H13503

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

DESCRIPTIVE REPORT

Type of Survey:	Basic Hydrographic Survey
Registry Number:	H13503

LOCALITY

State(s):	Texas
General Locality:	Western Gulf of Mexico
Sub-locality:	13NM SW from Freeport

2021

CHIEF OF PARTY
Paul L. Donaldson

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H13503

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):	**Texas**
General Locality:	**Western Gulf of Mexico**
Sub-Locality:	**13NM SW from Freeport**
Scale:	**5000**
Dates of Survey:	**07/17/2021 to 10/06/2021**
Instructions Dated:	**05/13/2021**
Project Number:	**OPR-K380-KR-21**
Field Unit:	**Leidos**
Chief of Party:	**Paul L. Donaldson**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter Side Scan Sonar**
Verification by:	**Atlantic 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 15N, 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

List of Tables

List of Figures

Descriptive Report to Accompany Survey H13503

Project: OPR-K380-KR-21

Locality: Western Gulf of Mexico

Sublocality: 13NM SW from Freeport

Scale: 1:5000

July 2021 - October 2021

Leidos

Chief of Party: Paul L. Donaldson

A. Area Surveyed

H13503 was located 13NM SW from Freeport, Texas; with southern extents approximately 4.36km offshore continuing north to approximately 0.73km offshore of Fort Quintana (Figure 1). The survey was conducted in accordance with coverage requirements listed in the Project Instructions.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
28° 55' 44.11" N 95° 38' 59.06" W	28° 39' 22.05" N 95° 13' 41.78" W

Table 1: Survey Limits

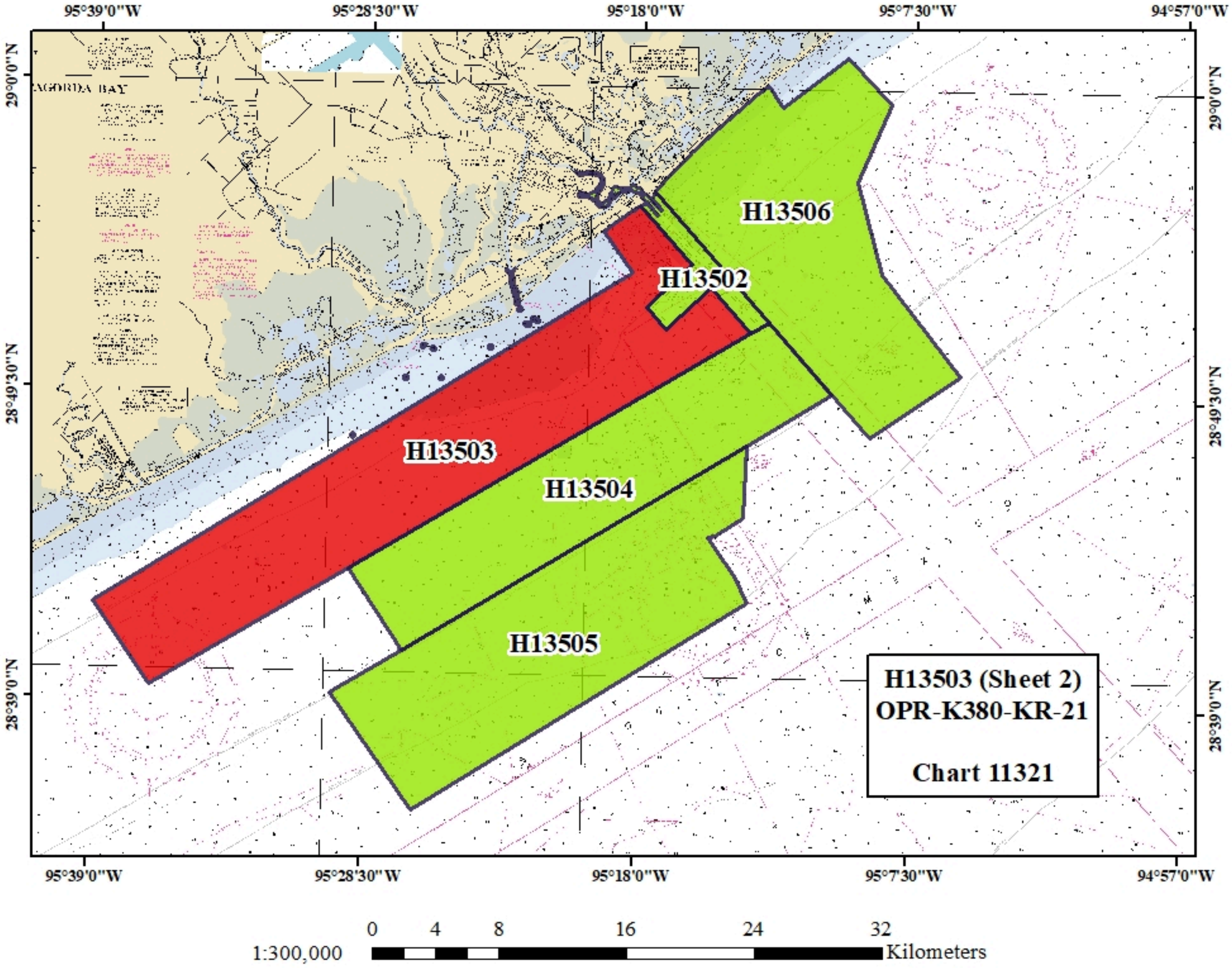

Figure 1: H13503 Survey Bounds

Survey limits were acquired in accordance with the requirements in the Project Instructions and the Hydrographic Survey Specifications and Deliverables (HSSD), April 2021.

A.2 Survey Purpose

This survey covers the general vicinity of the entrance channel to Port Freeport, Texas between the U.S. Coast Guard Station on the northwest of the entrance and Quintana Harbor to the southwest. The survey will wind 4.7 nautical miles south and west, around the Dow Chemical Plant Thumb to the Freeport Channel terminus. The surveyed area extends offshore 11 nautical miles to cover the approach channel, and 18 nautical miles southwest and 8 nautical miles northwest, outside safety fairway, where the AIS traffic deems intensity. Port Freeport, TX is undergoing channel expansion and deepening administered by the U.S Army

Corps of Engineers. Freeport will become the deepest port in Texas once the entrance and terminal channels reach the authorized 51-56 feet depth. With the physical position on the Intercoastal Waterway, direct rail and highway connections to major Texas hubs, and the deepened channels, Port Freeport is poised to exceed its current 28th ranking as the U.S. busiest port in tonnage transfer. Several powerful storms impacted the Port Freeport since the offshore vicinity was last surveyed in 2002 and the nearshore vicinity was last surveyed in the 1930s and 1960s. The Office of Coast Survey expects that modern hydrographic techniques will find significant changes to the seabed due to hurricane forces transforming the seafloor. 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.

H13503 was surveyed in accordance with the following documents:
1. 1305M221FNCNJ0270 signed.pdf, received 08 June 2021
2. Hydrographic Survey Specifications and Deliverables (HSSD), April 2021
3. OPR-K380-KR-21_PRF_FINAL_05032021.000, received 08 June 2021
4. OPR-K380-KR-21_CSF_FINAL_05032021.000, received 08 June 2021
5. OPR-K380-KR-21 Project Brief, held 24 June 2021
6. OPR-K380-KR-21 and OPR-K380-KR-21 feature guidance follow-up.pdf, 30 July 2021
7. 1305M221FNCNJ0270 - Modification P21001.pdf received 11 August 2021

A.4 Survey Coverage

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

Water Depth	Coverage Required
All waters in survey area Sheets 2 through 5	Complete Coverage (Refer to HSSD Section 5.2.2.3)

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 through Figure 4). The assigned survey bounds were achieved across H13503 except where the inshore limit of the Navigable Area Limit Line (NALL) was achieved in the vicinity of Fort Quintana.

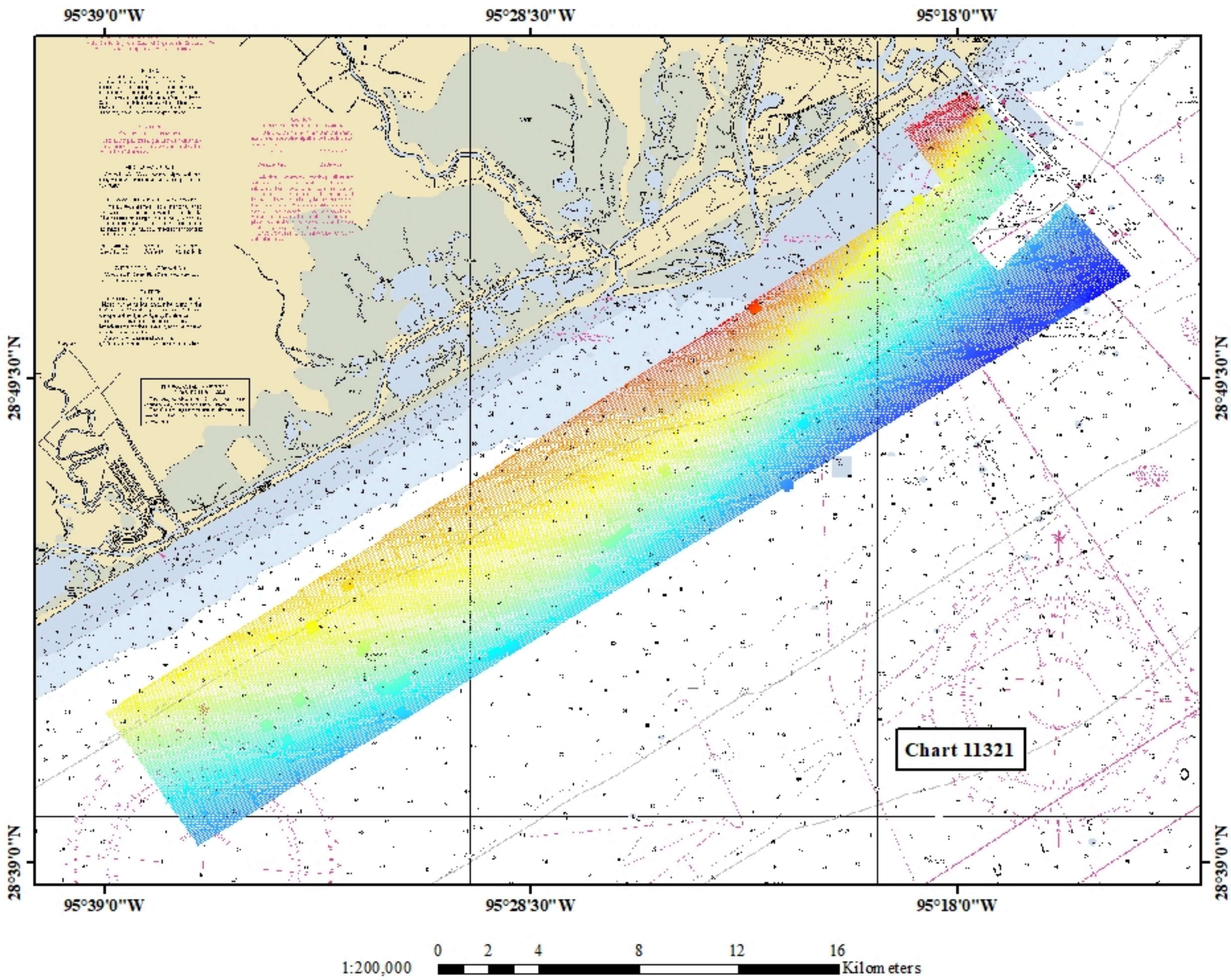

Figure 2: Final Bathymetry Coverage for H13503

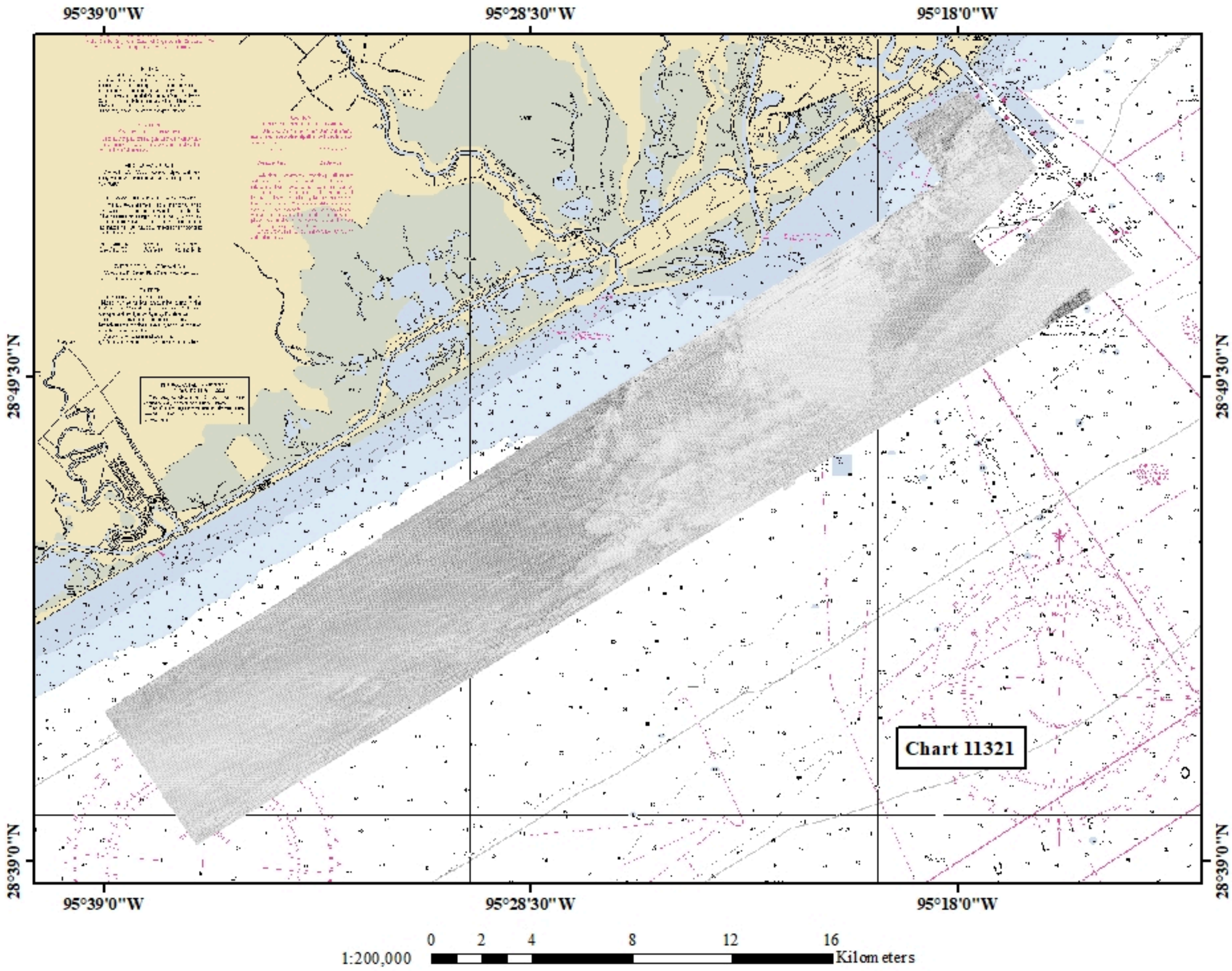

Figure 3: Final Side Scan Coverage for H13503 (First 100% Coverage)

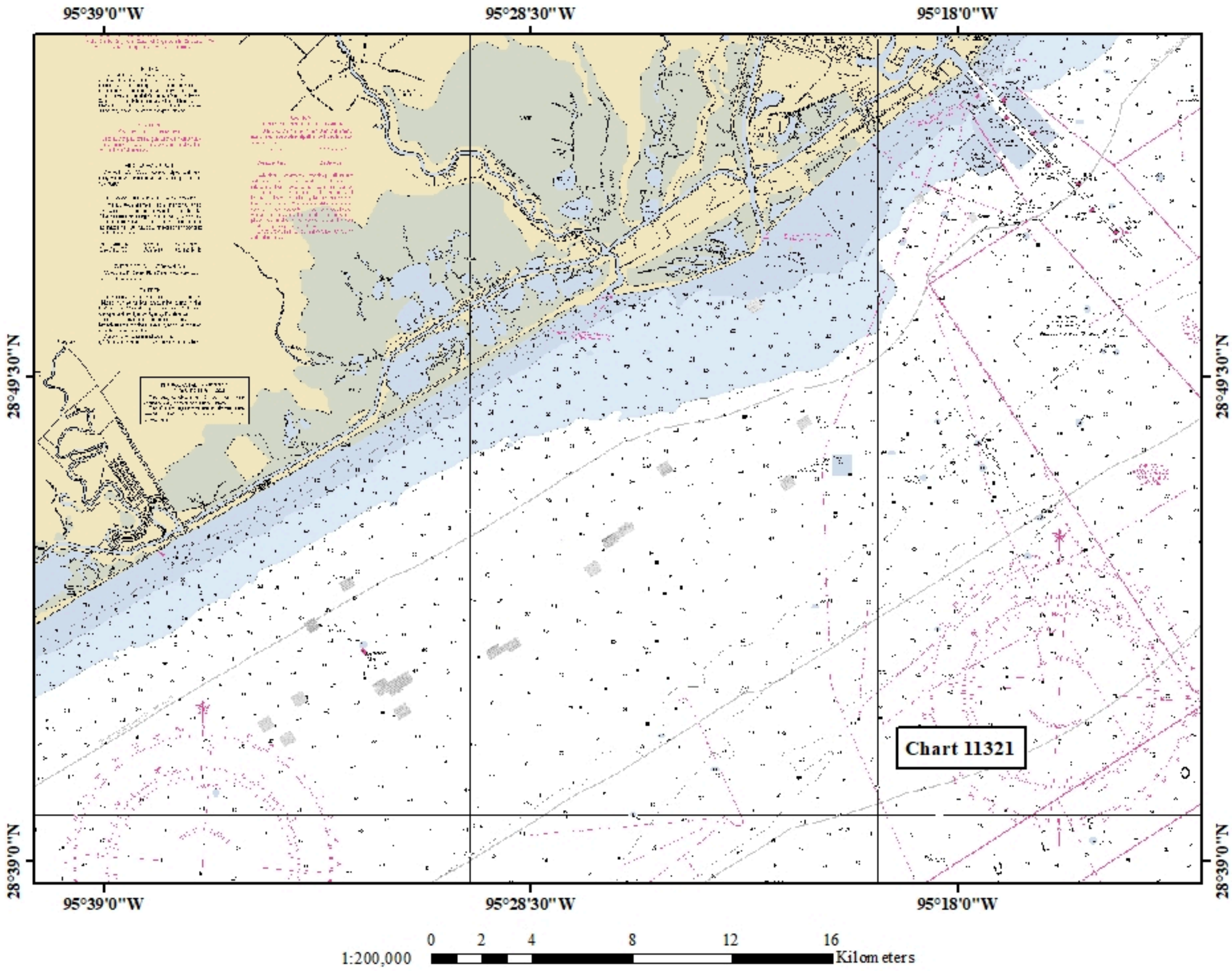

Figure 4: Final Side Scan Coverage for H13503 (Second 100% Coverage)

A.6 Survey Statistics

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

	HULL ID	*M/V Atlantic Surveyor*	*R/V Oyster Bay II*	*Total*
LNM	**SBES Mainscheme**	0	0	0
	MBES Mainscheme	0	0	0
	Lidar Mainscheme	0	0	0
	SSS Mainscheme	0	0	0
	SBES/SSS Mainscheme	0	0	0
	MBES/SSS Mainscheme	1841.34	315.81	2157.15
	SBES/MBES Crosslines	73.38	9.64	83.02
	Lidar Crosslines	0	0	0
Number of Bottom Samples				9
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				87.01

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
07/17/2021	198

Survey Dates	Day of the Year
07/18/2021	199
07/19/2021	200
07/20/2021	201
07/21/2021	202
07/22/2021	203
07/30/2021	211
07/31/2021	212
08/01/2021	213
08/02/2021	214
08/03/2021	215
08/04/2021	216
08/05/2021	217
08/06/2021	218
08/07/2021	219
08/08/2021	220
08/12/2021	224
08/13/2021	225
08/14/2021	226
08/15/2021	227
08/16/2021	228
08/17/2021	229
08/18/2021	230
10/02/2021	275
10/03/2021	276
10/04/2021	277
10/06/2021	279

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 vessels used to acquire and process these data is included in the Data Acquisition and Processing Report (DAPR) for OPR-K380-KR-21, delivered previously with H13502. 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	*M/V Atlantic Surveyor*	*R/V Oyster Bay II*
LOA	110 feet	30 feet
Draft	9 feet	3 feet

Table 5: Vessels Used

Figure 5: M/V Atlantic Surveyor

Figure 6: R/V Oyster Bay II

The M/V Atlantic Surveyor (Figure 5) 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 6) 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:

Manufacturer	Model	Type
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	MVP30	Sound Speed System
AML Oceanographic	BaseX2	Sound Speed System

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 3.84% of mainscheme acquisition. The resulting crossline to mainscheme percentage met the requirement to achieve approximately four percent of mainscheme mileage for a Complete Coverage survey (Section 5.2.4.2 of the HSSD).

The mainscheme lines were spaced 80 meters apart. Crosslines were generally spaced 1500 and 2000 meters apart based on line spacing and linear nautical miles of each survey area. 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. One grid contained the full valid swath (±65° from nadir, Class 2) of mainscheme multibeam and the other included only the near nadir swath (±5° from nadir, Class 1) crossline data. The difference grid was created by subtracting the at 1-meter H13503 mainscheme CUBE depths from the 1-meter H13503 crossline CUBE depths. Additional comparison was conducted of each vessel mainscheme to crossline depth data. These results are summarized in Figure 7.

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]. In all cases the depth difference values were within the maximum allowable TVU with one exception. The vessel to vessel analysis between the common area of the M/V Atlantic Surveyor and the R/V Oyster Bay II had one depth difference which exceeded the maximum allowable TVU. This difference was related to a discrete obstruction where a feature was present in the CUBE surface from one vessel during item investigations, but not in the coincident data from the other vessel. Results for all crossing analysis if presented in Figure 7 through Figure 16.

Difference Grid	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
M/V Atlantic Surveyor and R/V Oyster Bay II Multibeam 1-meter Crossline (Class 1) to M/V Atlantic Surveyor and R/V Oyster Bay II Multibeam 1-meter Mainscheme	3.361 – 17.434	0.502 – 0.549	100.00%
M/V Atlantic Surveyor Multibeam 1-meter Crossline (Class 1) to M/V Atlantic Surveyor Multibeam 1-meter Mainscheme	7.000 – 17.434	0.508 – 0.549	100.00%
R/V Oyster Bay II Multibeam 1-meter Crossline (Class 1) to R/V Oyster Bay II Multibeam 1-meter Mainscheme	3.361 – 13.064	0.502 – 0.528	100.00%

Figure 7: Summary of Crossing Analysis

Difference Grid	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
M/V Atlantic Surveyor 1-meter Multibeam Data to R/V Oyster Bay II 1-meter Multibeam Data	5.022 – 13.535	0.504 – 0.530	99.99%

Figure 8: Summary of Vessel Comparison Repeatability Analysis M/V Atlantic Surveyor vs. R/V Oyster Bay II

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	51987	19.51	23730	8.90	25688	9.64	2569	0.96
>0.01-0.02	41426	35.05	19242	16.12	22184	17.96		
>0.02-0.03	42558	51.02	19574	23.47	22984	26.59		
>0.03-0.04	35580	64.37	15874	29.43	19706	33.98		
>0.04-0.05	31953	76.36	14178	34.75	17775	40.65		
>0.05-0.06	20912	84.21	9680	38.38	11232	44.87		
>0.06-0.07	14766	89.75	6716	40.90	8050	47.89		
>0.07-0.08	9355	93.26	4569	42.61	4786	49.68		
>0.08-0.09	7384	96.03	3560	43.95	3824	51.12		
>0.09-0.10	4585	97.75	2131	44.75	2454	52.04		
>0.10-0.11	2410	98.66	1047	45.14	1363	52.55		
>0.11-0.12	1474	99.21	621	45.37	853	52.87		
>0.12-0.13	830	99.52	326	45.50	504	53.06		
>0.13-0.14	501	99.71	194	45.57	307	53.17		
>0.14-0.15	392	99.85	191	45.64	201	53.25		
>0.15-0.16	187	99.92	115	45.68	72	53.28		
>0.16-0.17	73	99.95	48	45.70	25	53.29		
>0.17-0.27	127	100.00	117	45.75	10	53.29		
Total	**266500**	**100.00%**	**121913**	**45.75%**	**142018**	**53.29%**	**2569**	**0.96%**
Reference Grid: H13503_MB_1m_AS_OBII_cross_5degree_pfm_H13503_MB_1m_AS_OBII_main_pfm.dif								

Figure 9: Tabular Results Crossing Analysis, Crosslines vs. Mainscheme Lines

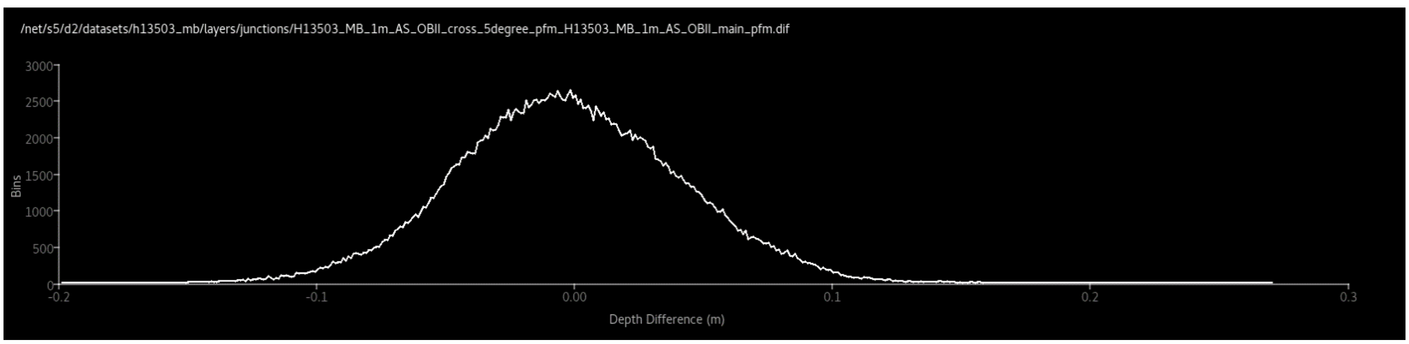

Figure 10: Plot of Crossing Analysis Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	47754	20.32	21846	9.30	23556	10.02	2352	1.00
>0.01-0.02	37644	36.34	17648	16.81	19996	18.53		
>0.02-0.03	38571	52.76	17933	24.44	20638	27.32		
>0.03-0.04	31916	66.34	14504	30.61	17412	34.73		
>0.04-0.05	28129	78.31	13124	36.20	15005	41.11		
>0.05-0.06	17915	85.93	8916	39.99	8999	44.94		
>0.06-0.07	12311	91.17	6035	42.56	6276	47.61		
>0.07-0.08	7619	94.41	4047	44.28	3572	49.13		
>0.08-0.09	5734	96.85	3149	45.62	2585	50.23		
>0.09-0.10	3519	98.35	1873	46.42	1646	50.93		
>0.10-0.11	1732	99.09	881	46.79	851	51.29		
>0.11-0.12	995	99.51	463	46.99	532	51.52		
>0.12-0.13	548	99.74	245	47.09	303	51.65		
>0.13-0.14	242	99.85	129	47.15	113	51.70		
>0.14-0.15	182	99.92	114	47.20	68	51.73		
>0.15-0.16	122	99.98	102	47.24	20	51.74		
>0.16-0.189	56	100.00	48	47.26	8	51.74		
Total	**234989**	**100.00%**	**111057**	**47.26%**	**121580**	**51.74%**	**2352**	**1.00%**
Reference Grid: H13503_MB_1m_AS_cross_5degree_pfm_H13503_MB_1m_AS_main_pfm.dif								

Figure 11: Tabular Results Crossing Analysis, M/V Atlantic Surveyor Crosslines vs. Mainscheme Lines

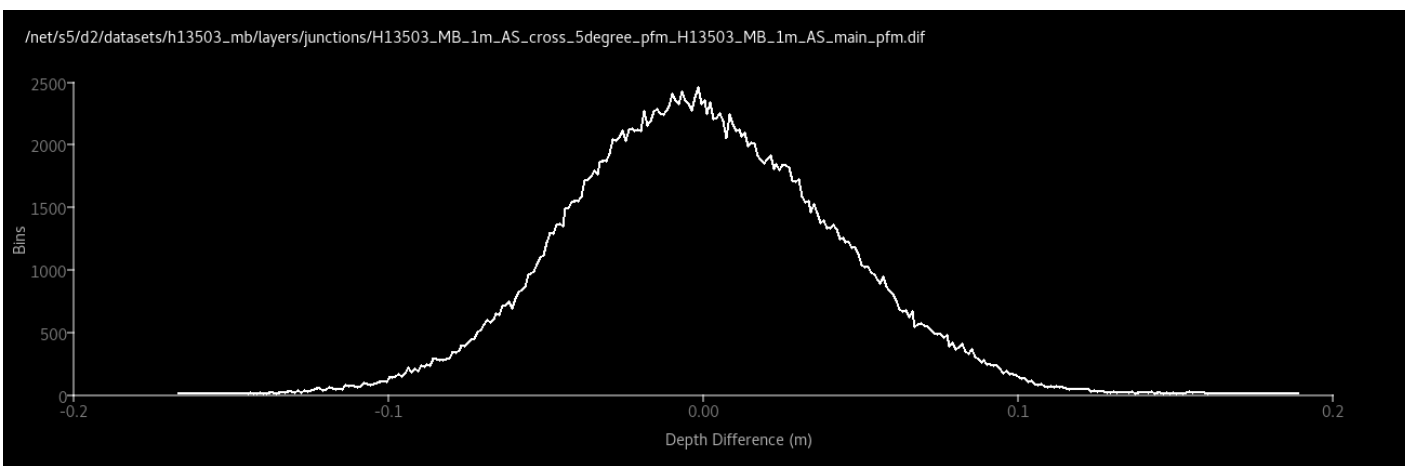

Figure 12: Plot of Crossing Analysis M/V Atlantic Surveyor Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	3363	14.90	1591	7.05	1595	7.07	177	0.78
>0.01-0.02	2893	27.72	1374	13.14	1519	13.80		
>0.02-0.03	3295	42.32	1546	19.99	1749	21.55		
>0.03-0.04	3072	55.93	1339	25.92	1733	29.22		
>0.04-0.05	2765	68.18	961	30.18	1804	37.22		
>0.05-0.06	2204	77.94	660	33.10	1544	44.06		
>0.06-0.07	1797	85.90	523	35.42	1274	49.70		
>0.07-0.08	1054	90.57	304	36.76	750	53.02		
>0.08-0.09	735	93.83	187	37.59	548	55.45		
>0.09-0.10	514	96.11	131	38.17	383	57.15		
>0.10-0.11	326	97.55	91	38.58	235	58.19		
>0.11-0.12	206	98.46	56	38.82	150	58.85		
>0.12-0.13	73	98.79	21	38.92	52	59.08		
>0.13-0.14	62	99.06	29	39.05	33	59.23		
>0.14-0.19	110	99.55	59	39.31	51	59.46		
>0.19-0.24	87	99.93	86	39.69	1	59.46		
>0.24-0.27	15	100.00	15	39.75	0	59.46		
Total	**22571**	**100.00%**	**8973**	**39.75%**	**13421**	**59.46%**	**177**	**0.78%**
Reference Grid: H13503_MB_1m_OBII_cross_5degree_pfm_H13503_MB_1m_OBII_main_pfm.dif								

Figure 13: Tabular Results Crossing Analysis, R/V Oyster Bay II Crosslines vs. Mainscheme Lines

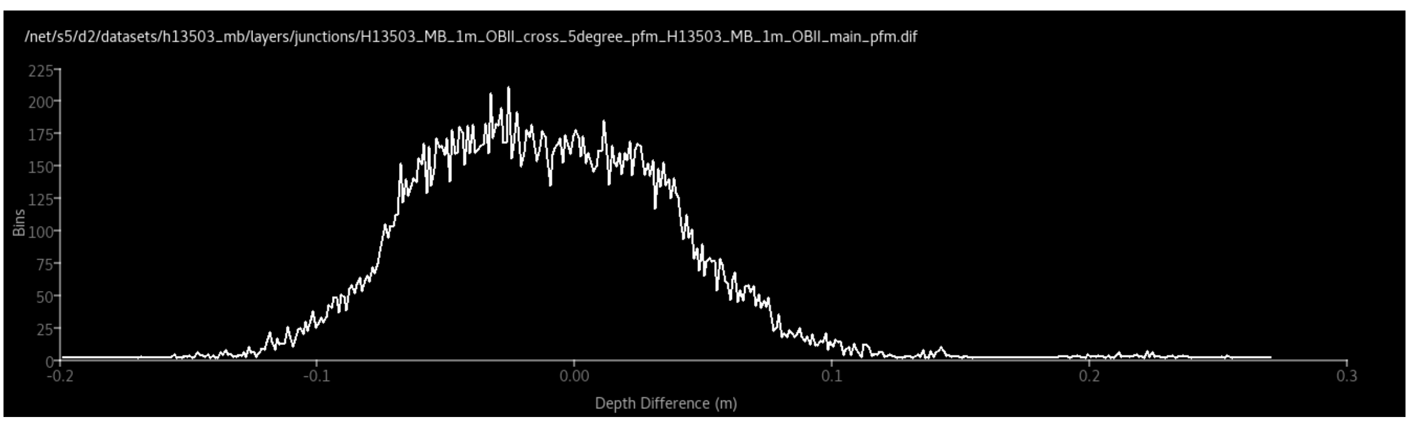

Figure 14: Plot of Crossing Analysis R/V Oyster Bay II Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	336915	14.84	152955	6.74	167747	7.39	16213	0.71
>0.01-0.02	277457	27.07	117257	11.90	160200	14.45		
>0.02-0.03	278316	39.33	99740	16.30	178576	22.31		
>0.03-0.04	239512	49.88	78907	19.77	160605	29.39		
>0.04-0.05	230261	60.02	76220	23.13	154041	36.18		
>0.05-0.06	200571	68.86	62807	25.90	137764	42.24		
>0.06-0.07	181919	76.87	55318	28.34	126601	47.82		
>0.07-0.08	121600	82.23	43236	30.24	78364	51.27		
>0.08-0.09	100871	86.67	40994	32.05	59877	53.91		
>0.09-0.10	69765	89.74	31998	33.46	37767	55.57		
>0.10-0.11	48134	91.86	24044	34.51	24090	56.64		
>0.11-0.12	40405	93.64	19488	35.37	20917	57.56		
>0.12-0.13	39437	95.38	15368	36.05	24069	58.62		
>0.13-0.14	36776	97.00	12641	36.61	24135	59.68		
>0.14-0.15	26306	98.16	10175	37.06	16131	60.39		
>0.15-0.16	13148	98.74	7982	37.41	5166	60.62		
>0.16-0.17	7042	99.05	6115	37.68	927	60.66		
>0.17-0.18	5463	99.29	5251	37.91	212	60.67		
>0.18-0.19	3867	99.46	3826	38.08	41	60.67		
>0.19-0.20	3110	99.60	3099	38.21	11	60.67		
>0.20-0.25	7888	99.95	7885	38.56	3	60.67		
>0.25-0.30	1010	99.99	1010	38.60	0	60.67		
>0.30-0.43	211	99.99	211	38.61	0	60.67		
>0.43-3.406	1	100.00	0	38.61	1	60.67		
Total	**2269985**	**100.00%**	**876527**	**38.61%**	**1377245**	**60.67%**	**16213**	**0.71%**
Reference Grid: H13503_MB_1m_AS_pfm_H13503_MB_1m_OBII_all_pfm.dif								

Figure 15: Tabular Results Vessel Comparison Analysis, M/V Atlantic Surveyor vs. R/V Oyster Bay II

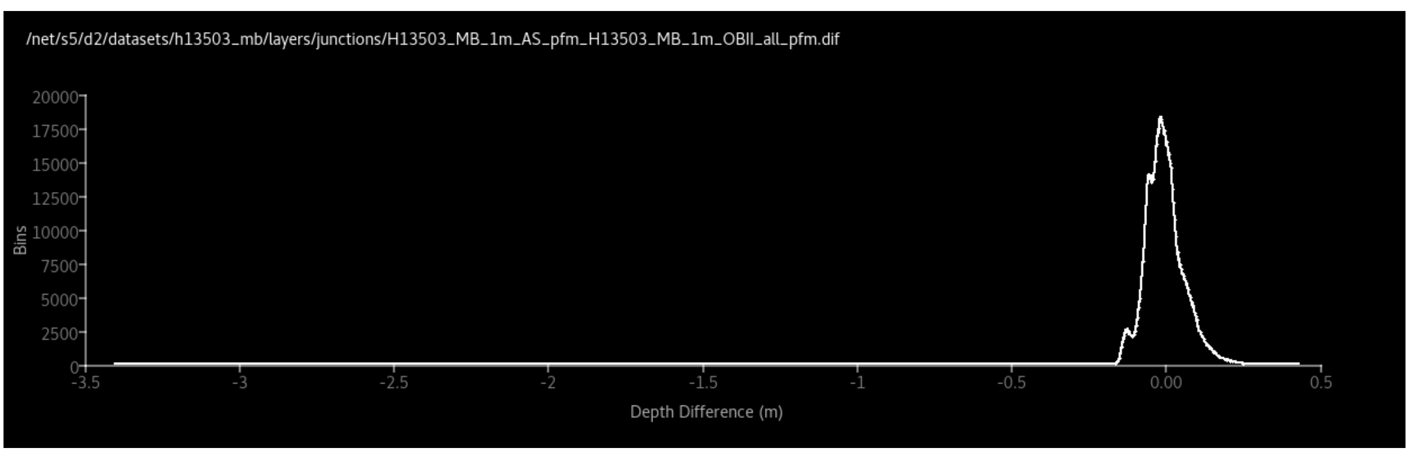

Figure 16: Plot of Vessel Comparison Analysis M/V Atlantic Surveyor vs. R/V Oyster Bay II

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.093 meters	0.20 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
M/V Atlantic Surveyor	1.0 meters/second	1.0 meters/second	1.0 meters/second	1.0 meters/second
R/V Oyster Bay II	1.0 meters/second	1.0 meters/second	1.0 meters/second	1.0 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 5.2.2.2, H13503 depth data fell within a single grid resolution at 1-meter.

The final H13503 1-meter PFM CUBE surface contained final vertical uncertainties that ranged from 0.210 meters to 0.944 meters. The IHO Order 1a maximum allowable vertical uncertainty was calculated to range between 0.502 to 0.550 meters, based on the minimum CUBE depth (3.254 meters) and maximum CUBE depth (17.635 meters). Results from the SABER Check PFM Uncertainty function identified that there were 1,632 nodes in the final H13503 1-meter PFM CUBE surface with final vertical uncertainties that exceeded IHO Order 1a allowable vertical uncertainty. Many of the nodes were associated with features on the sea floor however the majority of uncertainties were seen in the outer ranges of swath data resulting from the SABER calculated uncertainty due to variability between sound speed profiles (SSP) within MBES data. Uncertainties were limited to a few R/V Oyster Bay II data files where SSP casts were variable as a result of the water mixing near the Port Freeport inlet. In these instances, sound speed profiles had high variability leading to SABER calculating a higher uncertainty value for some outer beam data. 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 H13503 1-meter PFM grid. Results showed that 99.99% of all nodes had final uncertainties less than or equal to maximum allowable vertical uncertainty of 0.550 meters.

B.2.3 Junctions

Per the Project Instructions, junction analysis was performed between H13503 and the survey listed in Table 9. Figure 17 shows the general locality of H13503 as it relates to the sheet against which junctions were performed. Analysis of sheet H13503 to the adjacent sheet H13504 will be discussed within the H13504 Descriptive Report, as final analysis and processing efforts for this sheet remains on-going. Results from the comparison between H13503 and H13502 are detailed below.

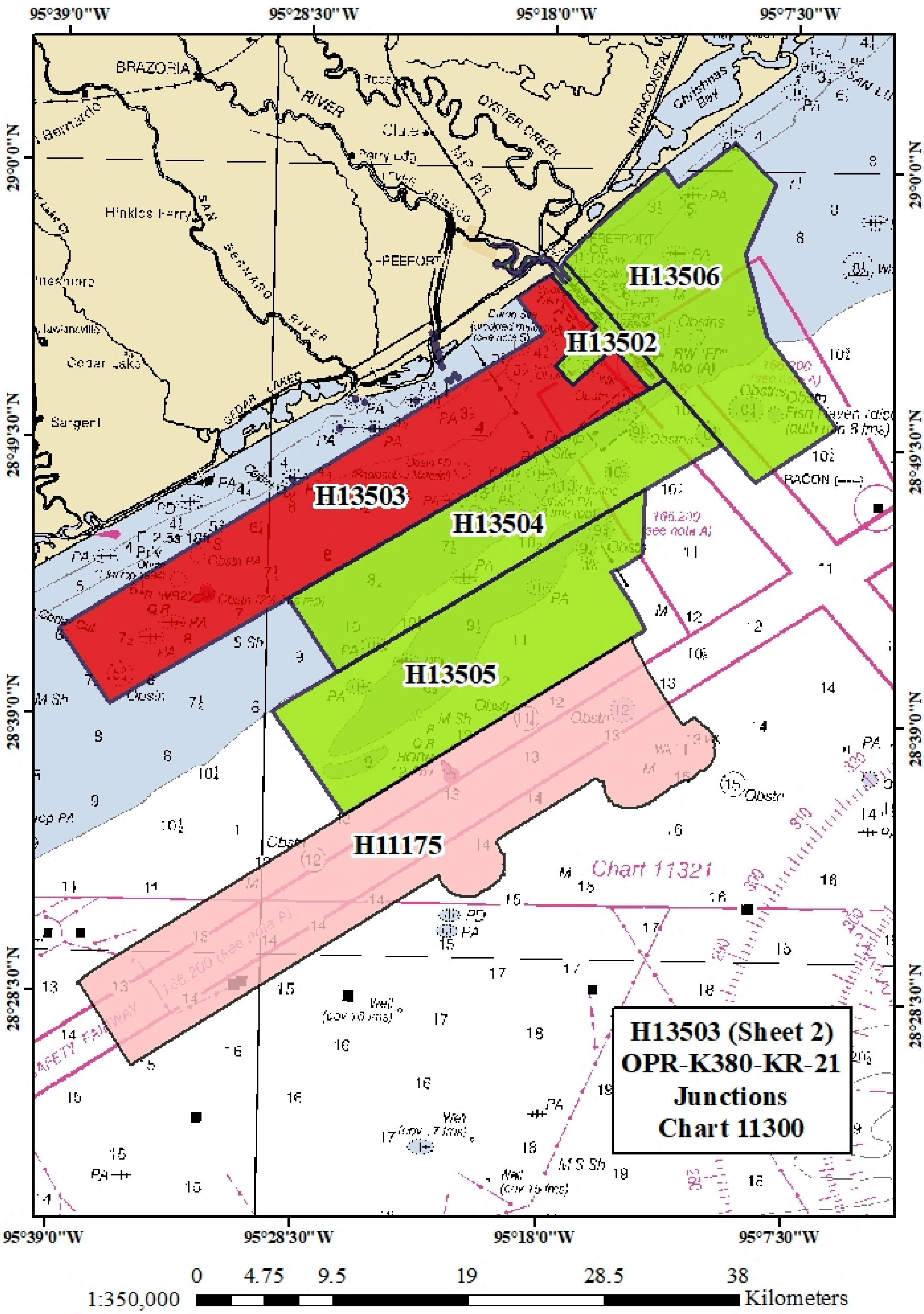

Figure 17: General Locality of H13503 with Junctioning Surveys

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13502	1:5000	2021	Leidos, Inc.	NE

Table 9: Junctioning Surveys

H13502

Junctioning survey H13502 was conducted in 2021 and junctions to the northeast of H13503. For this analysis, the H13502 50-centimeter final CUBE depth surface was compared to the H13503 1-meter CUBE depth surface. Junction analysis was conducted on the common area of these two sheets, with an overlapping area approximately 230-260 meters wide along the northeastern boundary of H13503. Observed depths within the common area were 3.258 to 17.748 meters which resulted in a calculated allowable TVU range of 0.502 to 0.551 meters.

The difference grid was generated by subtracting the H13502 data from the H13503 data. Negative values indicate that H13503 depth data were generally shoaler than H13502 depth data along the common area. Analysis show that 99.99% of the comparisons were 0.26 meters or less, within the maximum calculated allowable TVU value of 0.551 meters. Throughout the common area, H13503 CUBE depths were deeper than H13502 22.78% of the time and were shoaler than H13502 76.60% of the time (Figure 18). Comparison results are presented in Figure 19.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	161064	13.08	70693	5.74	82702	6.71	7669	0.62
>0.01-0.02	134437	23.99	53002	10.04	81435	13.33		
>0.02-0.03	139664	35.33	45276	13.72	94388	20.99		
>0.03-0.04	124283	45.42	32369	16.35	91914	28.45		
>0.04-0.05	122758	55.38	26250	18.48	96508	36.28		
>0.05-0.06	101673	63.64	18642	19.99	83031	43.03		
>0.06-0.07	91606	71.07	13487	21.08	78119	49.37		
>0.07-0.08	72163	76.93	8025	21.74	64138	54.57		
>0.08-0.09	65983	82.29	5606	22.19	60377	59.48		
>0.09-0.10	50830	86.42	3298	22.46	47532	63.33		
>0.10-0.11	38646	89.55	1995	22.62	36651	66.31		
>0.11-0.12	27704	91.80	1074	22.71	26630	68.47		
>0.12-0.13	20568	93.47	467	22.75	20101	70.10		
>0.13-0.14	15647	94.74	179	22.76	15468	71.36		
>0.14-0.15	13005	95.80	91	22.77	12914	72.41		
>0.15-0.16	11719	96.75	42	22.77	11677	73.36		
>0.16-0.17	10788	97.63	19	22.77	10769	74.23		
>0.17-0.18	9477	98.39	14	22.77	9463	75.00		
>0.18-0.19	6425	98.92	6	22.77	6419	75.52		
>0.19-0.20	4928	99.32	0	22.77	4928	75.92		
>0.20-0.26	8276	99.99	2	22.77	8274	76.59		
>0.26-1.159	145	100.00	7	22.78	138	76.60		
Total	**1231789**	**100.00%**	**280544**	**22.78**	**943576**	**76.60%**	**7669**	**0.62%**
Reference Grid: H13503 MB 1m MLLW 20211222 pfm H13502 MB 50cm MLLW Final bag.dif								

Figure 18: Tabular Results Junction Analysis H13503 vs. H13502

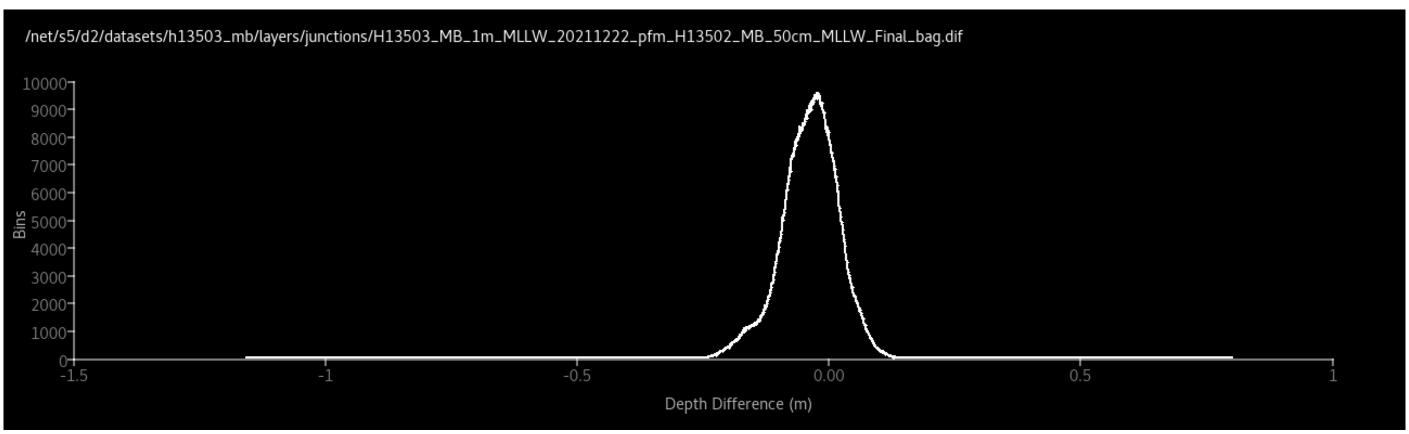

Figure 19: Plot of Junction Analysis H13503 vs. H13502

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

Biological Interference

Dense biological interference, rafts of vegetation and tide lines were observed during discrete areas on various days of survey which required numerous holiday fill lines (Figure 20). These observances did not have any significant impact on the final CUBE surface. Throughout survey acquisition sport fishing and commercial shrimping via trawls were common within the H13503 survey bounds.

Figure 20: Tide Line Observed During H13503 Acquisition

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: On the M/V Atlantic Surveyor, the MVP30 was the primary system used to collect SSP data; 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. SSP data were monitored during survey within the environmental monitor program to determine when a new cast was required. Section 5.2.3.3 of the HSSD requires that if the sound speed measured at the sonar head differs by more than two meters/second from the commensurate profile data, then another cast shall be acquired.

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 conducted by comparing at least two consecutive casts taken with different SSP sensors.

All individual SSP files are delivered with the H13503 data and are broken out into sub-folders, which correspond to the purpose of each cast. Also, all individual SSP files for H13503 have been concatenated into two separate files based on the purpose of the cast, provided in CARIS format files (.svp), and delivered under (H13503/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

As stated in Section A.4, H13503 was assigned as Complete Coverage; Leidos chose to achieve the coverage requirement following Option B (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 80-meter to ensure 100% SSS coverage. Disproval areas were covered with either 100% multibeam coverage or 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. Bathymetric data and SSS 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 of the H13503 1-meter PFM 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, outside of the SSS nadir coverage gap, and was fully covered with 100% SSS coverage. In the vicinity of Fort Quintana of H13503 the NALL was reached prior to reaching the SOW bounds (Figure 21).

The final H13503 CUBE PFM grid was 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 the PFM grid 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 PFM grid 99.45% of all nodes contained five or more soundings.

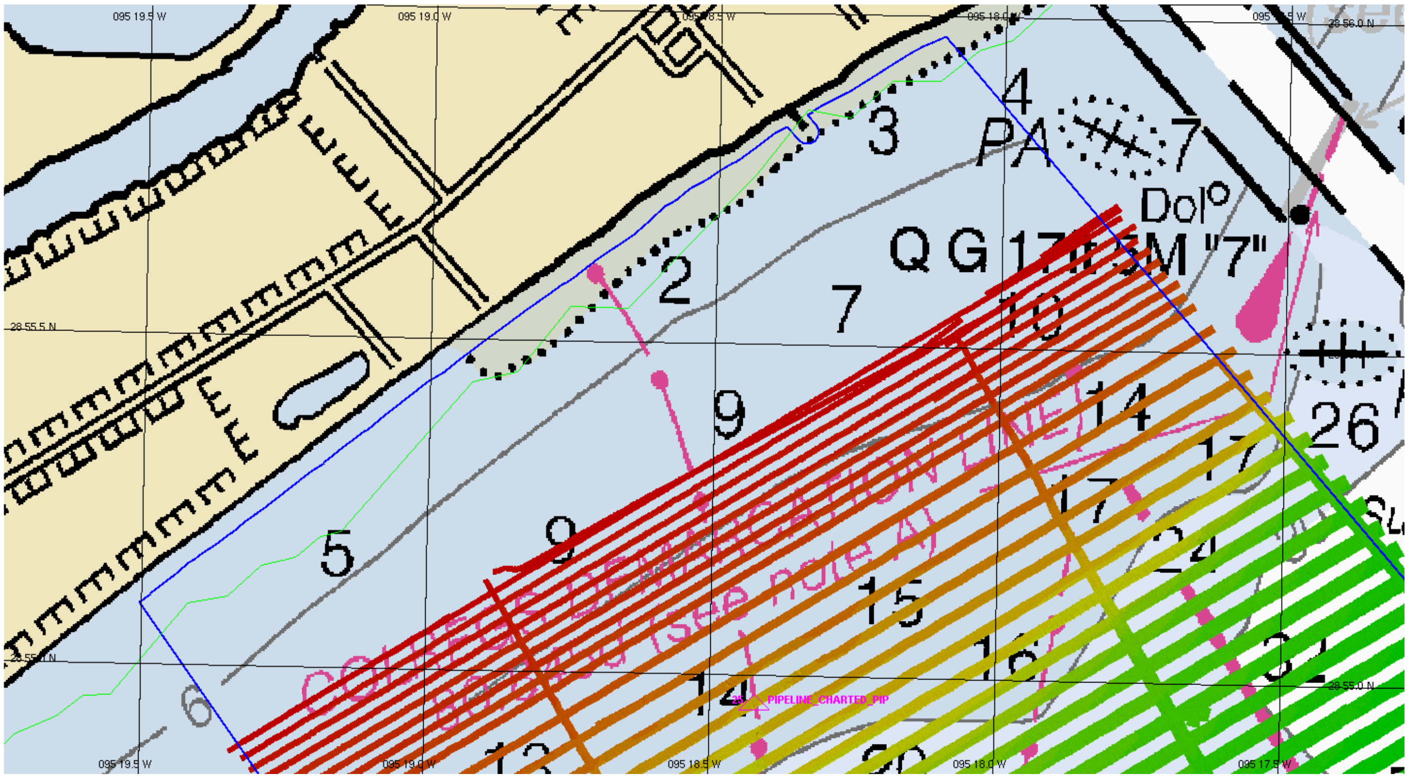

Figure 21: H13503 Achieved Coverage to NALL vs. SOW Boundary (Blue)

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. Multibeam files associated with calibration were previously delivered with the OPR-K380-KR-21 DAPR previously delivered with H13502.

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. Both coverage mosaics are determined to be complete and sufficient to meet the requirements contained within the Project Instructions and HSSD. Each 100 percent coverage mosaic is delivered as a single georeferenced raster file (datum of NAD83) in floating point GeoTIFF format, as specified in Sections 8.2.1 and 8.3.3 in the HSSD.

Multibeam Echo Sounder Seafloor Backscatter: Leidos collected MBES backscatter data with all GSF data acquired, in accordance with HSSD Section 6.2. The MBES settings used were checked to ensure acceptable quality standards were met and to mitigate acoustic saturation of the backscatter data. 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. Evaluation of backscatter data and processing were not required for OPR-K380-KR-21 and therefore no additional processing was performed by Leidos and no additional products were produced.

B.5 Data Processing

B.5.1 Primary Data Processing Software

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

Manufacturer	Name	Version
Leidos	SABER	5.4.1.5.5

Table 10: Primary bathymetric data processing software

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

Manufacturer	Name	Version
Leidos	SABER	5.4.1.5.5

Table 11: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Profile Version 2021.

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
H13503_MB_1m_MLLW_Final	BAG	1 meters	3.254 meters - 17.635 meters	N/A	Complete Coverage, Option B (100% side scan sonar coverage with concurrent multibeam)
H13503_SSSAB_1m_400kHz_900kHz_1of1	SSS Mosaic (.tif)	1 meters	0 meters - 0 meters	N/A	First 100% SSS
H13503_SSSAB_1m_400kHz_900kHz_2of2	SSS Mosaic (.tif)	1 meters	0 meters - 0 meters	N/A	Second 100% SSS (Disproval coverage)

Table 12: Submitted Surfaces

Complete Coverage Section 5.2.2.3 of the HSSD requires 1-meter node resolution for depths ranging from 0 meters to 20 meters. Leidos generated the CUBE PFM grid for H13503 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 H13503 1-meter PFM grid were from 3.254 meters (10.676 feet; 0.210 meters TVU) to 17.635 meters (57.857 feet; 0.230 meters TVU).

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

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 GSF MBES 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-K380-KR-21_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 of 1983 (NAD 83).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 15.

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. H13503 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 H13503 depth data were generally within ±1.0 meters with charted depths compared to the ENCs listed in Section D.1.1.

Charting recommendations for new features and updates to charted features, are documented in the H13503 S-57 FFF.

United States Coast Guard (USCG) District 8 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 23/21 (09 June 2021) until week 03/22 (19 January 2022).

An unassigned platform, Black Pool-101-1 (Feature 37), was updated in LNM 14/21 as having a light extinguished. No additional updates were present in the LNM publications except for the addition of dangers to navigation captured in Section D.1.2 of this report.

D.1.1 Electronic Navigational Charts

The following are the largest scale ENCs, which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date
US5FPOBB	1:10000	1	06/15/2020	01/05/2022
US5FPOBC	1:10000	3	09/27/2021	01/05/2022
US5FPOCA	1:10000	8	12/02/2021	12/02/2021
US5FPOCB	1:10000	8	09/30/2021	12/16/2021
US5FPOCC	1:10000	4	09/13/2021	09/13/2021
US5TX51M	1:40000	42	12/13/2021	12/14/2021
US4TX41M	1:80000	21	09/27/2021	01/05/2022

Table 14: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

Figure 22 details the Leidos submitted DTON and Anti-DTON reports for H13503. DTON reports were submitted per HSSD in S-57 format to the Atlantic Hydrographic Branch (AHB). Refer to the Project Correspondence for email correspondence related to submitted files.

The day after survey was completed (JD280), a capsized vessel was a drift within the survey area near Port Freeport inlet. The M/V Atlantic Surveyor maintained watch on the vessel until Port Freeport pilots arrived on site. The M/V Atlantic Surveyor departed the survey area and the capsized vessel remained adrift.

DTON Report Name	Date Submitted to AHB	AHB Submitted to NDB and MCD	NDB Registration	Feature Number(s)
H13503_DTON_01.000	2021-08-16	2021-08-16	DD-34781	06
H13503_DTON_Anti_DTON_02.000	2021-12-14	2021-12-14	DD-35563	08
H13503_DTON_03.000	2021-12-14	2021-12-14	DD-35563	13

Figure 22: DTON Reports

Figure 23: Capsized Vessel Adrift Near Port Freeport Inlet

D.1.3 Charted Features

There were numerous assigned charted features in the final CSF (OPR-K380-KR-21_CSF.000) within the SOW of H13503. Per HSSD Section 8.1.4, refer to the H13503 S-57 FFF (H13503_FFF.000) for details and recommendations regarding these features.

D.1.4 Uncharted Features

See the H13503 S-57 FFF for all details and recommendations regarding new uncharted features investigated.

D.1.5 Channels

There were no assigned channels within the H13503 SOW from the final CSF.

D.2 Additional Results

D.2.1 Aids to Navigation

There was one assigned feature designated as an aid to navigation (ATON) within the SOW of H13503 from the final CSF. The ATON within the survey limits was observed on station and serving its intended purpose. Per the investigation requirements from the CSF, as it was on station and serving it's intended purpose, it is included in the H13503 FFF with description of retain.

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 Project Instructions and Section 7.2.3 of the HSSD, bottom characteristics were obtained for H13503 at the nine locations assigned in the final PRF (OPR-K380-KR-21_PRF_Final_05032021.000). Leidos did not modify the bottom sample locations from the locations 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 H13503/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 were several assigned submarine features for investigation, cables and pipelines. Within H13503, 15 features were characterized as a submarine feature. Nine were exposed pipelines associated with assigned or uncharted submarine features and were located within the State of Texas Coastal Zone Management Area (CZMA). In accordance with HSSD Section 1.7 and Project Instructions dated 06 July 2021, the pipelines were submitted as a Non-Dangerous Pipeline Report to NOAA (.000) and as a .KMZ file to the General Land Office of Texas (GLO). The remaining six submarine features were not observed as exposed and therefore were not included in the Non-Dangerous Pipeline Report.

The CSF investigation requirements for the submerged cables (CBLSUB) listed “Visually confirm feature object existence. If discrepancy, discuss in DR (see HSSD Section 8.1.4). Do not include feature in FFF.”

A charting discrepancy between ENC US4TX41M, US5FPOBB, US5FPOBC and RNC 11321_1 was identified. A submarine cable is charted on RNC 11321_1 while both a submarine cable and a pipeline are charted on the three ENC's. A short section of exposed cable (Feature 41) was identified to be charted correctly and therefore not included in the FFF. Refer to H13503_Feature_41.png in the Multimedia folder for details.

See the H13503 S-57 FFF for details regarding the pipelines. Side scan contacts associated with the submarine features were retained within the H13503 Side Scan Sonar Contact S-57 file (H13503_SSS_Contacts.000) and classified as non-significant.

D.2.6 Platforms

There were fourteen platforms assigned from the CSF for H13503. One charted platform was not provided or assigned within the final CSF (Feature 37). All platforms are addressed in the H13503 FFF.

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 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.2.6 and D.1.2.

D.2.9 Construction and Dredging

No construction or dredging exists for this survey area.

D.2.10 New Survey Recommendations

No new survey recommendations are made for the area surrounding this survey area.

D.2.11 ENC Scale Recommendations

No new ENC recommendations are made for the area surrounding this survey 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.

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 concurrently, submitted deliverables for OPR-K380-KR-21 are provided in the table below.

Report Name	Report Date Sent
OPR-K380-KR-21 Final Project Summary Report.pdf	2021-11-05
OPR-K380-KR-21_ Marine_Species_Awareness_Training_Record.pdf	2021-11-22
OPR-K380-KR-21_Coast Pilot Review Report.pdf	2021-11-30
OPR-K380-KR-21_DAPR.pdf	2022-01-21
H13502_DR.pdf	2022-01-21
OPR-K380-KR-21_20220201.zip (NCEI Sound Speed Data)	2022-02-01
OPR-K380-KR-21 Marine Mammal Sighting Forms.pdf	2022-02-03

Approver Name	Approver Title	Approval Date	Signature
Paul L. Donaldson	Chief Hydrographer	02/07/2022	Paul L Donaldson Digitally signed by: Paul L Donaldson DN: CN = Paul L Donaldson C = US O = Leidos OU = A01410D00000171EA2490940000BA8A Date: 2022.02.07 07:56:50 -05'00'

F. Table of Acronyms

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

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

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