H13819

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13819

LOCALITY

State(s):	Louisiana
General Locality:	Calcasieu, Louisiana
Sub-locality:	14 NM South of Hackberry Beach

2023

CHIEF OF PARTY
Alex T. Bernier

LIBRARY & ARCHIVES

Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H13819

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):	**Louisiana**
General Locality:	**Calcasieu, Louisiana**
Sub-Locality:	**14 NM South of Hackberry Beach**
Scale:	**10000**
Dates of Survey:	**09/12/2023 to 12/08/2023**
Instructions Dated:	**07/13/2023**
Project Number:	**OPR-K356-KR-23**
Field Unit:	**Leidos**
Chief of Party:	**Alex T. Bernier**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Side Scan Sonar Multibeam Echo Sounder Backscatter**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

Contract: 1305M220DNCNJ0056/TO-04. Contractor: Leidos, 221 Third Street, Newport, RI 02840 USA. Subcontractors: OARS, 8705 Shoal Creek Blvd, Suite 109, Austin, TX 78757. Leidos Doc. 24-TR-007. 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 H13819

Project: OPR-K356-KR-23

Locality: Calcasieu, Louisiana

Sublocality: 14 NM South of Hackberry Beach

Scale: 1:10000

September 2023 - December 2023

Leidos

Chief of Party: Alex T. Bernier

A. Area Surveyed

Leidos conducted hydrographic survey H13819, within the assigned area 14 NM South of Hackberry Beach, Louisiana (Figure 1). The survey was conducted in accordance with coverage requirements listed in the Project Instructions (PI) OPR-K356-KR-23 and the Statement of Work. Additionally, the survey data were acquired in accordance with Hydrographic Survey Specifications and Deliverables (HSSD), March 2022.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
29° 35' 47.87" N 93° 14' 3.93" W	29° 23' 24.05" N 92° 59' 46.22" W

Table 1: Survey Limits

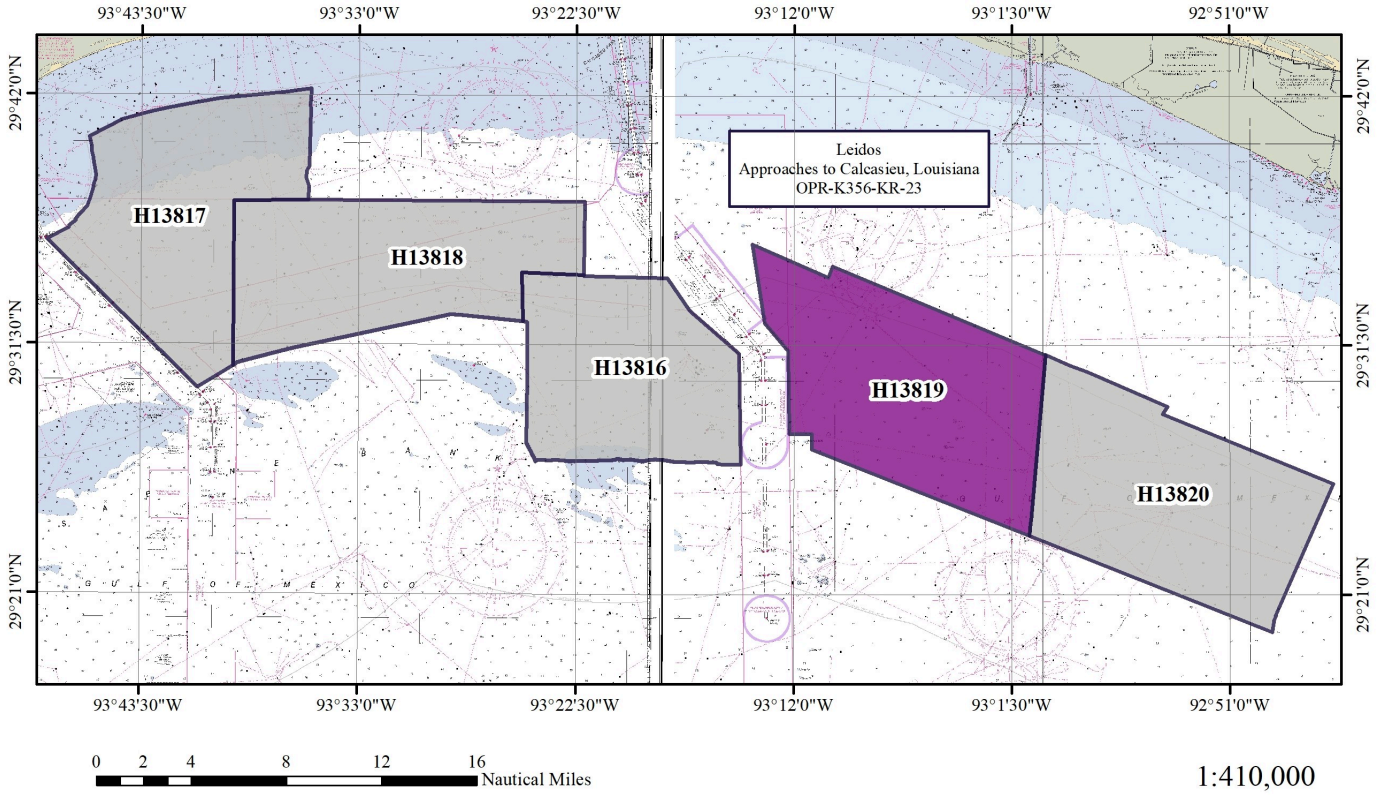

Figure 1: H13819 Survey Bounds

Survey limits were acquired in accordance with the requirements in the PI and the HSSD. The resulting survey limit is shown in Figure 1.

A.2 Survey Purpose

The Survey Purpose as defined in the PI: “The area offshore of Calcasieu Lake and Port Charles, Louisiana have been identified as an area in critical need of updated hydrographic data by NOAA's Hydrographic Health models and the Lake Charles Pilot's Association. The Port of Lake Charles is ranked fourteenth by tonnage for U.S. Ports (1), and the region is expected to see an expansion in marine commerce due in part to an increase in LNG distribution, as well as offshore wind-energy development. Since 2020, the Louisiana Coast has been hit by six hurricanes and two named tropical storms, several of which caused serious damage to the Ports of Lake Charles and Calcasieu. Many parts of the coverage area have not been charted since the 1930s.

This survey will provide contemporary data to update National Ocean Service (NOS) nautical charting products and services, improving the safety of maritime traffic and services available to the Port of Lake Charles by reducing the current risk that is present due to outdated bathymetry. Survey data from this project is intended to supersede all prior survey data in the common area.”

1: Bureau of Transportation Statistics, 2023. https://www.bts.gov/content/tonnage-top-50-us-water-ports-ranked-total-tons

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.

H13819 was surveyed in accordance with the following documents:
1. 1305M223FNCNJ0326 signed.pdf, received 13 July 2023
2. Hydrographic Survey Specifications and Deliverables (HSSD), March 2022
3. NOAA provided Project Reference File (PRF) OPR-K356-KR-23_PRF_FINAL.000, received 13 July 2023
4. NOAA provided Composite Source File (CSF) OPR-K356-KR-23_CSF_FINAL.000, received 13 July 2023
5. OPR-K356-KR-23 Project Brief, held 26 July 2023

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	Complete Coverage (Refer to HSSD Section 5.2.2.3)
All waters in survey area where 75-meter range scale is utilized on the side scan sonar.	Side scan may be acquired at an altitude of 6-20% of the range scale.

Table 2: Survey Coverage

Leidos chose to achieve the coverage requirement using Complete Coverage, Option B (100% side scan sonar coverage with concurrent multibeam) over the entire survey area. Multibeam Backscatter was logged continuously during data acquisition. Feature Disprovals were conducted in accordance with defined disproval radii from the NOAA provided PRF, HSSD, and PI. Per HSSD Section 5.2.2.3, H13819 depth data fell within one resolution surface (1-meter). Refer to the Data Processing and Acquisition Report (DAPR) for additional information; the DAPR was previously delivered with H13817.

Survey coverage achieved was in accordance with the requirements in the PI and the HSSD (Figure 2).

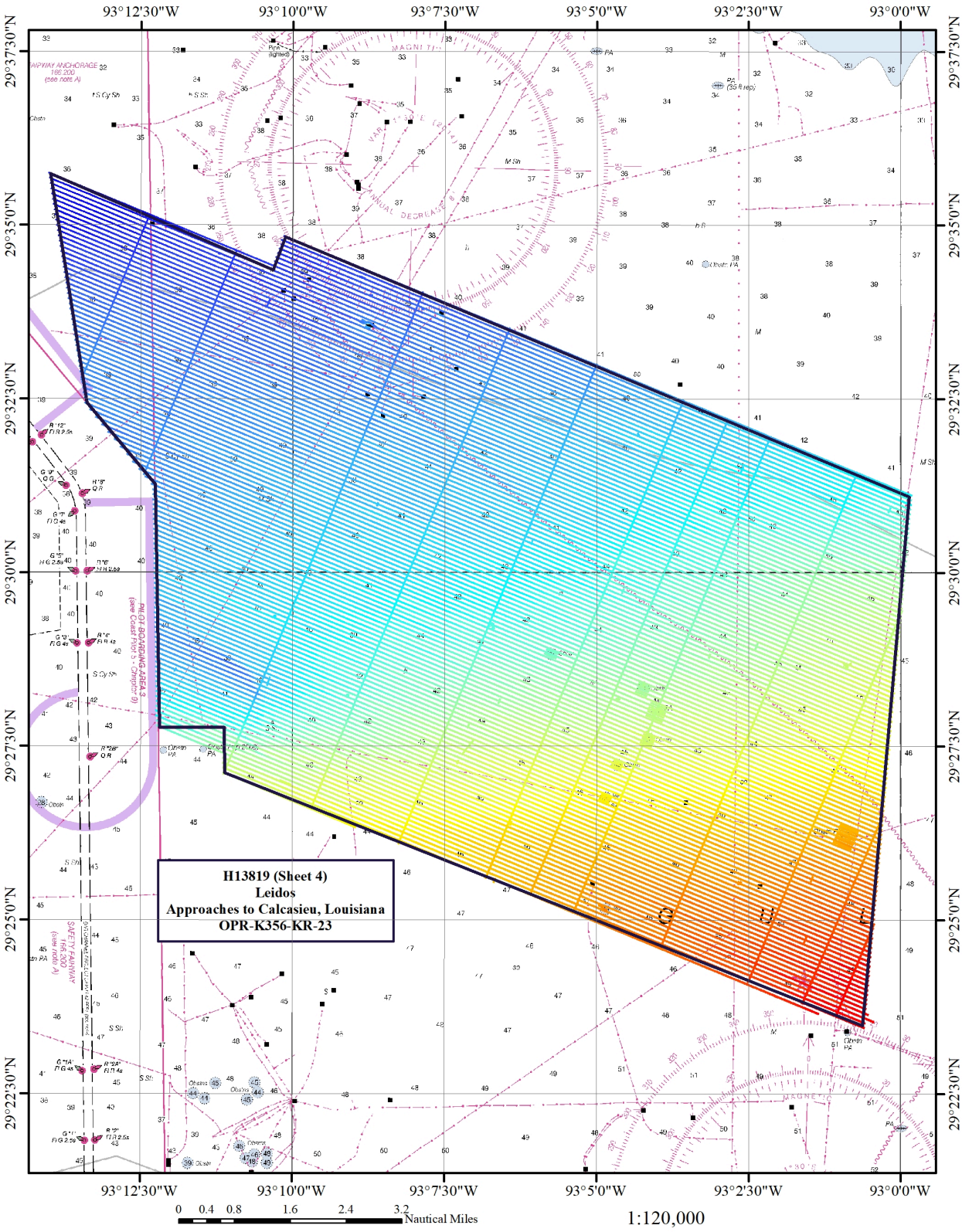

Figure 2: Final Bathymetry Coverage for H13819

A.6 Survey Statistics

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

	HULL ID	*R/V Sea Innovator I*	*Total*
LNM	**SBES Mainscheme**	0.0	0.0
	MBES Mainscheme	0.0	0.0
	Lidar Mainscheme	0.0	0.0
	SSS Mainscheme	0.0	0.0
	SBES/SSS Mainscheme	0.0	0.0
	MBES/SSS Mainscheme	1475.46	1475.46
	SBES/MBES Crosslines	68.65	68.65
	Lidar Crosslines	0.0	0.0
Number of Bottom Samples			3
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			89.0

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
09/12/2023	255
09/13/2023	256
09/14/2023	257
09/15/2023	258
09/16/2023	259
09/17/2023	260
09/18/2023	261
09/19/2023	262
09/20/2023	263
09/21/2023	264
09/22/2023	265
09/23/2023	266
09/24/2023	267
09/25/2023	268
09/26/2023	269
09/27/2023	270
11/18/2023	322
12/03/2023	337
12/04/2023	338
12/05/2023	339
12/06/2023	340
12/08/2023	342

Table 4: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

A detailed description of the systems and vessel used to acquire and process these data is included in the DAPR. There were no variations from the vessel or equipment configuration described in the DAPR.

The Leidos owned and operated R/V Sea Innovator I was utilized as the survey platform. The R/V Sea Innovator I was used to collect multibeam echo sounder (MBES) (RESON SeaBat T50), side scan sonar (SSS) (Klein 4000), and sound speed data during twenty-four hours per day survey operations. As detailed in the DAPR the data acquisition was logged through Leidos ISS-2000 software and Klein SonarPro; side scan sonar (SSS) only. Post processing and review of MBES and SSS data were conducted in Leidos' SABER software.

B.1.1 Vessels

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

Hull ID	***R/V Sea Innovator I***
LOA	135.0 feet
Draft	9.0 feet

Table 5: Vessels Used

Figure 3: R/V Sea Innovator I

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
Teledyne RESON	SeaBat T50-R	MBES Backscatter
Klein Marine Systems	System 4000	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

MBES crosslines acquired 4.65% of H13819 and were distributed spatially and temporally across the sheet and survey duration per HSSD. 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). H13819 requirements were for Complete Coverage, Option B, based on the classifications defined in Section 5.2.2.3 of the HSSD.

Refer to the DAPR, Section D.1.5 for details for Leidos conducting the repeatability analysis of mainscheme and crossline data. Crossline analysis was conducted within SABER, utilizing a 1-meter difference grid between the CUBE depth of mainscheme data and CUBE depth of near nadir cross line data. The SABER Frequency Distribution Tool was used to statistically analyze the difference grid created from the mainscheme and crossline PFM grids; results are summarized in Figure 4.

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]. For H13819, 100% of the comparisons were within TVU for crossing analysis as summarized in Figure 5 and Figure 6.

Crossing Analysis	Minimum and Maximum CUBE Depth (meters) of Crossline Grid	IHO Order 1A Maximum Allowable Uncertainty (meters) for the Range of Depths	Percentage of Depth Differences Within IHO Order 1A Maximum Allowable Uncertainty
MBES 1m Crossline (Class 1) to MBES 1m Mainscheme	12.143 – 15.637	0.524 – 0.540	100.00%

Figure 4: Summary of Crossing Analysis

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	32366	16.74	15277	7.90	15469	8.00	1620	0.84
>0.01-0.02	26535	30.47	13189	14.73	13346	14.91		
>0.02-0.03	27180	44.53	13519	21.72	13661	21.97		
>0.03-0.04	23294	56.58	11488	27.66	11806	28.08		
>0.04-0.05	23456	68.71	9961	32.81	13495	35.06		
>0.05-0.06	17258	77.64	6512	36.18	10746	40.62		
>0.06-0.07	13796	84.78	4867	38.70	8929	45.24		
>0.07-0.08	9253	89.56	2949	40.23	6304	48.50		
>0.08-0.09	7108	93.24	2266	41.40	4842	51.00		
>0.09-0.1	4443	95.54	1309	42.07	3134	52.62		
>0.1-0.11	3260	97.22	1055	42.62	2205	53.77		
>0.11-0.12	2221	98.37	889	43.08	1332	54.45		
>0.12-0.13	1622	99.21	750	43.47	872	54.91		
>0.13-0.14	850	99.65	385	43.67	465	55.15		
>0.14-0.15	400	99.86	177	43.76	223	55.26		
>0.15-0.16	193	99.96	132	43.83	61	55.29		
>0.16-0.17	53	99.99	45	43.85	8	55.3		
>0.17-0.18	18	99.99	14	43.86	4	55.3		
>0.18-0.19	7	99.99	4	43.86	3	55.3		
>0.19-0.197	2	100.00	1	43.86	1	55.30		
Total	**193315**	**100.00%**	**84789**	**43.86%**	**106906**	**55.30%**	**1620**	**0.84%**
Reference Grid: H13819_MB_1m_cross_5degree_pfm_CUBE_vs_H13819_MB_1m_main_pfm_CUBE.dif								

Figure 5: Tabular Results Crossing Analysis, Crosslines vs. Mainscheme Lines

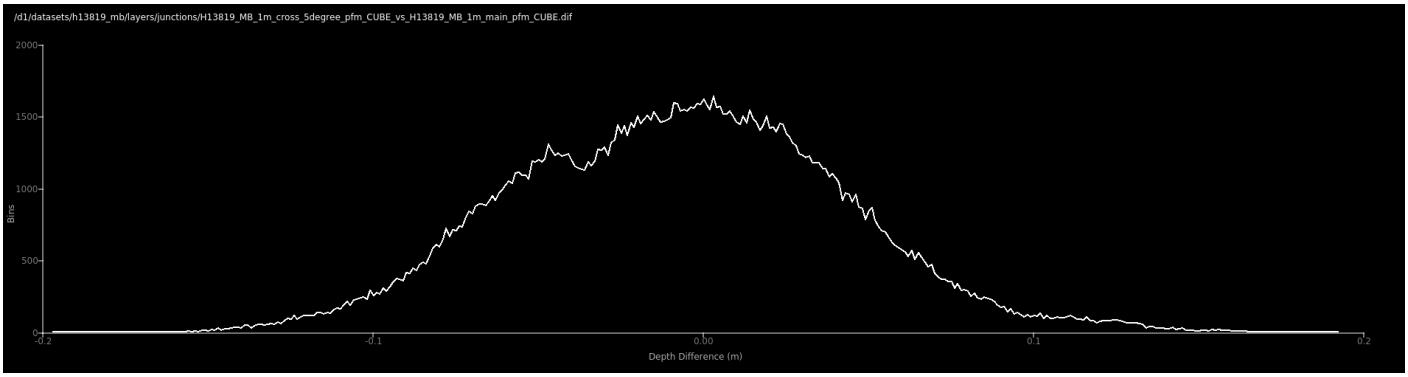

Figure 6: Plot of Crossing Analysis Crosslines vs. Mainscheme Lines

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.012 meters	0.2 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
R/V Sea Innovator I	N/A meters/second	1 meters/second	N/A meters/second	1 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

For specific details on the use and application of the SABER Total Propagated Uncertainty (TPU) model, refer to the DAPR. Once the TPU model was applied to the GSF bathymetry data, each beam was attributed with the horizontal uncertainty and the vertical uncertainty at the 95% Confidence Interval (CI). 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 referenced in the DAPR, Leidos analyses the grid surface several ways to verify that the data meet IHO S-44 6th Edition, Order 1a. The first is to analyze the range of derived uncertainty across the sheet and second is to compare each CUBE depth's allowable uncertainty. The second method utilizes a statistical tool within SABER which outputs a designation if the allowable uncertainty exceeded IHO 6th Ed. Order 1a based on node depth.

The final uncertainty surface contained vertical uncertainties from 0.280 meters to 0.530 meters. The IHO Order 1a maximum allowable vertical uncertainty was calculated to range between 0.521 to 0.545 meters, based on the minimum CUBE depth (11.172 meters) and maximum CUBE depth (16.660 meters). Further analysis was conducted to compute statistical analysis on the vertical uncertainty surface using SABER's Frequency Distribution Tool; results showed that 100% of all nodes had final uncertainties less than or equal to maximum allowable vertical uncertainty of 0.545 meters.

The comparison between the allowable uncertainty to the node depth reported 134 nodes in the final surface which had final vertical uncertainties that exceeded IHO Order 1a allowable vertical uncertainty. All these nodes were associated with a small section of a single survey line which was run twice; an original pass and a second pass to fill a SSS holiday. The depth data from both passes of MBES data agree well and there is no vertical offset or artifact between the files. These 134 nodes were associated with the holiday pass of MBES data, which had slightly elevated TPU values due to the age of the applied SSP profile (amount of time passed since the SSP acquisition time). Refer to the DAPR for information on SABER's application of

the TPU model. There were no SSP artifacts in this location, in the MBES data, or in the SSP profile, and when a new SSP was acquired and applied to the GSF, the resulting TPU values were lowered and there were no significant changes to the resulting MBES depth 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 ellipsoid separation model uncertainty value (ERS via VDATUM) listed in Table 7 was incorrectly populated. The correct value = 0.12 meters.

B.2.3 Junctions

Per the Project Instructions, junction analysis was performed between H13819, and the surveys listed in the Table 9 and illustrated in Figure 7; results are discussed below. Comparison to H13820 will be provided in the H13820 Descriptive Report as final analysis and processing efforts for H13820 remain on-going.

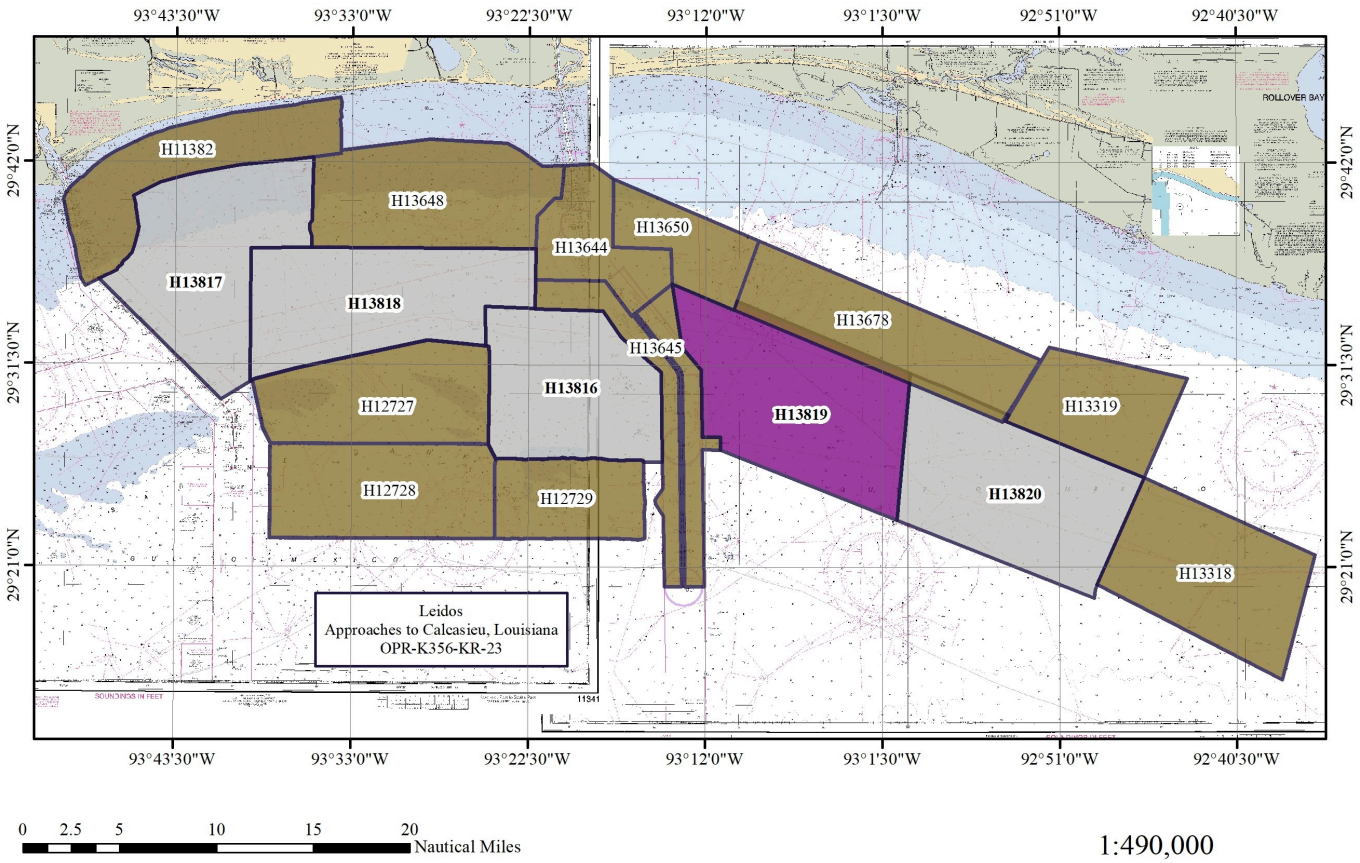

Figure 7: General Locality of H13819 with Junctioning Surveys

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13644	1:10000	2022	DEA	N
H13645	1:10000	2022	DEA	W
H13650	1:20000	2022	DEA	N
H13678	1:20000	2022	DEA	N

Table 9: Junctioning Surveys

H13644

Repeatability analysis was conducted by comparing the H13644 50-centimeter BAG depth surface to the H13819 1-meter BAG depth surface. The overlapping area was approximately 200 by 175 meters. Within the common area, observed depths were 11.569 to 11.886 meters which resulted in a calculated allowable TVU range of 0.522 to 0.523 meters. Results, show in Figure 8 indicate that 100.00% of the comparisons were 0.227 meters or less, within the calculated allowable TVU range. The distribution is skewed positive of zero 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	0	0.00	0	0.00	0	0.00	0	0.00
>0.01-0.02	0	0.00	0	0.00	0	0.00		
>0.02-0.03	0	0.00	0	0.00	0	0.00		
>0.03-0.04	0	0.00	0	0.00	0	0.00		
>0.04-0.05	0	0.00	0	0.00	0	0.00		
>0.05-0.06	0	0.00	0	0.00	0	0.00		
>0.06-0.07	0	0.00	0	0.00	0	0.00		
>0.07-0.08	4	0.04	4	0.04	0	0.00		
>0.08-0.09	70	0.78	70	0.78	0	0.00		
>0.09-0.1	373	4.73	373	4.73	0	0.00		
>0.1-0.11	599	11.08	599	11.08	0	0.00		
>0.11-0.12	410	15.42	410	15.42	0	0.00		
>0.12-0.13	292	18.51	292	18.51	0	0.00		
>0.13-0.14	559	24.43	559	24.43	0	0.00		
>0.14-0.15	1503	40.34	1503	40.34	0	0.00		
>0.15-0.16	2233	63.99	2233	63.99	0	0.00		
>0.16-0.17	2027	85.45	2027	85.45	0	0.00		
>0.17-0.18	1019	96.24	1019	96.24	0	0.00		
>0.18-0.19	246	98.85	246	98.85	0	0.00		
>0.19-0.2	77	99.66	77	99.66	0	0.00		
>0.2-0.21	26	99.94	26	99.94	0	0.00		
>0.21-0.22	5	99.99	5	99.99	0	0.00		
>0.22-0.227	1	100.00	1	100.00	0	0.00		
Total	**9444**	**100.00%**	**9444**	**100.00%**	**0**	**0.00%**	**0**	**0.00%**
Reference Grid: H13819_MB_1m_MLLW_Final_bag_vs_H13644_MB_50cm_MLLW_1of1_bag.dif								

Figure 8: Tabular Results Junction Analysis H13819 vs. H13644

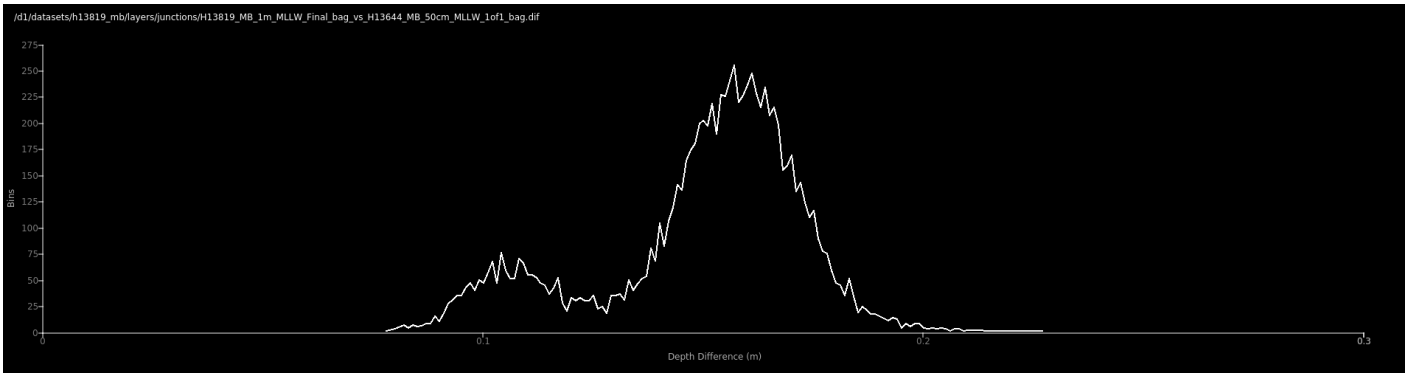

Figure 9: Plot of Junction Analysis H13819 vs. H13644

H13645

The H13645 1-meter BAG file (2of2) had coincident data with H13819. Leidos conducted repeatability analysis by comparing the H13645 1-meter BAG depth surface to the H13819 1-meter BAG depth surface. The overlapping area was approximately 16,500 by 300 meters. Within the common area, observed depths

were 11.521 to 14.065 meters which resulted in a calculated allowable TVU range of 0.522 to 0.532 meters. Results, shown in Figure 10 indicate that 99.08% of the comparisons were 0.250 meters or less, within the calculated allowable TVU range. The distribution is skewed positive of zero as presented in Figure 11.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	6309	0.44	4987	0.35	1103	0.08	219	0.02
>0.01-0.02	13715	1.39	13259	1.27	456	0.11		
>0.02-0.03	24117	3.06	24023	2.93	94	0.11		
>0.03-0.04	26461	4.90	26445	4.77	16	0.12		
>0.04-0.05	29458	6.95	29455	6.82	3	0.12		
>0.05-0.06	22852	8.53	22850	8.40	2	0.12		
>0.06-0.07	24827	10.26	24824	10.12	3	0.12		
>0.07-0.08	28996	12.27	28995	12.14	1	0.12		
>0.08-0.09	36810	14.83	36808	14.69	2	0.12		
>0.09-0.1	42920	17.80	42918	17.67	2	0.12		
>0.1-0.11	56527	21.73	56527	21.6	0	0.12		
>0.11-0.12	74576	26.91	74576	26.77	0	0.12		
>0.12-0.13	88198	33.03	88198	32.90	0	0.12		
>0.13-0.14	99037	39.90	99037	39.77	0	0.12		
>0.14-0.15	107260	47.35	107260	47.22	0	0.12		
>0.15-0.16	106928	54.77	106928	54.64	0	0.12		
>0.16-0.17	101829	61.84	101829	61.71	0	0.12		
>0.17-0.18	108982	69.41	108982	69.28	0	0.12		
>0.18-0.19	96477	76.11	96477	75.98	0	0.12		
>0.19-0.2	89625	82.33	89625	82.20	0	0.12		
>0.2-0.21	79686	87.86	79686	87.73	0	0.12		
>0.21-0.22	64534	92.34	64534	92.21	0	0.12		
>0.22-0.23	47624	95.65	47624	95.52	0	0.12		
>0.23-0.24	31254	97.82	31254	97.69	0	0.12		
>0.24-0.25	18122	99.08	18122	98.94	0	0.12		
>0.25-0.63	13308	99.99	13308	99.87	0	0.12		
>0.63-0.635	1	100.00	1	99.87	0	0.12		
Total	**1440433**	**100.00%**	**1438532**	**99.87%**	**1682**	**0.12%**	**219**	**0.02%**
Reference Grid: H13819_MB_1m_MLLW_Final_bag_vs_H13645_MB_1m_MLLW_2of2_bag.dif								

Figure 10: Tabular Results Junction Analysis H13819 vs. H13645

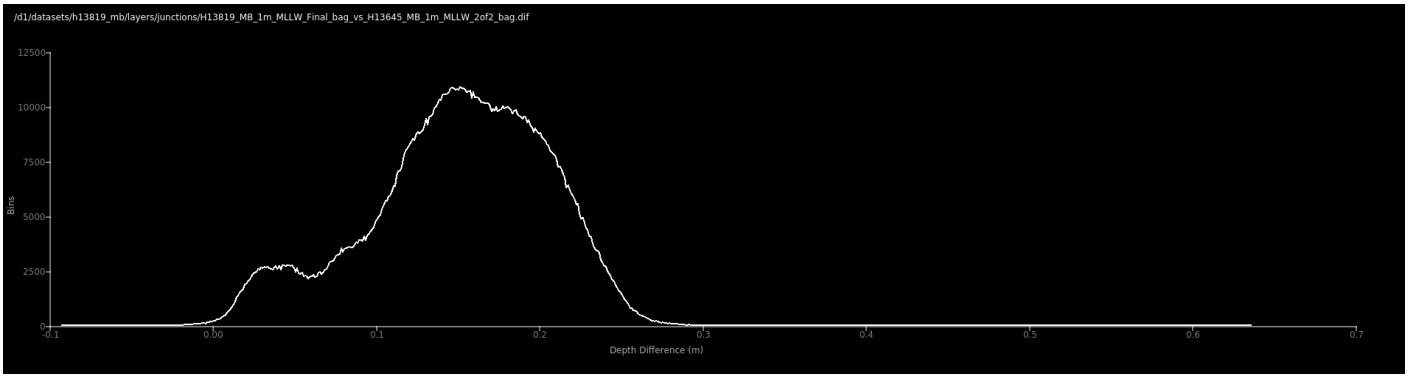

Figure 11: Plot of Junction Analysis H13819 vs. H13645

H13650

Repeatability analysis was conducted by comparing the H13650 1-meter BAG depth surface to the H13819 1-meter BAG depth surface. The overlapping area was approximately 7,500 by 150 meters. Within the common area, observed depths were 11.464 to 12.566 meters which resulted in a calculated allowable TVU range of 0.522 to 0.526 meters. Results, shown in Figure 12 indicate that 100.00% of the comparisons were 0.417 meters or less, within the calculated allowable TVU range. The distribution is skewed positive of zero as presented in Figure 13.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	85	0.02	47	0.01	36	0.01	2	0.00
>0.01-0.02	61	0.03	35	0.01	26	0.01		
>0.02-0.03	90	0.04	67	0.03	23	0.02		
>0.03-0.04	109	0.06	92	0.04	17	0.02		
>0.04-0.05	329	0.12	320	0.10	9	0.02		
>0.05-0.06	1005	0.31	1002	0.28	3	0.02		
>0.06-0.07	3306	0.91	3302	0.89	4	0.02		
>0.07-0.08	8318	2.42	8315	2.40	3	0.02		
>0.08-0.09	21042	6.25	21039	6.23	3	0.02		
>0.09-0.1	41398	13.79	41397	13.76	1	0.02		
>0.1-0.11	60163	24.74	60160	24.71	3	0.02		
>0.11-0.12	66012	36.75	66011	36.73	1	0.02		
>0.12-0.13	65354	48.65	65354	48.63	0	0.02		
>0.13-0.14	62902	60.10	62902	60.08	0	0.02		
>0.14-0.15	55013	70.11	55013	70.09	0	0.02		
>0.15-0.16	45580	78.41	45580	78.39	0	0.02		
>0.16-0.17	38101	85.35	38101	85.32	0	0.02		
>0.17-0.18	31761	91.13	31761	91.10	0	0.02		
>0.18-0.19	18854	94.56	18854	94.53	0	0.02		
>0.19-0.2	11088	96.58	11088	96.55	0	0.02		
>0.2-0.21	6462	97.75	6462	97.73	0	0.02		
>0.21-0.22	4441	98.56	4441	98.54	0	0.02		
>0.22-0.23	3159	99.14	3159	99.11	0	0.02		
>0.23-0.24	1944	99.49	1944	99.47	0	0.02		
>0.24-0.25	1327	99.73	1327	99.71	0	0.02		
>0.25-0.26	769	99.87	769	99.85	0	0.02		
>0.26-0.27	404	99.95	404	99.92	0	0.02		
>0.27-0.28	169	99.98	169	99.95	0	0.02		
>0.28-0.29	63	99.99	63	99.96	0	0.02		
>0.29-0.41	66	99.99	66	99.98	0	0.02		
>0.41-0.417	1	100.00	1	99.98	0	0.02		
Total	**549376**	**100.00%**	**549245**	**99.98%**	**129**	**0.02%**	**2**	**0.00%**
Reference Grid: H13819_MB_1m_MLLW_Final_bag_vs_H13650_MB_1m_MLLW_1of1_bag.dif								

Figure 12: Tabular Results Junction Analysis H13819 vs. H13650

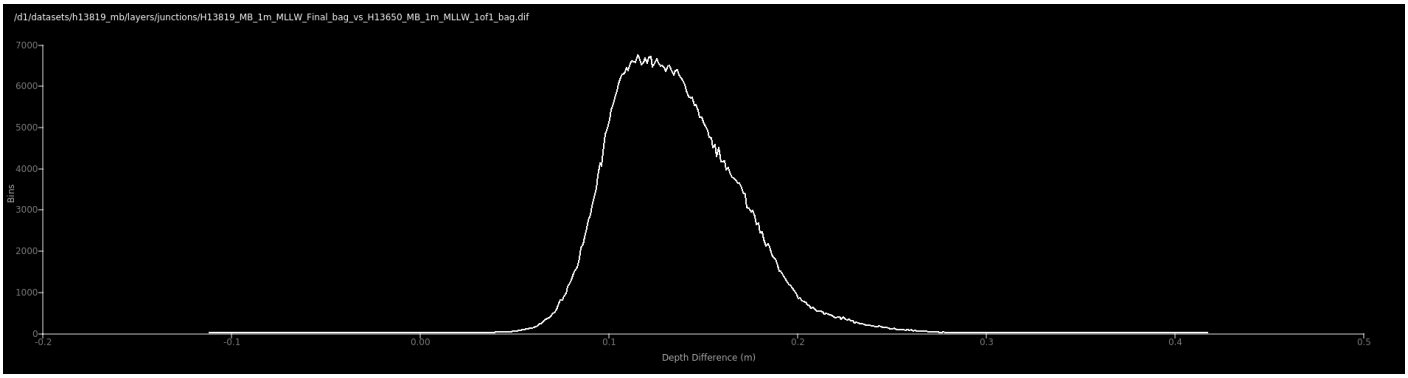

Figure 13: Plot of Junction Analysis H13819 vs. H13650

H13678

Repeatability analysis was conducted by comparing the H13678 1-meter BAG depth surface to the H13819 1-meter BAG depth surface. The overlapping area was approximately 18,100 by 150 meters. Within the common area, observed depths were 12.012 to 14.370 meters which resulted in a calculated allowable TVU range of 0.524 to 0.534 meters. Results, show in Figure 14 indicate that 100.00% of the comparisons were 0.421 meters or less, within the calculated allowable TVU range. The distribution is skewed positive of zero as presented in Figure 15.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	5700	0.69	3729	0.45	1706	0.21	265	0.03
>0.01-0.02	5861	1.40	5038	1.06	823	0.31		
>0.02-0.03	7995	2.37	7590	1.98	405	0.36		
>0.03-0.04	9295	3.50	9123	3.09	172	0.38		
>0.04-0.05	12005	4.95	11924	4.53	81	0.39		
>0.05-0.06	13200	6.55	13171	6.13	29	0.39		
>0.06-0.07	17177	8.64	17161	8.21	16	0.39		
>0.07-0.08	19489	11.00	19479	10.57	10	0.39		
>0.08-0.09	25963	14.15	25949	13.72	14	0.39		
>0.09-0.1	29203	17.69	29193	17.26	10	0.40		
>0.1-0.11	35687	22.01	35681	21.58	6	0.40		
>0.11-0.12	45577	27.54	45573	27.11	4	0.40		
>0.12-0.13	56691	34.41	56690	33.98	1	0.40		
>0.13-0.14	67785	42.63	67785	42.20	0	0.40		
>0.14-0.15	75388	51.77	75388	51.34	0	0.40		
>0.15-0.16	77660	61.18	77660	60.75	0	0.40		
>0.16-0.17	77675	70.60	77675	70.17	0	0.40		
>0.17-0.18	76776	79.90	76776	79.47	0	0.40		
>0.18-0.19	56256	86.72	56256	86.29	0	0.40		
>0.19-0.2	42682	91.90	42682	91.47	0	0.40		
>0.2-0.21	28462	95.35	28462	94.92	0	0.40		
>0.21-0.22	17606	97.48	17606	97.05	0	0.40		
>0.22-0.23	8483	98.51	8483	98.08	0	0.40		
>0.23-0.24	4318	99.03	4318	98.60	0	0.40		
>0.24-0.25	2179	99.30	2179	98.87	0	0.40		
>0.25-0.26	1146	99.44	1146	99.01	0	0.40		
>0.26-0.27	696	99.52	696	99.09	0	0.40		
>0.27-0.28	572	99.59	572	99.16	0	0.40		
>0.28-0.29	625	99.67	625	99.24	0	0.40		
>0.29-0.3	691	99.75	691	99.32	0	0.40		
>0.3-0.31	644	99.83	644	99.40	0	0.40		
>0.31-0.32	566	99.90	566	99.47	0	0.40		
>0.32-0.33	397	99.94	397	99.51	0	0.40		
>0.33-0.34	209	99.97	209	99.54	0	0.40		
>0.34-0.35	99	99.98	99	99.55	0	0.40		
>0.35-0.42	153	99.99	153	99.57	0	0.40		
>0.42-0.421	1	100.00	1	99.57	0	0.40		
Total	**824912**	**100.00%**	**821370**	**99.57%**	**3277**	**0.40%**	**265**	**0.03%**
Reference Grid: H13819_MB_1m_MLLW_Final_bag_vs_H13678_MB_1m_MLLW_1of1_bag.dif								

Figure 14: Tabular Results Junction Analysis H13819 vs. H13678

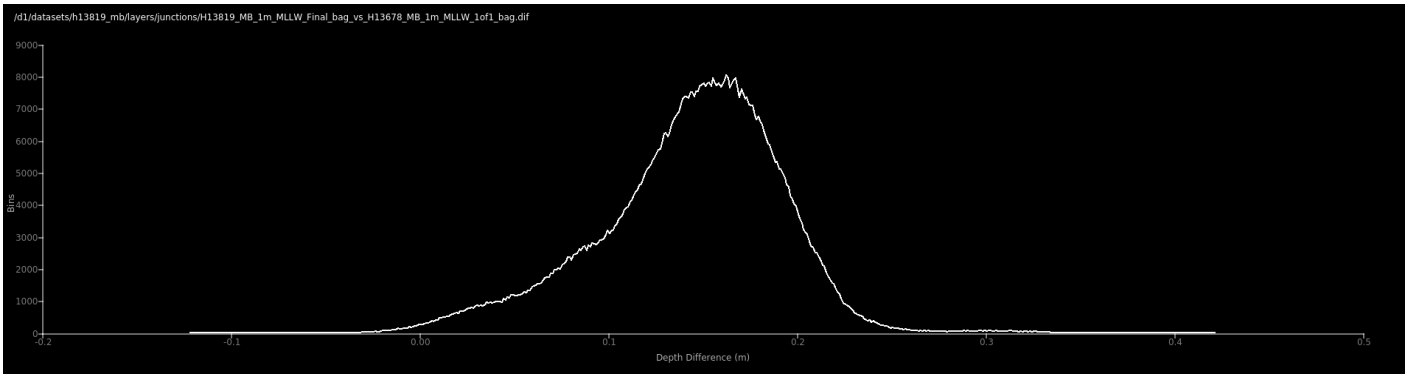

Figure 15: Plot of Junction Analysis H13819 vs. H13678

B.2.4 Sonar QC Checks

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

B.2.5 Equipment Effectiveness

RESON SeaBat T50-R

As discussed in the DAPR the RESON SeaBat T50-R exhibited degradation during OPR-K356-KR-23 and was replaced. Data acquisition was able to continue until the unit was swapped as data quality was not impacted and data acquired were validated. Refer to the DAPR for when the RESON SeaBat T50-R transducer was replaced.

B.2.6 Factors Affecting Soundings

Biological Interference

Dense biological interference were observed during discrete areas and during various days of survey which required numerous holiday reruns. There were no significant impacts to the final sounding data.

B.2.7 Sound Speed Methods

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

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

All individual SSP files are delivered with the H13819 data and are broken out into sub-folders, which correspond to the purpose of each cast. Also, all individual SSP files for H13819 have been concatenated into two separate files based on the purpose of the cast, provided in CARIS format files (.svp), and delivered under (H13819/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 will be provided as a separate delivery to NCEI.

B.2.8 Coverage Equipment and Methods

All equipment and survey methods are detailed in the DAPR.

For H13819, Leidos chose to achieve the complete coverage requirement using Complete Coverage, Option B (100% side scan sonar coverage with concurrent multibeam). To achieve this coverage the SSS was set to 75-meter range scale. Per the PI, if an OFSPLF was not present during data acquisition a formal disproval did not need to be conducted.

Leidos utilized SABER's Gapchecker program to flag MBES data gaps within the final CUBE surface as well as within the SSS mosaics. Surfaces were also visually scanned for holidays throughout the data processing effort. During data acquisition, additional lines were run to fill 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.

A final review of the CUBE depth surface showed that there were no holidays as defined for Complete Coverage surveys in HSSD Section 5.2.2.3. 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.

For all details regarding SSS data processing, see the DAPR. Leidos generated two separate coverage mosaics at 1-meter cell size resolution as specified in HSSD Section 8.2.1. 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 any 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. The first 100% coverage mosaic contains one instance of a small across swath coverage gap, which was completely covered by 100% MBES data during holiday line acquisition and in the final CUBE depth surface. All coverage mosaics are determined to be complete and sufficient to meet the requirements

contained within the PI and HSSD. Each 100 percent coverage mosaic is delivered as a georeferenced raster file(s) (datum of NAD-83) in floating point GeoTIFF format, as specified in Sections 8.2.1 and 8.3.3 in the HSSD.

B.2.9 Multibeam Sounding Density

The Frequency Distribution Tool was used to analyze the number of soundings which contributed to the chosen CUBE hypothesis; to verify HSSD Section 5.2.2.3 for 95% of nodes to be populated with at least 5 soundings. Within the final 1-meter CUBE surface 99.69% 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.

B.4 Backscatter

For all details regarding MBES backscatter acquisition and processing see the DAPR. The MBES backscatter data acquired were written to the GSF in real-time by ISS-2000 and are delivered in the final GSF files for this sheet under the Processed/Sonar_Data/H13819_MB directory. Leidos followed previous guidance from NOAA to deliver the data in a single directory only as the data files are identical; therefore the raw directory is not populated.

Final MBES backscatter were mosaicked at 2-meter cell resolution. The MBES backscatter mosaics were reviewed for data quality and coverage. All MBES backscatter mosaics are determined to be complete and sufficient to meet the requirements contained within the PI and HSSD. The coverage mosaics are delivered as a single georeferenced raster file (datum of NAD-83) in floating point GeoTIFF format, as specified in HSSD Section 6.2.4.2.

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	6.0.3.2.2

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	6.0.3.2.2
QPS	FMGT	7.10.3

Table 11: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Profile Version 2023.

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
H13819_MB_1m_MLLW_Final	BAG	1 meters	11.172 meters - 16.66 meters	N/A	Complete coverage; Option B
H13819_SSSAB_1m_400kHz_1of1	SSS Mosaic	1 meters	-	N/A	First 100% SSS
H13819_SSSAB_1m_400kHz_2of2	SSS Mosaic	1 meters	-	N/A	Second 100% SSS (Disproval coverage)

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H13819_MBAB_2m_SeaInnovatorI_350kHz_1of2	MB Backscatter Mosaic	2 meters	-	N/A	MBES Backscatter
H13819_MBAB_2m_SeaInnovatorI_350kHz_2of2	MB Backscatter Mosaic	2 meters	-	N/A	MBES Backscatter

Table 12: Submitted Surfaces

Complete Coverage HSSD Section 5.2.2.3 requires 1-meter grid resolution for depths ranging from 0 meters to 20 meters. Leidos generated the CUBE PFM grids for H13819 at 1-meter resolution. The final gridded MBES data are delivered in Bathymetric Attributed Grid (BAG) format 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-K356-KR-23_NAD83_VDatum_MLLW.cov

Table 13: ERS method and SEP file

Final MBES data are reduced to MLLW through VDatum; refer to the DAPR for additional information.

No final tide note was provided nor was it required from NOAA Center for Operational Oceanographic Products and Services (CO-OPS).

C.2 Horizontal Control

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

The projection used for this project is Universal Transverse Mercator (UTM) Zone 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 MBES 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 do not contribute 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. H13819 data met data accuracy standards and bottom coverage requirements. Charting recommendations for new features and updates to charted features, are documented in the H13819 FFF. Additional charted objects are discussed in later sections within this DR.

United States Coast Guard (USCG) District 8 Local Notice to Mariners (LNM) publications were reviewed for changes subsequent to the date of the Project Instructions and through final processing. The LNM reviewed were from week 30/23 (26 July 2023) until week 11/24 (13 March 2024).

Review showed that the H13819 CUBE data were generally in agreement with charted depths. Compared to the ENC's listed in Section D.1.1. CUBE depths generally agreed with the charted depths within ±0.1-1.3 meters and were generally found to be deeper than charted.

Leidos recommends updating the common areas of all charts using data from this survey.

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
US4LA14M	1:80000	34	01/10/2024	01/10/2024
US5LA16M	1:50000	26	11/30/2023	11/30/2023
US5LCHCC	1:20000	1	06/13/2023	12/20/2023
US5LCHDC	1:20000	1	06/13/2023	12/20/2023
US5LCHEB	1:20000	1	06/13/2023	12/20/2023

Table 14: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

Refer to Section D.1.4 for significant shoals or hazardous features within the area covered by this survey. Leidos submitted the following DTON report to the Atlantic Hydrographic Branch (AHB) in S-57 format per HSSD:

- H13819_DTON_01_02.000, submitted to AHB 2023-09-29. Per AHB, based on the least depths of the features, the charted depths, and the drafts of AIS traffic in the general location, AHB elected to not forward H13819 DTON #01-02 to Marine Chart Division (MCD) as immediate dangers to navigation submission.

The features represented in H13819_DTON_01_02.000 are submitted as features in the H13819 FFF to be submitted to MCD as part of general chart updates for the H13819 coverage area.

Refer to the H13819 FFF (H13819_FFF.000).

D.1.3 Charted Features

There were numerous assigned charted features in the final CSF within the SOW of H13819. Per HSSD Section 8.1.4, these charted features are not addressed in this section, refer to the H13819 FFF (H13819_FFF.000) for all the details and recommendations regarding these features.

Assigned features from the NOAA provided CSF were addressed within H13819 and are included in the H13819 FFF. Any charted features that were disproven are also included within the H13819 FFF with assignment flag of Delete.

D.1.4 Uncharted Features

See the H13819 FFF for details and recommendations regarding new uncharted features investigated during this survey.

D.1.5 Channels

There were no assigned channels within the H13819 SOW from the final CSF.

During the transit to and from port throughout OPR-K356-KR-23 Leidos observed shoaling within the Cameron Loop. This was submitted as a DTON to NOAA and is not directly associated with any sheet within this Project; refer to Project Correspondence.

D.2 Additional Results

D.2.1 Aids to Navigation

There were no assigned Aids to Navigation (ATON) within the SOW of H13819 from the final CSF. There were no ATONs within the surveyed area.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

In accordance with both the PI and Section 7.2.3 of the HSSD, bottom characteristics were obtained for H13819. Bottom characteristics were acquired as assigned from the PRF; Leidos did not modify the bottom sample locations from the location proposed by NOAA in the PRF. Bottom characteristics are included in

the H13819 FFF. In addition, images of the sediment obtained for each bottom sample are referenced in the FFF and are included on the delivery drive under the folder H13819/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. Within the H13819 SOW bounds there was one assigned CBLSUB feature, which had investigation requirements in the CSF "Visually confirm feature object existence. If discrepancy, discuss in DR (see HSSD Section 8.1.4). Do not include feature in FFF". This CBLSUB feature was not found during the H13819 survey, and as such it is not included in the H13819 FFF. All other assigned submarine features are detailed within the H13819 FFF.

D.2.6 Platforms

Platforms are addressed within the H13819 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 other abnormal seafloor or environmental conditions, as defined in HSSD Section 8.1.4, exist within this survey area.

D.2.9 Construction and Dredging

No construction or dredging exists within this survey area.

D.2.10 New Survey Recommendations

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

D.2.11 ENC Scale Recommendations

No new ENC scales are recommended for this area.

E. Approval Sheet

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

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-K356-KR-23 are provided in the table below.

Report Name	Report Date Sent
OPR-K356-KR-23 Final Project Summary Report.pdf	2024-01-05
OPR-K356-KR-23_ Coast Pilot Review Report.pdf	2024-01-09
OPR-K356-KR-23_ Marine_Species_ Awareness_Training_Record.pdf	2024-01-30
OPR-K356-KR-23_DAPR.pdf	2024-03-05
H13817_DR.pdf	2024-03-05
H13816_DR.pdf	2024-03-07
H13818_DR.pdf	2024-03-08

Approver Name	Approver Title	Approval Date	Signature
Alex T. Bernier	Lead Hydrographer	03/15/2024	Alex Bernier:A01410D00000187B3F4CA1100058883 Digitally signed by Alex Bernier:A01410D00000187B3F4CA1100058883 Date: 2024.03.15 13:13:47 -04'00'

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