H13505

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

DESCRIPTIVE REPORT

Type of Survey:	Basic Hydrographic Survey
Registry Number:	H13505

LOCALITY

State(s):	Texas
General Locality:	Western Gulf of Mexico
Sub-locality:	15NM SSW from Freeport

2021

CHIEF OF PARTY
Dorena S. Vogel

LIBRARY & ARCHIVES

Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H13505

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:	**15NM SSW from Freeport**
Scale:	**40000**
Dates of Survey:	**09/04/2021 to 10/05/2021**
Instructions Dated:	**05/13/2021**
Project Number:	**OPR-K380-KR-21**
Field Unit:	**Leidos**
Chief of Party:	**Dorena S. Vogel**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Side Scan Sonar**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

Contract: 1305M220DNCNJ0056/TO-0002. Contractor: Leidos, 221 Third Street, Newport, RI 02840 USA. Subcontractors: Divemasters, Inc., 15 Pumpshire Road, Toms River, NJ 08753; OARS, 8705 Shoal Creek Blvd, Suite 109, Austin, TX 78757. Leidos Doc. 22-TR-005. 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 15N.

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.

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Descriptive Report to Accompany Survey H13505

Project: OPR-K380-KR-21

Locality: Western Gulf of Mexico

Sublocality: 15NM SSW from Freeport

Scale: 1:40000

September 2021 - October 2021

Leidos

Chief of Party: Dorena S. Vogel

A. Area Surveyed

H13505 was located 15NM SSW from Freeport, Texas; with southern extents approximately offshore 16.82km continuing to north to approximately 16.17km (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° 47' 57.43" N 95° 29' 48.14" W	28° 35' 18.6" N 95° 13' 38.42" W

Table 1: Survey Limits

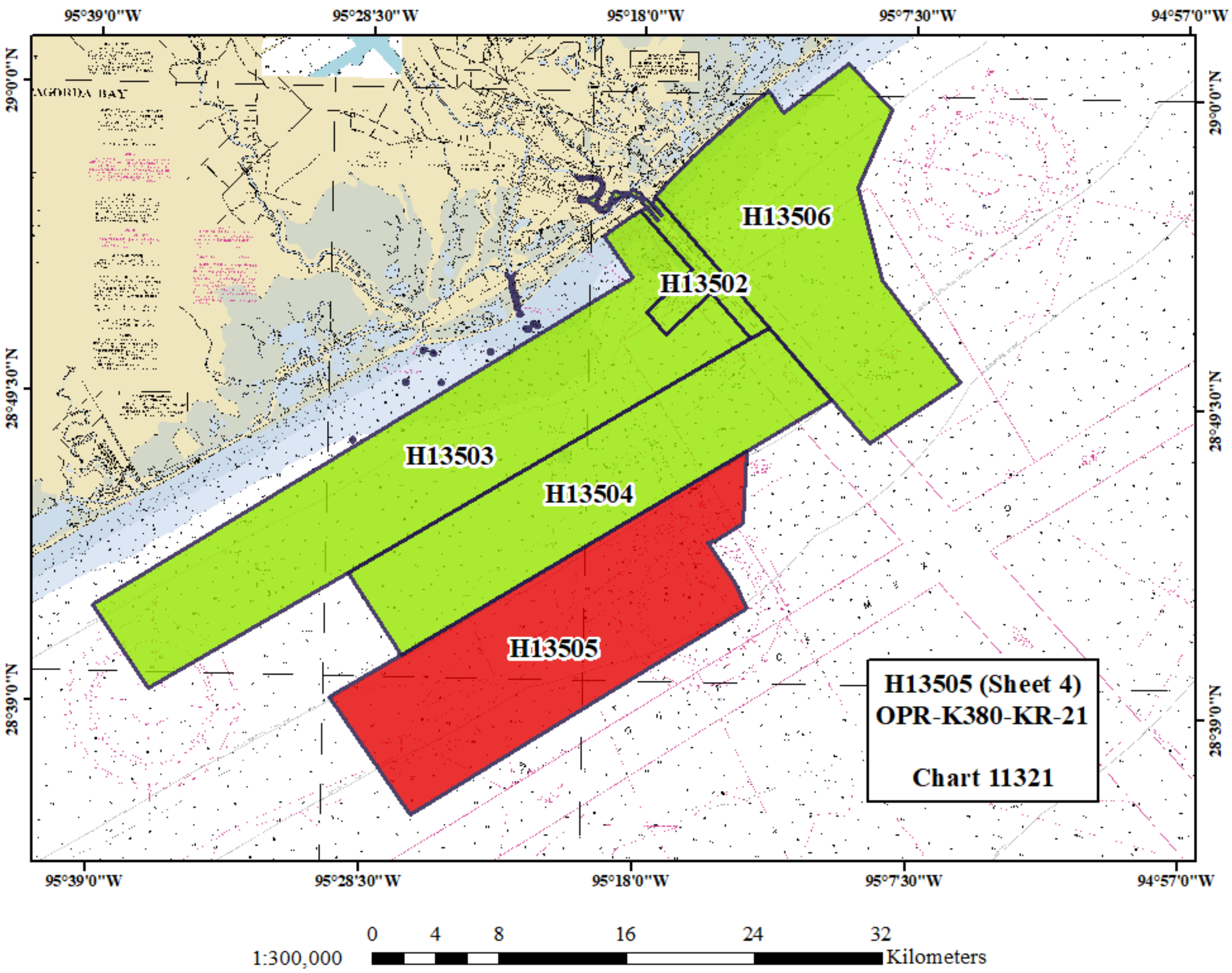

Figure 1: H13505 Survey Bounds

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.

H13505 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 6).

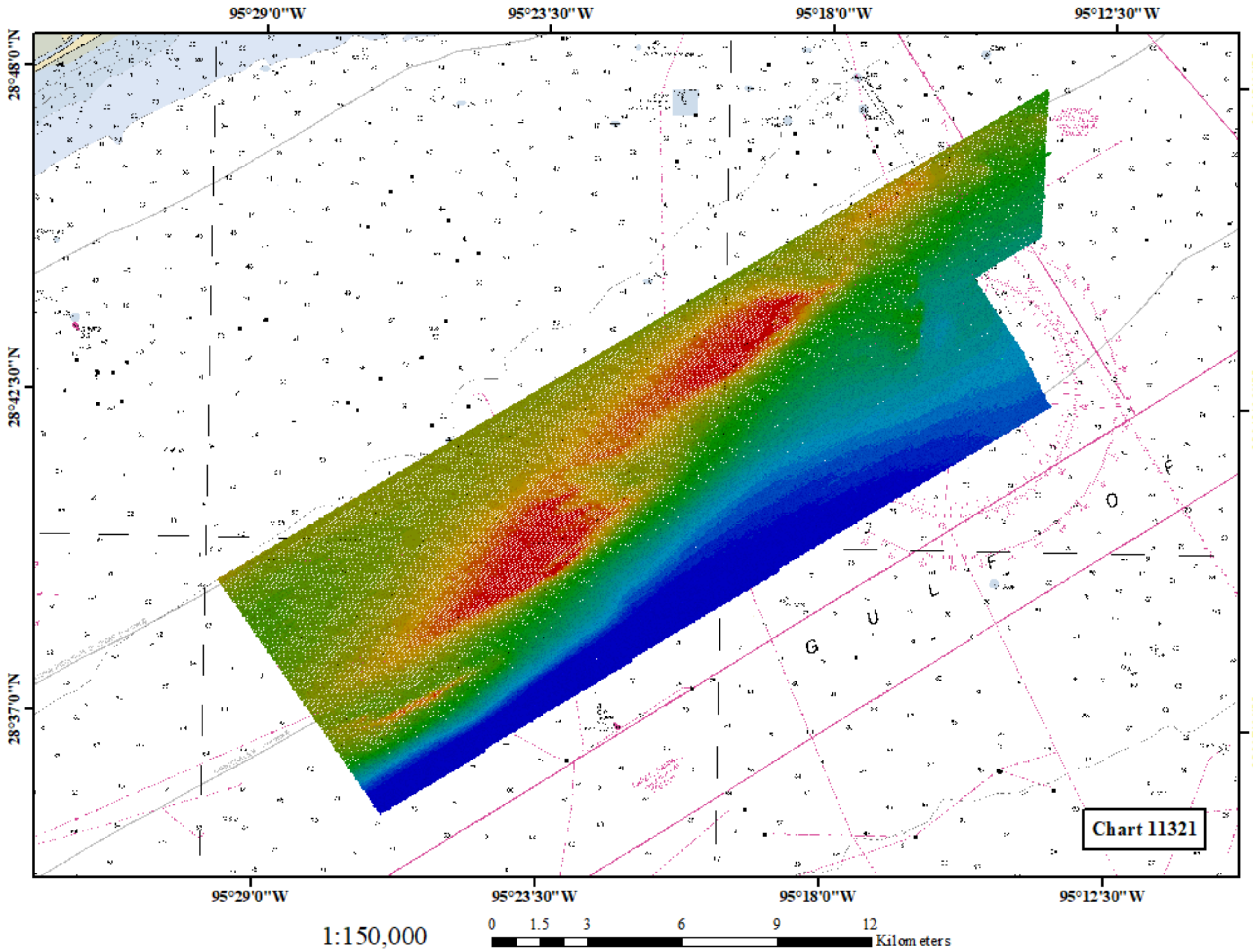

Figure 2: Final Bathymetry Coverage for H13505 (All Depths)

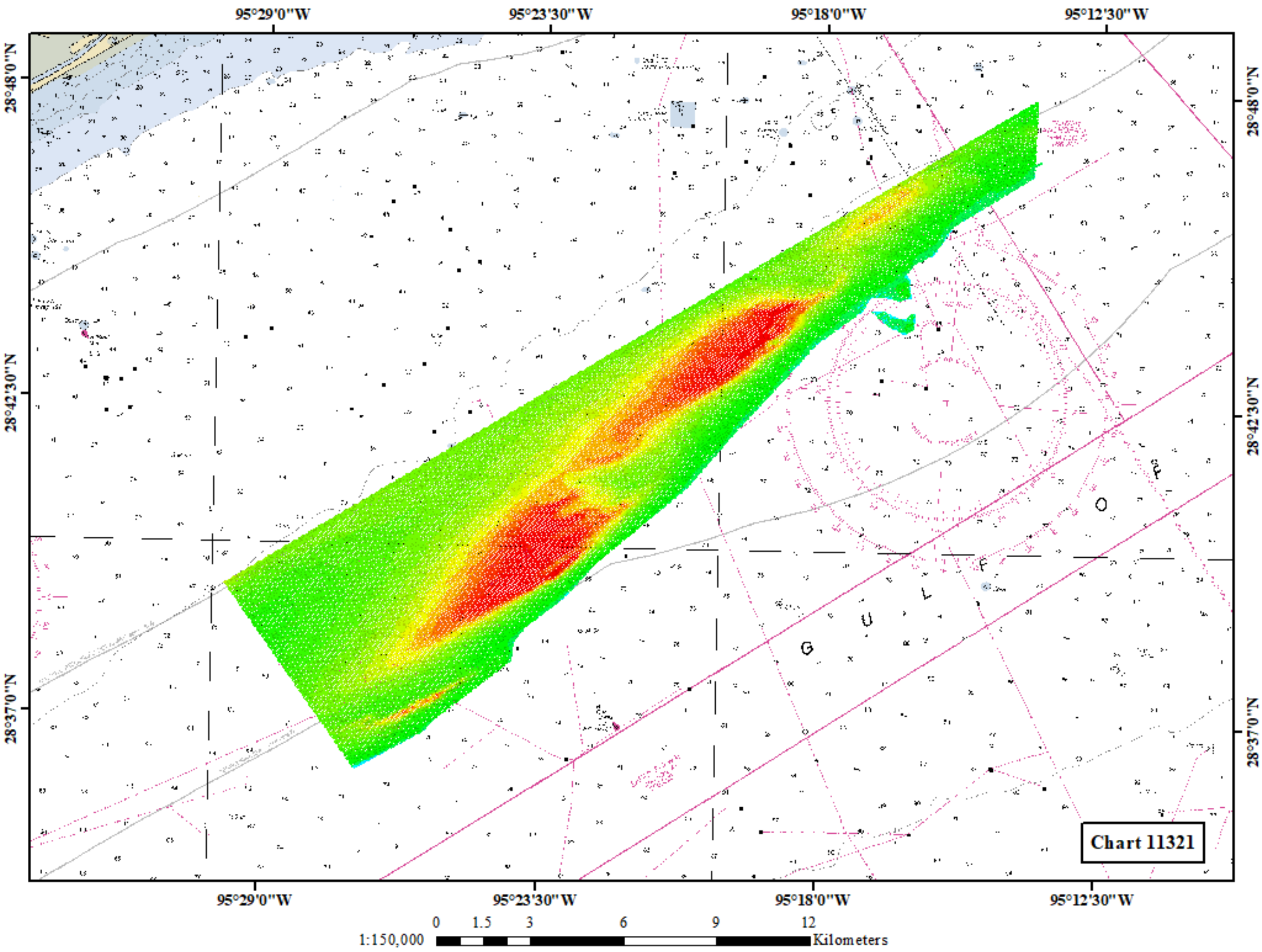

Figure 3: Final Bathymetry coverage for H13505 (1-meter Grid Resolution)

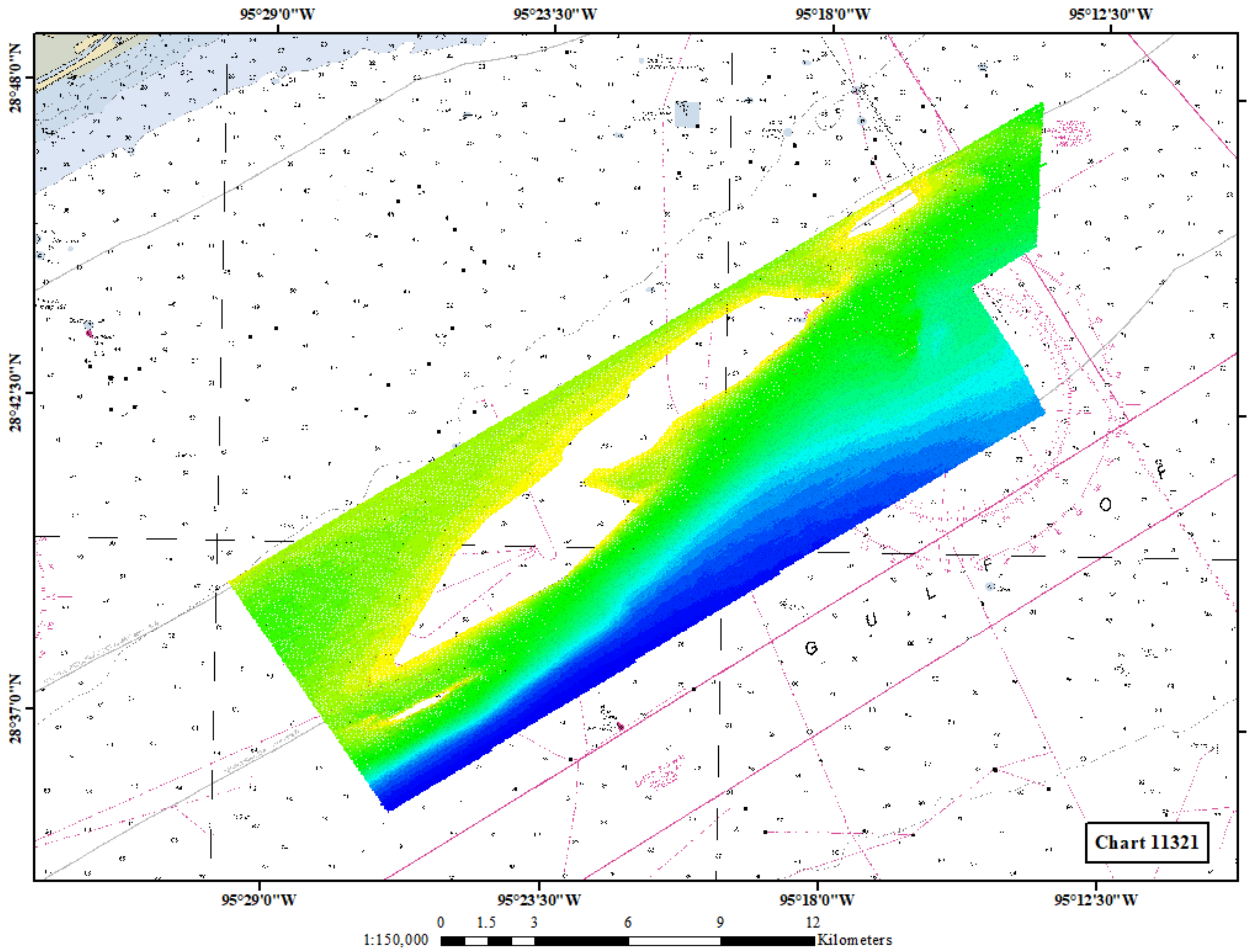

Figure 4: Final Bathymetry coverage for H13505 (2-meter Grid Resolution)

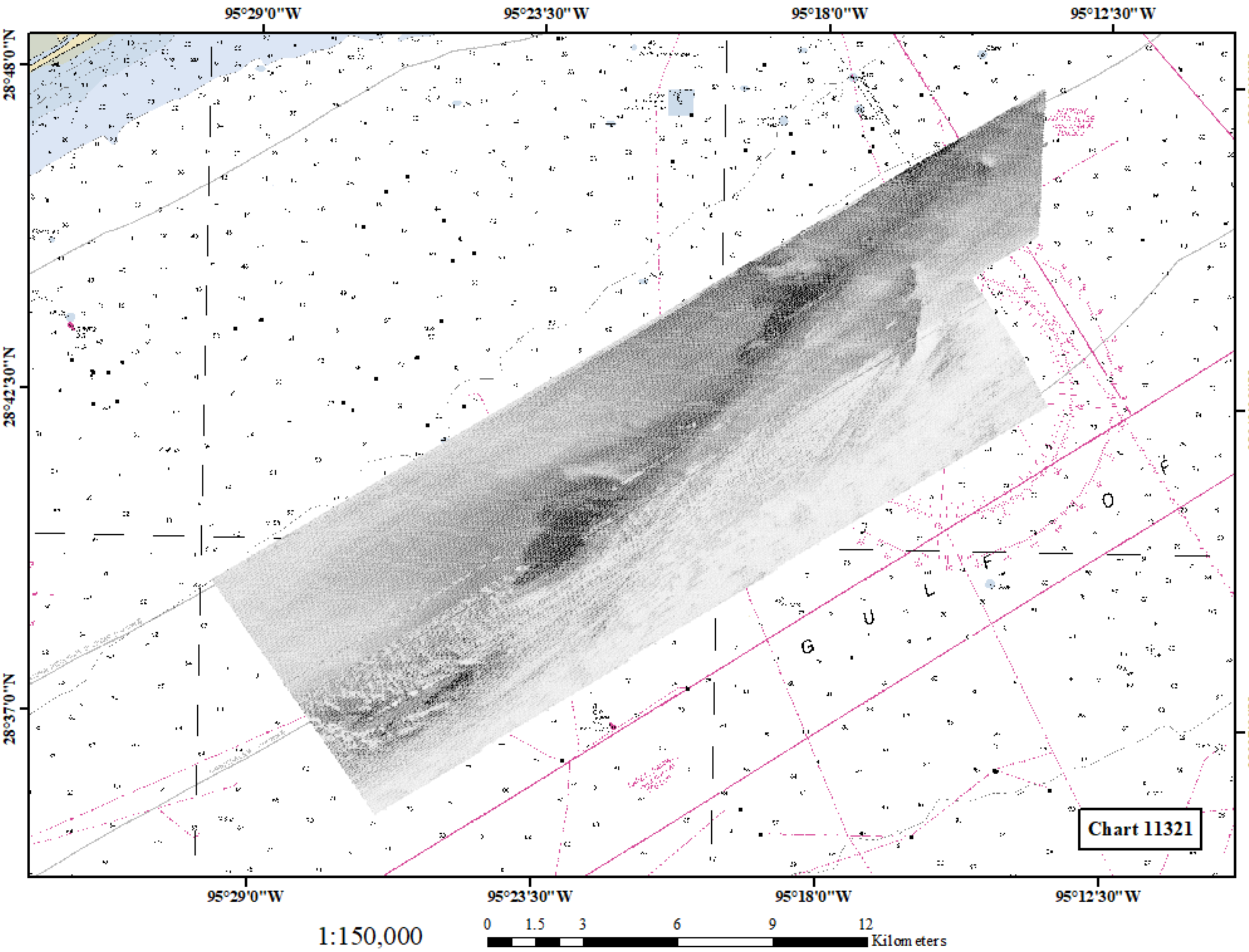

Figure 5: Final Side Scan Coverage for H13505 (First 100% coverage)

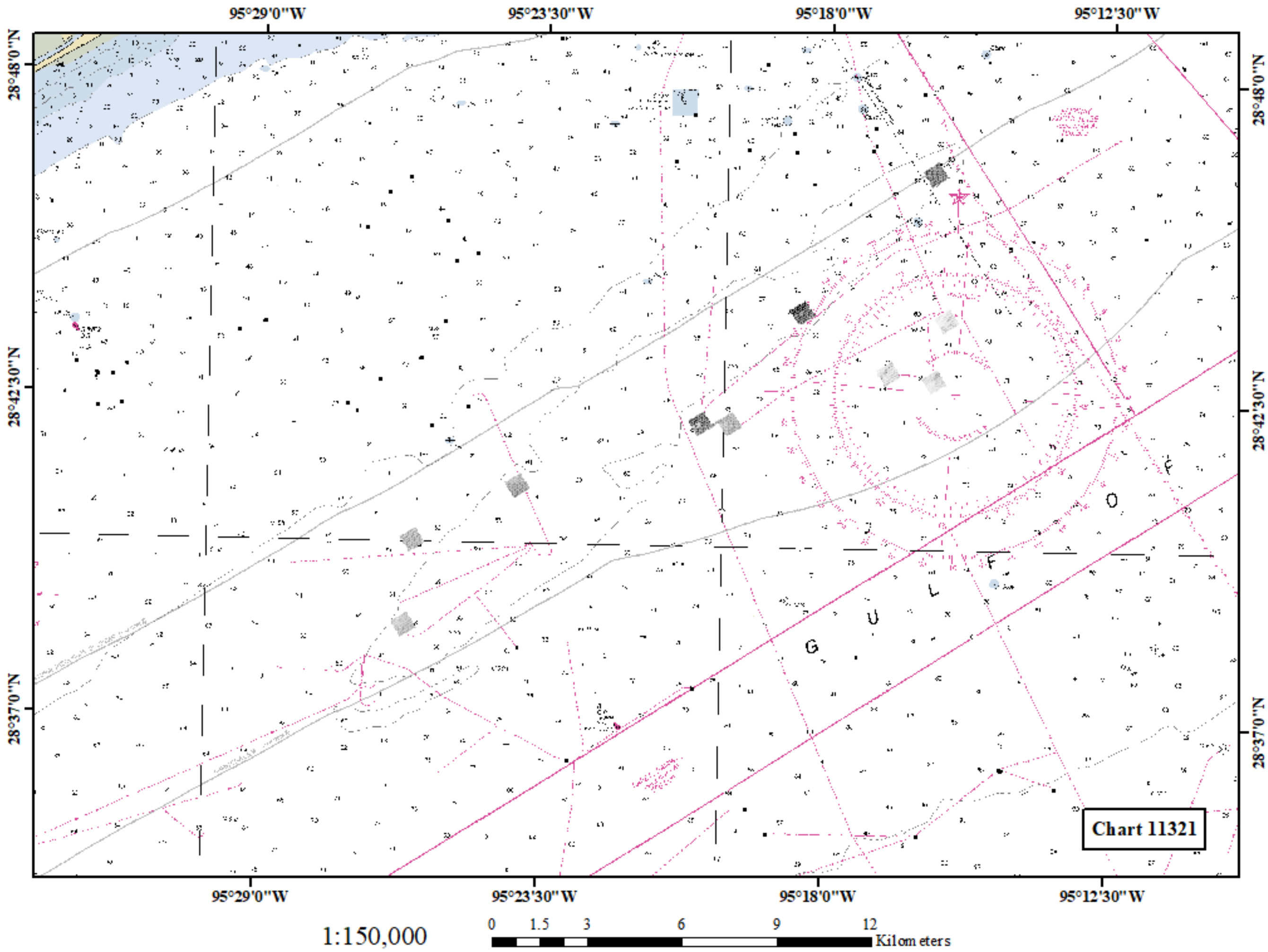

Figure 6: Final Side Scan Coverage for H13505 (Second 100% coverage)

A.6 Survey Statistics

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

	HULL ID	*M/V Atlantic Surveyor*	*Total*
LNM	**SBES Mainscheme**	0	0
	MBES Mainscheme	0	0
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/SSS Mainscheme	0	0
	MBES/SSS Mainscheme	1721.89	1721.89
	SBES/MBES Crosslines	74.46	74.46
	Lidar Crosslines	0	0
Number of Bottom Samples			6
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			69.61

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
09/04/2021	247

Survey Dates	Day of the Year
09/05/2021	248
09/06/2021	249
09/07/2021	250
09/08/2021	251
09/09/2021	252
09/10/2021	253
09/11/2021	254
09/16/2021	259
09/17/2021	260
09/18/2021	261
09/19/2021	262
09/20/2021	263
09/21/2021	264
09/26/2021	269
09/27/2021	270
09/28/2021	271
09/29/2021	272
10/05/2021	278

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***
LOA	110 feet
Draft	9 feet

Table 5: Vessels Used

Figure 7: M/V Atlantic Surveyor

The M/V Atlantic Surveyor (Figure 7) 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.

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
Applanix	POS MV 320 v5	Positioning and Attitude System
AML Oceanographic	MVP30	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 4.32% 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). H13505 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 80 meters apart. Crosslines were generally spaced 2,000 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 H13505 mainscheme CUBE depths from the at 1-meter H13505 crossline CUBE depths.

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 TVU, which for the range of depths observed in the crossline PFM comparison area (15.988 to 23.315 meters) was calculated to be between 0.541 to 0.585 meters. Comparisons of the final crossline data versus final mainscheme data showed that 100.00% of comparisons were within 0.299 meters or less, than the calculated allowable TVU ranges Figure 8). The distribution is well spread about zero for all comparisons as presented in Figure 9.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	127027	23.13	58247	10.61	62605	11.40	6175	1.12
>0.01-0.02	98659	41.09	45243	18.84	53416	21.13		
>0.02-0.03	94073	58.22	40874	26.29	53199	30.81		
>0.03-0.04	73968	71.69	29536	31.66	44432	38.90		
>0.04-0.05	58766	82.39	21366	35.55	37400	45.71		
>0.05-0.06	35954	88.94	12300	37.79	23654	50.02		
>0.06-0.07	23327	93.19	7373	39.14	15954	52.92		
>0.07-0.08	13496	95.64	4020	39.87	9476	54.65		
>0.08-0.09	9891	97.44	2746	40.37	7145	55.95		
>0.09-0.1	6089	98.55	1649	40.67	4440	56.76		
>0.1-0.11	3616	99.21	879	40.83	2737	57.26		
>0.11-0.12	2063	99.59	658	40.95	1405	57.51		
>0.12-0.13	1185	99.80	428	41.03	757	57.65		
>0.13-0.14	513	99.90	142	41.05	371	57.72		
>0.14-0.15	249	99.94	86	41.07	163	57.75		
>0.15-0.16	119	99.96	33	41.07	86	57.76		
>0.16-0.17	72	99.98	21	41.08	51	57.77		
>0.17-0.18	55	99.99	13	41.08	42	57.78		
>0.18-0.19	26	99.99	9	41.08	17	57.78		
>0.19-0.2	18	99.99	5	41.08	13	57.79		
>0.2-0.21	9	99.99	2	41.08	7	57.79		
>0.21-0.22	9	99.99	4	41.08	5	57.79		
>0.22-0.23	4	99.99	2	41.08	2	57.79		
>0.23-0.24	6	99.99	3	41.08	3	57.79		
>0.24-0.25	2	99.99	1	41.09	1	57.79		
>0.25-0.26	2	99.99	1	41.09	1	57.79		
>0.26-0.299	4	100.00	3	41.09	1	57.79		
Total	549202	100.00%	549202	41.09%	317383	57.79%	6175	1.12%
Reference Grid: H13505_MB_1m_cross_5degree_pfm_CUBE_vs_H13505_MB_1m_main_pfm_CUBE.dif								

Figure 8: Tabular Results Crossing Analysis, Crosslines vs. Mainscheme Lines

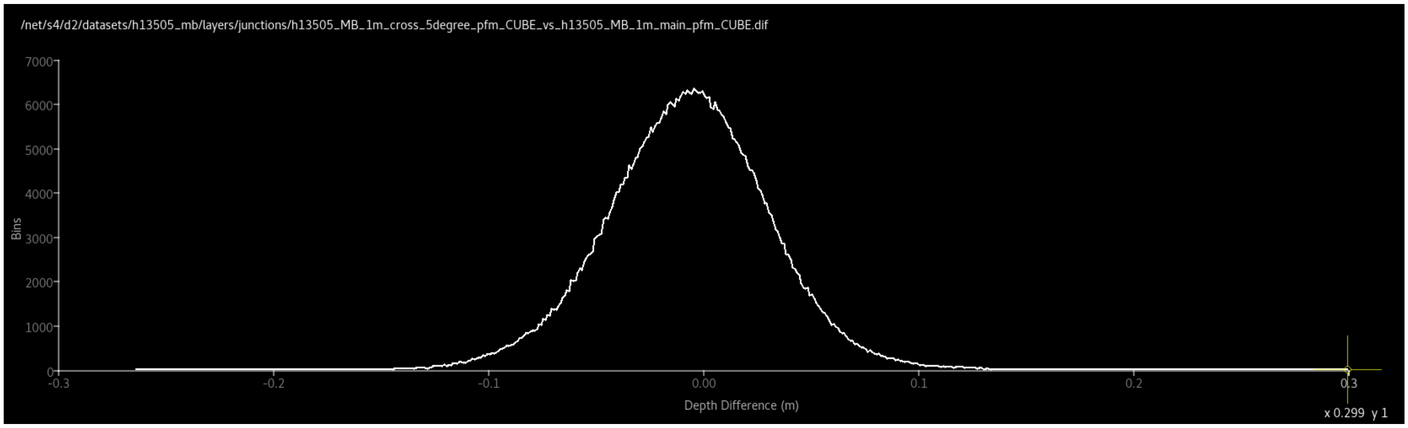

Figure 9: Plot of Crossing Analysis Crosslines vs. Mainscheme Lines

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

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, H13505 depth data fell within two grid resolutions (1-meter and 2-meter).

The final H13505 1-meter PFM CUBE surface contained final vertical uncertainties that ranged from 0.210 meters to 0.444 meters. The IHO Order 1a maximum allowable vertical uncertainty was calculated to range between 0.541 to 0.567 meters, based on the minimum CUBE depth (15.854 meters) and maximum CUBE depth (20.647 meters). There were no nodes with final vertical uncertainties that exceeded IHO Order 1a within the final H13505 1-meter PFM CUBE surface. The SABER Frequency Distribution Tool was also used to review the Hyp. Final Uncertainty surface within the final H13505 1-meter PFM grid. Results showed that 99.99% of all nodes had final uncertainties less than 0.250 meters.

The final H13505 2-meter PFM CUBE surface contained final vertical uncertainties that ranged from 0.210 meters to 0.456 meters. The IHO Order 1a maximum allowable vertical uncertainty was calculated to range between 0.545 to 0.586 meters, based on the minimum CUBE depth (16.652 meters) and maximum CUBE depth (23.473 meters). There were no nodes with final vertical uncertainties that exceeded IHO Order 1a within the final H13505 2-meter PFM CUBE surface. The SABER Frequency Distribution Tool was also used to review the Hyp. Final Uncertainty surface within the final H13505 2-meter PFM grid. Results showed that 99.99% of all nodes had final uncertainties less than 0.270 meters.

B.2.3 Junctions

Per the Project Instructions, junction analysis was performed between H13505 and the surveys listed in the table below and illustrated in Figure 10. Results from the comparison conducted between H13505 to H13504 and H11175 are discussed below.

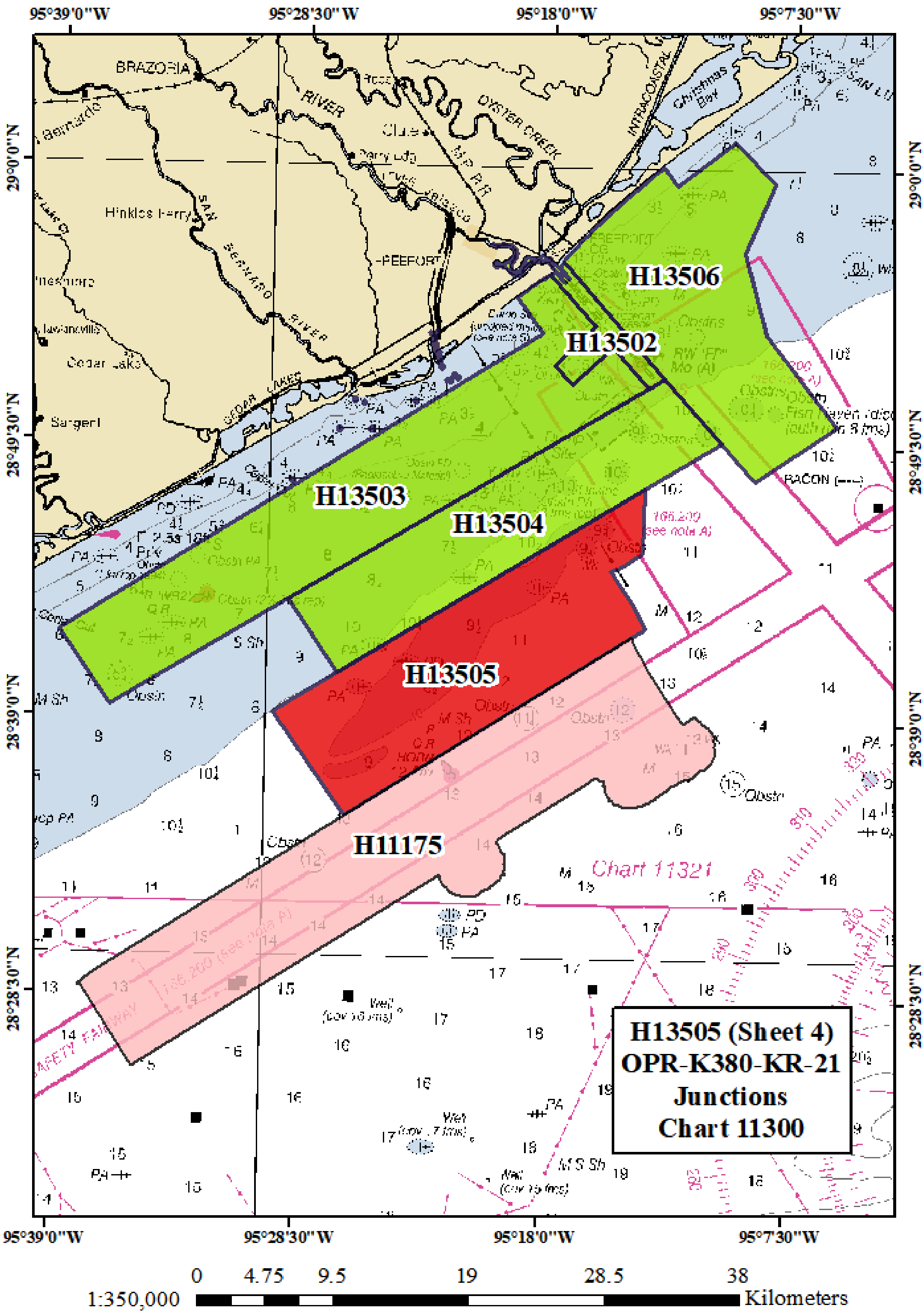

Figure 10: General Locality of H13505 with Junctioning Surveys

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13504	1:10000	2021	Leidos, Inc.	N
H11175	1:40000	2003	C&C Technologies	SE

Table 9: Junctioning Surveys

H13504

Junctioning survey H13504 was conducted in 2021 and junctions to the north of H13505. For this analysis the H13504 Final 1-meter CUBE surface was compared to the H13505 1-meter (all H13505 data) CUBE depth surface. Junction analysis was conducted on the common area of these two sheets, with an overlapping area approximately 150 to 170 meters along the entirety of the northern edge of H13505. Observed depths within the common area were 17.645 to 19.746 meters which resulted in a calculated allowable TVU range of 0.550 to 0.562 meters.

The difference grid was generated by subtracting the H13504 data from the H13505 data. Positive values indicate that H13505 depth data were deeper than H13504 depth data. Throughout the common area, H13505 CUBE depths were deeper than H13504 60.59% of the time and were shoaler than H13504 38.22% of the time (Figure 11). The distribution is well spread about zero for all comparisons as presented in Figure 12.

100.00% of the comparisons were 0.308 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	870339	24.19	441758	12.28	385935	10.73	42646	1.19
>0.01-0.02	654692	42.38	374555	22.69	280137	18.51		
>0.02-0.03	587253	58.70	351009	32.44	236244	25.08		
>0.03-0.04	439868	70.93	275462	40.10	164406	29.65		
>0.04-0.05	352878	80.73	231842	46.54	121036	33.01		
>0.05-0.06	234867	87.26	164027	51.10	70840	34.98		
>0.06-0.07	167649	91.92	123484	54.53	44165	36.20		
>0.07-0.08	104099	94.81	78601	56.71	25498	36.91		
>0.08-0.09	76217	96.93	57931	58.32	18286	37.42		
>0.09-0.1	46597	98.23	35098	59.30	11499	37.74		
>0.1-0.11	26315	98.96	19450	59.84	6865	37.93		
>0.11-0.12	14905	99.37	10854	60.14	4051	38.04		
>0.12-0.13	8984	99.62	6518	60.32	2466	38.11		
>0.13-0.14	5215	99.77	3759	60.43	1456	38.15		
>0.14-0.15	3156	99.85	2275	60.49	881	38.18		
>0.15-0.16	1939	99.91	1413	60.53	526	38.19		
>0.16-0.17	1249	99.94	859	60.55	390	38.20		
>0.17-0.18	792	99.96	536	60.57	256	38.21		
>0.18-0.19	484	99.98	332	60.58	152	38.21		
>0.19-0.2	300	99.99	196	60.58	104	38.22		
>0.2-0.21	189	99.99	112	60.59	77	38.22		
>0.21-0.22	135	99.99	74	60.59	61	38.22		
>0.22-0.23	65	99.99	32	60.59	33	38.22		
>0.23-0.24	41	99.99	21	60.59	20	38.22		
>0.24-0.25	22	99.99	8	60.59	14	38.22		
>0.25-0.26	23	99.99	7	60.59	16	38.22		
>0.26-0.27	19	99.99	7	60.59	12	38.22		
>0.27-0.28	14	99.99	5	60.59	9	38.22		
>0.28-0.29	6	99.99	2	60.59	4	38.22		
>0.29-0.308	7	100.00	1	60.59	6	38.22		
Total	3598319	100.00%	2180228	60.59%	1375445	38.22%	42646	1.19%
Reference Grid: H13505_MB_1m_MLLW_Final_pfm_H13504_MB_1m_MLLW_Final_bag.dif								

Figure 11: Tabular Results Junction Analysis H13505 vs. H13504

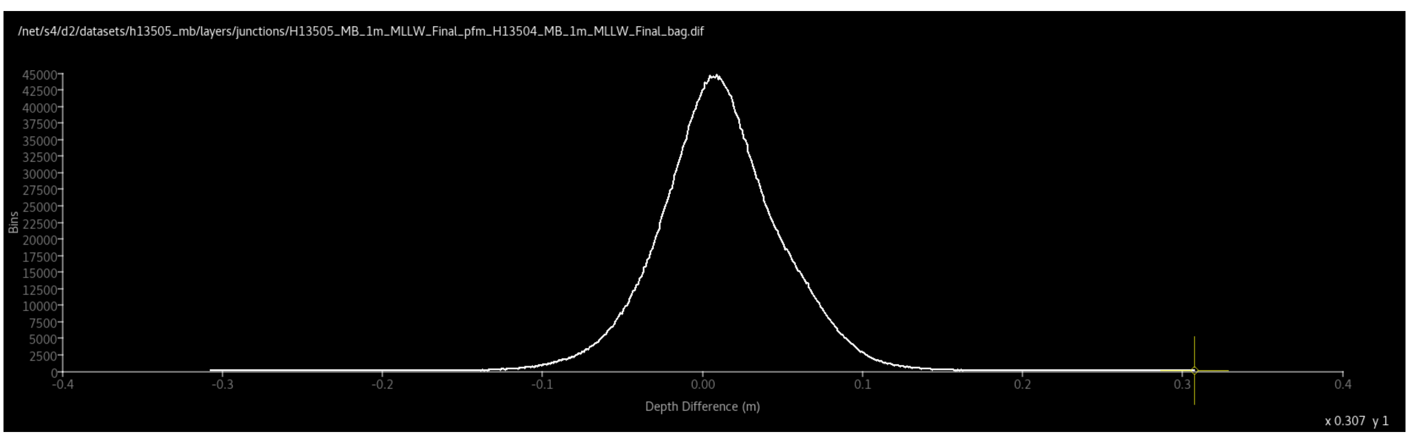

Figure 12: Plot of Junction Analysis H13505 vs. H13504

H11175

Junctioning survey H11175 was conducted in 2003 and junctions to the southeast of H13505. For this analysis the H11175 10-meter average grid surface was compared to the H13505 1-meter CUBE depth surface. Junction analysis was conducted on the common area of these two sheets, with an overlapping area approximately 200 to 250 meters along the entirety of the southeastern edge of H13505. Observed depths within the common area were 21.016 to 23.770 meters which resulted in a calculated allowable TVU range of 0.570 to 0.588 meters.

The difference grid was generated by subtracting the H11175 data from the H13505 data. Positive values indicate that H13505 depth data were deeper than H11175 depth data. Throughout the common area, H13505 CUBE depths were deeper than H11175 11.46% of the time and were shoaler than H11175 88.33% of the time (Figure 13). The distribution is presented in Figure 14.

100.00% of the comparisons were 0.541 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	752	3.56	364	1.72	343	1.62	45	0.21
>0.01-0.02	463	5.75	222	2.77	241	2.76		
>0.02-0.03	589	8.53	240	3.91	349	4.41		
>0.03-0.04	537	11.07	204	4.87	333	5.99		
>0.04-0.05	595	13.88	206	5.84	389	7.83		
>0.05-0.06	486	16.18	153	6.57	333	9.40		
>0.06-0.07	491	18.5	109	7.08	382	11.21		
>0.07-0.08	540	21.06	113	7.62	427	13.23		
>0.08-0.09	620	23.99	188	8.51	432	15.27		
>0.09-0.1	557	26.62	153	9.23	404	17.18		
>0.1-0.11	607	29.49	99	9.70	508	19.58		
>0.11-0.12	601	32.33	122	10.28	479	21.85		
>0.12-0.13	622	35.28	87	10.69	535	24.38		
>0.13-0.14	555	37.90	41	10.88	514	26.81		
>0.14-0.15	534	40.42	53	11.13	481	29.08		
>0.15-0.16	490	42.74	23	11.24	467	31.29		
>0.16-0.17	460	44.92	22	11.34	438	33.36		
>0.17-0.18	477	47.17	15	11.41	462	35.54		
>0.18-0.19	441	49.26	6	11.44	435	37.60		
>0.19-0.2	445	51.36	2	11.45	443	39.70		
>0.2-0.21	421	53.35	1	11.46	420	41.68		
>0.21-0.22	459	55.52	0	11.46	459	43.85		
>0.22-0.23	422	57.52	0	11.46	422	45.85		
>0.23-0.24	423	59.52	0	11.46	423	47.85		
>0.24-0.25	408	61.45	0	11.46	408	49.78		
>0.25-0.26	475	63.69	0	11.46	475	52.02		
>0.26-0.27	470	65.92	0	11.46	470	54.25		
>0.27-0.28	600	68.75	0	11.46	600	57.08		
>0.28-0.29	603	71.60	0	11.46	603	59.93		
>0.29-0.3	710	74.96	0	11.46	710	63.29		
>0.3-0.35	2858	86.91	0	11.46	2858	75.24		
>0.35-0.4	2858	92.59	0	11.46	2858	80.92		
>0.4-0.45	5716	97.83	0	11.46	5716	86.16		
>0.45-0.5	11432	98.97	0	11.46	11432	87.30		
>0.5-0.541	22864	100.00	0	11.46	22864	88.33		
Total	21148	100.00%	2423	11.46%	18680	88.33%	45	0.21%
Reference Grid: H13505_MB_1m_MLLW_Final_pfm_H11175_10m_clf.dif								

Figure 13: Tabular Results Junction Analysis H13505 vs. H11175

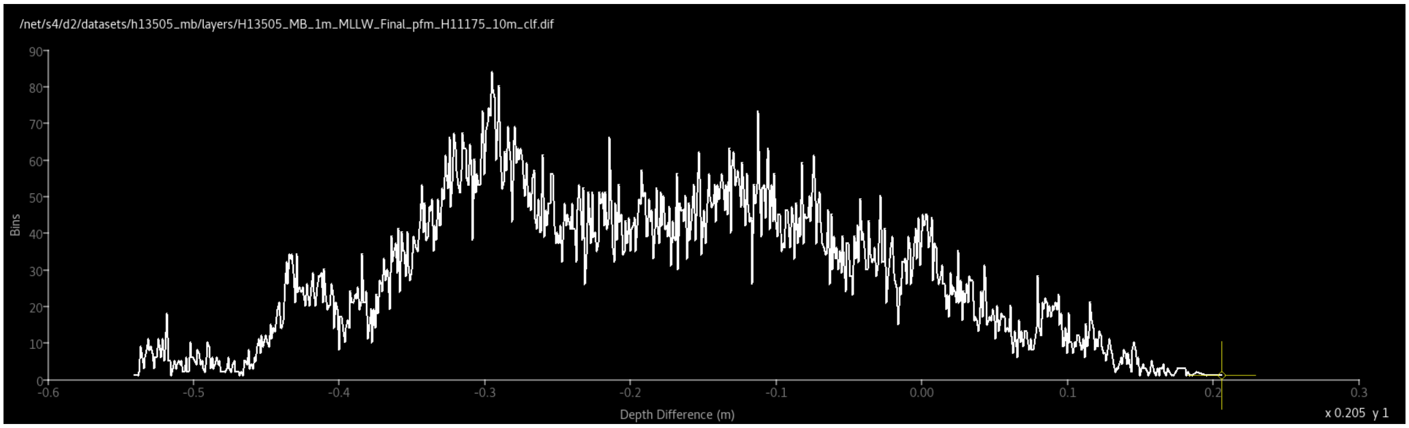

Figure 14: Plot of Junction Analysis H13505 vs. H11175

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 was observed in discrete areas and during various days of survey which required numerous holiday reruns. Additionally, intermittent local weather events produced an increased sea state that occasionally introduced residual motion artifacts that were visible in the data ranging between ±5 to 23 centimeters. These observances did not have any significant impact on the final CUBE surface and the calculated uncertainties remained within IHO Order 1a.

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 sound speed profile (SSP) data, refer to the DAPR for additional details. SSP data were obtained at intervals frequent enough to meet depth accuracy requirements. 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 routinely by comparing at least two consecutive casts taken with different SSP sensors.

All individual SSP files are delivered with the H13505 data and are broken out into sub-folders, which correspond to the purpose of each cast. Also, all individual SSP files for H13505 have been concatenated into two separate files based on the purpose of the cast, provided in CARIS format files (.svp), and delivered under (H13505/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 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 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.

As referenced in Section B.2.2, the depth data for H13505 fell within multiple depth resolution thresholds as defined in the HSSD for Single Resolution Surfaces, Section 5.2.2.3. A final review of the CUBE Depth surface of both the H13505 1-meter PFM and 2-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, beyond the side scan nadir coverage gap, and fully covered with 100% SSS coverage.

The final H13505 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 each of the 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 PFM grid 99.16% of all nodes contained five or more soundings; and within the final 2-meter PFM grid 99.76% of all nodes contained five or more soundings.

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 listed within the OPR-K380-KR-21 DAPR; the DAPR and calibration data were 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
H13505_MB_1m_MLLW_Final	BAG	1 meters	15.854 meters - 20.647 meters	N/A	Complete coverage, Option B (100% side scan sonar coverage with concurrent multibeam)
H13505_MB_2m_MLLW_Final	BAG	2 meters	16.652 meters - 23.473 meters	N/A	Complete coverage, Option B (100% side scan sonar coverage with concurrent multibeam)
H13505_SSSAB_1m_400kHz_1of1	SSS Mosaic (.tif)	1 meters	0 meters - 0 meters	N/A	First 100% SSS
H13505_SSSAB_1m_400kHz_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 grid resolution for depths ranging from 0 meters to 20 meters and 2-meter grid resolution for depths ranging from 18 meters to 40 meters. Leidos generated the CUBE PFM grids for H13505 at 1-meter and 2-meter resolutions. Based on previous guidance from NOAA, the two grid resolution surfaces were built using all data by area; and therefore not restricting the resulting surfaces to be of the single depth bands. This was done to ensure that any feature over-rides were retained between overlapping areas of coverage; as occurred within H13505 data.

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 H13505 1-meter PFM grid were from 15.854 meters (52.290 feet; 0.210 meters Total Vertical Uncertainty [TVU]) to 20.647 meters (67.739 feet; 0.210 meters TVU). The range of CUBE depths of the H13505 2-meter PFM grid were from 16.652 meters (54.632 feet; 0.210 meters TVU) to 23.473 meters (77.011 feet; 0.240 meters TVU).

The final gridded bathymetry data are delivered in Bathymetric Attributed Grid (BAG) format. The BAG files were exported from the CUBE PFM grids 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 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-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. H13505 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 H13505 depth data were generally within ±0.5 meters of charted depths compared to the ENC listed in Section D.1.1.

Charting recommendations for new features and updates to charted features, are documented in the H13505 S-57 FFF. Additional charted objects are discussed in later sections.

United States Coast Guard (USCG) District 5 Local Notice to Mariners (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 35/21 (01 September 2021) until week 05/22 (02 February 2022).

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
US4TX41M	1:80000	21	09/27/2021	01/05/2022

Table 14: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

Figure 15 details the Leidos submitted DTON report for H13505. The DTON report was submitted per HSSD as S-57 format to the Atlantic Hydrographic Branch (AHB). DTON 01 was not forwarded by AHB for immediate charting. Refer to Project Correspondence.

DTON Report Name	Date Submitted to AHB	AHB Submitted to NDB and MCD	NDB Registration	Feature Number(s)
H13505_DTON_01.000	2022-01-21	N/A	N/A	01

Figure 15: DTON Reports

D.1.3 Charted Features

There were numerous assigned charted features in the final CSF (OPR-K380-KR-21_CSF_FINAL_05032021.000) within the SOW of H13505. Per HSSD Section 8.1.4, these charted features are not addressed in this section, refer to the H13505 S-57 FFF (H13505_FFF.000) for all the details and recommendations regarding these features.

D.1.4 Uncharted Features

See the H13505 S-57 FFF for all the details and recommendations regarding new uncharted features investigated.

D.1.5 Channels

There were no assigned channels within the H13505 SOW from the final CSF.

D.2 Additional Results

D.2.1 Aids to Navigation

There were no assigned Aids to Navigation (ATON) within the SOW of H13505 from the final CSF.

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 H13505. Bottom characteristics were acquired at the six locations assigned in the final PRF (OPR-K380-KR-21_PRF.000). 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 H13505/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; one submarine cable and 30 pipelines. None of the assigned submarine features were observed in H13505 to be exposed or unburied. However, within H13505, there were two features Leidos classified as pipelines, due to characteristics and size as seen in SSS data (Features 04 and 05). The two identified pipelines were not seen in the MBES data and not identified as exposed; therefore, they were not submitted as a Non-Dangerous Pipeline Report (HSSD Section 1.7). Features 04 and 05 fell outside of charted pipeline or cable areas. Refer to the H13505 S-57 FFF for details.

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.” No sections of charted cables were observed within the H13505 MBES or SSS data, therefore the CBLSUB are not discussed within the H13505 S-57 FFF.

SSS contacts associated with the submarine features were retained within the H13505 Side Scan Sonar Contact S-57 file (H13505_SSS_Contacts.000).

D.2.6 Platforms

Platforms were assigned from the CSF and are addressed in the H13505 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

During the H13505 period of survey data collection, Tropical Storm Nicholas transited through the H13505 survey area, between 2021-09-13 (JD 256) and 2021-09-14 (JD 257). After the storm event, bathymetric splits, holiday fills, and item investigations were conducted coincident to previously acquired mainscheme data. An example is shown in Figure 16 which depicts mainscheme data acquired on 2021-09-11 (JD 254) and additional item investigation data acquired on 2021-09-27 (JD 270) and 2021-09-28 (JD 271). The resulting item data showed that the seafloor had dynamically changed from the previously acquired data which had been flat (depicted in the image with the red line segment). While the prior data did not impact the CUBE surface, as it no longer reflected the seafloor Leidos invalidated that data such that it no longer contributed to the final CUBE depth. Within Figure 16, the left image shows data with the older data prior to final analysis and the right image shows data as represented in the final CUBE surface. No additional abnormal seafloor or environmental conditions, as defined in Section 8.1.4 of the HSSD, exist within this survey area other than those discussed above and in Section B.2.6.

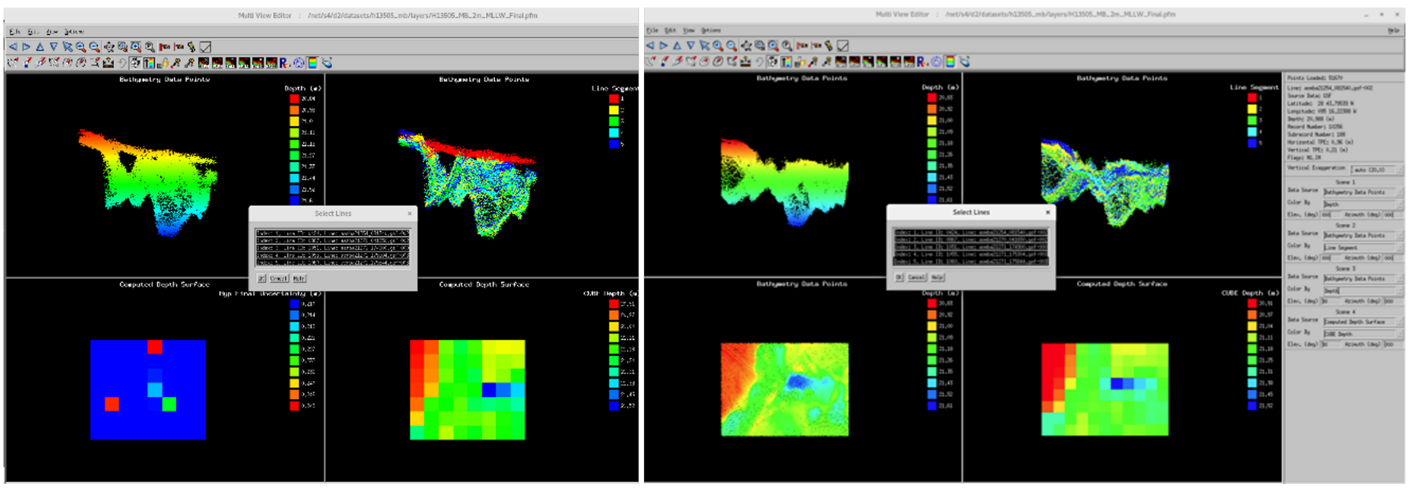

Figure 16: Bathymetric Variability after TS Nicholas JD 254 (red line segment) vs. JD 270 and JD 271 [Left displaying all data prior to final analysis, Right displaying final data]

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 Surveys 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	2021-01-14
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
H13503_DR.pdf	2022-02-07
H13504_DR.pdf	2022-02-07

Approver Name	Approver Title	Approval Date	Signature
Dorena S. Vogel	Lead Hydrographer	02/10/2022	Dorena S Vogel Digitally signed by: Dorena S Vogel DN: CN = Dorena S Vogel C = US O = Leidos OU = A01410C00000176150EC6740000CC8B Date: 2022.02.10 11:46:11 -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