H13342

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

DESCRIPTIVE REPORT

Type of Survey:	Basic Hydrographic Survey
Registry Number:	H13342

LOCALITY

State(s):	Maryland
General Locality:	Areas of Mobjack Bay, VA and Choptank River, MD
Sub-locality:	Choptank River

2021

CHIEF OF PARTY
Bridget W. Bernier

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13342**

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

State(s):	**Maryland**
General Locality:	**Areas of Mobjack Bay, VA and Choptank River, MD**
Sub-Locality:	**Choptank River**
Scale:	**20000**
Dates of Survey:	**09/17/2020 to 05/20/2021**
Instructions Dated:	**08/19/2020**
Project Number:	**OPR-E350-KR-20**
Field Unit:	**Leidos**
Chief of Party:	**Bridget W. Bernier**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter Side Scan Sonar**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

Contract: 1305M220DNCNJ0056/TO-0001. Contractor: Leidos, 221 Third Street, Newport, RI 02840 USA. Leidos Doc. 21-TR-007. Subcontractors: Divemasters, Inc., 15 Pumpshire Road, Toms River, NJ 08753; OARS, 8705 Shoal Creek Blvd, Suite 109, Austin, TX 78757.

Any revisions to the Descriptive Report (DR) applied during office processing are shown in red italic text. The DR is maintained as a field unit product, therefore all information and recommendations within this report are considered preliminary unless otherwise noted. The final disposition of survey data is represented in the NOAA nautical chart products. All pertinent records for this survey are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via https://www.ncei.noaa.gov/. Products created during office processing were generated in NAD83 UTM 18N, MLLW. All references to other horizontal or vertical datums in this report are applicable to the processed hydrographic data provided by the field unit.

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Descriptive Report to Accompany Survey H13342

Project: OPR-E350-KR-20

Locality: Areas of Mobjack Bay, VA and Choptank River, MD

Sublocality: Choptank River

Scale: 1:20000

September 2020 - May 2021

Leidos

Chief of Party: Bridget W. Bernier

A. Area Surveyed

The area surveyed was a section of the Chesapeake Bay, with southern survey extents west of Taylors Island, continuing north to approximately Tilghman Island and east into the Choptank River (Figure 1).

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
38° 41' 19.8" N 76° 25' 20.79" W	38° 27' 30.22" N 76° 2' 56.71" W

Table 1: Survey Limits

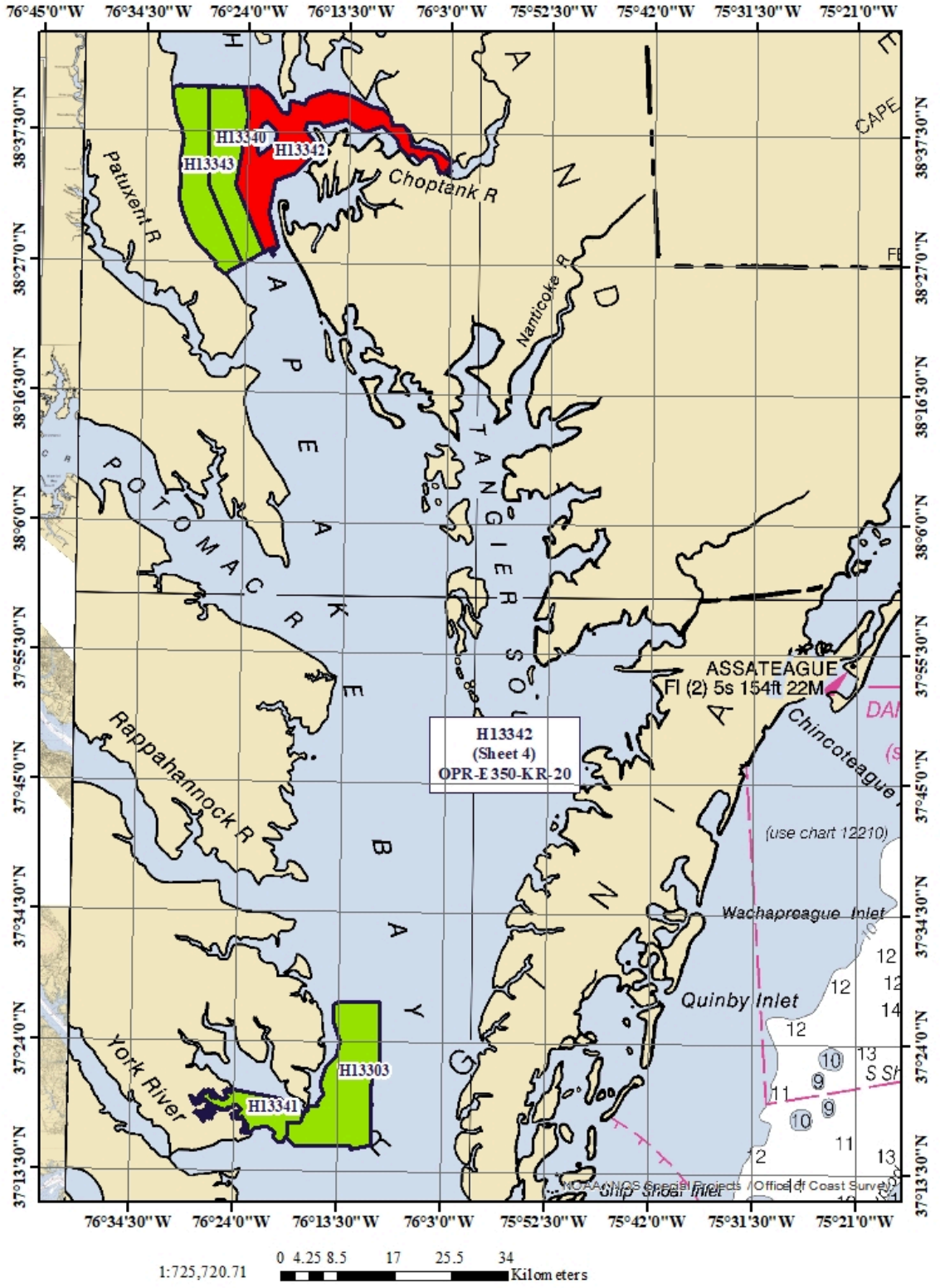

Figure 1: H13342 Survey Bounds

Survey limits were acquired in accordance with the requirements in the Project Instructions and the Hydrographic Surveys Specifications and Deliverables (HSSD), May 2020.

A.2 Survey Purpose

The central Chesapeake Bay is a critical shipping corridor for commerce transiting to and from the Port of Baltimore, as well the region supports an important commercial fishery, which includes menhaden, crabs and oysters. The purpose of this project is to provide contemporary surveys to update National Ocean Service nautical charts and products to support navigation safety and monitor the health of the environment.

Survey vintage predates the 1950s for the majority of the project area despite vessels transiting within close proximity to the seafloor. This project covers approximately 203 square nautical miles that will close a critical gap in existing modern hydrographic data for the stretch between the entrance to Chesapeake Bay up through Baltimore, MD. This project will provide critical data for the updating of National Ocean Service (NOS) nautical charting products to increase maritime safety in the region. 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.

H13342 was surveyed in accordance with the following documents:
1. 1305M220DNCNJ0056/1305M220FNCNJ0278P21001 dated 19 August 2020
2. Hydrographic Surveys Specifications and Deliverables (HSSD), May 2020
3. OPR-E350-KR-20_PRF.000, received 02 September 2020
4. OPR-E350-KR-20_CSF.000, received 12 August 2020
5. LeidosMeeting_Q&A_3-23-2021.pdf, dated 23 March 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
H13342	Complete Coverage (Refer to HSSD Section 5.2.2.3)
8 meters water depth and shoaler	Sidescan may be acquired at an altitude of 6-20% of the range scale.

Table 2: Survey Coverage

Leidos chose to achieve the coverage requirement using Complete Coverage, Option B (100% side scan sonar coverage with concurrent multibeam). Survey coverage achieved was in accordance with the requirements in the Project Instructions and the HSSD (Figure 2 through Figure 6). In many areas of H13342 the inshore limit of the Navigable Area Limit Line (NALL) was reached seaward of the assigned survey bounds. Leidos surveyed to the NALL as defined by HSSD Section 1.3.2; within the surveyed bounds. However, due to safety concerns for personnel and survey equipment, at a few discrete locations some areas were not fully covered with multibeam echo sounder (MBES) data to exactly the 3.5-meter depth contour. This was due to limited vessel maneuverability around the shoal depth areas at these discrete locations, which were observed to have steep slopes in the seafloor rising to an unsafe depth for the vessel and survey equipment. In these areas the side scan sonar (SSS) swath extended shoreward of the MBES swath, and indicated that the seafloor continued to rise abruptly and in a manner that the vessel could not navigate over for further MBES coverage; while also indicating in the SSS data that there were no significant objects that would require individual cartographic representation.

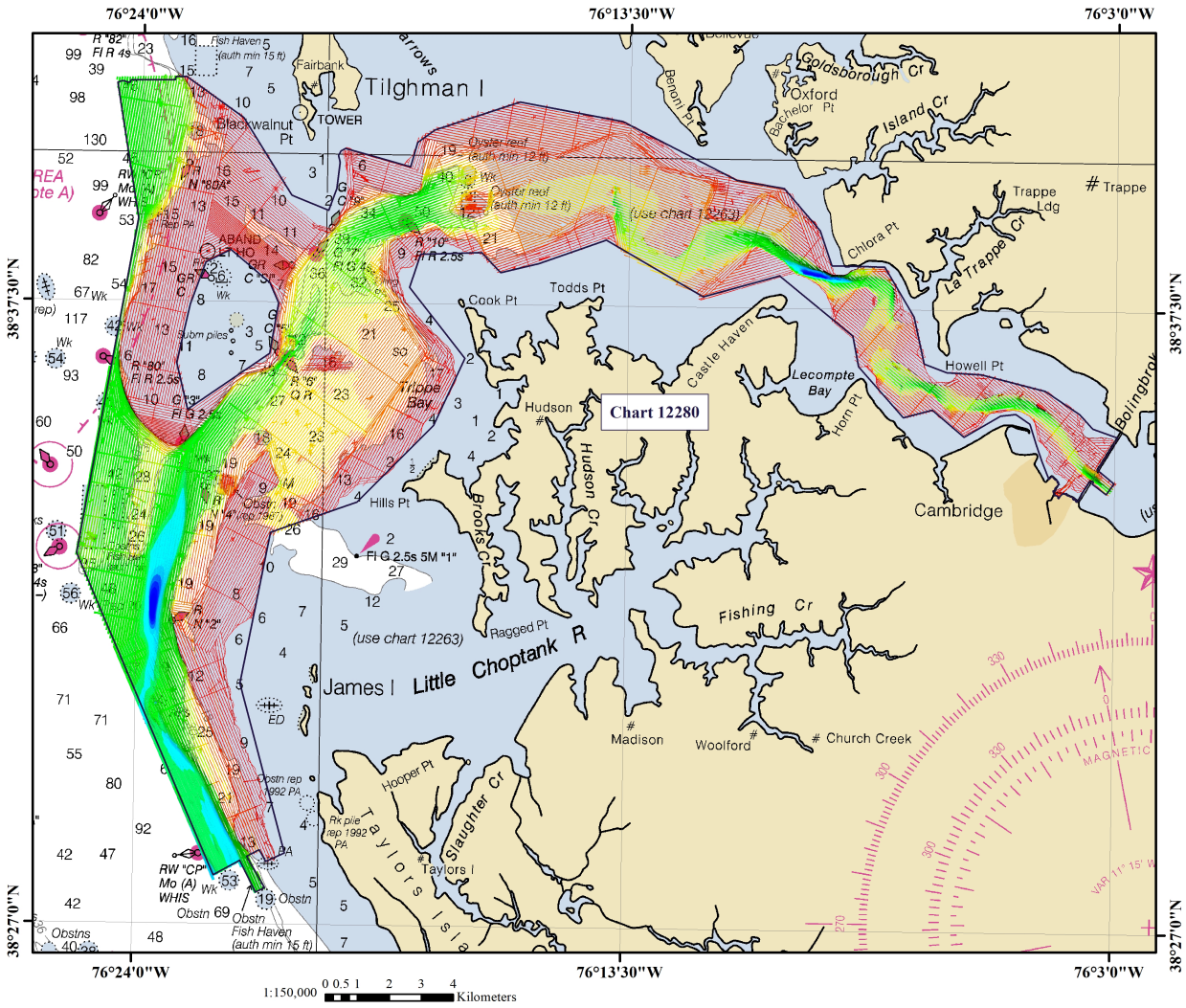

Figure 2: Final Bathymetry Coverage for H13342 (All Depths, 1-meter and 2-meter Grid Resolution)

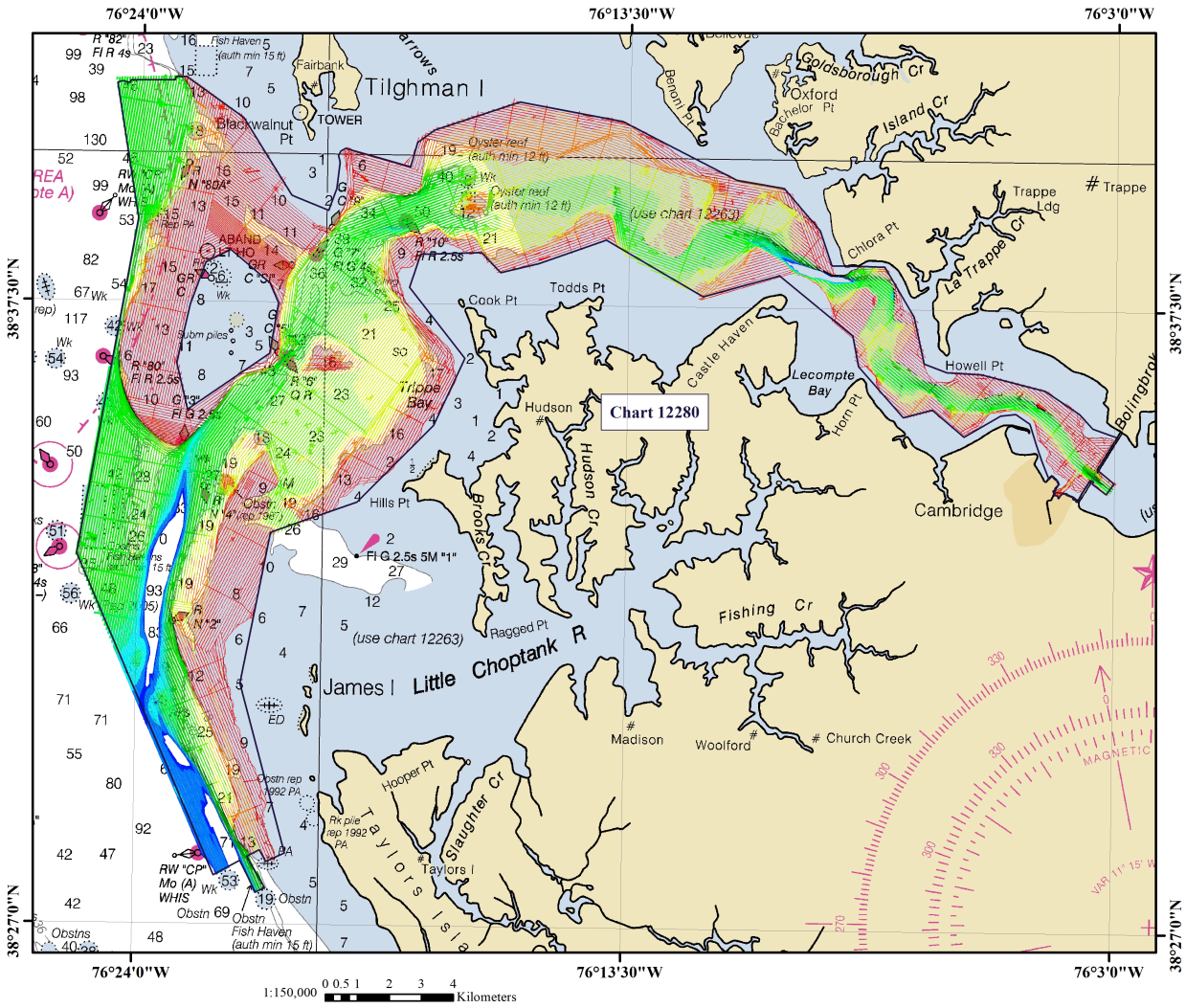

Figure 3: Final Bathymetry Coverage for H13342 (1-meter Grid Resolution)

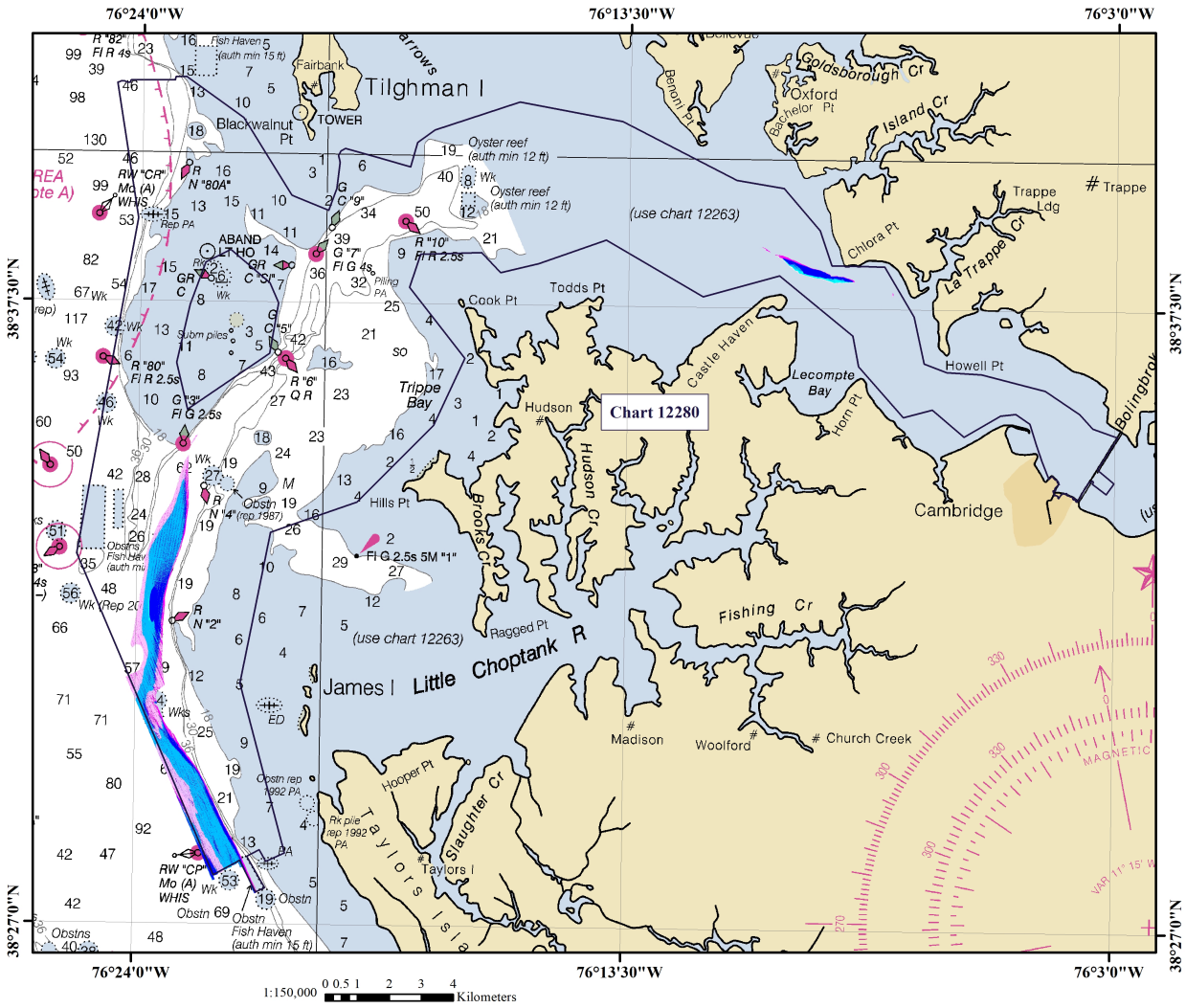

Figure 4: Final Bathymetry Coverage for H13342 (2-meter Grid Resolution)

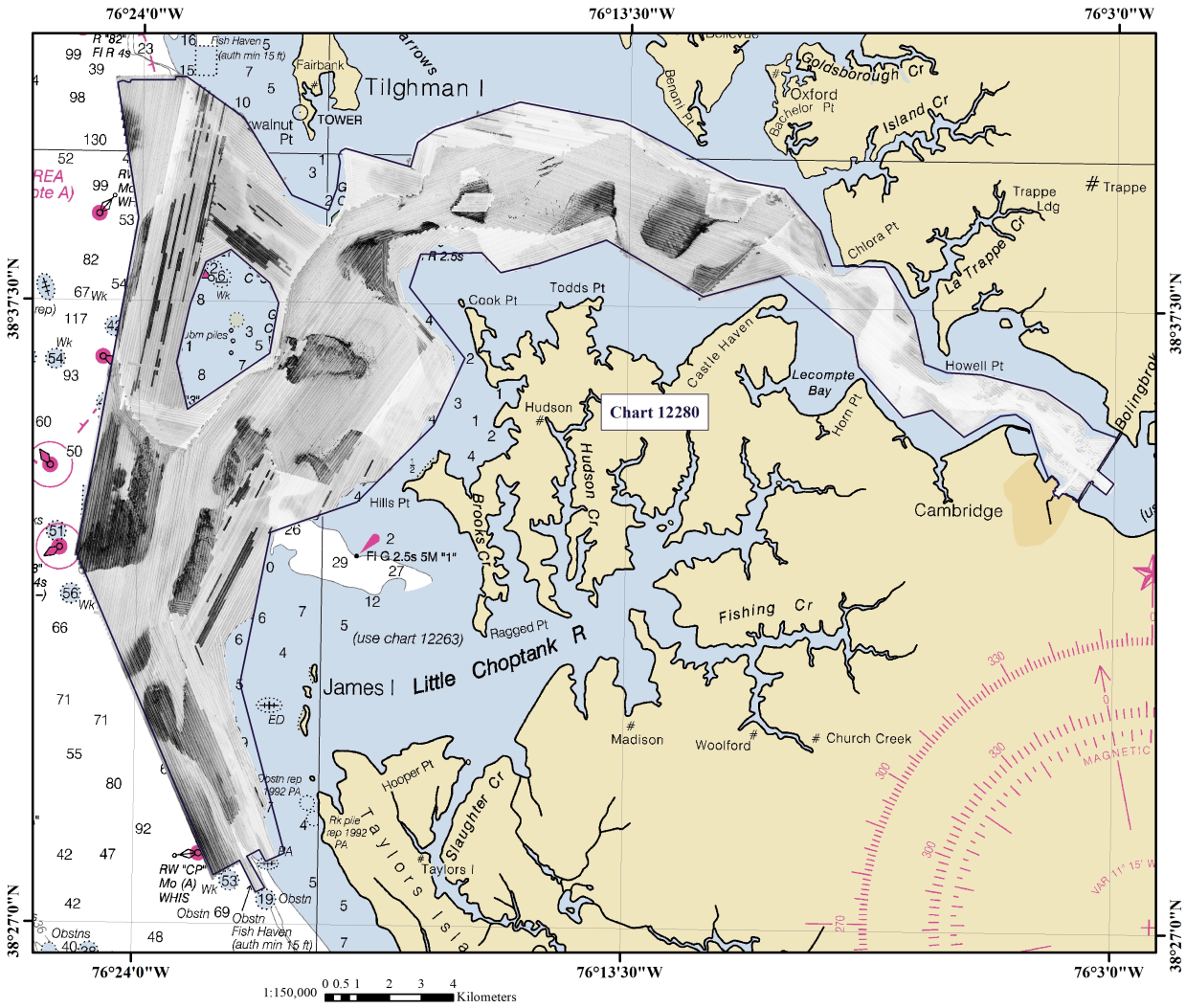

Figure 5: Final Side Scan Coverage for H13342 (First 100% coverage)

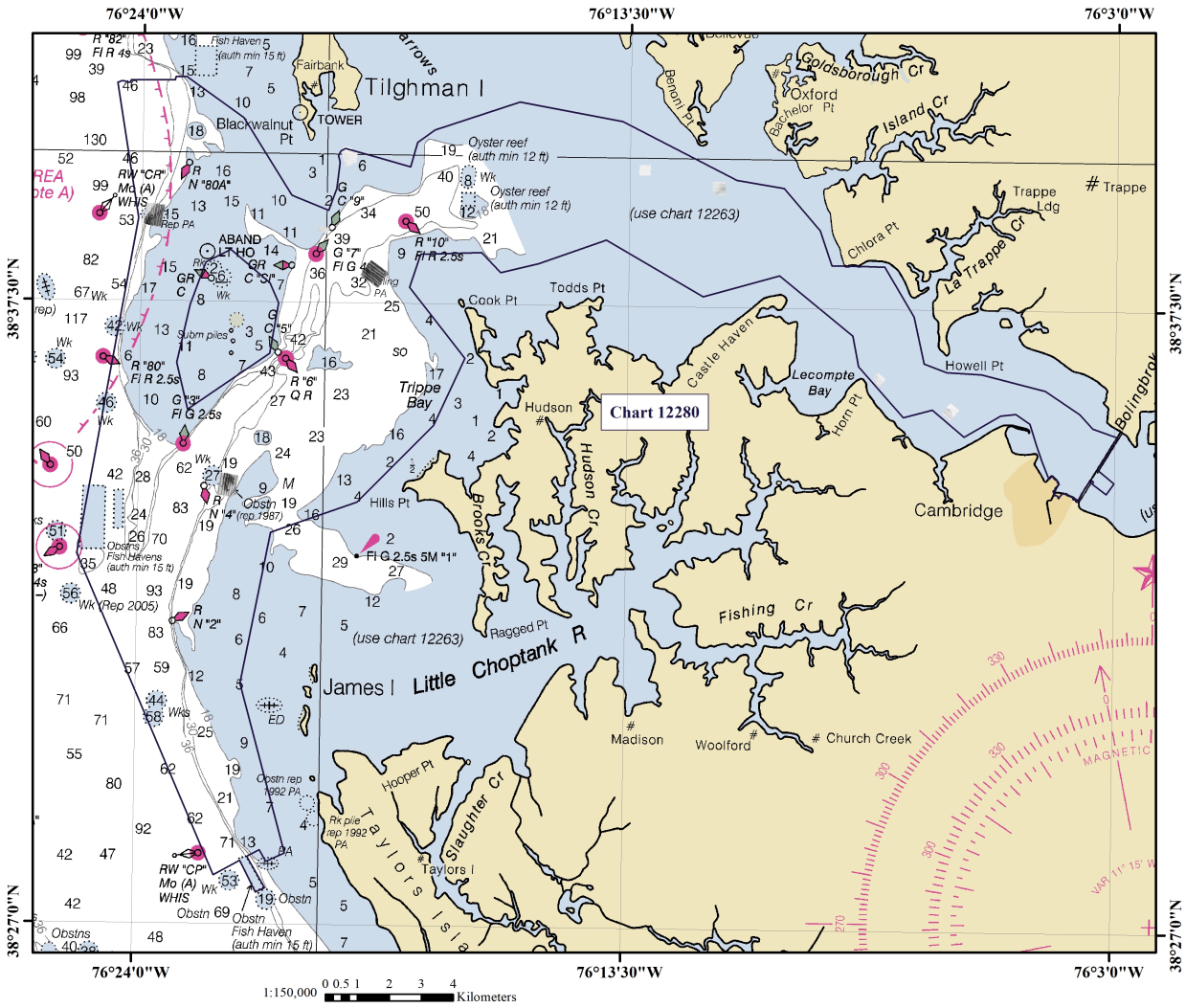

Figure 6: Final Side Scan Coverage for H13342 (Second 100% coverage)

A.6 Survey Statistics

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

	HULL ID	*M/V Atlantic Surveyor*	*R/V Oyster Bay II*	*Total*
LNM	**SBES Mainscheme**	0.0	0.0	0.0
	MBES Mainscheme	0.0	0.0	0.0
	Lidar Mainscheme	0.0	0.0	0.0
	SSS Mainscheme	0.0	0.0	0.0
	SBES/SSS Mainscheme	0.0	0.0	0.0
	MBES/SSS Mainscheme	877.99	994.74	1872.73
	SBES/MBES Crosslines	35.3	30.74	66.04
	Lidar Crosslines	0.0	0.0	0.0
Number of Bottom Samples				21
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				62.55

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
09/17/2020	261

Survey Dates	Day of the Year
09/18/2020	262
09/19/2020	263
09/20/2020	264
09/21/2020	265
09/22/2020	266
10/05/2020	279
10/06/2020	280
10/07/2020	281
10/08/2020	282
10/09/2020	283
10/10/2020	284
10/11/2020	285
10/12/2020	286
10/15/2020	289
03/16/2021	75
03/18/2021	77
03/20/2021	79
03/21/2021	80
03/22/2021	81
03/23/2021	82
03/28/2021	87
03/29/2021	88
03/30/2021	89
03/31/2021	90
04/03/2021	93
04/04/2021	94
04/05/2021	95
04/06/2021	96
04/07/2021	97
04/08/2021	98
04/09/2021	99
04/10/2021	100

Survey Dates	Day of the Year
04/11/2021	101
04/12/2021	102
04/13/2021	103
04/14/2021	104
04/15/2021	105
04/17/2021	107
04/20/2021	110
04/21/2021	111
04/23/2021	113
04/25/2021	115
04/26/2021	116
04/27/2021	117
04/28/2021	118
04/29/2021	119
05/01/2021	121
05/02/2021	122
05/03/2021	123
05/20/2021	140

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-E350-KR-20, delivered previously with H13341. There were no variations from the equipment configuration described in the DAPR except for Section A.5.4 Laser Rangefinders. A TruPulse 200X was utilized to determine the elevation of an assigned feature.

B.1.1 Vessels

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

Hull ID	*M/V Atlantic Surveyor*	*R/V Oyster Bay II*
LOA	110.0 feet	30.0 feet
Draft	9.0 feet	3.0 feet

Table 5: Vessels Used

Figure 7: M/V Atlantic Surveyor

Figure 8: R/V Oyster Bay II

The M/V Atlantic Surveyor (Figure 7) was used to collect multibeam echo sounder (MBES) (RESON SeaBat T50), side scan sonar (SSS) (Klein 3000), and sound speed data during twenty-four hours per day survey operations. The R/V Oyster Bay II (Figure 8) was used to collect MBES (RESON SeaBat T50), SSS (Klein 4900), and sound speed data during twelve hours per day survey operations.

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

B.1.2 Equipment

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

Manufacturer	Model	Type
Teledyne RESON	SeaBat T50-R	MBES
Klein Marine Systems	System 3000	SSS
Klein Marine Systems	System 4900	SSS
Applanix	POS MV 320 v5	Positioning and Attitude System
AML Oceanographic	MVP30	Sound Speed System
AML Oceanographic	BaseX2	Sound Speed System

Table 6: Major Systems Used

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

B.2 Quality Control

B.2.1 Crosslines

Multibeam echo sounder crosslines acquired for this survey totaled 3.5% of mainscheme acquisition.

Refer to Separates II for details about how the crossing analyses were performed and a complete discussion of each analysis and tabular results. Figure 9 summarizes the crossline comparison results conducted for H13342. Additionally, repeatability analysis was conducted between the two vessels used during H13342, results are summarized in Figure 10.

Difference Grid	Minimum and Maximum CUBE Depth (meters) of Crossline Grid	IHO Order 1A Maximum Allowable Uncertainty (meters) for the Range of Depths	Percentage of Depth Differences Within IHO Order 1A Maximum Allowable Uncertainty
All Multibeam 1-meter Crossline (Class 1) to All 1-meter Mainscheme	2.548 – 25.403	0.501 – 0.599	100.00%
M/V Atlantic Surveyor Multibeam 1-meter Crossline (Class 1) to M/V Atlantic Surveyor Multibeam 1--meter Mainscheme	6.043 – 25.403	0.506 – 0.599	100.00%
R/V Oyster Bay II Multibeam 1-meter Crossline (Class 1) to R/V Oyster Bay II Multibeam 1--meter Mainscheme	2.548 – 20.810	0.501 – 0.568	100.00%

Figure 9: Summary of Crossing Analysis

Difference Grid	Minimum and Maximum CUBE Depth (meters) of Comparison	IHO Order 1A Maximum Allowable Uncertainty (meters) for the Range of Depths	Percentage of Depth Differences Within IHO Order 1A Maximum Allowable Uncertainty
M/V Atlantic Surveyor 1-meter Multibeam Data to R/V Oyster Bay II 1-meter Multibeam Data	1.696 – 27.932	0.500 – 0.618	99.99%

Figure 10: Summary of Vessel Comparison Repeatability Analysis

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.09 meters	0.2 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
M/V Atlantic Surveyor	1.0 meters/second	1.0 meters/second	1.0 meters/second	1.0 meters/second
R/V Oyster Bay II	1.0 meters/second	1.0 meters/second	1.0 meters/second	1.0 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

For specific details on the use and application of the SABER Total Propagated Uncertainty (TPU) model, refer to the DAPR. Once the TPU model was applied to the GSF bathymetry data, each beam was attributed with the horizontal uncertainty and the vertical uncertainty at the 95% confidence level. The vertical and horizontal uncertainty values, estimated by the TPU model for individual multibeam soundings, varied little across the dataset, tending to be most affected by beam angle. Individual soundings that had vertical and horizontal uncertainty values above IHO S-44 5th Edition, Order 1a were flagged as invalid during the uncertainty attribution.

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

Per HSSD Section 5.2.2.2, H13342 depth data fell within two grid resolutions (1-meter and 2-meter).

The final H13342 1-meter PFM CUBE surface contained final vertical uncertainties that ranged from 0.210 meters to 0.990 meters. The IHO Order 1a maximum allowable vertical uncertainty was calculated to range between 0.500 to 0.580 meters, based on the minimum CUBE depth (0.786 meters) and maximum CUBE depth (22.591 meters). Results from the SABER Check PFM Uncertainty function identified that there were 41 nodes in the final H13342 1-meter PFM CUBE surface with final vertical uncertainties that exceeded IHO Order 1a allowable vertical uncertainty. These nodes were associated with features and in areas of steep slopes.

The SABER Frequency Distribution Tool was also used to review the Hyp. Final Uncertainty surface within the final H13342 1-meter PFM grid. Results showed that 99.99% of all nodes had final uncertainties less than or equal to 0.340 meters.

The final H13342 2-meter PFM CUBE surface contained final vertical uncertainties that ranged from 0.210 meters to 0.484 meters. The IHO Order 1a maximum allowable vertical uncertainty was calculated to range between 0.529 to 0.624 meters, based on the minimum CUBE depth (13.280 meters) and maximum CUBE depth (28.658 meters). The SABER Check PFM Uncertainty function reported zero nodes exceeded IHO Order 1a from the final surface. The SABER Frequency Distribution Tool was also used to review the Hyp. Final Uncertainty surface within the final H13342 2-meter PFM grid. Results showed that 99.99% of all nodes had final uncertainties less than or equal to 0.360 meters.

B.2.3 Junctions

Per the Project Instructions, junction analysis was performed between H13342 and the surveys listed in the table below. Figure 11 shows the general locality of H13342 as it relates to the sheets against which junctions were performed. Refer to Separates II for details about how junction analyses were performed and a complete discussion of each analysis and tabular results.

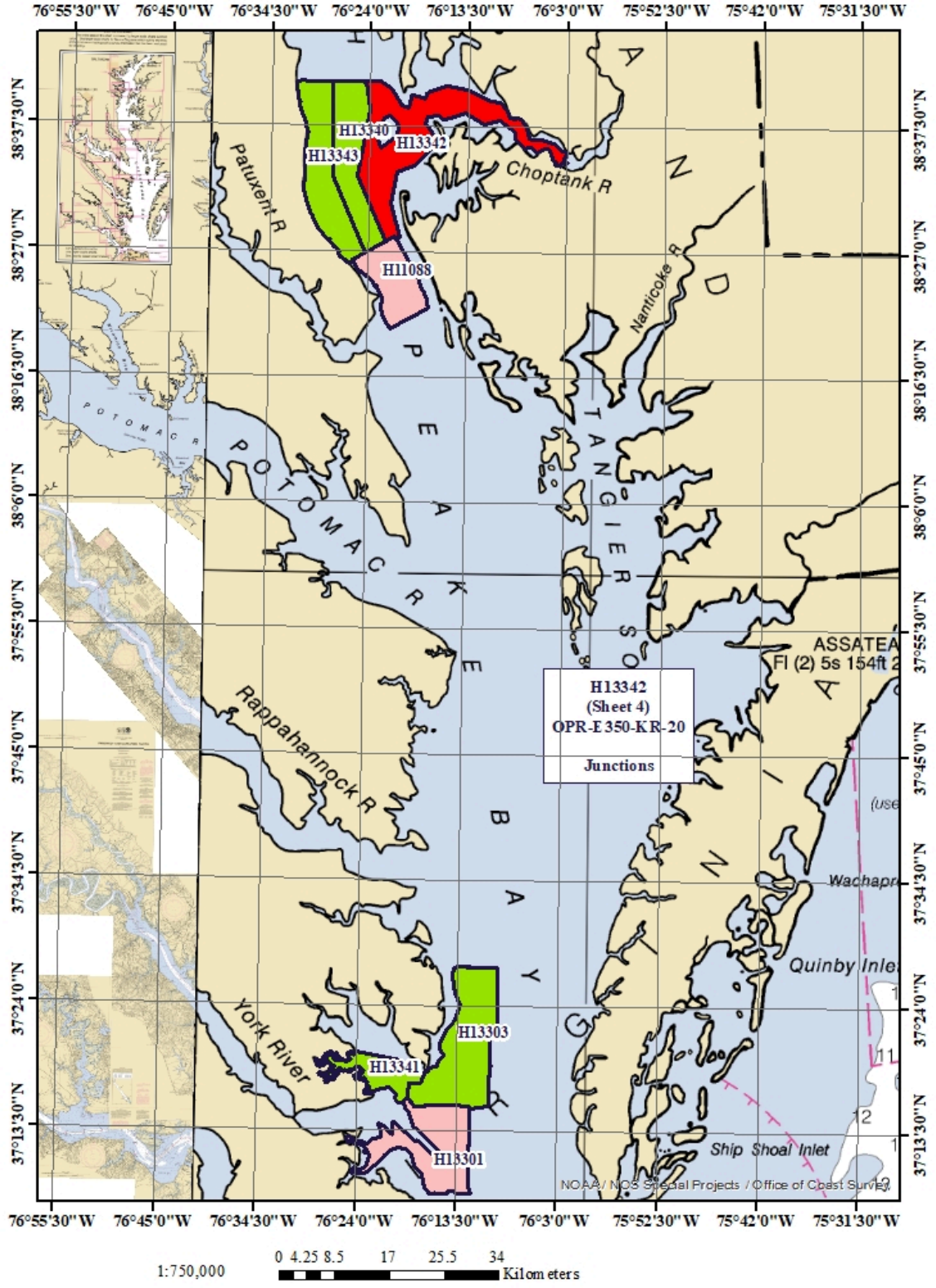

Figure 11: General Locality of H13342 with Junctioning Surveys

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13340	1:20000	2021	Leidos, Inc.	W
H11088	1:10000	2004	NOAA R/V Bay Hydrographer	S

Table 9: Junctioning Surveys

H13340

H13340 junctions to the west of H13342; 100% of the comparisons agreed within ±1.584 meters while 99.99% of the comparisons fell within the calculated maximum allowable TVU of 0.566 meters.

H11088

H11088 junctions to the south of H13342; 100% of the comparisons agreed within ±6.590 meters while 78.93% of the comparisons fell within the calculated maximum allowable TVU of 0.566 meters.

B.2.4 Sonar QC Checks

Sonar system quality control checks were conducted as detailed in the DAPR; quality control checks conducted during H13342 are reported in Separates I.

B.2.5 Equipment Effectiveness

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

B.2.6 Factors Affecting Soundings

Holidays Caused by Dense Biological Interference

Dense biological interference were observed within discrete areas and during various days of survey which required numerous holiday reruns. The end result was that there were no significant impacts to the final sounding data. Throughout survey acquisition fishing, trawling, and dredging were all observed and artifacts

from these activities were present within the data. There were a significant number of fishing pots and temporary markers throughout the survey area, see Section D.1.4 for more information.

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, and on the R/V Oyster Bay II, the AML BaseX2 was the primary system used to collect SSP data, refer to the DAPR for additional details. SSP data were obtained at intervals frequent enough to meet depth accuracy requirements. Section 5.2.3.3 of the HSSD requires that if the sound speed measured at the sonar head differs by more than two meters/second from the commensurate profile data, then another cast shall be acquired.

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

Confidence checks of the sound speed profile casts were conducted by comparing at least two consecutive casts taken with different SSP sensors. Results for the sound speed confidence checks conducted during H13342 can be found in Separates II within the “Comparison Cast Log” section.

All individual SSP files are delivered with the H13342 data and are broken out into sub-folders, which correspond to the purpose of each cast. Also, all individual SSP files for H13342 have been concatenated into four separate files based on the purpose of the cast, provided in CARIS format files (.svp), and delivered under (H13342/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 and Separates II 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 primarily set to 50-meter range scale, and main scheme survey lines were spaced at 80-meters, to ensure 100% SSS coverage. Some SSS data were acquired at 25-meter range scale, with line spacing adjusted accordingly.

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, in accordance with Section 5.2.2.1 of the HSSD.

As referenced in Section B.2.2, the depth data for H13342 fell within multiple grid resolution thresholds as defined in the HSSD for Single Resolution Surfaces. A final review of the CUBE Depth surface of the H13342 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 H13342 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 surfaces from each of the PFM grids to ensure that the requirements for object detection coverage surveys, as specified in HSSD Section 5.2.2.2 were met. Within the final 1-meter PFM grid 99.41% of all nodes contained five or more soundings; and in the 2-meter PFM grid 99.71% 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 previously delivered with the OPR-E350-KR-20 DAPR as part of the H13341 delivery.

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). As referenced in Section A.4, the Project Instructions provided a waiver to HSSD Section 6.1.2.3 for towed side scan towfish height. In

waters less than 8 meters the towfish height above the bottom could be 6% of the range scale. Mosaics were analyzed for coverage at both 8% and 6% of range based on water depths greater or less than 8 meters.

Leidos generated two separate coverage mosaics at 1-meter cell size resolution as specified in Section 8.2.1 of the HSSD. 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-E350-KR-20 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	5.4.1.5.3

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	5.4.1.5.3

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. Since the submittal of the DAPR with H13341, the SABER version was upgraded to SABER version 5.4.1.5.3 and was used for bathymetry and imagery data processing and analysis.

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
H13342_MB_1m_MLLW_Final	BAG	1 meters	0.786 meters - 22.591 meters	N/A	Complete coverage, Option B (100% side scan sonar coverage with concurrent multibeam)
H13342_MB_2m_MLLW_Final	BAG	2 meters	13.28 meters - 28.658 meters	N/A	Complete coverage, Option B (100% side scan sonar coverage with concurrent multibeam)
H13342_SSSAB_1m_500kHz_900kHz_1of1	SSS Mosaic (.tif)	1 meters	0.0 meters - 0.0 meters	N/A	First 100% SSS
H13342_SSSAB_1m_500kHz_900kHz_2of2	SSS Mosaic (.tif)	1 meters	0.0 meters - 0.0 meters	N/A	Second 100% SSS (Disproval)

Table 12: Submitted Surfaces

Complete Coverage Section 5.2.2.3 of the HSSD requires 1-meter node resolution for depths ranging from 0 meters to 20 meters and 2-meter node resolution for depths ranging from 18 meters to 40 meters. Leidos generated individual CUBE PFM grids for H13342 at 1-meter and 2-meter resolutions. Per previous approval, Leidos generated the two node resolution surfaces 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 H13342 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 H13342 1-meter BAG were from 0.786 meters (2.579 feet; 0.210 meters Total Vertical Uncertainty [TVU]) to 22.591 meters (74.117 feet; 0.237 meters TVU). The range of CUBE depths of the H13342 2-meter BAG were from 13.280 meters (43.569 feet; 0.220 meters TVU) to 28.658 meters (94.022 feet; 0.210 meters TVU).

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

C. Vertical and Horizontal Control

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-E350-KR-20_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 18.

PPP

The vessel kinematic data (POS/MV files) were post-processed in Applanix POSPac software using the Applanix PP-RTX solution to generate the Smoothed Best Estimate of Trajectory (SBET) solutions which were applied through SABER to the multibeam data. Refer to the DAPR for additional information and for details regarding all antenna and transducer offsets. Any soundings with total horizontal uncertainties exceeding the maximum allowable IHO S-44 5th 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. H13342 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 H13342 depth data were generally in good agreement (primarily within ±0.5 meters) with charted depths compared to the ENCs listed in Section D.1.1. There were areas with greater variability where observed depths were significantly shoaler than charted depths on ENC US5MD1AM and US5MD16M.

Charting recommendations for new features and updates to charted features, are documented in the H13342 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 (as specified in Section 8.1.4 of the HSSD). The LNM reviewed were from week 33/20 (18 August 2020) until week 21/21 (25 May 2021).

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
US5MD19M	1:40000	9	10/25/2018	06/09/2021
US5MD1AM	1:40000	8	12/10/2020	06/22/2021
US5MD16M	1:40000	30	06/30/2021	06/30/2021
US5MD21M	1:40000	25	05/14/2018	06/09/2021

Table 14: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

Refer to Figure 12 and Section D.1.4 for significant shoals or hazardous features within the area covered by this survey. As discussed in Section D.1.1, shoaling was observed in vicinity of Choptank River Entrance Buoy 5 (Feature 82).

Figure 12 details the Leidos submitted DTON reports for H13342. DTON reports were submitted per HSSD as S-57 format to the Atlantic Hydrographic Branch (AHB). Copies of the email correspondence for Leidos' submissions of DTON Reports, as well as the DTON recommendation files, are included within Appendix II of this Descriptive Report, as required in the HSSD. Additionally, linear objects which Leidos classified as an exposed pipeline due to characteristics and size, not falling within a charted pipeline or cable area, were identified. Associated positions and images within imagery and bathymetry data were provided to COR by email as a shape file on 2021-07-16 (H13342 Feature 31). Note that for Feature 31 the entire length that is provided in the FFF is not exposed and there are sections which are exposed.

DTON Report Name	Date Submitted to AHB	AHB Submitted to NDB and MCD	NDB Registration	Feature Number(s)
H13342 DTON 01 05.000	2021-05-07	2021-05-10	DD-34384	16, 20, 21, 19, and 18
H13342 DTON 06 07.000	2021-06-03	2021-06-04	DD-34465	110 and 115
H13342 DTON 08.000	2021-06-08	2021-06-09	DD-34549	6
H13342 DTON 09.000	2021-06-08	2021-06-09	DD-34549	38
H13342 DTON 10.000	2021-06-08	2021-06-09	DD-34549	39
H13342 DTON 11.000	2021-06-09	N/A		41
H13342 DTON 12.000	2021-06-09	N/A		59
H13342 DTON 13.000	2021-06-11	N/A		25
H13342 DTON 14.000	2021-06-11	N/A		29
H13342 DTON 15-17.000	2021-06-16	2021-06-16	DD-34564	63, 45 and 35
H13342 DTON 18-19.000	2021-07-16	N/A		44 and 36

Figure 12: DTON Reports

D.1.3 Charted Features

There were numerous assigned charted features in the final CSF (OPR-E350-KR-20_CSF.000) within the SOW of H13342. Per HSSD Section 8.1.4, these charted features are not addressed in this section, refer to the H13342 S-57 FFF (H13342_FFF.000) for all the details and recommendations regarding these features.

D.1.4 Uncharted Features

See the H13342 S-57 FFF for all the details and recommendations regarding new uncharted features investigated.

Feature 11 is not represented within the H13342 FFF per HSSD Section 7.3.2 as it was identified as a rock outcropping.

Throughout H13342 there were several separate locations of uncharted obstructions observed, which based on characteristics and size Leidos determined to be groups of derelict, now permanent, submerged piles from prior fish traps. These individual features are represented in the H13342 FFF as point objects and in some cases as line objects, but in all cases these individual features represent multiple observed objects which exceed 1-meter of height. In these cases only the shoalest object and depth was designated within the CUBE surface in accordance with HSSD. Therefore, around these point features and the areas represented by these line objects, there are discrete non-CUBE depths with heights greater than 1-meter from the seafloor which are not represented in the CUBE surface or individually identified within the FFF.

Within H13342 there were several submerged features which met the appropriate minimum required feature size for this Complete Coverage survey, as defined in the HSSD, and within 2mm at survey scale to an observed exposed above water surface feature. Guidance was received from AHB (2021-07-27 included in Project Correspondence) to designate both the submerged feature and the exposed feature within the data and FFF; which is a deviation from the HSSD.

During the course of H13342 survey operations, various fishing markers and crab pot floats were observed within the survey limits. These were determined to be temporary in nature as over the course of survey operations it was observed that several of the markers would no longer be present or were moved. Due to their temporary nature, there are no features associated with these markers within the H13342 S-57 FFF. When a temporary fishing surface float was identified and correlated to objects in the MBES data, as these were not true surface the MBES data were invalidated and no longer contributed to a CUBE surface. In many cases, where it was not possible to confirm the numerous fishing pots were not derelict, the object was retained in the MBES data.

D.1.5 Channels

There were no assigned channels within the H13342 SOW from the final CSF. However, the survey area was coincident to Cambridge Channel (ENC US5MD1AM); H13342 CUBE depths were in agreement with the charted depth range for Cambridge Channel.

D.2 Additional Results

D.2.1 Aids to Navigation

There were several assigned aids to navigation (ATON) within the SOW of H13342 from the final CSF. All ATONs within the survey limits were observed on station and serving their intended purpose. Per the investigation requirements from the CSF, as they were on station and serving intended purpose, they are included in the H13342 FFF with description of retain. Additional buoys that were not in the final CSF and were observed during survey are documented within the H13342 FFF.

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 H13342. Bottom characteristics were acquired at the 21 locations assigned in the final PRF (OPR-E350-KR-20_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 H13342/Processed/Multimedia.

D.2.4 Overhead Features

There was one overhead feature within the H13342 survey limits, the Choptank River Bridge. Per the CSF investigation requirements the S-57 BRIDGE object was not included within the S-57 FFF. The Choptank River Bridge (Feature 146) was observed visually, in MBES, and in SSS data to be adequately charted. Leidos recommends retaining as charted (ENC US5MD1AM and US5MD19M), Figure 13.

Figure 13: Choptank River Bridge (Feature 146)

D.2.5 Submarine Features

Within the final CSF there were no assigned submarine features for investigation. A linear object which Leidos classified as an exposed pipeline due to characteristics and size, not falling within a charted pipeline or cable area, was identified (H13342 Feature 31). Associated positions and images within imagery and bathymetry data were provided to the COR by email as a shape file on 2021-07-16.

D.2.6 Platforms

No platforms exist within this survey area.

D.2.7 Ferry Routes and Terminals

No ferry routes or terminals exist within this survey area.

D.2.8 Abnormal Seafloor or Environmental Conditions

No abnormal seafloor or environmental conditions, as defined in Section 8.1.4 of the HSSD, exist within this survey area other than those discussed in Section B.2.6 and D.1.2.

D.2.9 Construction and Dredging

No construction or dredging exists for this survey area.

D.2.10 New Survey Recommendations

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

D.2.11 ENC Scale Recommendations

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

E. Approval Sheet

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

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

The survey data meets or exceeds requirements as set forth in the Hydrographic 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-E350-KR-20 are provided in the table below.

Report Name	Report Date Sent
OPR-E350-R-20_Marine_Species_ Awareness_Training_Record.pdf	2021-04-14
OPR-E350-KR-20_20210419.zip (NCEI Sound Speed Data 2020 data only)	2021-04-19
OPR-E350-KR-20_Coast Pilot Review Report.pdf	2021-04-19
OPR-E350-KR-20_DAPR.pdf	2021-04-27
H13341_DR.pdf	2021-04-27
H13340_DR.pdf	2021-04-29
OPR-E350-KR-20_Final_Project_ Summary_Report_June_18.pdf	2021-06-18
OPR-E350-KR-20_Coast Pilot Review Report_Rev1.pdf	2021-08-11
H13303_DR.pdf	2021-08-13
OPR-E350-KR-20_20210423.zip (NCEI Sound Speed Data 2021 data only)	2021-08-23
OPR-E350-KR-20_ Marine_Mammal_Observation_Logs.pdf	2021-08-23

Approver Name	Approver Title	Approval Date	Signature
Bridget W. Bernier	Data Processing Manager	08/24/2021	Bridget W Bernier Digitally signed by Bridget W Bernier Date: 2021.08.24 13:46:24 -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