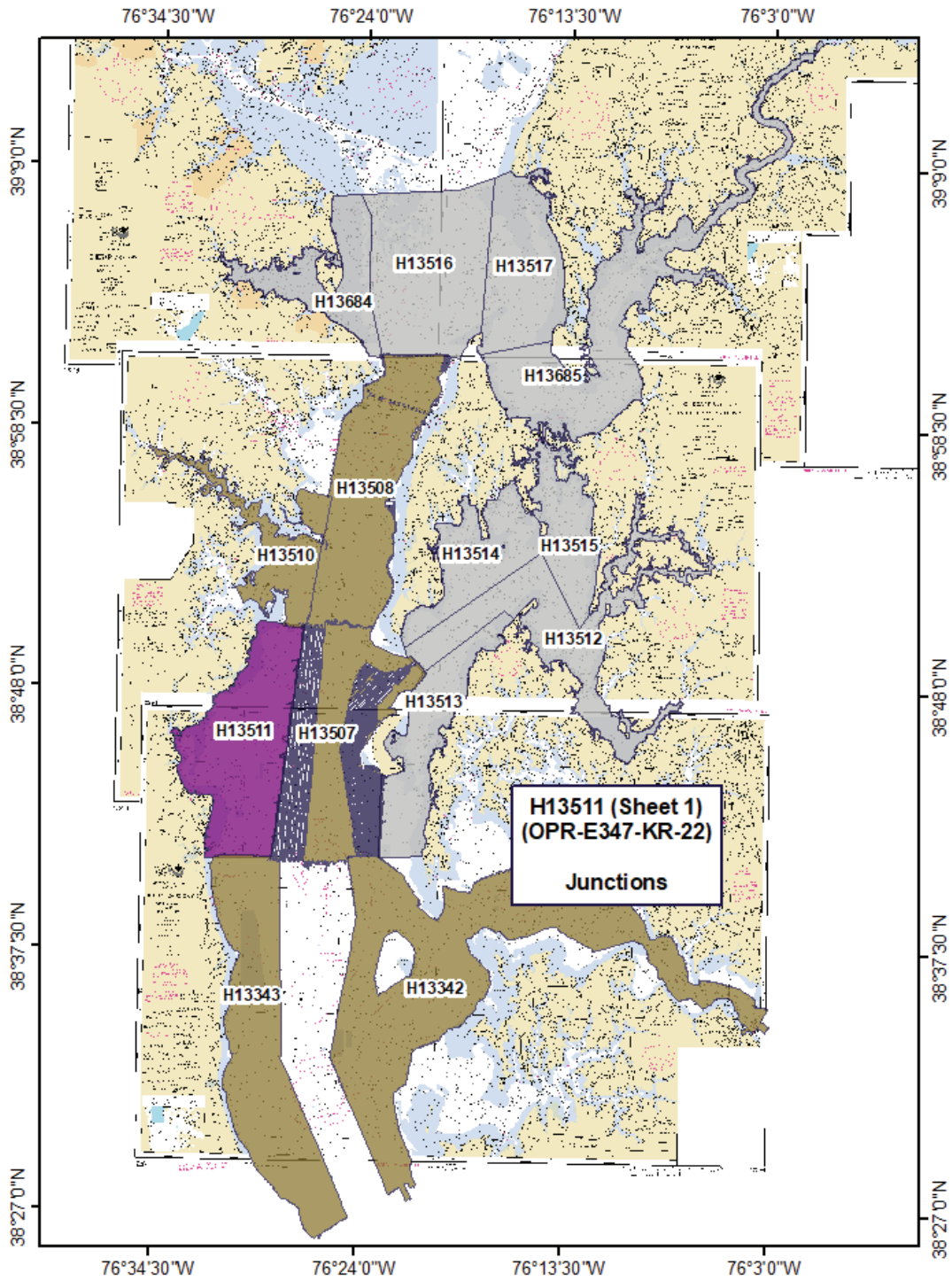


Figure 15: General Locality of H13511 with Junctioning Surveys

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13343	1:20000	2020	Leidos	S
H13507	1:20000	2021	NOAA Ship Thomas Jefferson	E
H13508	1:5000	2021	NOAA Ship Thomas Jefferson	NE
H13510	1:5000	2021	NOAA Ship Thomas Jefferson	N

*Table 9: Junctioning Surveys*

### H13343

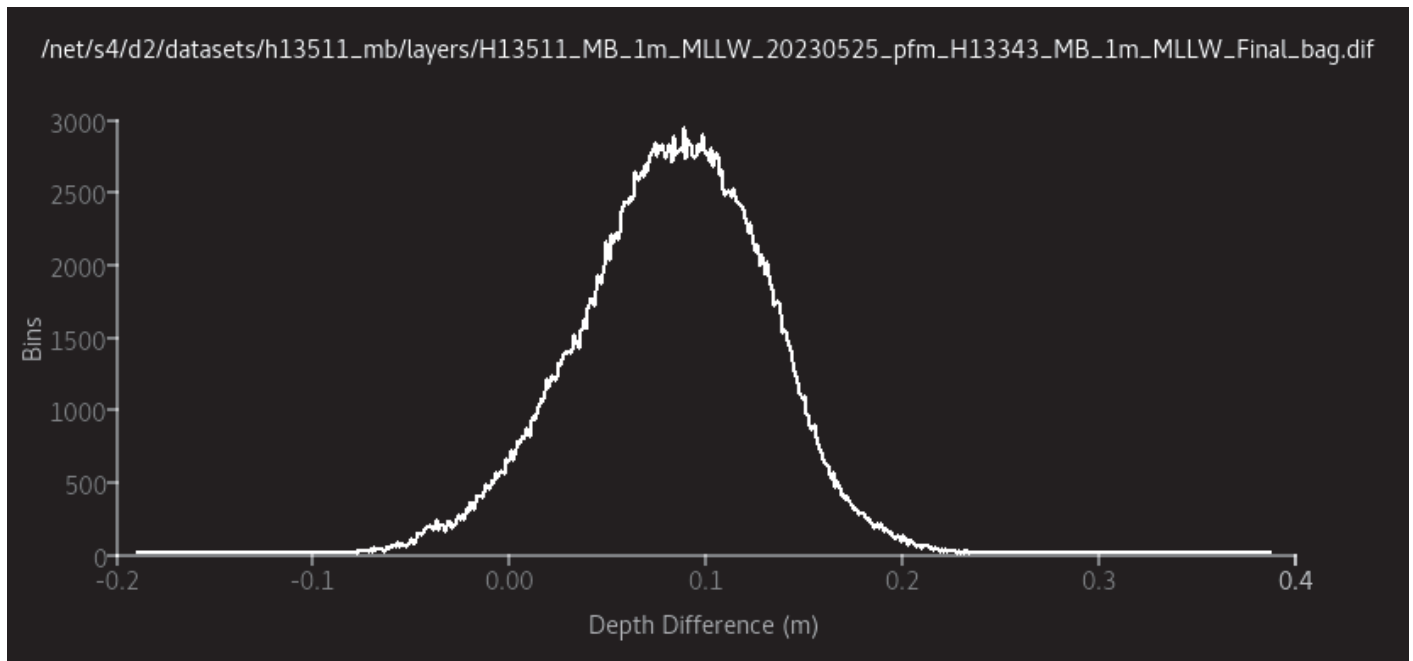
Junctioning survey H13343 was conducted in 2020 and junctions to the south of H13511. For this analysis the H13343 1-meter BAG depth surface was compared to the H13511 1-meter CUBE depth surface. Junction analysis was conducted on the common area of these two sheets, with an overlapping area approximately 4,410 by 405 meters along the southern edge of H13511. Observed depths within the common area were 1.356 to 10.786 meters which resulted in a calculated allowable TVU range of 0.500 to 0.519 meters.

The difference grid was generated by subtracting the H13343 data from the H13511 data. Positive values indicate that H13511 depth data were deeper than H13343 depth data. Throughout the common area, H13511 CUBE depths were deeper 94.96% of the time and were shallower 4.83% of the time (Figure 16) with 100% of the comparisons within 0.387. The distribution is skewed positive of zero as presented in Figure 17.

100.00% of the comparisons were 0.387 meters or less, within the calculated allowable TVU range.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	14379	4.28	8160	2.43	5507	1.64	712	0.21
>0.01-0.02	13254	8.22	9693	5.31	3561	2.70		
>0.02-0.03	15735	12.90	13139	9.22	2596	3.47		
>0.03-0.04	17449	18.09	15523	13.83	1926	4.04		
>0.04-0.05	22889	24.89	21380	20.19	1509	4.49		
>0.05-0.06	23896	32.00	23265	27.11	631	4.68		
>0.06-0.07	26615	39.91	26315	34.94	300	4.77		
>0.07-0.08	25270	47.43	25121	42.41	149	4.81		
>0.08-0.09	28046	55.77	28010	50.74	36	4.82		
>0.09-0.1	27852	64.05	27848	59.02	4	4.82		
>0.1-0.11	26427	71.91	26426	66.88	1	4.82		
>0.11-0.12	24135	79.09	24133	74.05	2	4.82		
>0.12-0.13	20900	85.30	20899	80.27	1	4.82		
>0.13-0.14	17026	90.37	17025	85.33	1	4.82		
>0.14-0.15	12080	93.96	12079	88.92	1	4.83		
>0.15-0.25	20283	99.99	20282	94.95	1	4.83		
>0.25-0.35	27	99.99	27	94.96	0	4.83		
>0.35-0.387	1	100.00	1	94.96	0	4.83		
<b>Total</b>	<b>336264</b>	<b>100.00%</b>	<b>319326</b>	<b>94.96%</b>	<b>16226</b>	<b>4.83%</b>	<b>712</b>	<b>0.21%</b>
Reference Grid: H13511_MB_1m_MLLW_20230525_pfm_H13343_MB_1m_MLLW_Final_bag.dif								

Figure 16: Tabular Results Junction Analysis H13511 vs. H13343



*Figure 17: Plot of Junction Analysis H13511 vs. H13343*

### H13507

Junctioning survey H13507 was conducted in 2021 and junctions to the east of H13511. For this analysis the H13507 76-meter BAG depth surface was compared to the H13511 1-meter CUBE depth surface. Junction analysis was conducted on the common area of these two sheets, with an overlapping area approximately 17,970 by 550 meters along the entirety of the eastern edge of H13511. Observed depths within the common area were 8.259 to 11.774 meters which resulted in a calculated allowable TVU range of 0.511 to 0.523 meters.

The difference grid was generated by subtracting the H13507 data from the H13511 data. Positive values indicate that H13511 depth data were deeper than H13507 depth data. Throughout the common area, H13511 CUBE depths were deeper 38.65% of the time and were shallower 60.70% of the time (Figure 18). The distribution is well spread about zero for all comparisons as presented in Figure 19.

99.66% of the comparisons were 0.520 meters or less, within the calculated allowable TVU range.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	304657	13.27	144478	6.29	145260	6.33	14919	0.65
>0.01-0.02	251085	24.20	124184	11.70	126901	11.85		
>0.02-0.03	259602	35.51	116673	16.78	142929	18.08		
>0.03-0.04	230242	45.54	94936	20.92	135306	23.97		
>0.04-0.05	223799	55.28	82278	24.50	141521	30.13		
>0.05-0.06	180358	63.14	61825	27.19	118533	35.30		
>0.06-0.07	161362	70.17	53011	29.50	108351	40.02		
>0.07-0.08	135166	76.05	43798	31.41	91368	43.99		
>0.08-0.09	134181	81.90	41907	33.23	92274	48.01		
>0.09-0.1	106511	86.54	32519	34.65	73992	51.24		
>0.1-0.11	79825	90.01	25576	35.76	54249	53.60		
>0.11-0.12	62918	92.75	18375	36.56	44543	55.54		
>0.12-0.13	44770	94.70	11948	37.08	32822	56.97		
>0.13-0.14	32667	96.13	8266	37.44	24401	58.03		
>0.14-0.15	24079	97.17	5581	37.69	18498	58.84		
>0.15-0.35	53369	99.50	19210	38.52	34159	60.32		
>0.35-0.55	4290	99.68	1476	38.59	2814	60.45		
>0.55-0.75	2769	99.81	1144	38.64	1625	60.52		
>0.75-0.95	1432	99.87	108	38.64	1324	60.57		
>0.95-1.15	1415	99.93	79	38.65	1336	60.63		
>1.15-1.35	1360	99.99	13	38.65	1347	60.69		
>1.35-1.514	260	100.00	0	38.65	14	60.70		
<b>Total</b>	<b>2296117</b>	<b>100.00%</b>	<b>887385</b>	<b>38.65%</b>	<b>1393813</b>	<b>60.70%</b>	<b>14919</b>	<b>0.65%</b>
Reference Grid: H13511_MB_1m_MLLW_20230525_pfm_H13507_MB_VR_MLLW_bag.dif								

Figure 18: Tabular Results Junction Analysis H13511 vs. H13507

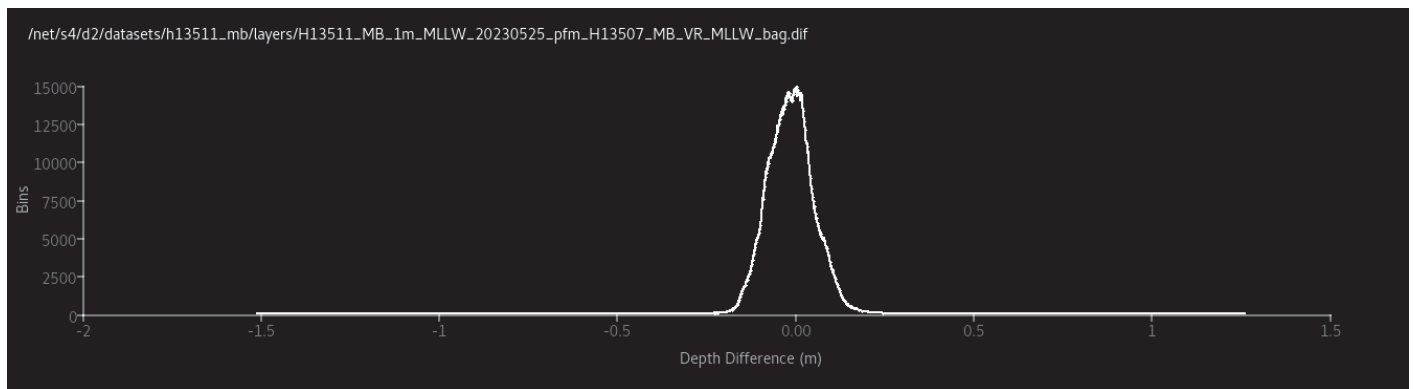


Figure 19: Plot of Junction Analysis H13511 vs. H13507

H13508

Junctioning survey H13508 was conducted in 2021 and junctions to the northeast of H13511. For this analysis the NOAA provided H13508 BAG (H13508\_MB\_VR\_MLLW\_1of1.bag) depth surface was compared to the H13511 1-meter CUBE depth surface. Junction analysis was conducted on the common

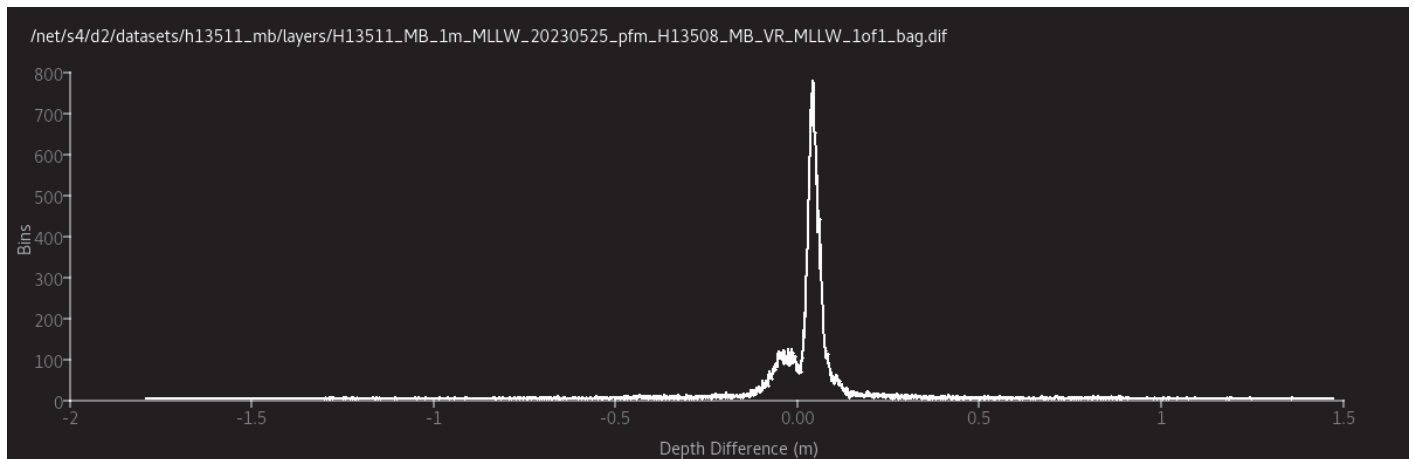
area of these two sheets, with an overlapping area approximately 320 by 430 meters along the northeastern corner of H13511. Observed depths within the common area were 8.287 to 10.538 meters which resulted in a calculated allowable TVU range of 0.511 to 0.518 meters.

The difference grid was generated by subtracting the H13508 data from the H13511 data. Positive values indicate that H13511 depth data were deeper than H13508 depth data. Throughout the common area, H13511 CUBE depths were deeper 74.65% of the time and were shallower 25.18% of the time (Figure 20). The distribution is skewed positive of zero for all comparisons as presented in Figure 21.

95.53% of the comparisons were 0.520 meters or less, within the calculated allowable TVU range

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	1758	3.92	845	1.89	840	1.88	73	0.16
>0.01-0.02	2633	9.80	1700	5.68	933	3.96		
>0.02-0.03	5251	21.53	4266	15.21	985	6.16		
>0.03-0.04	7942	39.26	6926	30.67	1016	8.43		
>0.04-0.05	7857	56.80	6728	45.69	1129	10.95		
>0.05-0.06	5061	68.10	4077	54.79	984	13.14		
>0.06-0.07	2963	74.72	2217	59.74	746	14.81		
>0.07-0.08	1531	78.13	1016	62.01	515	15.96		
>0.08-0.09	1166	80.74	734	63.65	432	16.92		
>0.09-0.1	777	82.47	483	64.73	294	17.58		
>0.1-0.11	715	84.07	493	65.83	222	18.08		
>0.11-0.12	558	85.31	363	66.64	195	18.51		
>0.12-0.13	374	86.15	219	67.13	155	18.86		
>0.13-0.14	253	86.71	152	67.47	101	19.08		
>0.14-0.15	200	87.16	118	67.73	82	19.27		
>0.15-0.35	2596	92.96	1533	71.15	1063	21.64		
>0.35-0.55	1294	95.85	578	72.44	716	23.24		
>0.55-0.75	668	97.34	349	73.22	319	23.95		
>0.75-0.95	559	98.58	371	74.05	188	24.37		
>0.95-1.15	283	99.22	135	74.35	148	24.70		
>1.15-1.35	268	99.81	116	74.61	152	25.04		
>1.35-1.55	72	99.98	18	74.65	54	25.16		
>1.55-1.75	8	99.99	0	74.65	8	25.18		
>1.75-1.793	3	100.00	0	74.65	3	25.18		
<b>Total</b>	<b>44790</b>	<b>100.00%</b>	<b>33437</b>	<b>74.65%</b>	<b>11280</b>	<b>25.18%</b>	<b>73</b>	<b>0.16%</b>
Reference Grid: H13511_MB_1m_MLLW_20230525_pfm_H13508_MB_VR_MLLW_1of1_bag.dif								

Figure 20: Tabular Results Junction Analysis H13511 vs. H13508



*Figure 21: Plot of Junction Analysis H13511 vs. H13508*

## H13510

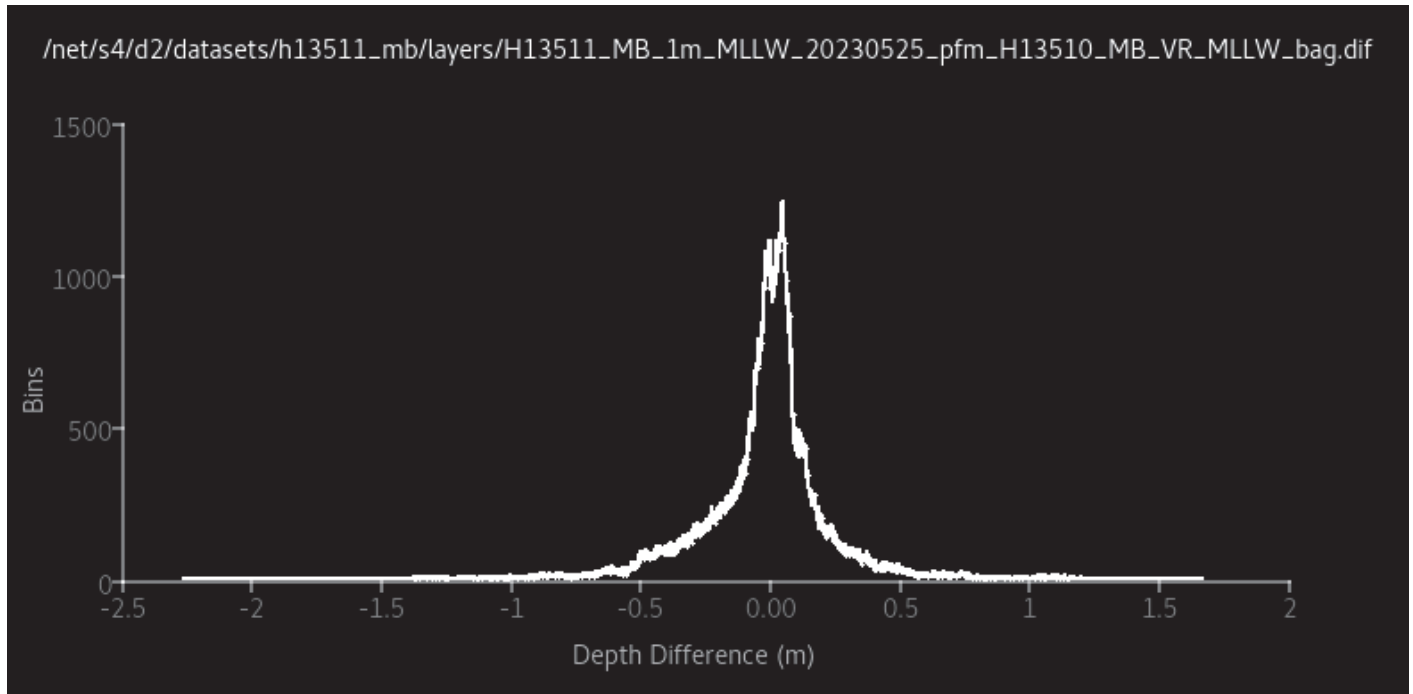
Junctioning survey H13510 was conducted in 2021 and junctions to the northeast of H13511. For this analysis the NOAA provided H13510 BAG (H13510\_MB\_VR\_MLLW.bag) depth surface was compared to the H13511 1-meter CUBE depth surface. Junction analysis was conducted on the common area of these two sheets, with an overlapping area approximately 1770 by 370 meters along the northern edge of H13511. Observed depths within the common area were 2.324 to 10.538 meters which resulted in a calculated allowable TVU range of 0.501 to 0.518 meters.

The difference grid was generated by subtracting the H13510 data from the H13511 data. Positive values indicate that H13511 depth data were deeper than H13510 depth data. Throughout the common area, H13511 CUBE depths were deeper 48.96% of the time and were shallower 50.73% of the time (Figure 22). The distribution was spread positive of zero for all comparisons as presented in Figure 23.

94.61% of the comparisons were 0.520 meters or less, within the calculated allowable TVU range.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	20971	6.97	9690	3.22	10346	3.44	935	0.31
>0.01-0.02	18886	13.25	9382	6.34	9504	6.60		
>0.02-0.03	21090	20.26	10866	9.95	10224	10.00		
>0.03-0.04	20079	26.94	11610	13.81	8469	12.81		
>0.04-0.05	20673	33.81	12351	17.92	8322	15.58		
>0.05-0.06	16509	39.30	9435	21.06	7074	17.93		
>0.06-0.07	14350	44.07	8239	23.80	6111	19.97		
>0.07-0.08	10352	47.52	5683	25.69	4669	21.52		
>0.08-0.09	9620	50.71	4831	27.29	4789	23.11		
>0.09-0.1	8673	53.60	4532	28.80	4141	24.49		
>0.1-0.11	8147	56.31	4469	30.29	3678	25.71		
>0.11-0.12	8014	58.97	4479	31.77	3535	26.89		
>0.12-0.13	7439	61.44	4189	33.17	3250	27.97		
>0.13-0.14	6551	63.62	3539	34.34	3012	28.97		
>0.14-0.15	5734	65.53	2913	35.31	2821	29.91		
>0.15-0.35	65050	87.16	27529	44.47	37521	42.38		
>0.35-0.55	24361	95.26	8055	47.14	16306	47.80		
>0.55-0.75	7283	97.68	2797	48.07	4486	49.29		
>0.75-0.95	3281	98.77	1061	48.77	2220	50.03		
>0.95-1.15	2154	99.49	1113	48.80	1041	50.38		
>1.15-1.35	1056	99.84	339	48.91	717	50.62		
>1.35-1.55	420	99.98	122	48.95	298	50.72		
>1.55-1.75	49	99.99	22	48.96	27	50.72		
>1.75-1.95	14	99.99	0	48.96	14	50.73		
>1.95-2.15	5	99.99	0	48.96	5	50.73		
>2.15-2.267	3	100.00	0	48.96	3	50.73		
<b>Total</b>	<b>300765</b>	<b>100.00%</b>	<b>147246</b>	<b>48.96%</b>	<b>152584</b>	<b>50.73%</b>	<b>935</b>	<b>0.31%</b>
Reference Grid: H13511_MB_1m_MLLW_20230525_pfm_H13510_MB_VR_MLLW_bag.dif								

Figure 22: Tabular Results Junction Analysis H13511 vs. H13510



*Figure 23: Plot of Junction Analysis H13511 vs. H13510*

#### **B.2.4 Sonar QC Checks**

Sonar system quality control checks were conducted as detailed in the DAPR.

#### **B.2.5 Equipment Effectiveness**

There were no conditions or deficiencies that affected equipment operational effectiveness.

#### **B.2.6 Factors Affecting Soundings**

##### Additional Factors Affecting Soundings

Dense biological interference were observed during discrete areas and during various days of survey which required numerous holiday reruns. Additionally, throughout survey acquisition both commercial and recreational fishing activity was heavy causing fishing gear to be present in the MBES data and required

deviations in the survey acquisition lines requiring numerous holiday reruns. The end result was that there were no significant impacts to the final sounding data.

### **B.2.7 Sound Speed Methods**

Sound Speed Cast Frequency: On the R/V Sea Innovator I, the MVP30 was the primary system used to collect sound speed profile (SSP) data, and on the R/V Oyster Bay II, the AML BaseX2 was the primary system used to collect SSP data, refer to the DAPR for additional details. SSP data were obtained at intervals frequent enough to meet depth accuracy requirements.

All sound speed profiles applied for online bathymetry data collection were acquired within 500 meters of the bounds of the survey area as specified in Section 5.2.3.3 of the HSSD.

Confidence checks of the sound speed profile casts were routinely conducted by comparing at least two consecutive casts taken with different SSP sensors.

All individual SSP files are delivered with the H13511 data and are broken out into sub-folders, which correspond to the purpose of each cast. Also, all individual SSP files for H13511 have been concatenated into two separate files based on the purpose of the cast, provided in CARIS format files (.svp), and delivered under (H13511/Processed/SVP/CARIS\_SSP) on the delivery drive. In accordance with HSSD Section 8.3.6, SSP files were also converted to NCEI format, as detailed in the DAPR, and provided as a separate delivery to NCEI. Refer to the DAPR for additional details.

### **B.2.8 Coverage Equipment and Methods**

All equipment and survey methods are detailed in the DAPR.

### **B.2.9 Multibeam Coverage Analysis**

Leidos chose to achieve the complete coverage requirement using 100% side scan sonar coverage with concurrent multibeam bathymetry. To achieve this coverage, the SSS was set to 50-meter range scale, and main scheme survey lines were spaced at 70-meters to ensure 100% SSS coverage. Disproval areas were covered with 200% side scan coverage.

The SABER Gapchecker program was used to flag MBES data gaps within the CUBE surface. Additionally, the entire surface was visually scanned for holidays at various points during the data processing effort. Additional survey lines were run to fill any holidays that were detected as defined for complete coverage surveys in Section 5.2.2.3 of the HSSD and email correspondence dated 02-22-2023 (refer to Project Correspondence for additional details Bathymetric data and side scan sonar imagery were reviewed and

bathymetric splits were acquired if deemed necessary per Hydrographer's discretion, as noted in Section 5.2.2.1 of the HSSD.

A final review of the CUBE Depth surface for H13511 showed that there were no holidays as defined for complete coverage surveys in Section 5.2.2.3 of the HSSD. Any remaining three by three unpopulated nodes in the final MBES surfaces were along the outer swath data, beyond the side scan nadir coverage gap, and fully covered with 100% SSS coverage.

All final H13511 CUBE PFM grids were examined for the number of soundings contributing to the chosen CUBE hypotheses for each node by running SABER's Frequency Distribution Tool on the Hypothesis Number of Soundings (Hyp. # Soundings) surface. The Hyp. # Soundings surface reports the number of soundings that were used to compute the chosen hypothesis. Analysis was conducted on the Hyp. # Soundings surface from all PFM grids to ensure that the requirements for complete coverage surveys, as specified in HSSD Section 5.2.2.3 were met. Within the final 1-meter CUBE PFM grid 99.52% of all nodes contained five or more soundings.

As noted in Section A.4, the assigned survey bounds were achieved across H13511 except where the inshore limit of the Navigable Area Limit Line (NALL) was reached or the shoreline bathymetry made it unsafe of equipment and crew to continue into shoaler depths.

## **B.3 Echo Sounding Corrections**

### **B.3.1 Corrections to Echo Soundings**

All data reduction procedures conform to those detailed in the DAPR.

### **B.3.2 Calibrations**

All sounding systems were calibrated as detailed in the DAPR.

## **B.4 Backscatter**

Side Scan Sonar (SSS) Coverage Analysis: For all details regarding SSS data processing, see the DAPR. Leidos chose to adhere to the coverage requirements in the Project Instructions using Complete Coverage, Option B (100% side scan sonar coverage with concurrent multibeam). Leidos generated two separate coverage mosaics at 1-meter cell size resolution as specified in Section 8.2.1 of the HSSD (See section B.2.9 for additional information). The first 100% and second 100% coverage mosaics were independently reviewed using tools in SABER to verify data quality and swath coverage. The SABER Gapchecker routine

was used to flag data gaps within each of the 100% SSS coverage mosaics. Additionally, the entirety of each SSS surface was visually scanned for holidays at various points during the data processing effort. Additional survey lines were run to fill any holidays that were detected. All coverage mosaics are determined to be complete and sufficient to meet the requirements contained within the PI and HSSD. Each 100 percent coverage mosaic is delivered as a single georeferenced raster file (datum of NAD-83) in floating point GeoTIFF format, as specified in Sections 8.2.1 and 8.3.3 in the HSSD.

Multibeam Echo Sounder Seafloor Backscatter: For all details regarding MBES backscatter acquisition and processing see the DAPR. Leidos generated a MBES backscatter at 2-meter cell resolution per vessel; per HSSD. The MBES backscatter mosaics were reviewed for data quality and coverage. The MBES backscatter data acquired were written to the GSF in real-time by ISS-2000 and are delivered in the final GSF files for this sheet under the Processed/Sonar\_Data/H13511\_MB directory. All MBES backscatter mosaics are determined to be complete and sufficient to meet the requirements contained within the PI and HSSD. The coverage mosaics are delivered as a single georeferenced raster file (datum of NAD-83) in floating point GeoTIFF format, as specified in Section 6.2.4.2 in the HSSD.

## B.5 Data Processing

### B.5.1 Primary Data Processing Software

The following software program was the primary program used for bathymetric data processing:

<b>Manufacturer</b>	<b>Name</b>	<b>Version</b>
Leidos	SABER	5.4.1.6.1

*Table 10: Primary bathymetric data processing software*

The following software program was the primary program used for imagery data processing:

<b>Manufacturer</b>	<b>Name</b>	<b>Version</b>
Leidos	SABER	5.4.1.6.1
QPS	FMGT	7.10.3

*Table 11: Primary imagery data processing software*

The following Feature Object Catalog was used: NOAA Profile Version 2022.

The primary data processing software used for both bathymetry and imagery was SABER.

### B.5.2 Surfaces

The following surfaces and/or BAGs were submitted to the Processing Branch:

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H13511_MB_1m_MLLW_Final	BAG	1 meters	0.923 meters - 12.713 meters	N/A	Complete coverage, Option B (100% side scan sonar coverage with concurrent multibeam)
H13515_SSSAB_1m_400kHz_900kHz_1of1	SSS Mosaic	1 meters	-	N/A	First 100% SSS
H13515_SSSAB_1m_900kHz_2of2	SSS Mosaic	1 meters	-	N/A	Second 100% SSS (Disproval coverage)
H13511_MBAB_2m_SeaInnovatorI_400kHz_1of2	MB Backscatter Mosaic	2 meters	-	N/A	Complete MBES
H13511_MBAB_2m_OysterBayII_300kHz_2of2	MB Backscatter Mosaic	2 meters	-	N/A	Complete MBES

Table 12: Submitted Surfaces

Complete Coverage Section 5.2.2.3 of the HSSD requires 1-meter grid resolution for depths ranging from 0 meters to 20 meters. Leidos generated the CUBE PFM grids for H13511 at 1-meter resolution.

SABER populates the CUBE depth with either the node's chosen hypothesis or the depth of a feature or designated sounding set by the hydrographer, which overrides the chosen hypothesis. The range of CUBE depths of the H13511 1-meter PFM grid were from 0.923 meters (3.028 feet; 0.210 meters TVU) to 12.713 meters (41.709 feet; 0.210 meters TVU).

The final gridded bathymetry data are delivered in Bathymetric Attributed Grid (BAG) format. The BAG files were exported from the CUBE PFM grid as detailed in the DAPR.

**Disregard SSS mosaics in Table 12 of Section B.5.2 regarding survey H13515. Correct side scan sonar mosaics actually submitted to the branch are named as followed:**

***H13511\_SSSAB\_1m\_400kHz\_900kHz\_1of1***

***H13511\_SSSAB\_1m\_400kHz\_900kHz\_2of2***

## C. Vertical and Horizontal Control

In accordance with HSSD Section 2.2, the horizontal datum for this project is NAD83. HSSD Section 2.2 states that the “only exception for the NAD83 datum requirement is that the S-57 Final Feature File (Section 7.3) will be in the WGS84 datum to comply with international S-57 specifications”. As discussed in the DAPR Section C.7, for every feature flag in a MBES GSF file, SABER converts the position from the NAD83 datum to the WGS84 datum to generate the S-57 file and comply with HSSD and IHO requirements. Feature positions meet the precision stated in HSSD Section 7.4 for each respective datum. Depending on geographic reference there may be approximately a 1-meter difference comparing positions between NAD83 and WGS84 datums. Therefore, if the feature overrides from the BAG surface (NAD83) are compared to the Final Feature File S-57 positions (WGS84) it is anticipated that there could be positional differences exceeding those listed in Section 7.4 of the HSSD. Additional information discussing the vertical and horizontal control for this survey can be found in the DAPR.

### C.1 Vertical Control

The vertical datum for this project is Mean Lower Low Water.

#### ERS Datum Transformation

The following ellipsoid-to-chart vertical datum transformation was used:

Method	Ellipsoid to Chart Datum Separation File
ERS via VDATUM	OPR-E347-KR-22 _NAD83_VDatum_MLLW.cov

*Table 13: ERS method and SEP file*

Refer to the DAPR for details regarding the application of VDatum to the MBES data files. No final tide note was provided nor was it required from NOAA Center for Operational Oceanographic Products and Services (CO-OPS).

### C.2 Horizontal Control

The horizontal datum for this project is North American Datum 1983 (2011).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 18.

### PPP

The vessel kinematic data (POS/MV files) were post-processed in Applanix POSPac software using the Applanix PP-RTX solution to generate the Smoothed Best Estimate of Trajectory (SBET) solutions which were applied through SABER to the multibeam data. Refer to the DAPR for additional information and for details regarding all antenna and transducer offsets. Any soundings with total horizontal uncertainties exceeding the maximum allowable IHO S-44 6th Edition Order 1a specifications were flagged as invalid and therefore were not used in the CUBE depth calculations.

## **D. Results and Recommendations**

### **D.1 Chart Comparison**

Chart comparisons were conducted using a combination of SABER and CARIS' HIPS and SIPS. H13511 data met data accuracy standards and bottom coverage requirements. Leidos recommends updating the common areas of all charts using data from this survey. Review showed that the H13511 CUBE data were generally in agreement with charted depths compared to the ENC's listed in Section D.1.1. CUBE depths generally agreed with the charted depths within  $\pm 0.3$ - $0.4$  meters and were generally found to be deeper than charted.

Charting recommendations for new features and updates to charted features, are documented in the H13511 S-57 FFF. Additional charted objects are discussed in later sections.

United States Coast Guard (USCG) District 5 LNM publications were reviewed for changes subsequent to the date of the Project Instructions and before the end of survey. The LNM reviewed were from week 35/22 (30 August 2022) until week 24/23 (13 June 2023).

#### **D.1.1 Electronic Navigational Charts**

The following are the largest scale ENC's, which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date
US5MD13M	1:40000	32	05/09/2023	05/09/2023
US5MD16M	1:40000	34	05/09/2023	05/09/2023

*Table 14: Largest Scale ENC's*

### D.1.2 Shoal and Hazardous Features

Refer to Figure 24 and Section D.1.4 for significant shoals or hazardous features within the area covered by this survey. Figure 24 details the Leidos submitted DTON reports for H13511. Reports were submitted per HSSD in S-57 format to the Atlantic Hydrographic Branch (AHB).

DTON Report Name	Date Submitted to AHB	AHB Submitted to NDB and MCD	NDB Registration	Feature Number(s)
H13511_DT0N_01.000	2022-11-14	2022-11-14	DD-37350	51
H13511_DT0N_02.000	2022-11-14	2022-11-14	DD-37350	23
H13511_DT0N_03.000	2023-01-27	2023-01-30	DD-37626	34

*Figure 24: DTON Reports*

### D.1.3 Charted Features

There were numerous assigned charted features in the final CSF within the SOW of H13511. Per HSSD Section 8.1.4, these charted features are not addressed in this section, refer to the H13511 S-57 FFF (H13511\_FFF.000) for all the details and recommendations regarding these features.

### D.1.4 Uncharted Features

See the H13511 S-57 FFF for all the details and recommendations regarding new uncharted features investigated. During the course of H13511 survey operations, fishing gear in the form of fish weirs and temporary floats associated with crab pots were observed within the survey area. Due to the temporary nature of the crab floats, there are no features associated with these within the H13511 S-57 FFF. When a temporary fishing surface float was identified and correlated to objects in the MBES data, as these were not true seafloor the MBES data were invalidated and no longer contributed to a CUBE surface. In many cases, where it was not possible to confirm the fishing gear were not derelict or tied to a surface float, the object was retained in the MBES data. See Section B.2.5 for more information.

Exposed fish weir piles were present within the survey area as well as numerous submerged piles associated derelict fish weirs. Fish weirs are represented in the S-57 FFF as both point objects and area files based on their size and complexity.

### D.1.5 Channels

There were three channels assigned as dredge areas (DRGARE) within the H13511 SOW from the final CSF. All assigned dredge areas fell inshore of NALL and were not surveyed.

## **D.2 Additional Results**

### **D.2.1 Aids to Navigation**

There were no assigned Aids to Navigation (ATON) within the SOW of H13511 from the final CSF. All ATONs present within the survey area were present and serving their intended purpose. There were yellow HHSA sail race buoys present for part of the survey as well as “no shell fishing” and “clam line” buoys present. As these buoys are temporary in nature or repositioned frequently, they are not included in the H13511 S-57 FFF per the HSSD. Associated contacts are provided within the SSS Contacts S-57.

### **D.2.2 Maritime Boundary Points**

No Maritime Boundary Points were assigned for this survey.

### **D.2.3 Bottom Samples**

In accordance with both the PI and Section 7.2.3 of the HSSD, bottom characteristics were obtained for H13511. Bottom characteristics were acquired at the four locations assigned in the final PRF. Leidos did not modify the bottom sample locations from the location proposed by NOAA in the PRF. Bottom characteristics are included in the S-57 FFF. In addition, images of the sediment obtained for each bottom sample are referenced in the S-57 FFF and are included on the delivery drive under the folder H13511/Processed/Multimedia.

### **D.2.4 Overhead Features**

There were no overhead features within this survey area.

### **D.2.5 Submarine Features**

Within the final CSF, there was one assigned submarine feature (PIPSOL) for investigation with a category of sewer. The charted pipeline was located inshore of NALL and covered by SSS for approximately 50 meters and covered by MBES for approximately 15 meters. No pipeline was identified however an obstruction was identified approximately 20 meters north of the charted pipeline. Refer to the H13511 FFF for details. No other uncharted or unburied pipelines were found within the H13511 survey data.

### **D.2.6 Platforms**

There were two assigned offshore platforms (OFSPLF) assigned in the CSF and are addressed in the H13511 FFF. Both were located inside of NALL and not covered during survey. One OFSPLF was visually confirmed as present. Refer to the H13511 FFF for details.

**D.2.7 Ferry Routes and Terminals**

No ferry routes or terminals exist within this survey area.

**D.2.8 Abnormal Seafloor or Environmental Conditions**

No other abnormal seafloor or environmental conditions, as defined in Section 8.1.4 of the HSSD, exist within this survey area other than those discussed in Section B.2.5 and D.1.2.

**D.2.9 Construction and Dredging**

No construction or dredging exists within the assigned H13511 area.

**D.2.10 New Survey Recommendations**

No new surveys or further investigations are recommended for this area.

**D.2.11 ENC Scale Recommendations**

No new ENC scales are recommended for this area.

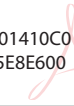
## E. Approval Sheet

As Chief of Party, field operations for this hydrographic survey were conducted under my direct supervision, with frequent personal checks of progress and adequacy. I have reviewed the attached survey data and reports.

All field sheets, this Descriptive Report, and all accompanying records and data are approved. All records are forwarded for final review and processing to the Processing Branch.

The survey data meets or exceeds requirements as set forth in the Hydrographic Survey Specifications and Deliverables, Project Instructions, and Statement of Work. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required. Previously, or previously, submitted deliverables for OPR-E347-KR-22 are provided in the table below.

Report Name	Report Date Sent
OPR-E347-KR-22 Final Project Summary Report.pdf	2023-05-31
OPR-E347-KR-22_Marine_Species_Awareness_Training_Record.pdf	2023-06-21
OPR-E347-KR-22_Coast Pilot Review Report.pdf	2023-06-22
OPR-E347-KR-22_DAPR.pdf	2023-07-17

Approver Name	Approver Title	Approval Date	Signature
Paul L. Donaldson	Chief Hydrographer	07/17/2023	Paul Donaldson:A01410C0 0000186AE85E8E600 06097C  Digitally signed by Paul Donaldson:A01410C000001 86AE85E8E60006097C Date: 2023.07.17 13:26:17 -04'00'

## F. Table of Acronyms

<b>Acronym</b>	<b>Definition</b>
<b>AHB</b>	Atlantic Hydrographic Branch
<b>AST</b>	Assistant Survey Technician
<b>ATON</b>	Aid to Navigation
<b>AWOIS</b>	Automated Wreck and Obstruction Information System
<b>BAG</b>	Bathymetric Attributed Grid
<b>BASE</b>	Bathymetry Associated with Statistical Error
<b>CO</b>	Commanding Officer
<b>CO-OPS</b>	Center for Operational Products and Services
<b>CORS</b>	Continuously Operating Reference Station
<b>CTD</b>	Conductivity Temperature Depth
<b>CEF</b>	Chart Evaluation File
<b>CSF</b>	Composite Source File
<b>CST</b>	Chief Survey Technician
<b>CUBE</b>	Combined Uncertainty and Bathymetry Estimator
<b>DAPR</b>	Data Acquisition and Processing Report
<b>DGPS</b>	Differential Global Positioning System
<b>DP</b>	Detached Position
<b>DR</b>	Descriptive Report
<b>DTON</b>	Danger to Navigation
<b>ENC</b>	Electronic Navigational Chart
<b>ERS</b>	Ellipsoidal Referenced Survey
<b>ERTDM</b>	Ellipsoidally Referenced Tidal Datum Model
<b>ERZT</b>	Ellipsoidally Referenced Zoned Tides
<b>FFF</b>	Final Feature File
<b>FOO</b>	Field Operations Officer
<b>FPM</b>	Field Procedures Manual
<b>GAMS</b>	GPS Azimuth Measurement Subsystem
<b>GC</b>	Geographic Cell
<b>GPS</b>	Global Positioning System
<b>HIPS</b>	Hydrographic Information Processing System
<b>HSD</b>	Hydrographic Surveys Division

<b>Acronym</b>	<b>Definition</b>
<b>HSSD</b>	Hydrographic Survey Specifications and Deliverables
<b>HSTB</b>	Hydrographic Systems Technology Branch
<b>HSX</b>	Hypack Hysweep File Format
<b>HTD</b>	Hydrographic Surveys Technical Directive
<b>HVCR</b>	Horizontal and Vertical Control Report
<b>HVF</b>	HIPS Vessel File
<b>IHO</b>	International Hydrographic Organization
<b>IMU</b>	Inertial Motion Unit
<b>ITRF</b>	International Terrestrial Reference Frame
<b>LNM</b>	Linear Nautical Miles
<b>MBAB</b>	Multibeam Echosounder Acoustic Backscatter
<b>MCD</b>	Marine Chart Division
<b>MHW</b>	Mean High Water
<b>MLLW</b>	Mean Lower Low Water
<b>NAD 83</b>	North American Datum of 1983
<b>NALL</b>	Navigable Area Limit Line
<b>NTM</b>	Notice to Mariners
<b>NMEA</b>	National Marine Electronics Association
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NOS</b>	National Ocean Service
<b>NRT</b>	Navigation Response Team
<b>NSD</b>	Navigation Services Division
<b>OCS</b>	Office of Coast Survey
<b>OMAO</b>	Office of Marine and Aviation Operations (NOAA)
<b>OPS</b>	Operations Branch
<b>MBES</b>	Multibeam Echosounder
<b>NWLON</b>	National Water Level Observation Network
<b>PDBS</b>	Phase Differencing Bathymetric Sonar
<b>PHB</b>	Pacific Hydrographic Branch
<b>POS/MV</b>	Position and Orientation System for Marine Vessels
<b>PPK</b>	Post Processed Kinematic
<b>PPP</b>	Precise Point Positioning
<b>PPS</b>	Pulse per second

<b>Acronym</b>	<b>Definition</b>
<b>PRF</b>	Project Reference File
<b>PS</b>	Physical Scientist
<b>RNC</b>	Raster Navigational Chart
<b>RTK</b>	Real Time Kinematic
<b>RTX</b>	Real Time Extended
<b>SBES</b>	Singlebeam Echosounder
<b>SBET</b>	Smooth Best Estimate and Trajectory
<b>SNM</b>	Square Nautical Miles
<b>SSS</b>	Side Scan Sonar
<b>SSSAB</b>	Side Scan Sonar Acoustic Backscatter
<b>ST</b>	Survey Technician
<b>SVP</b>	Sound Velocity Profiler
<b>TCARI</b>	Tidal Constituent And Residual Interpolation
<b>TPU</b>	Total Propagated Uncertainty
<b>USACE</b>	United States Army Corps of Engineers
<b>USCG</b>	United States Coast Guard
<b>UTM</b>	Universal Transverse Mercator
<b>XO</b>	Executive Officer
<b>ZDF</b>	Zone Definition File