

H13763

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

DESCRIPTIVE REPORT

Type of Survey: Navigable Area

Registry Number: H13763

LOCALITY

State(s): North Carolina

General Locality: Albemarle Sound

Sub-locality: Perquimans River to Chowan River

2023

CHIEF OF PARTY
Nicholas Damm, CH

LIBRARY & ARCHIVES

Date:

HYDROGRAPHIC TITLE SHEET

H13763

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): **North Carolina**

General Locality: **North Carolina**

Sub-Locality: **Perquimans River to Chowan River**

Scale: **5000**

Dates of Survey: **04/06/2023 to 11/09/2023**

Instructions Dated: **02/14/2023**

Project Number: **OPR-F330-KR-22**

Field Unit: **Geodynamics LLC**

Chief of Party: **Nicholas Damm, CH**

Soundings by: **Multibeam Echo Sounder Singlebeam Echo Sounder**

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

Verification by: **Atlantic Hydrographic Branch**

Soundings Acquired in: **meters at Low Water Datum**

Remarks:

Any revisions to the Descriptive Report (DR) applied during office processing are shown in red italic text. The DR is maintained as a field unit product, therefore all information and recommendations within this report are considered preliminary unless otherwise noted. The final disposition of survey data is represented in the NOAA nautical chart products. All pertinent records for this survey are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via <https://www.ncei.noaa.gov/>. Products created during office processing were generated in NAD83 UTM 18N, Low Water Datum. 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 H13763

Project: OPR-F330-KR-22

Locality: North Carolina

Sublocality: Perquimans River to Chowan River

Scale: 1:5000

April 2023 - November 2023

Geodynamics LLC

Chief of Party: Nicholas Damm, CH

A. Area Surveyed

Geodynamics conducted a hydrographic survey in the assigned area of H13763 located in the Perquimans River to Chowan River. Within H13763, all survey operations were conducted in accordance with the provided Statement of Work (SOW), Hydrographic Survey Project Instructions (PI), and the March 2022 National Ocean Service (NOS) Hydrographic Survey Specifications and Deliverables (HSSD). Any deviations from the aforementioned guidelines have been approved by the National Oceanographic and Atmospheric Administration (NOAA) Hydrographic Survey Division (HSD) Operations (OPS) branch and are documented in the survey correspondences.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
36° 12' 53.91" N 76° 40' 48.61" W	35° 59' 54.33" N 76° 2' 23.14" W

Table 1: Survey Limits

Data were acquired to the survey limits in accordance with the requirements listed in the PI and the HSSD.

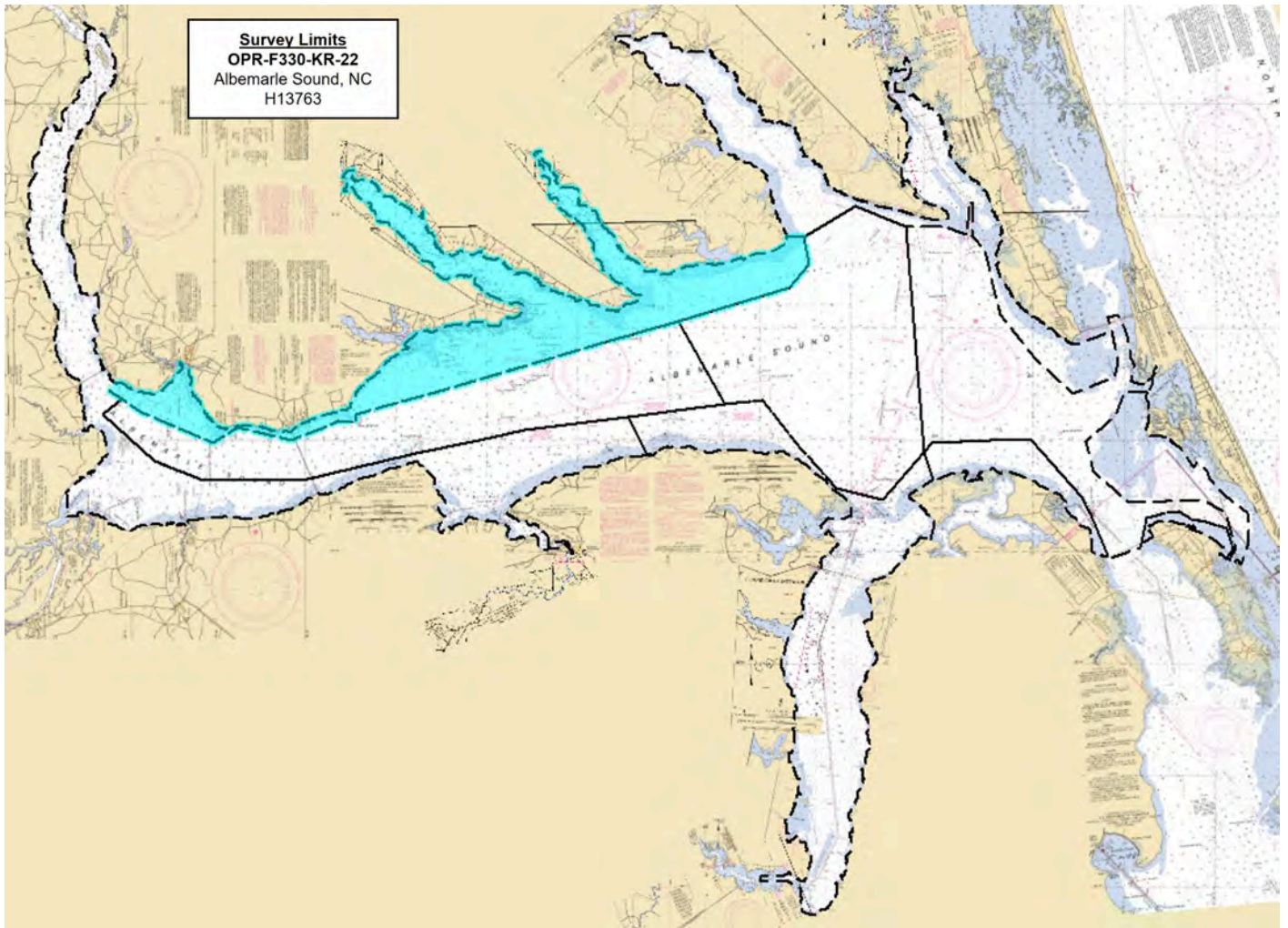


Figure 1: Overview of project survey limits (H13763 shown in blue), overlaid onto Charts 11553, 12205, and 12206

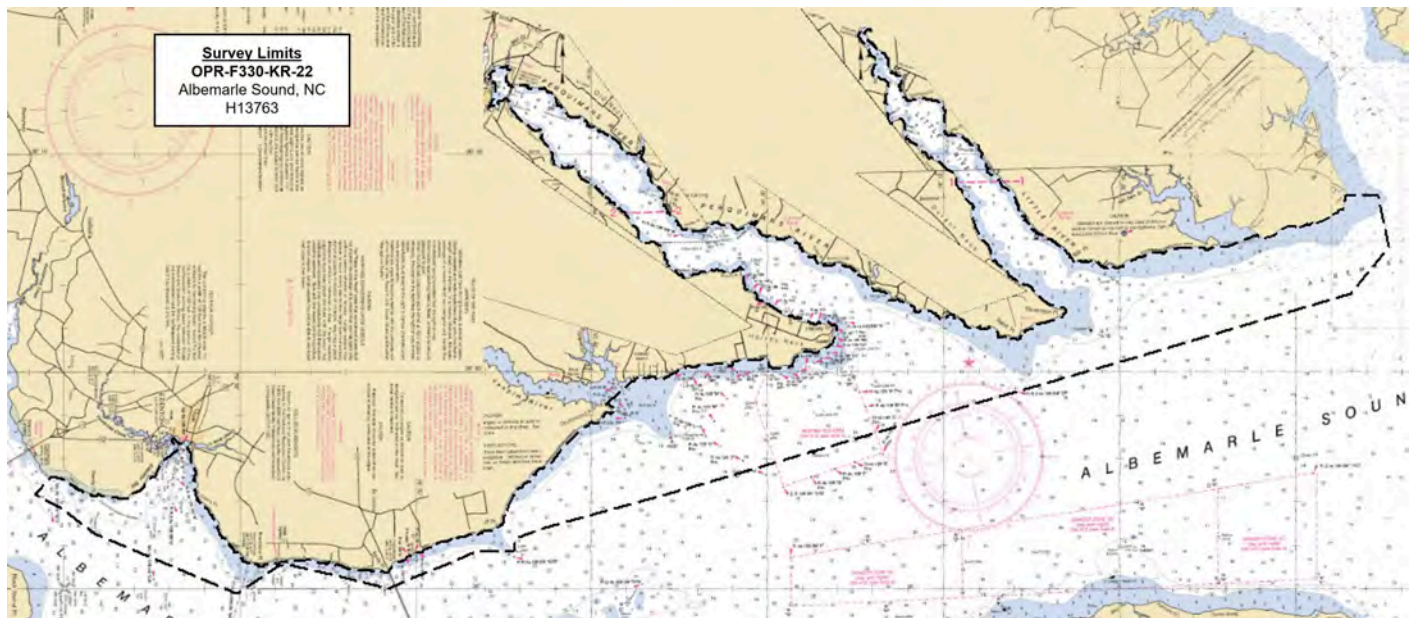


Figure 2: H13763 survey limits overlaid onto Chart 12205

A.2 Survey Purpose

Albemarle Sound in North Carolina is a large, shallow, low-salinity estuary which extends approximately 50 nautical miles inland from the Outer Banks barrier islands. For this project, approximately 522 square nautical miles of modern, high-resolution hydrographic data will be collected in Albemarle Sound and connecting rivers.

Commercial and recreational fishing as well as waterfront tourism are important economic drivers for the communities around the sound. Albemarle Sound has been facing recent and drastic decline in water quality and fishing stocks, and since the late 1980s, high levels of contaminants have been documented in the waters and biology of the sound and tributaries. To monitor this situation, the USGS and partners installed a network of monitoring stations as part of a program to study water quality to understand the sources and movement of nutrients and biota. The National Water Center along with the North Carolina Department of Environmental Quality have stated that there is a need for updated bathymetric data in the waterways to inform hydrodynamic models to improve understanding nutrient movement and to predict the effects of future sea-level and coastline change. Data collected by this survey will be used to characterize seabed habitat which will be used to help manage a healthy and sustainable seafood industry and help monitor future changes to the estuary ecology.

This hydrographic survey will update NOAA National Ocean Survey (NOS) charts and products to identify hazards and improve navigation safety in a region which includes areas of high need for modern bathymetry based on the age of the prior data (1920) and the Hydrographic Health model. Survey data from this project are intended to supersede all prior survey data in the common area.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Survey quality in H13763 meets or exceeds requirements set forth in the HSSD. Survey quality was assessed through visual inspection, the analysis of crosslines, and utilizing QC Tools to assess uncertainty and density. Additionally, junction analyses were conducted between overlapping data collected on this project. For more information on methods and results of the survey data quality assessments for this survey, refer to section B.2 of this report.

A.4 Survey Coverage

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

Water Depth	Coverage Required
Inshore limit to 3.5 meters (m)	50 m set line spacing Singlebeam Echosounder (SBES). Refer to HSSD Section 5.2.2.4 Set Line Spacing Option C
3.5 m and greater	Complete Coverage Side Scan Sonar (SSS) with concurrent SBES (Refer to the Special Data Handling Requirements Section of the PI)

Table 2: Survey Coverage

The entirety of H13763 was acquired with complete coverage as described in the Special Data Handling Requirements section of the PI and set line spacing in accordance with section 5.2.2.4 Option C of the HSSD (coverage shown in Figure 3). All efforts were made to acquire survey data to the sheet limits or to the Navigable Area Limit Line (NALL), as defined in section 1.3.2 of the HSSD. It should be noted that an exception to the depth that defines NALL, usually 3.5 m, was changed to 2 m at Low Water Datum (LWD) for this project and is stated as such in the PI.

Based on field observations, additional guidance from NOAA HSD OPS was given in respect to the SSS coverage requirements that are outlined in the PI. The additional guidance concluded any area deeper than 3.5 m, which is separated from the main central navigation areas by waters shoal of 3.5 m, on the hydrographer's discretion and keeping safety of navigation in mind, may be treated as an area 3.5 m or less, thus not requiring the collection of side scan data. Additionally, to account for the large areas with a flat shallow isobath, it was also agreed upon that in areas with depths that were deeper than 3.5 m but shoaler than 4 m, the collection of side scan data was not required. Maps were provided to NOAA HSD OPS prior to field closure that displayed the side scan coverage obtained in water sheds and tributaries, areas where the developed guidance was most frequently used. The maps were provided to NOAA HSD OPS to assure compliance and welcome feedback to the employed guidance. See DR Appendix II Supplemental Records for related correspondence.

Throughout the survey area NALL was often defined by safety limitations before the prescribed depth limit (2 m) was met, particularly along the shoreline or inhibited due to the presence of recreational fishing gear. Adaptive techniques and tools were used in the field to document areas where the 2 m depth contour was not reached due to safety concerns. More detail on these methods can be found in the DAPR. Figure 4 provides an example of the area defined by the 2 m NALL specification. Figures 5-8 provide examples of areas where NALL was defined by safety limitations.

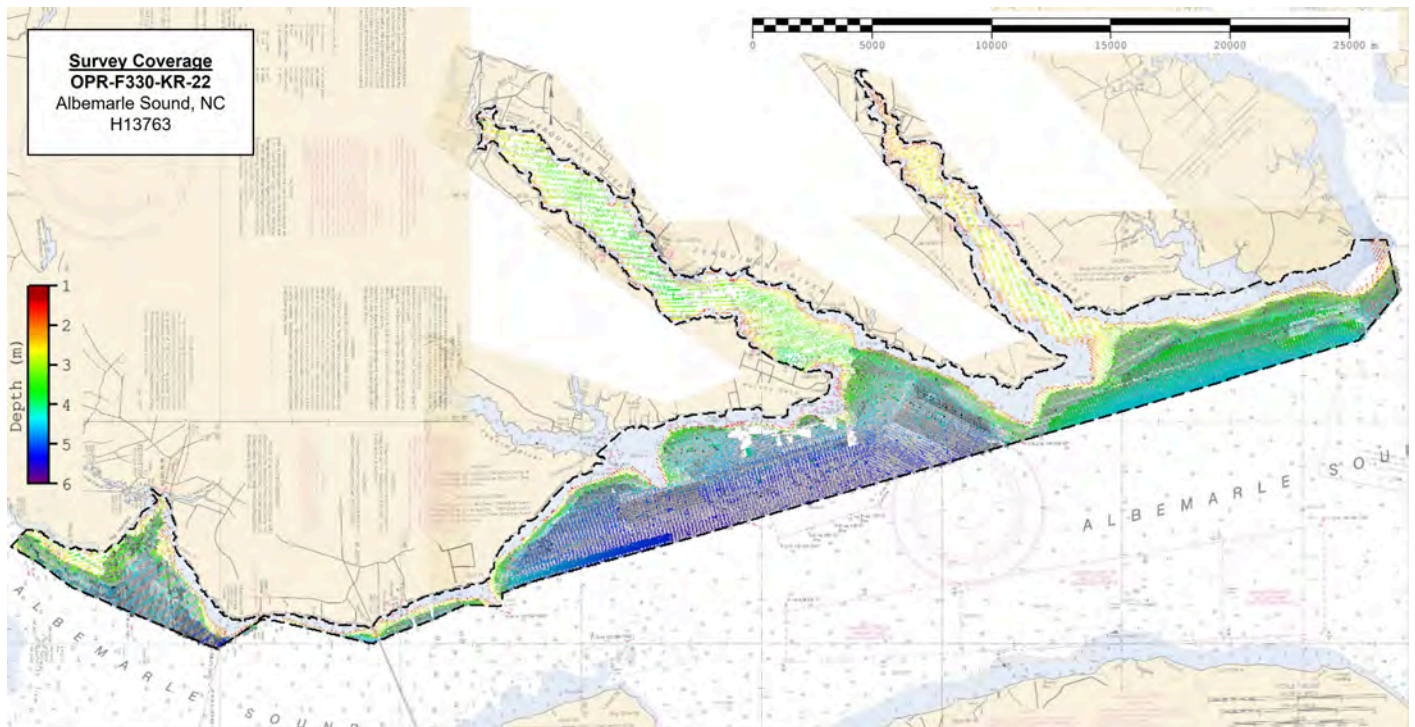


Figure 3: H13763 Complete Coverage SSS (greyscale) with bathymetric coverage and assigned sheet limits in black

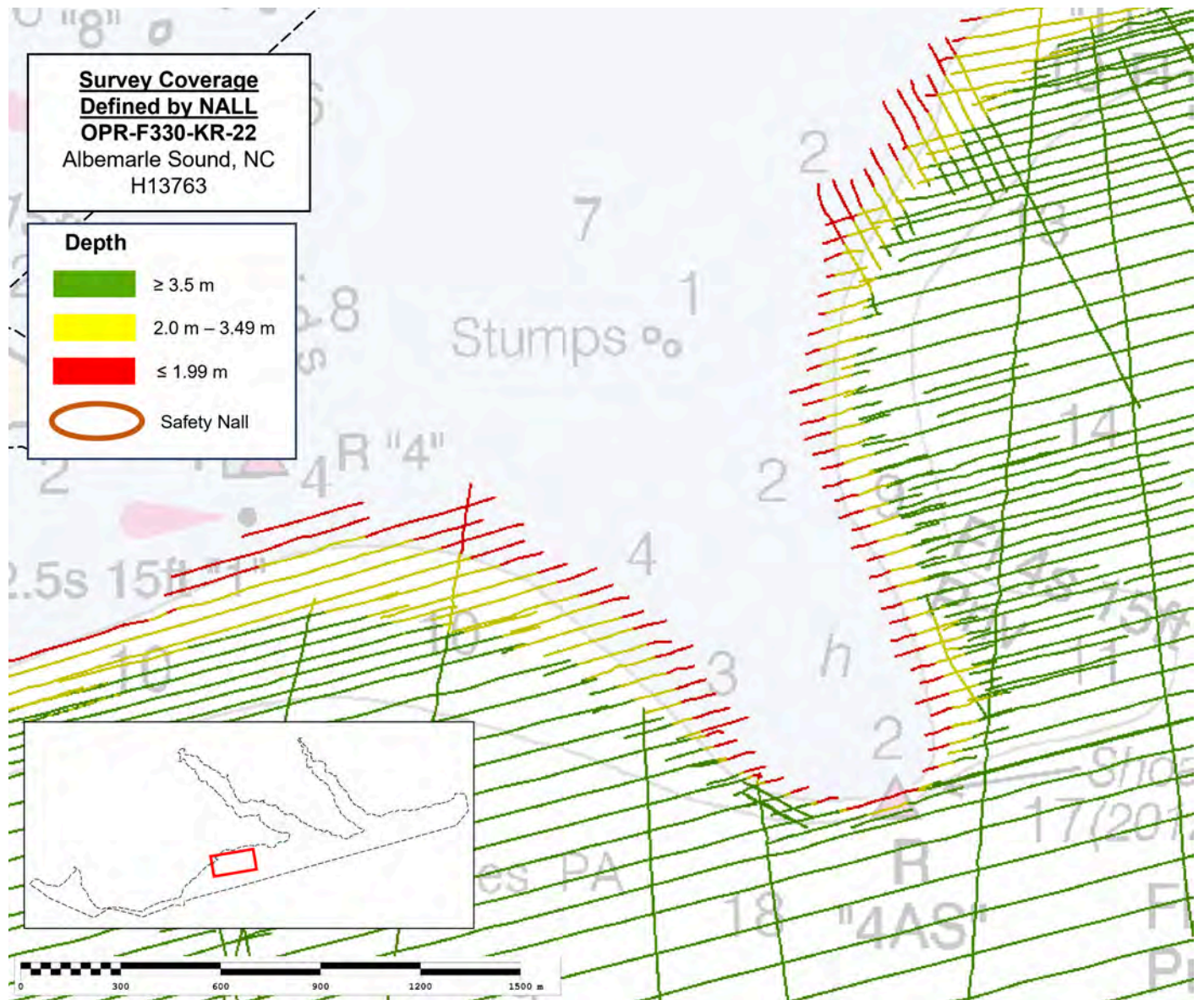


Figure 4: Area in H13763 where NALL is defined by depth (2m)



Figure 5: Area in H13763 where safety defined NALL because of fishing gear

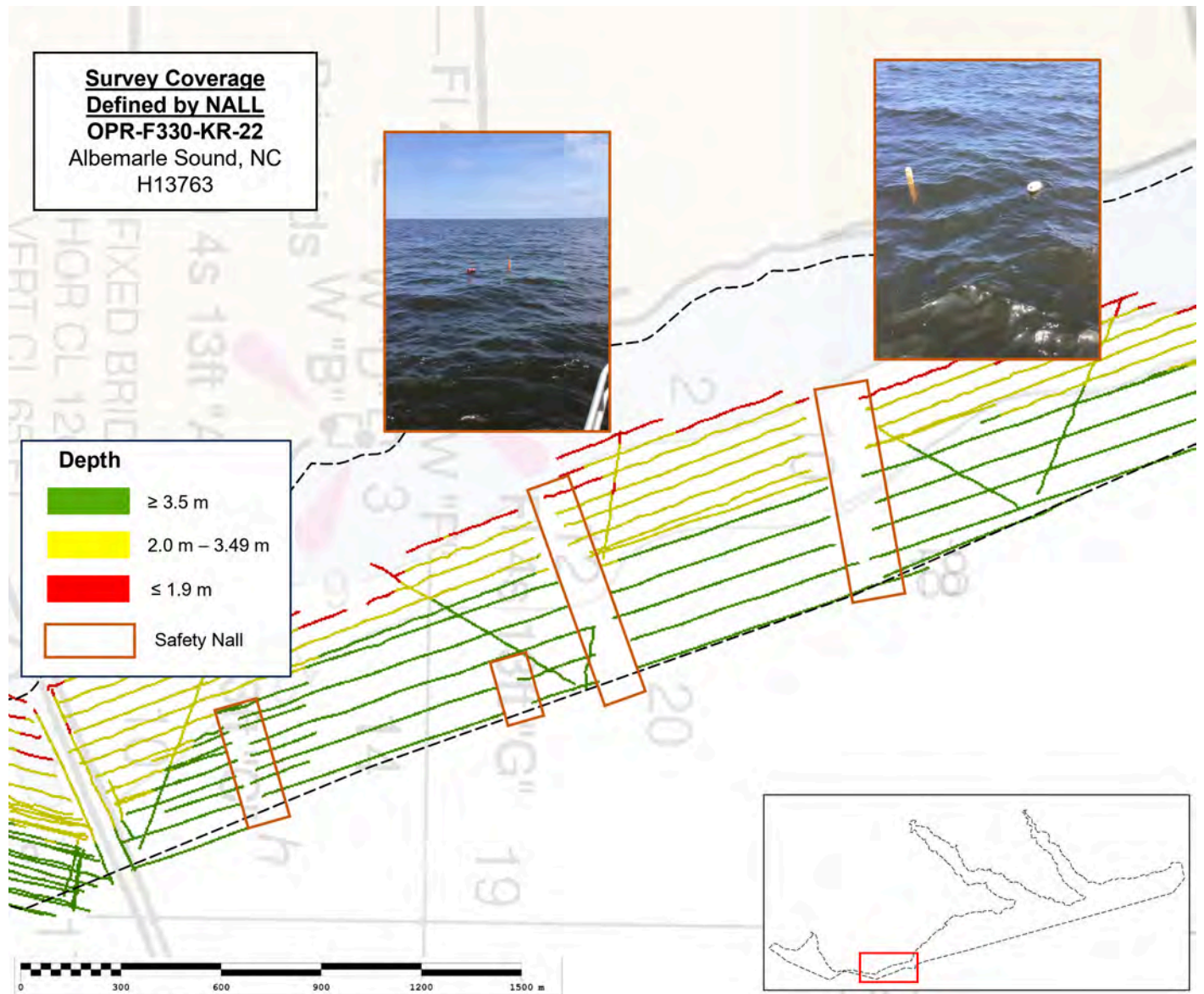


Figure 6: Area in H13763 where safety defined NALL because of fishing gear

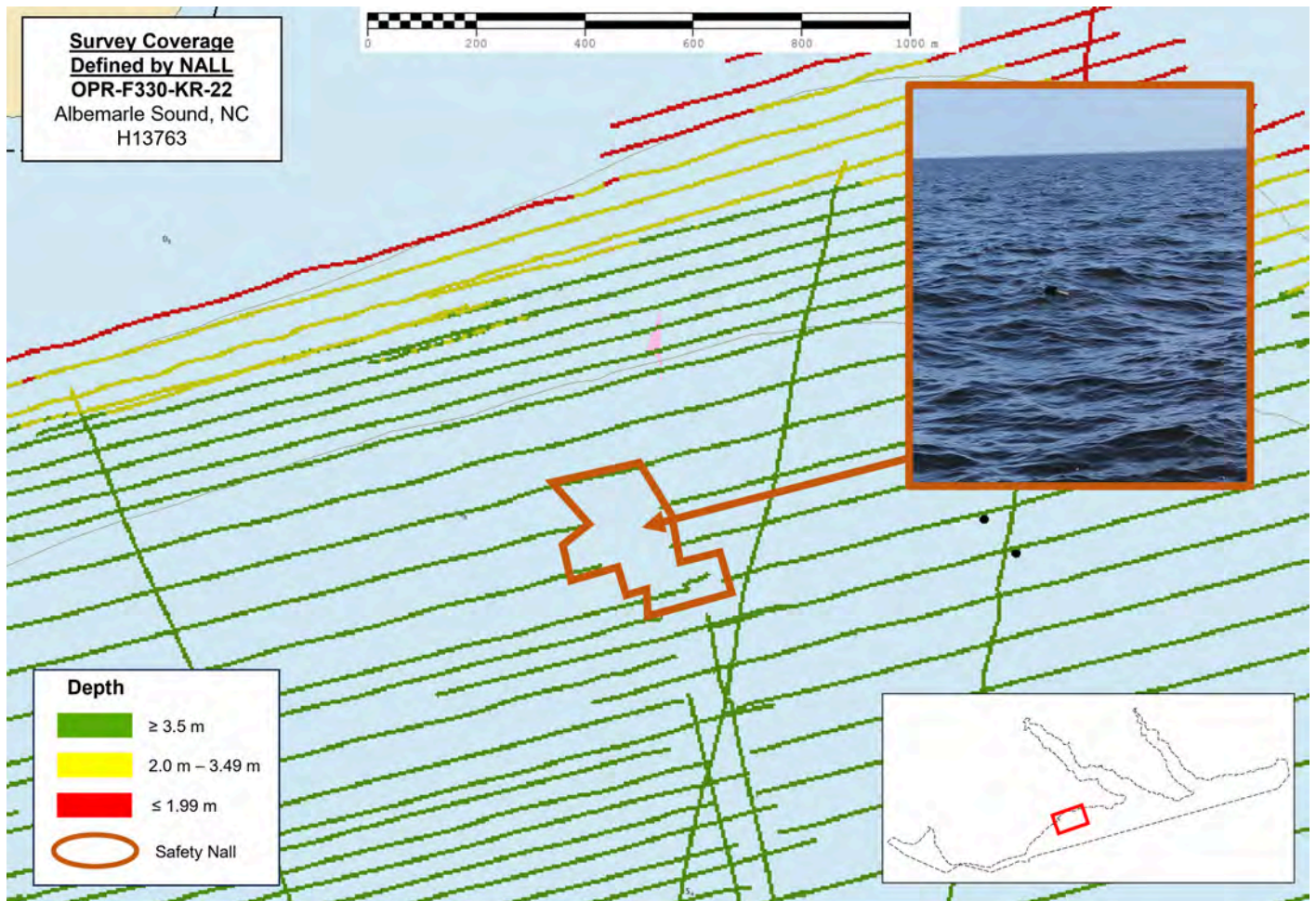


Figure 7: Area in H13763 where safety defined NALL because of fishing gear

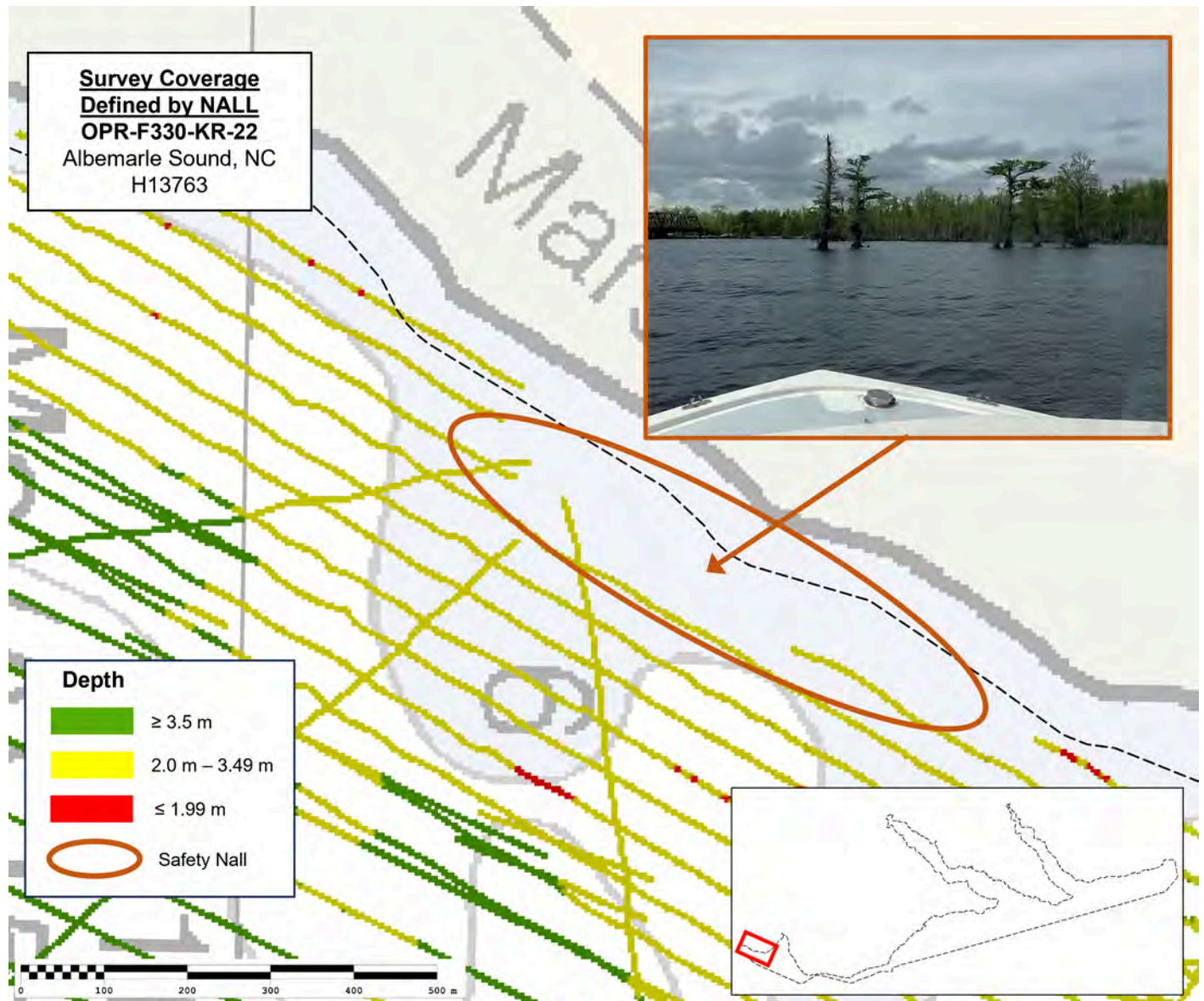


Figure 8: Area in H13763 where safety defined NALL due to the proximity of trees on the shoreline

A.6 Survey Statistics

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

	HULL ID	<i>R/V 4Points</i>	<i>R/V Benthos</i>	<i>R/V Chinook</i>	<i>R/V Substantial</i>	<i>Total</i>
LNM	SBES Mainscheme	688.61	892.43	287.85	0.0	1868.9
	MBES Mainscheme	0.0	61.78	27.67	282.43	371.9
	Lidar Mainscheme	0.0	0.0	0.0	0.0	0.0
	SSS Mainscheme	18.82	724.01	287.98	270.99	1301.8
	SBES/SSS Mainscheme	0.0	0.0	0.0	0.0	0.0
	MBES/SSS Mainscheme	0.0	0.0	0.0	0.0	0.0
	SBES/MBES Crosslines	77.59	71.59	0.0	0.0	149.18
	Lidar Crosslines	0.0	0.0	0.0	0.0	0.0
Number of Bottom Samples						0
Number Maritime Boundary Points Investigated						0
Number of DPs						0
Number of Items Investigated by Dive Ops						0
Total SNM						56.4

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
04/06/2023	96

Survey Dates	Day of the Year
04/11/2023	101
04/12/2023	102
04/13/2023	103
04/14/2023	104
04/15/2023	105
04/17/2023	107
04/18/2023	108
04/19/2023	109
04/21/2023	111
04/23/2023	113
04/25/2023	115
04/26/2023	116
04/27/2023	117
04/29/2023	119
05/02/2023	122
05/03/2023	123
05/04/2023	124
05/05/2023	125
05/06/2023	126
05/07/2023	127
05/08/2023	128
05/09/2023	129
05/10/2023	130
05/11/2023	131
05/12/2023	132
05/13/2023	133
05/14/2023	134
05/15/2023	135
05/16/2023	136
05/17/2023	137
05/22/2023	142
05/23/2023	143

Survey Dates	Day of the Year
05/29/2023	149
05/30/2023	150
05/31/2023	151
06/01/2023	152
06/02/2023	153
06/03/2023	154
06/04/2023	155
07/07/2023	188
07/08/2023	189
08/11/2023	223
08/15/2023	227
08/16/2023	228
08/17/2023	229
08/18/2023	230
08/19/2023	231
08/20/2023	232
08/21/2023	233
08/22/2023	234
08/24/2023	236
08/25/2023	237
09/04/2023	247
09/05/2023	248
09/18/2023	261
09/19/2023	262
09/21/2023	264
09/26/2023	269
09/27/2023	270
09/28/2023	271
09/29/2023	272
10/01/2023	274
10/02/2023	275
10/04/2023	277

Survey Dates	Day of the Year
10/06/2023	279
11/08/2023	312
11/09/2023	313

Table 4: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the OPR-F330-KR-22 Data Acquisition and Processing Report (DAPR) for a complete description of data acquisition and processing systems, survey vessels, quality control procedures and data processing methods. Additional information to supplement sounding and survey data, and any deviations from the DAPR are discussed in the following sections.

B.1.1 Vessels

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

Hull ID	<i>R/V 4Points</i>	<i>R/V Benthos</i>	<i>R/V Chinook</i>	<i>R/V Substantial</i>
LOA	7.62 meters	9.14 meters	9.44 meters	18.0 meters
Draft	0.91 meters	0.61 meters	0.61 meters	2.22 meters

Table 5: Vessels Used

B.1.2 Equipment

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

Manufacturer	Model	Type
Kongsberg Maritime	EM 2040C	MBES
Teledyne Odom Hydrographic	Echotrac CV100	SBES
Teledyne Odom Hydrographic	Echotrac E20	SBES
EdgeTech	4205	SSS
Applanix	POS MV OceanMaster	Positioning and Attitude System
AML Oceanographic	MVP30-350	Sound Speed System
AML Oceanographic	BaseX2	Sound Speed System
AML Oceanographic	AML-3 LGR	Sound Speed System
AML Oceanographic	MicroX SV	Sound Speed System

Table 6: Major Systems Used

The R/V Benthos and R/V 4-Points were installed with a Teledyne Echotrac E20 while the R/V Chinook was installed with a Teledyne Echotrac CV100 singlebeam system. All vessels utilized a dual-head Kongsberg EM 2040C multibeam system, a POS M/V OceanMaster positioning and attitude system, an EdgeTech 4205 side scan towfish for side scan operations, and AML Oceanographic surface sound speed units. The R/V Benthos and R/V Chinook utilized an AML BaseX2 system for sound speed profiles, the R/V 4-Points utilized an AML-3 LGR, and the R/V Substantial utilized an AML MVP30-350. Further details on equipment and software used can be found in the DAPR.

B.2 Quality Control

B.2.1 Crosslines

Singlebeam crosslines acquired for H13763 totaled 6.65% of mainscheme acquisition. In conjunction with the NOAA HSD PM/COR, it was agreed upon that a crossline percentage of approximately 5% of the mainscheme linear nautical miles was acceptable for mixed coverage sheets. Please see DR Appendix II Supplemental Records for the related correspondence.

H13763 crosslines were collected and analyzed in accordance with section 5.2.4.2 of the HSSD. Crosslines were evaluated in CARIS HIPS with a detailed visual inspection followed by a thorough statistical analysis. To conduct the statistical analysis, a 4 m surface was generated with strictly mainscheme data and another, separate 4 m surface was generated with only crossline data. The mainscheme surface was created by mosaicking the mainscheme 4 m SBES CARIS Uncertainty surface (using the shoal layer) with the 1 m MBES CUBE surface (depth layer). A separate 4 m SBES Uncertainty surface containing only crosslines

was created and the shoal layer from that surface was used for analysis. It should be noted in mixed coverage sheets crosslines were SBES only. The mainscheme and crossline files were analyzed using the Compare Grids tool in Pydro Explorer, which generated a difference surface and associated statistics. In addition to the direct statistics from the surface differencing, the tool assessed the difference surface statistics and computed the proportion of NOS total allowable vertical uncertainty (TVU) consumed by the mainscheme to crossline differences per surface node.

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.13 m, with a mean difference of 0.03 m (Figure 9). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.

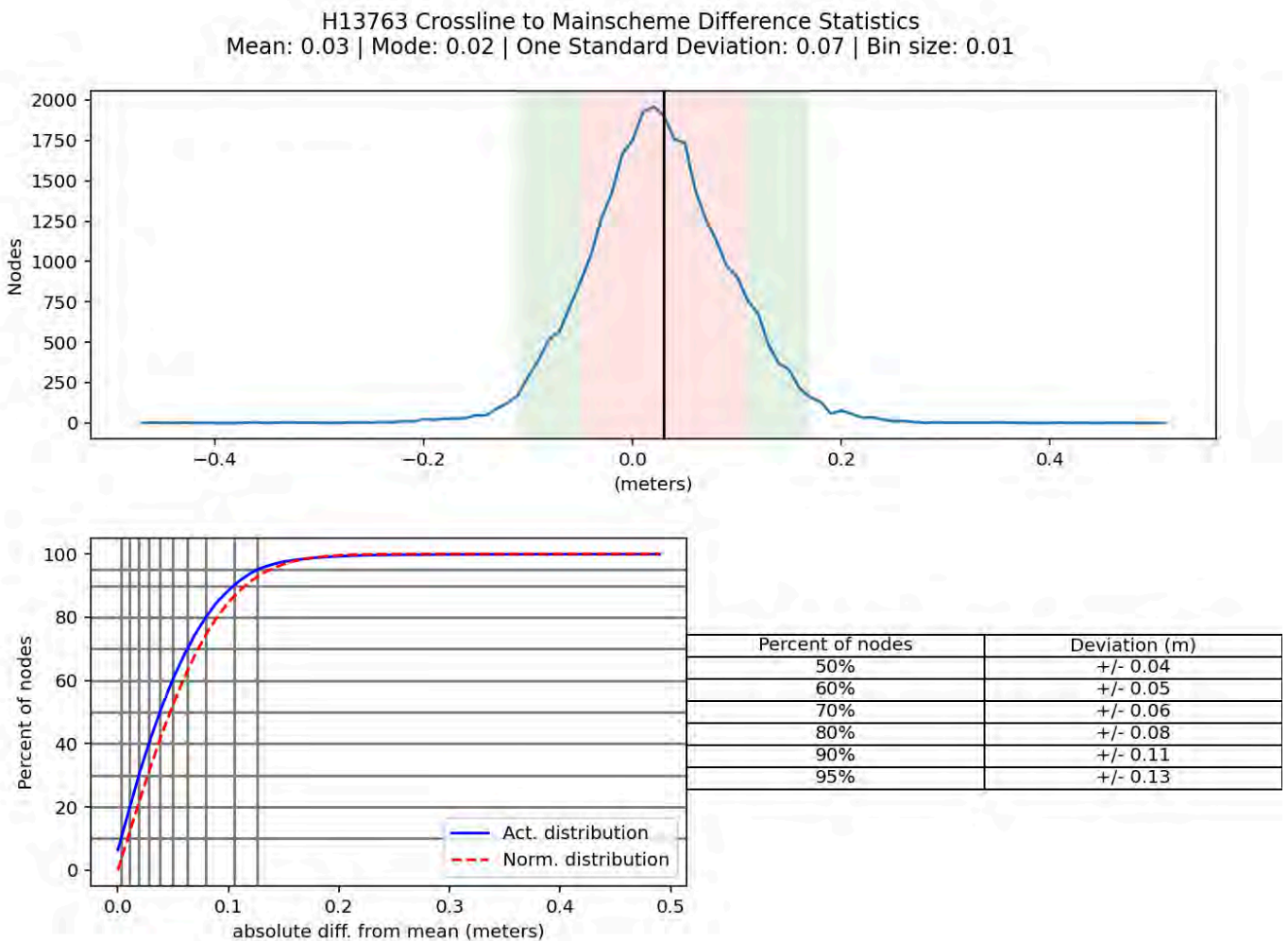


Figure 9: H13763 crossline to mainscheme difference statistics

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.0 meters	0.08 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
R/V 4Points	2.00 meters/second	N/A meters/second	N/A meters/second	0.05 meters/second
R/V Benthos	2.00 meters/second	N/A meters/second	N/A meters/second	0.05 meters/second
R/V Chinook	2.00 meters/second	N/A meters/second	N/A meters/second	0.05 meters/second
R/V Substantial	N/A meters/second	2.00 meters/second	N/A meters/second	0.05 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

The finalized CUBE and Uncertainty surfaces were analyzed using the HydrOffice QC Tools Grid QA tool to assure 95% of the surface nodes meet TVU specifications. The results of the Grid QA tool determined that the finalized CUBE and Uncertainty surfaces met or exceeded the TVU specifications, as shown in Figures 10-11.

The multibeam surface was finalized with the computed uncertainty, derived from a mix of a priori and real-time uncertainty estimates, assigned as the uncertainty value. The singlebeam surface was finalized with the standard deviation of soundings at 95% confidence interval assigned as the uncertainty value.

It should be noted that the uncertainty associated with the SEP model is applied in CARIS as the GPS sounding datum for multibeam data and applied as Tide Zoning for singlebeam data.

Additional details related to uncertainty methods may be found in the DAPR.

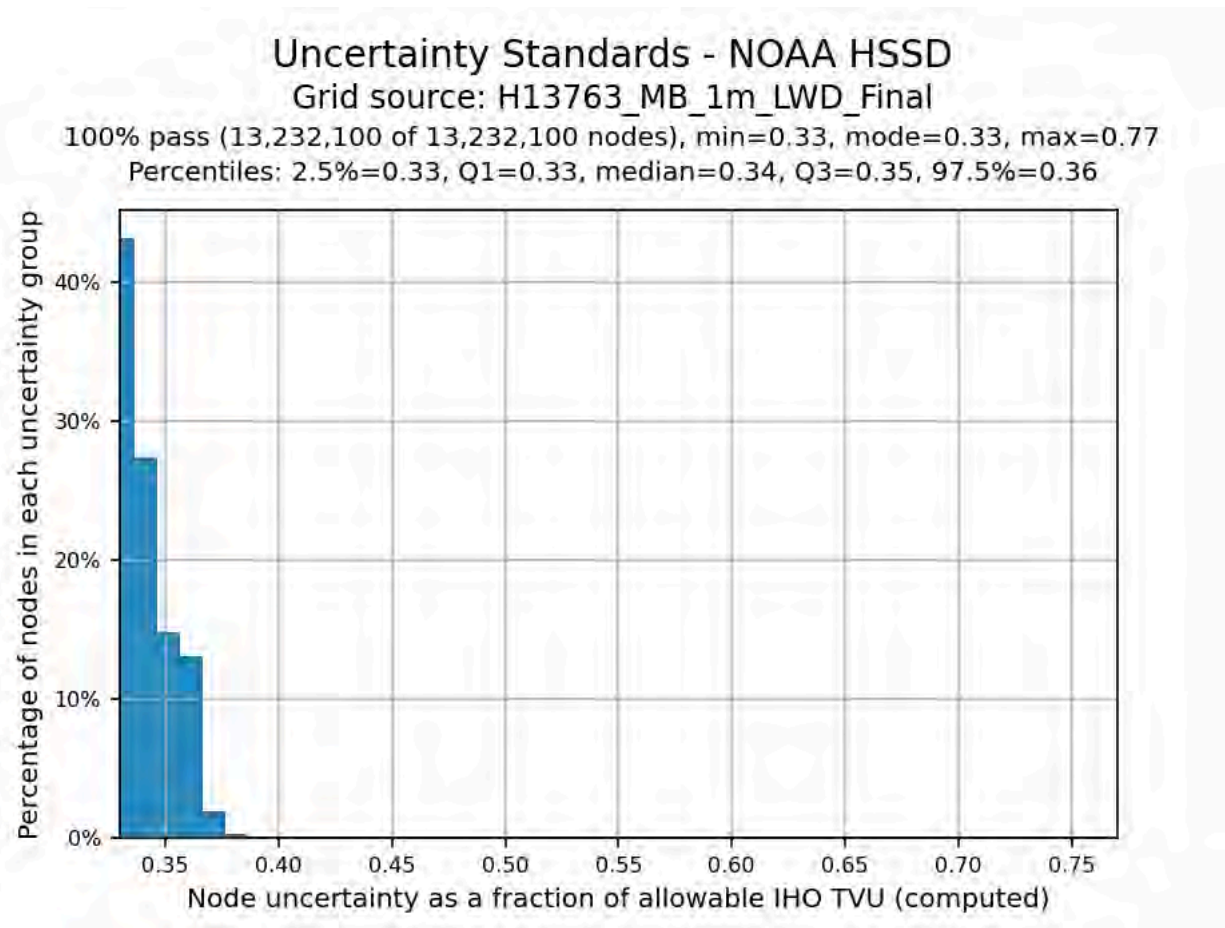


Figure 10: Finalized 1 m MBES CUBE surface TVU statistics for H13763

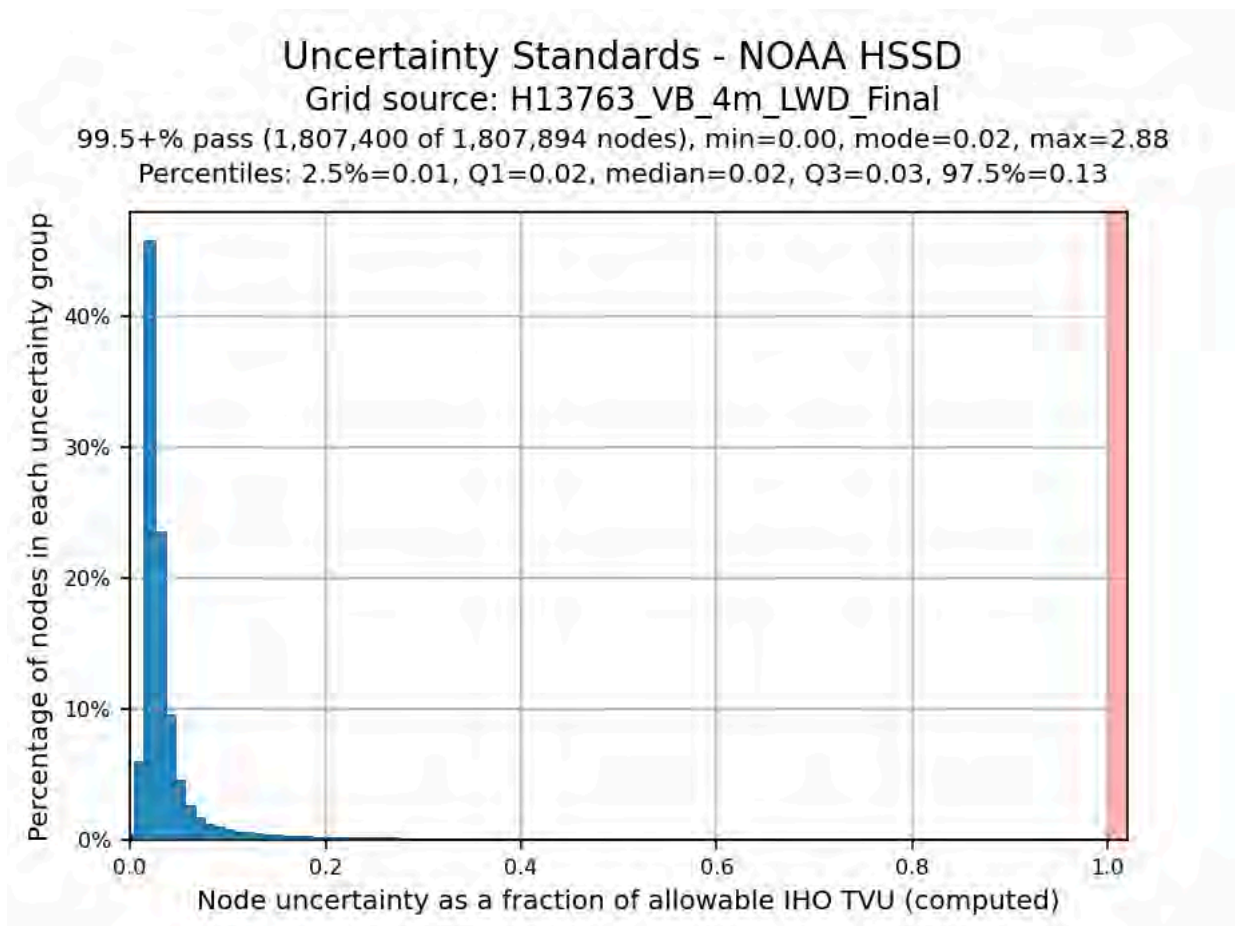


Figure 11: Finalized 4 m SBES Uncertainty surface TVU statistics for H13763

B.2.3 Junctions

No junctioning surveys were provided for this project (see PI). However, H13763 junctions with H13758, H13760, H13761, and H13764 (Figure 12). Data overlap between H13763 and the adjacent surveys were attained. To conduct the junction analyses, similar to section B.2.1 of this report, the Pydro Compare Grids tool was utilized. Please reference the Descriptive Reports of the aforementioned surveys for the junction analyses. In addition to the statistical results of the junction analyses, the resultant difference surfaces were visually inspected and CARIS HIPS Subset Editor was used to examine overlapping data for consistency, agreement between surveys, and confirming data met TVU specifications.

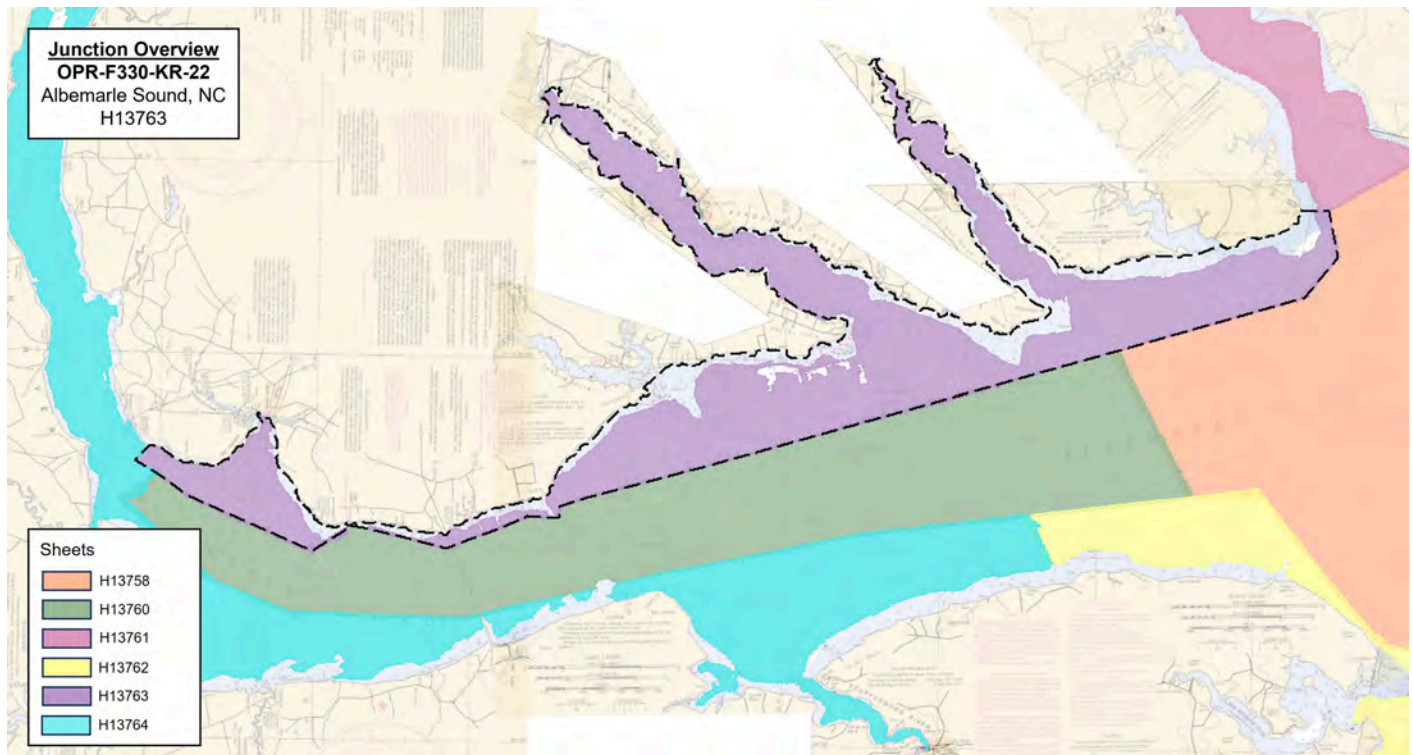


Figure 12: Overview of H13763 junction surveys

There are no contemporary surveys that junction with this survey.

B.2.4 Sonar QC Checks

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

B.2.5 Equipment Effectiveness

Environmental Influences Affecting Side Scan Imagery

Throughout the duration of the survey, side scan acquisition frequently encountered environmental conditions which affected portions of the swath which would hinder the selection of contacts in the affected regions. The persistent challenging environmental influences were communicated with NOAA HSD OPS in the field and was additionally discussed with AHB prior to sheet submission (see project correspondence). These environmental conditions included numerous bait balls (biologic organisms suspended within the water column), vessel prop wash, and effects from water column stratification.

The affected portions of side scan imagery which would be considered a holiday due to environmental effects were identified and reacquired with either side scan or multibeam bathymetry to meet the complete coverage requirements. The SSS lines that were reacquired frequently encountered similar environmental

influences, and the final mosaic has been layered as best as possible to minimize the portrayal of artifacts. The side scan sonar mosaics are not free from environmental influences, but multiple methods were taken to ensure complete coverage was achieved and side scan sonar imagery was sufficient to identify a 1m x 1m x 1m target.

An example of the effects of water column stratification on the SSS imagery collected near Harvey Point, is shown below in Figure 13. Following the initial processing of the SSS imagery in this area, recovery infill line plans were created, and additional SSS imagery was acquired to address the areas of environmental influences, as shown in Figure 14.

The side scan imagery at the mouth of the Yeopim River features speckled artifacts that were the result of the aforementioned bait balls suspended in the water column (Figure 15). Particular detail was given to this area to review these artifacts and reacquire the worst areas with side scan infill or multibeam bathymetry as previously described. Remaining imagery in this area that was not reacquired was deemed permissible, and bait balls included in the imagery were not deemed to be considered environmental holidays (inhibiting the detection of a 1 x 1 x 1 m object).

At the discretion of the hydrographer, occasionally recoveries for environmental influences present in the SSS mosaic were recovered with MBES. Figure 17 illustrates the use of MBES coverage to address more dispersed environmental influence artifacts in the SSS mosaic.

More details on the methods used to ensure complete coverage, assess side scan sonar image quality, and clarifications on the final mosaics can be found in the DAPR and were additionally discussed in the pre-submission meeting with AHB (see project correspondence).

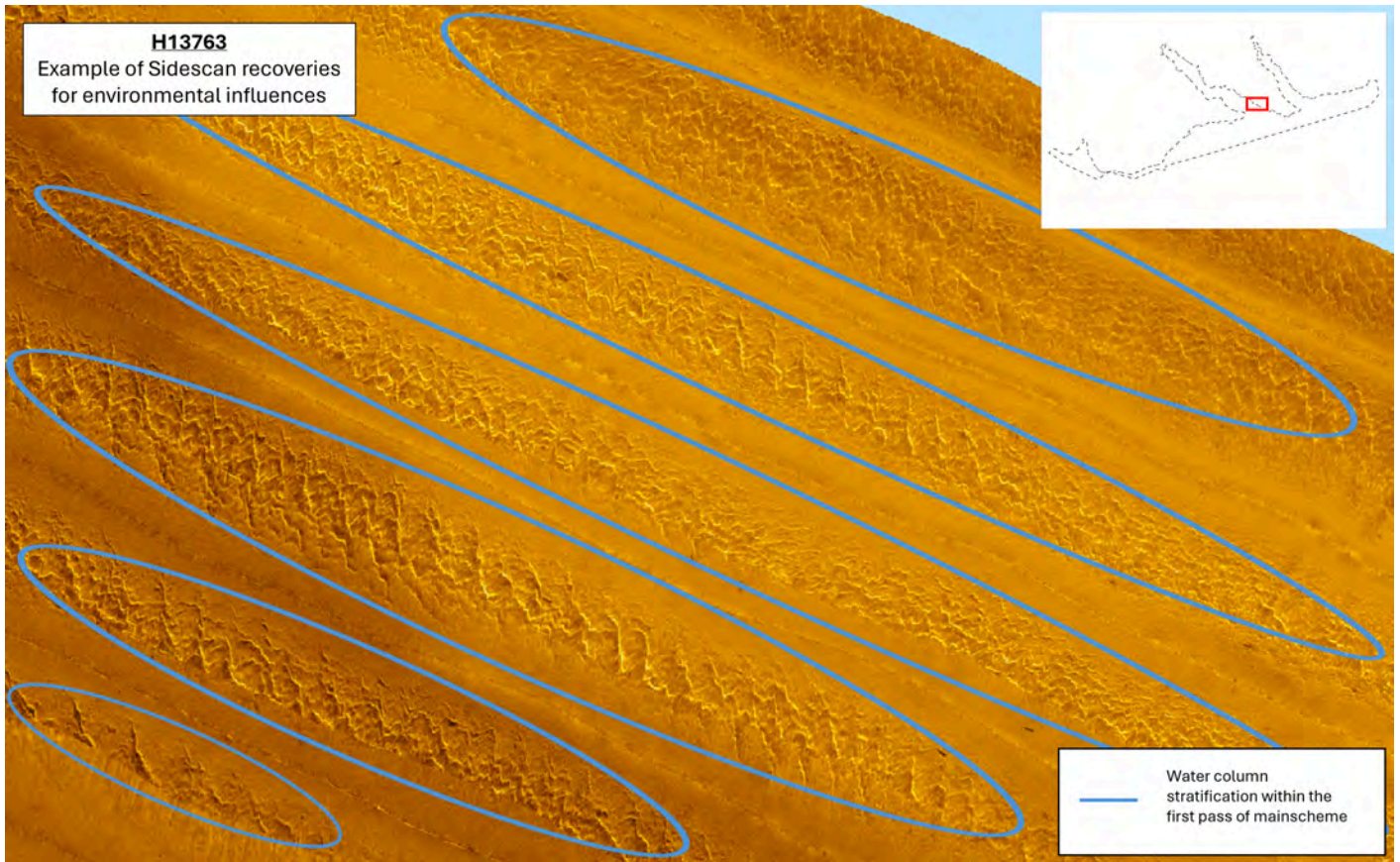


Figure 13: Example of environmental influences affecting SSS imagery which were persistent throughout the survey area

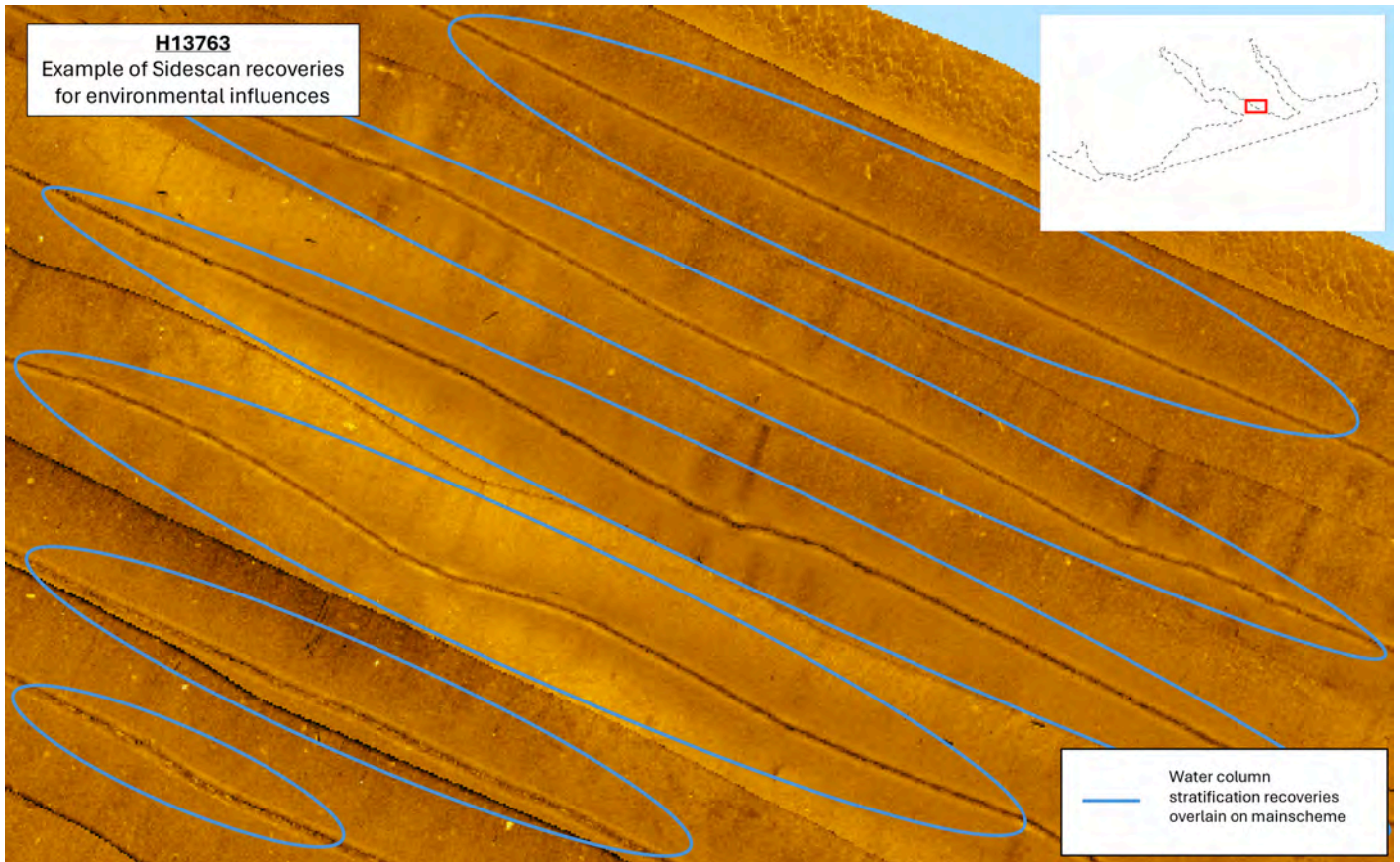


Figure 14: Example of lines reacquired as infill for the environmental influences as shown in Figure 11 above

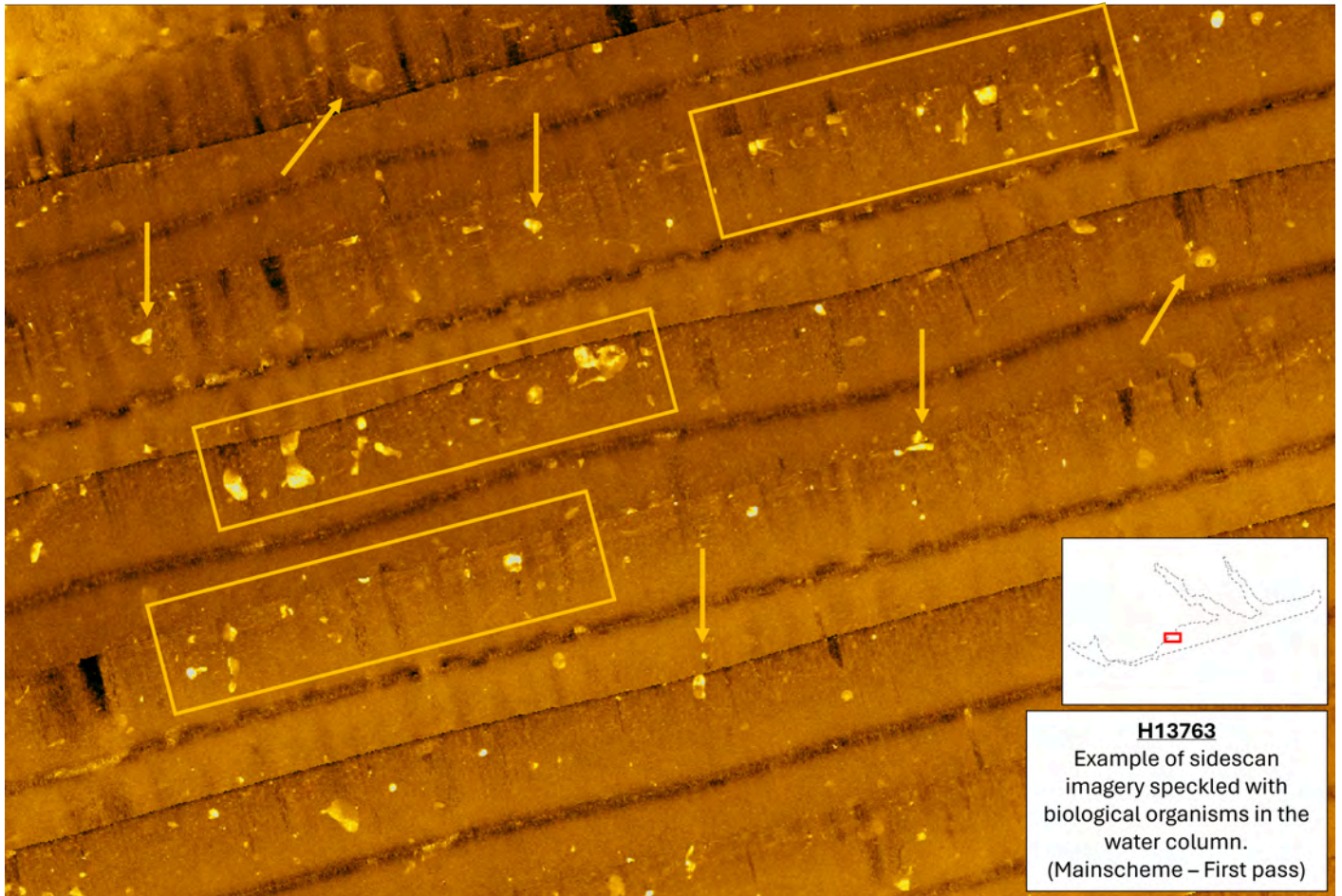


Figure 15: Example of biological influences affecting SSS imagery which were persistent throughout the survey area

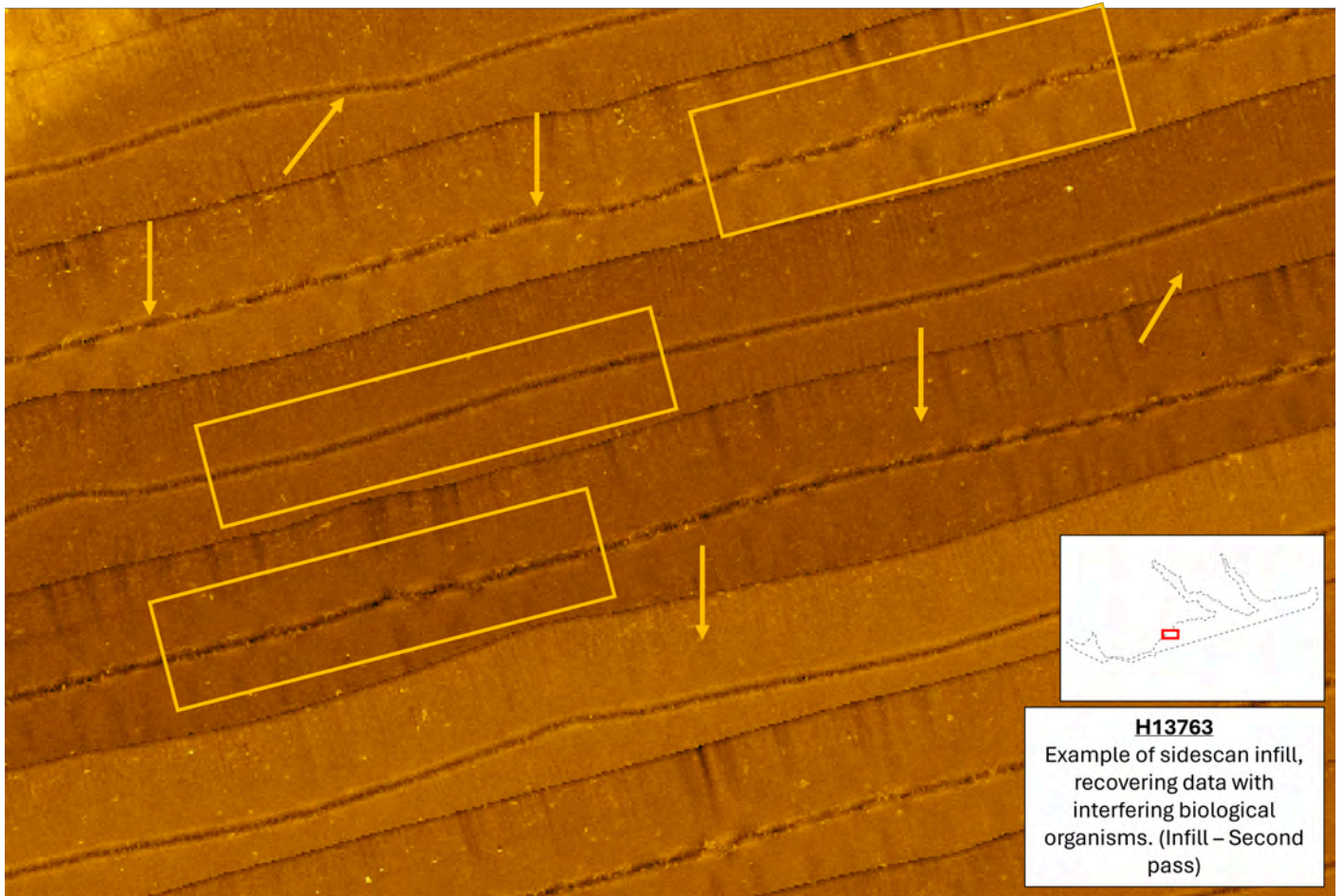


Figure 16: Example of lines reacquired as infill for the biological influences as shown in Figure 13 above

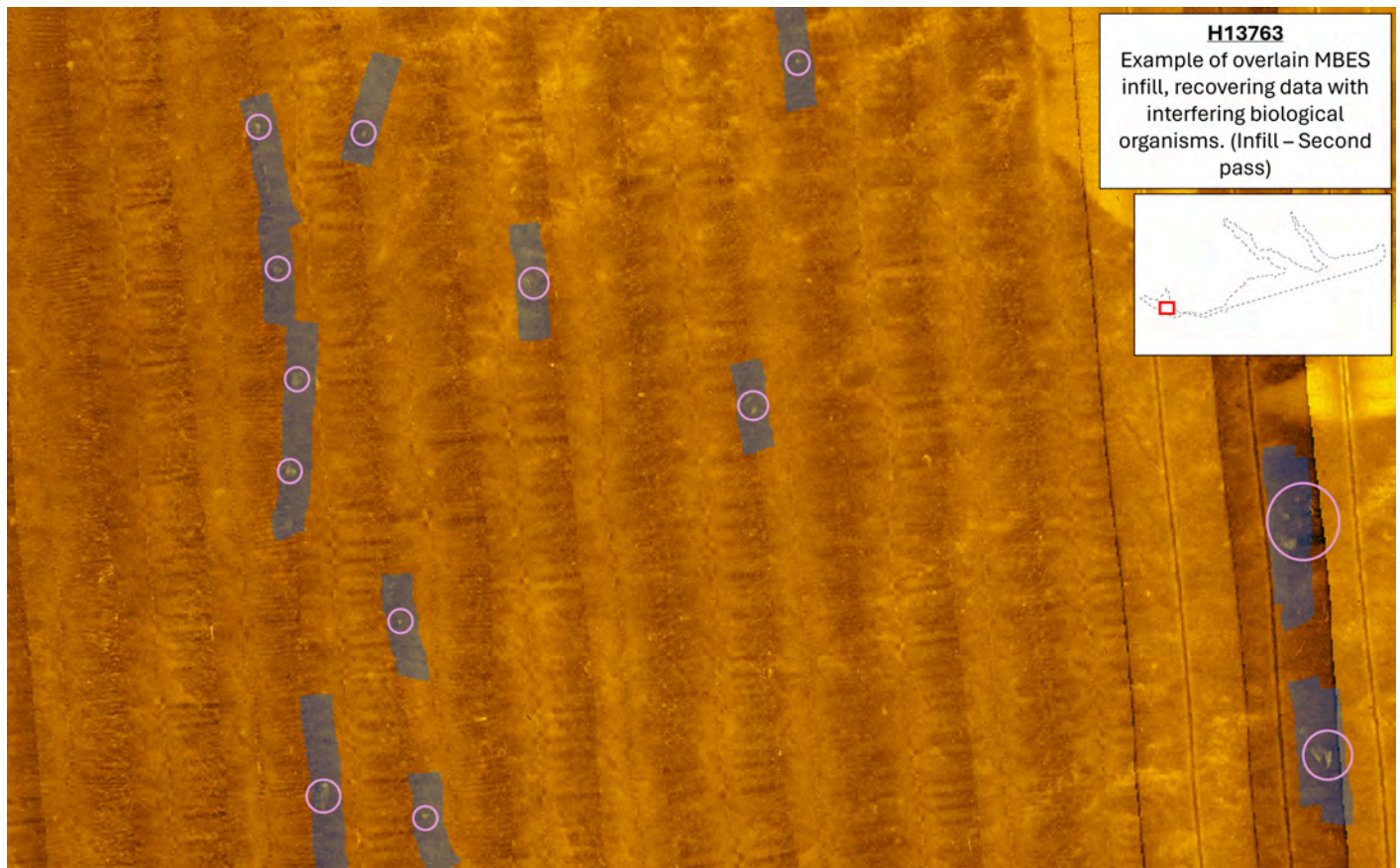


Figure 17: Example of SSS imagery blocked by biological organisms and reacquired with multibeam

Side Scan Towfish Altitude and Coverage Requirements

Side scan towfish altitude reports were generated from all side scan navigation data in SonarWiz and examined to ensure compliance with the adjusted altitude specifications as outlined in the PI. Even with the allowable towfish altitude adjusted to 4-20% of the range scale in use (<8m of water depth), occasional deviations were identified. Any side scan lines which did not adhere to the adjusted altitude specifications were identified and the associated .tif images were re-exported from SonarWiz at a range scale which reduced the effective horizontal range to achieve compliance with the towfish altitude requirements. Recoveries were then completed as necessary. Adjusted altitude requirements as well as the approval of the .tif trimming method of addressing deviations from the towfish altitude requirements (as outlined in the PI) can be found in the project correspondence as well as detailed in the DAPR.

Hydrographer discretion and best practices were utilized where the depth contour or the NALL defined by safety limitations determined the change in coverage type. Artifacts on the edges of SSS imagery where the coverage type changed were reviewed in detail and reacquired with additional side scan sonar or multibeam bathymetry when safe and practicable.

Recreational Fishing Gear

Throughout the survey area, crab pots and other types of recreational fishing gear were observed or identified within the data. Particular attention was taken to avoid gear interactions and promote the safety of vessels and equipment, and at times defined the survey limits, as described in section A.4. Crab pots were often identified within the side scan sonar imagery or multibeam data and found to be of dimensions that did not warrant investigation. These objects were rejected from the MBES data if they caused the surface to be pulled past TVU, but were otherwise not rejected. Please see the DAPR and section D.1.4 of this report for more information on fishing stakes.

B.2.6 Factors Affecting Soundings

Sounding Attenuation

While acquiring SBES data in H13763, especially in the Perquimans and Little River, hydrographers noticed a layering effect or 'double return' in the echogram, causing the soundings to jump from one layer to another. When this double return was noticed in the E20 software, hydrographers would manually adjust the gain and power settings within the software to better digitize the bottom. During post-processing, in Hypack SBMAX (64-bit), the hydrographer would confirm the return utilized to ensure sounds reflected the most accurate depth in relation to safety of navigation.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: When collecting multibeam data, casts were often taken every two hours, never exceeding the four hour limit, and immediately following transit to a new location. When collecting SBES data, generally two casts per day were conducted.

During MBES data collection, surface sound speed was compared in real-time to the sound speed profile. When the comparison differed by more than 2 m/s, a new sound speed profile was acquired. Additionally, Hypack and Kongsberg SIS provided a real-time visual assessment of data quality (bathymetric grids, swath views) aiding the hydrographer in determining when a new cast was required.

For more detailed information on sound speed methods, refer to the DAPR.

B.2.8 Coverage Equipment and Methods

All equipment and survey methods were used as detailed in the DAPR.

B.2.9 Density

The finalized CUBE and Uncertainty surfaces were analyzed using HydrOffice QC Tools Grid QA tool to assure data met the required density specifications. Density requirements were achieved for the finalized surfaces in H13763 with at least 95% of the MBES CUBE surface nodes (Figure 18) and at least 95% of the SBES Uncertainty surface nodes (Figure 19) containing at least five or more soundings, exceeding the specifications required by section 5.2.2.3 of the HSSD.

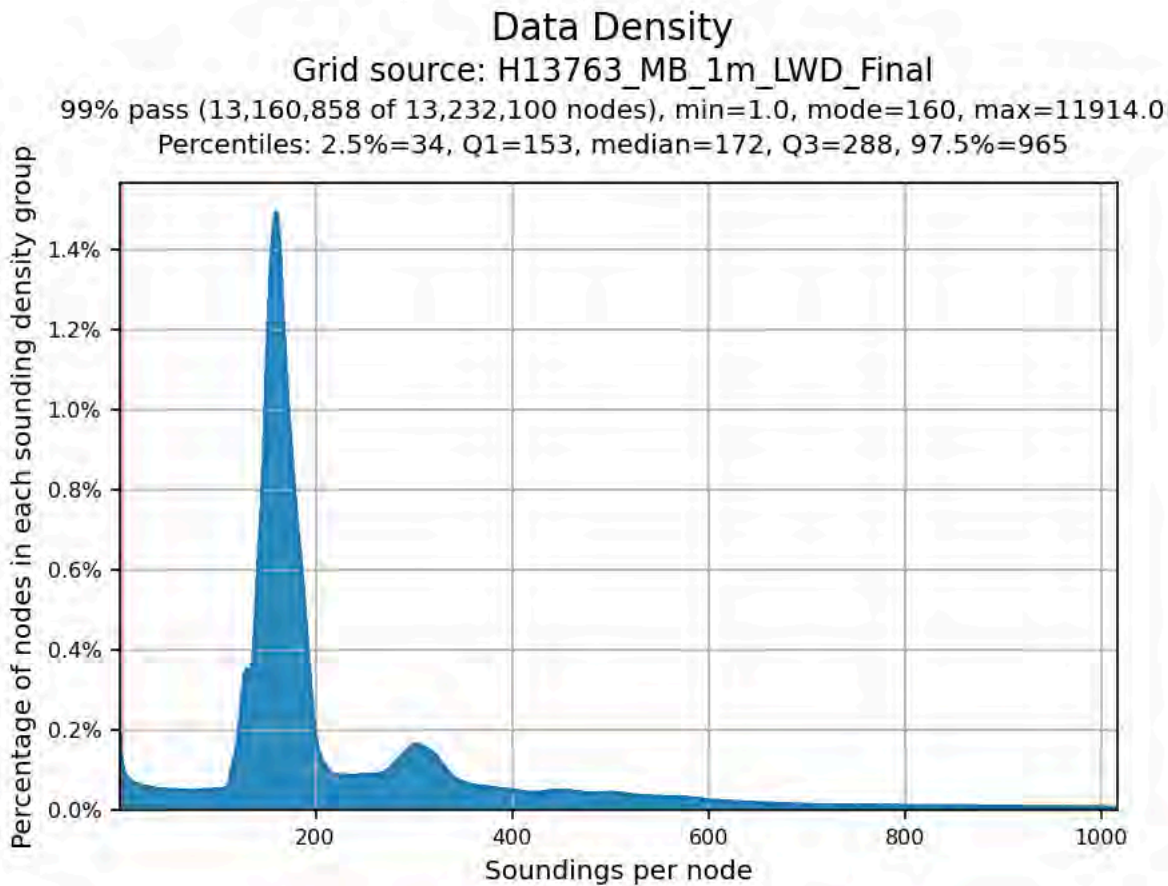


Figure 18: Finalized 1 m MBES CUBE surface density statistics for H13763

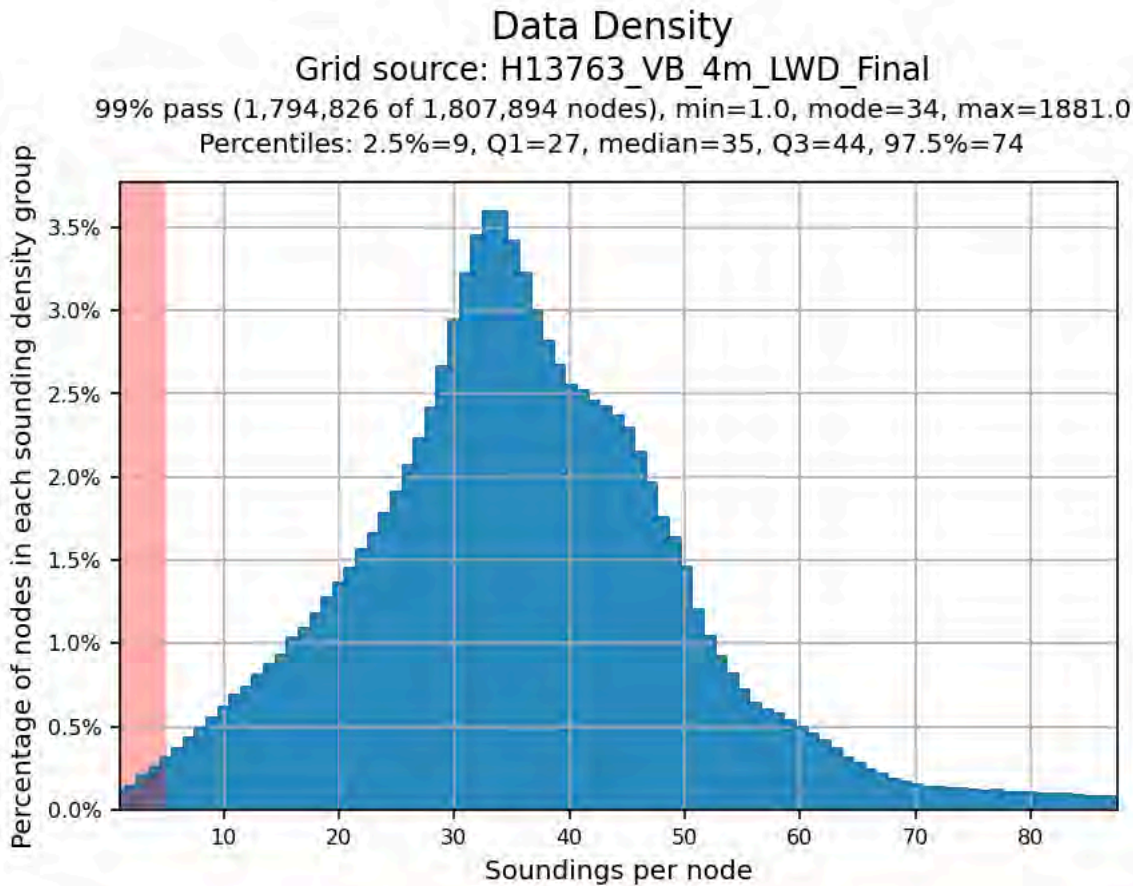


Figure 19: Finalized 4 m SBES Uncertainty surface density statistics for H13763

B.2.10 Flier Finder

In addition to a visual inspection, the multibeam CUBE surface was analyzed using HydrOffice QC Tools Flier Finder tool to assure data does not contain fliers (anomalous data as defined by QC Tools flier finding algorithms #2-5). While the Flier Finder tool flags surface fliers meeting a set criteria, it will also flag real surface features that meet the same criteria. Spurious soundings flagged by Flier Finder were cleaned until either no fliers remained or the remaining flagged fliers were deemed valid aspects of the surface.

For SBES flier identification, the Uncertainty surface shoal layer was reviewed manually in CARIS. In addition to a thorough visual inspection of the surface, the review involved applying display filters to the surface that flagged potential fliers and helped the hydrographer spot any anomalies. An emphasis was put on manual inspection because the Flier Finder tool in Pydro was found to be unreliable when searching for fliers in the SBES surfaces. See DAPR for more information on SBES quality control measures.

B.2.11 Holidays

All CUBE surfaces were analyzed using HydrOffice QC Tools Holiday Finder to determine if the surfaces contained holidays, as described in section 5.2.2.3 of the HSSD. The tool scanned the CUBE surfaces, identifying any holidays, and generated an S-57 file to illustrate the locations of holidays.

Another method of holiday evaluation was to visually pan the surfaces to identify holidays. The hydrographer would often alter the surface display (color ranges, symbology, shading) to help aid the hydrographer in identifying coverage gaps. The results reflected the same outcome as the tool. These manual evaluation methods were also employed to assess SBES.

The main source of data gaps in the MBES surface were the result of dense bait balls which were additionally identified in the side scan imagery. These erroneous soundings were rejected by the hydrographer, were recovered with additional MBES data, and are not reflected in the final surface.

The side scan mosaic was extensively reviewed for environmental influences which would prevent the detection of a 1m x 1m x 1m object, and where those were identified, additional SSS or MBES data was acquired to meet complete coverage requirements.

Additional information on data quality management can be found in the DAPR.

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

Raw backscatter data were collected and stored within the .ALL files. Backscatter data were processed and reviewed for quality assurance in QPS FMGT. In accordance with the HSSD, GSFs and backscatter mosaics were exported from FMGT. Hydrographers in the field monitored backscatter intensities in real-time and

made efforts to collect quality backscatter without hindering bathymetric data quality. Refer to the DAPR for more information on backscatter data acquisition and processing procedures.

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
CARIS	HIPS and SIPS	11.4.20
CARIS	HIPS and SIPS	11.4.22
CARIS	HIPS and SIPS	11.4.26
Xylem	Hypack	2022.Q3

Table 9: Primary bathymetric data processing software

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

Manufacturer	Name	Version
QPS	FMGT	7.10.1
Chesapeake Technologies	SonarWiz 7	7.10.02

Table 10: Primary imagery data processing software

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

It should be noted values for singlebeam surfaces are representative of the shoal layer. The singlebeam grid contains bathymetry data for both set line spacing and for filling the SSS nadir gap in full coverage areas. The multibeam CUBE surface is for fill and investigations, and filling the SSS nadir gap in some full coverage areas in agreement with NOAA HSD OPS. See DAPR for more details on the utilization of each sensor.

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
H13763_VB_4m_LWD_Final	CARIS Raster Surface (Uncertainty)	4 meters	0.84 meters - 6.47 meters	NOAA_4m	SBES Set Line Spacing
H13763_VB_4m_LWD	CARIS Raster Surface (Uncertainty)	4 meters	0.84 meters - 6.47 meters	NOAA_4m	SBES Set Line Spacing
H13763_MB_1m_LWD_Final	CARIS Raster Surface (CUBE)	1 meters	1.09 meters - 7.15 meters	NOAA_1m	Complete MBES
H13763_MB_1m_LWD	CARIS Raster Surface (CUBE)	1 meters	2.9 meters - 7.15 meters	NOAA_1m	Complete MBES
H13763_SSSAB_1m_540kHz_1of2	SSS Mosaic	1 meters	-	NOAA_1m	100% SSS
H13763_SSSAB_1m_540kHz_2of2	SSS Mosaic	1 meters	-	NOAA_1m	200% SSS
H13763_MBAB_2m_Benthos_300kHz_1of1	MB Backscatter Mosaic	2 meters	-	NOAA_2m	Complete MBES
H13763_MBAB_2m_Chinook_300kHz_1of1	MB Backscatter Mosaic	2 meters	-	NOAA_2m	Complete MBES
H13763_MBAB_2m_Substantial_300kHz_1of1	MB Backscatter Mosaic	2 meters	-	NOAA_2m	Complete MBES

Table 11: Submitted Surfaces

"H13763_SSSAB_1m_540kHz_1of2" represents the 100% complete coverage of the mainscheme acquisition sheetwide, while "H13763_SSSAB_1m_540kHz_2of2" is the 200% coverage required for feature disproval.

It should be noted that SBES data were cleaned with an emphasis to best represent objects extending from the seafloor. The shoal layer within the Uncertainty surface best represents these objects in the grid. These objects were not investigated further because of safety limitations.

All surfaces submitted are in compliance with the set line spacing requirement per section 5.2.2.4 Option C of the HSSD and the Complete Coverage SSS with Concurrent SBES Requirements outlined in the PI.

In addition to the surfaces listed above, interpolated grids were generated and delivered in accordance with PI and guidance from NOAA HSD OPS. These additional grids are for the National Water Center deliverable and reflect _NAVD88 in their respective filenames. Reference the DAPR section C.1.4 for more information on interpolation and gridding methods, and the project correspondence for more information on National Water Center deliverables.

AHB corrected the resolution in the surface name for the unfinalized vertical beam grid listed above; "H13763_VB_1m_LWD" was changed to "H13763_VB_4m_LWD."

B.5.3 Designated Soundings

H13763 contains 99 designated soundings in accordance with sections 5.2.1.2.3 and 7.4 of the HSSD. These designated soundings were created to facilitate feature management and best represent the least depths of features in the Final Feature File (FFF). In the finalized CUBE surfaces, the CARIS HIPS Apply Designated Soundings function ensured designated sounding depths are retained in the finalized surfaces.

C. Vertical and Horizontal Control

Additional information discussing the vertical or horizontal control for this survey can be found in the accompanying DAPR.

C.1 Vertical Control

The vertical datum for this project is Low Water Datum.

ERS Datum Transformation

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

Method	Ellipsoid to Chart Datum Separation File
ERS via VDATUM	Albemarle_Sound_NAD83- LWD(LMSLxGeoid20B-0.5ft)_m.csar Albemarle_Sound_ITRF- LWD(LMSLxGeoid20B-0.5ft)_m.csar

Table 12: ERS method and SEP file

Real-time positional data were corrected with G2+ Global Navigation Satellite System (GNSS) satellite corrections provided by the Fugro Marinestar Satellite-Based Augmentation System (SBAS). To improve the accuracy of the real-time data, real-time position data were post-processed using Applanix POSPac Mobile Mapping Solution (MMS) software. Trimble CenterPoint RTX correction methods were used to create Smoothed Best Estimate of Trajectory (SBET) files, which were applied to the survey data in CARIS HIPS for all multibeam data and in Hypack for all singlebeam data. For further information regarding processing and application of SBET and SEP files, please reference the DAPR.

C.2 Horizontal Control

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

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

RTK

Real-time positional data were corrected with G2+ GNSS satellite corrections provided by the Fugro Marinestar SBAS.

D. Results and Recommendations

D.1 Chart Comparison

A detailed visual comparison was performed in CARIS HIPS between H13763 and the ENC's listed in Table 13 of section D.1.1. Sounding layers were generated from the CUBE and Uncertainty surfaces and overlaid onto the ENC's to visually assess differences between the surveyed and charted depths.

In addition to a detailed visual inspection in CARIS HIPS, all soundings from the chart were downloaded as a shapefile from NOAA's ENC Direct to GIS application and differenced with the surveyed depths from the 4 m surface in ESRI ArcPro. A statistical analysis of the difference comparison is shown in Figure 20. The surveyed depths from H13763 generally agree with the charted soundings from the largest scale ENC's within the survey area, with a mean difference of -0.29 m (ENC soundings shoaler on average).

Due to the status of the outdated charts and potential risk of excessive bathymetric splits, guidance was provided by NOAA HSD OPS with allowance to omit bathymetric splits when a charted sounding between survey lines was shoal of the surveyed data. Data were reviewed in comparison to the chart but also between surveyed depths, conducting bathymetric splits at hydrographer's discretion. Please see project correspondence and the DAPR for further information on this topic.

In several sections of the Perquimans River, a charting discrepancy was observed during field operations. Chart US4NC53M has a portion of the bank of the river charted as land, however, during field operations the field team collected bathymetric data past the sheet limits this area (Figure 21). An ASSIST report was not submitted for the area because it was uncertain how it will be represented on the chart update and would benefit from the survey data. Updated aerials should be utilized when digitizing the shoreline.

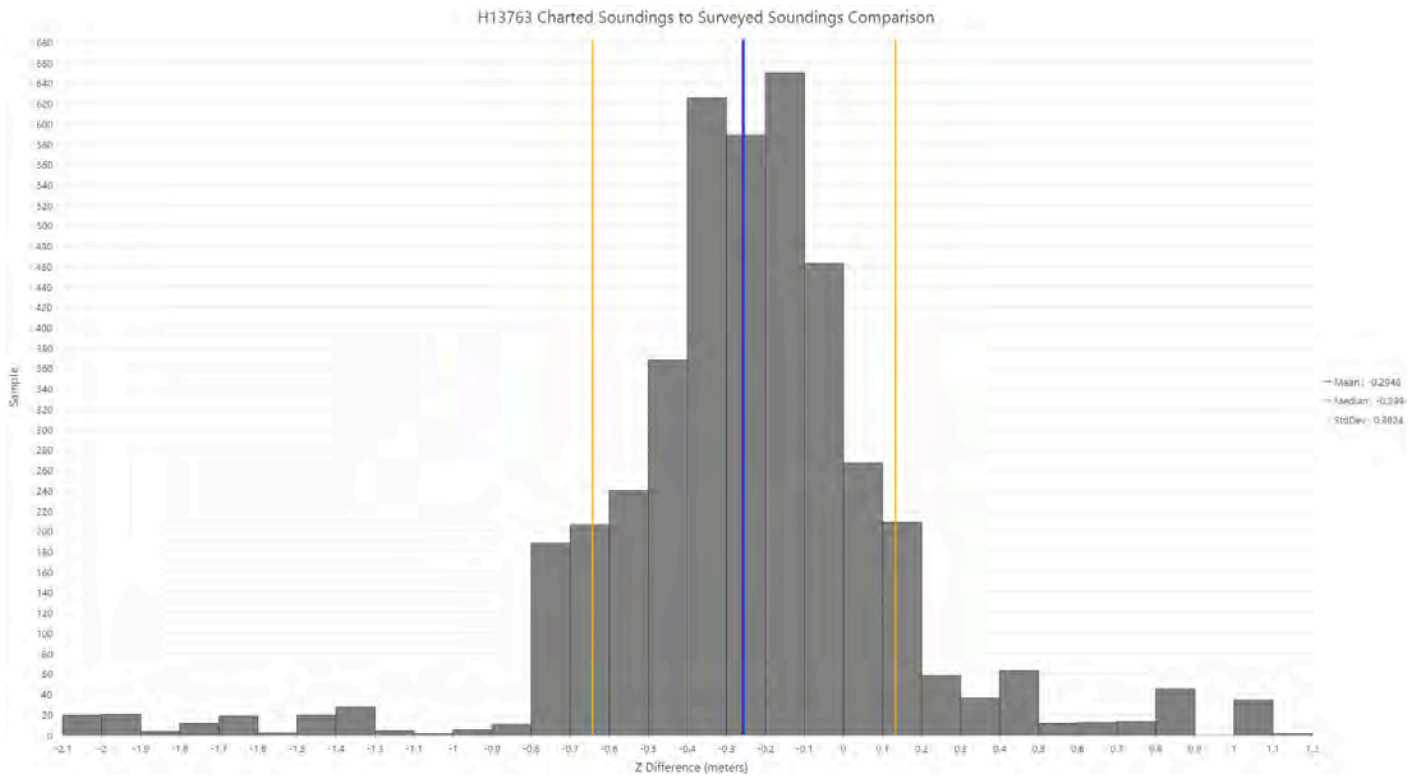


Figure 20: H13763 statistical analysis of surveyed soundings to charted soundings

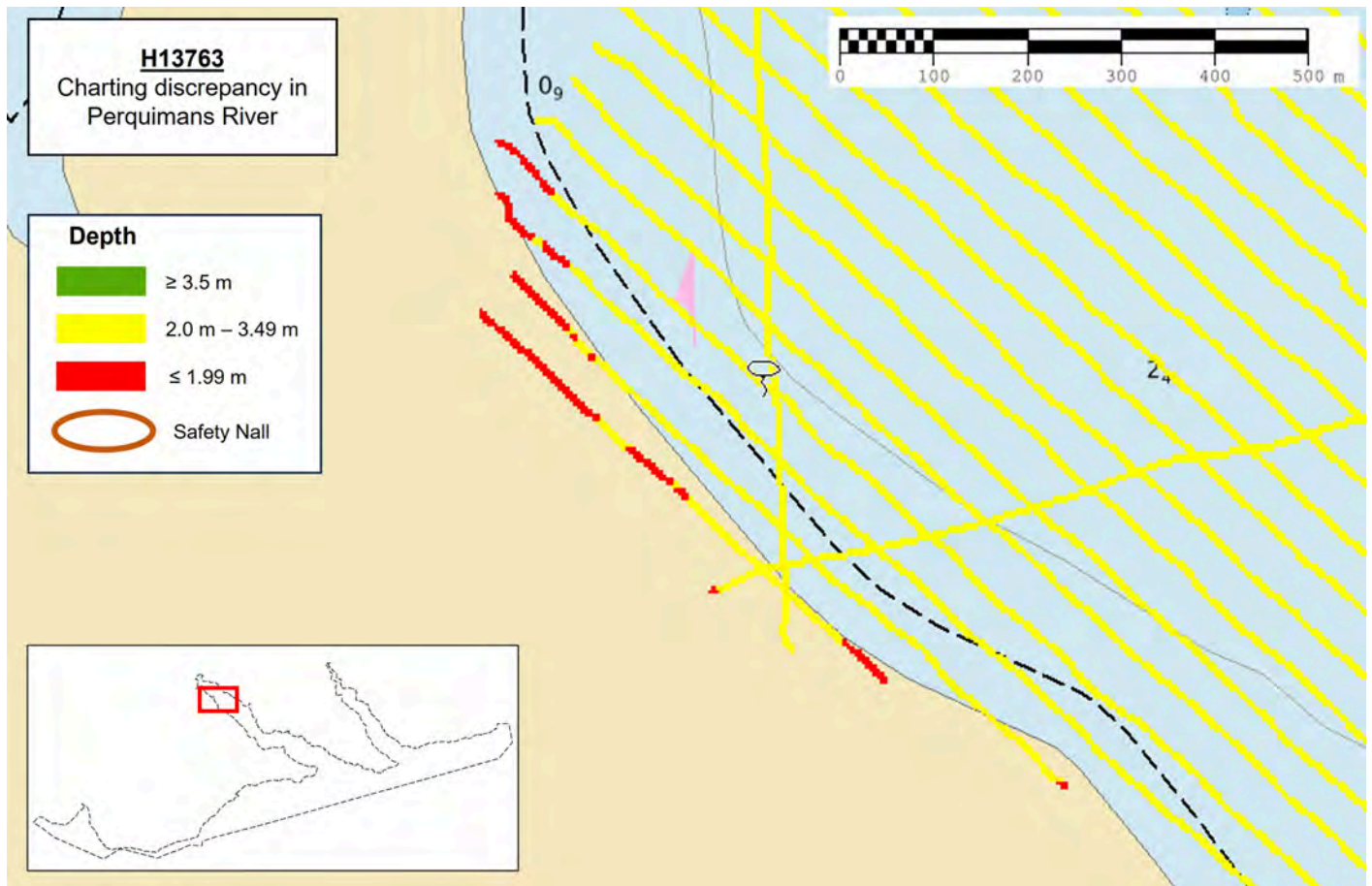


Figure 21: Surveyed soundings extending past the sheet limits and charted shoreline on ENC US4NC53M

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
US5NC54M	1:40000	19	03/15/2023	12/11/2023
US4NC53M	1:80000	38	08/29/2023	04/04/2024

Table 13: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

No significant shoals were identified to be hazardous in H13763. 28 DTONs were reported and 25 of which were forwarded to MCD and were added to the FFF with Special Feature Type as "DTON". It should be

noted that the least depth, position, or feature geometry may change slightly during post-processing for reported DTONs.

Two uncharted features that were found during survey operations and are included in the FFF were submitted and accepted as DTONs, however, the naming scheme was doubled up as a result of several DTONs that were submitted but not accepted. To ensure the FFF did not have any duplicate Unique IDs, these two features were assigned Unique IDs of 6_163_1 and 6_164_1. These two features coincide with the DTON report: H13763_DTON_18-19.

Refer to the FFF for the remarks and recommendations for each feature. See DR Appendix II Supplemental Records for the Submitted DTON reports and related correspondence with the HSD Project Manager.

D.1.3 Charted Features

Disprovals of charted features within areas that were surveyed with SSS coverage requirements were either conducted or attempted. In agreement with the NOAA HSD OPS, all disapproval search radii were addressed with consideration of the re-scheme chart scale and were of at least 150 m. When a feature was detected within this radius, completing the disapproval was not required and the new feature was addressed as New/Delete. In areas where the coverage requirements changed based on depth, disprovals were conducted at the hydrographers discretion with consideration to navigational significance and safety. Please reference correspondence for more information on disprovals for this project. It should be noted, similar to the infill practice described in Section B.2.5, MBES recovery lines over SSS imagery artifacts were also collected for disprovals to aid in achieving 200% coverage.

A side scan sonar contact was detected within the 150 m search radius for the assigned charted features (Unique ID: 6_031_1 and 6_034_1), therefore, a disapproval with 200% SSS was not conducted. The contacts were developed with MBES and addressed in the FFF (Unique ID: 6_031_2 and 6_034_2). It should be noted that charted feature associated with Unique ID 6_031_2 was populated with TECSOU "found by multi-beam" but QUASOU "Depth Known" instead of "Least Depth Known" because this feature was imaged as safely as possible, but due to the angle of the obstruction and shallow depth we were unable to image the top of the feature and therefore attributed the QUASOU as "depth known". Though very shallow, the obstruction was not observed above the waterline.

A disapproval was attempted for four assigned charted features (Unique ID: 6_006_1, 6_008_1, 6_010_1, 6_004_1), however the radius was not fully ensonified and 200% overlap was not achieved due to safety and proximity to the shoreline. These lines have been included in the respective mosaics and the feature addressed in the FFF with a description of "Retain".

A disapproval was unable to be conducted for two assigned charted features (Unique ID: 6_025_1 and 6_027_1) due to the density of fishing gear in close proximity to each charted feature. These features are addressed in the FFF with a description of "Retain".

It should be noted additional SSS tracklines were sometimes acquired perpendicular to the mainscheme tracklines to mitigate environmental holidays but still achieve the desired coverage (200% coverage). These

tracklines have been included in the respective mosaics. Please see the DAPR for more detailed information on disproval techniques.

In agreement with the NOAA HSD OPS, disprovals were not required for assigned charted features located within the SBES set line spacing coverage areas and these were investigated at the hydrographers discretion with navigational significance and safety in mind, and addressed with a description as "Retain" in FFF (see project correspondence). A formal disproval was not conducted for these features due to safety concerns and therefore addressed as "Retain" in the FFF.

Side scan contacts were not included for overhead features such as powerlines and bridges as these features are charted and above the surface. These areas were properly assessed to ensure contact shadows are associated with the charted overhead feature and not new, separate features.

With respect to the aforementioned deviations, all assigned charted features within H13763 are detailed in the FFF in accordance with section 7.3 of the HSSD. See DR Appendix II Supplemental Records for related correspondence with the NOAA HSD OPS.

D.1.4 Uncharted Features

Throughout the project area, uncharted fishing stakes and pound nets were both observed at the surface and identified in SSS and bathymetric data. In agreement with the NOAA HSD OPS, when identified as contacts or within bathymetric data, these features were developed accordingly with MBES to obtain a least depth when safe and practicable, and have been included in the FFF as new obstructions.

Lines 0046_20230406_165544_SU, 0025_20231006_141313_BE, and 0011_20230811_123842_BE were originally collected in sheet H13760 but were needed in H13763 to develop features with Unique ID: 6_156_1 and 6_165_1. These lines were imported into H13763 HIPS file in the same fashion as all other lines in the HIPS file. Since these two lines were originally collected for sheet H13760, CARIS's navigation editor was used to clip only the portion of the line within sheet H13763.

Contacts with Unique IDs: CH_H13763_230_2, BE_H13763_275_1, 4P_H13763_153_5, were identified in SSS, however, were not correlated with MBES due to safety considerations from nearby fishing gear or the approaching shoreline, and therefore have not been included in the FFF.

Due to the dense number of uncharted stump and obstructions within the H13763, guidance was provided by NOAA HSD OPS to assess the side scan sonar imagery in these areas with an 80 m radius and to attribute them as foul areas when these radii intersected, developing only those which were deemed safe to approach. In agreement with the COR, not all the contacts were selected in these foul areas, and a single representative SSS contact was selected to represent the numerous SSS contacts within a single new foul area. Multibeam was used to develop contacts within these areas when deemed safe and practicable. Side scan images were included with these foul areas in the FFF, with TECSOU = "found by side scan sonar", QUASOU = "depth unknown", and WATLEV = "Unknown". Four new foul area obstruction features were identified in H13763 with Unique IDs: 6_166_1, 6_167_1, 6_168_1, 6_169_1.

DTON features that were submitted as point obstructions that fall within greater foul area features, or are within 10 or 80 m from a new foul area feature, remain as point features to be left up to cartographic discretion.

In agreement with the NOAA HSD OPS, heights were not calculated for above water features, and the TECSOU and WATLEV for these features were attributed as "Unknown" and QUASOU as "Depth Unknown" in the FFF.

With respect to the aforementioned deviations, all new features found within H13763 are detailed in the FFF in accordance with section 7.3 of the HSSD. See DR Appendix II Supplemental Records for related correspondence with the NOAA HSD OPS.

D.1.5 Channels

The controlling depth for the section of Edenton Harbor Channel which is contained within H13763 has a DRVAL1 attribute value of 2.2 meters, however the survey data shows depths as shoal as 1.5 meters within the channel extents (Figure 22). While it appears that this channel is not a USACE maintained channel as it is not found in the USACE eHydro database, a report on this channel was sent to the PM and NOAA HSD OPS, and is detailed in DR Appendix II Supplemental Records.

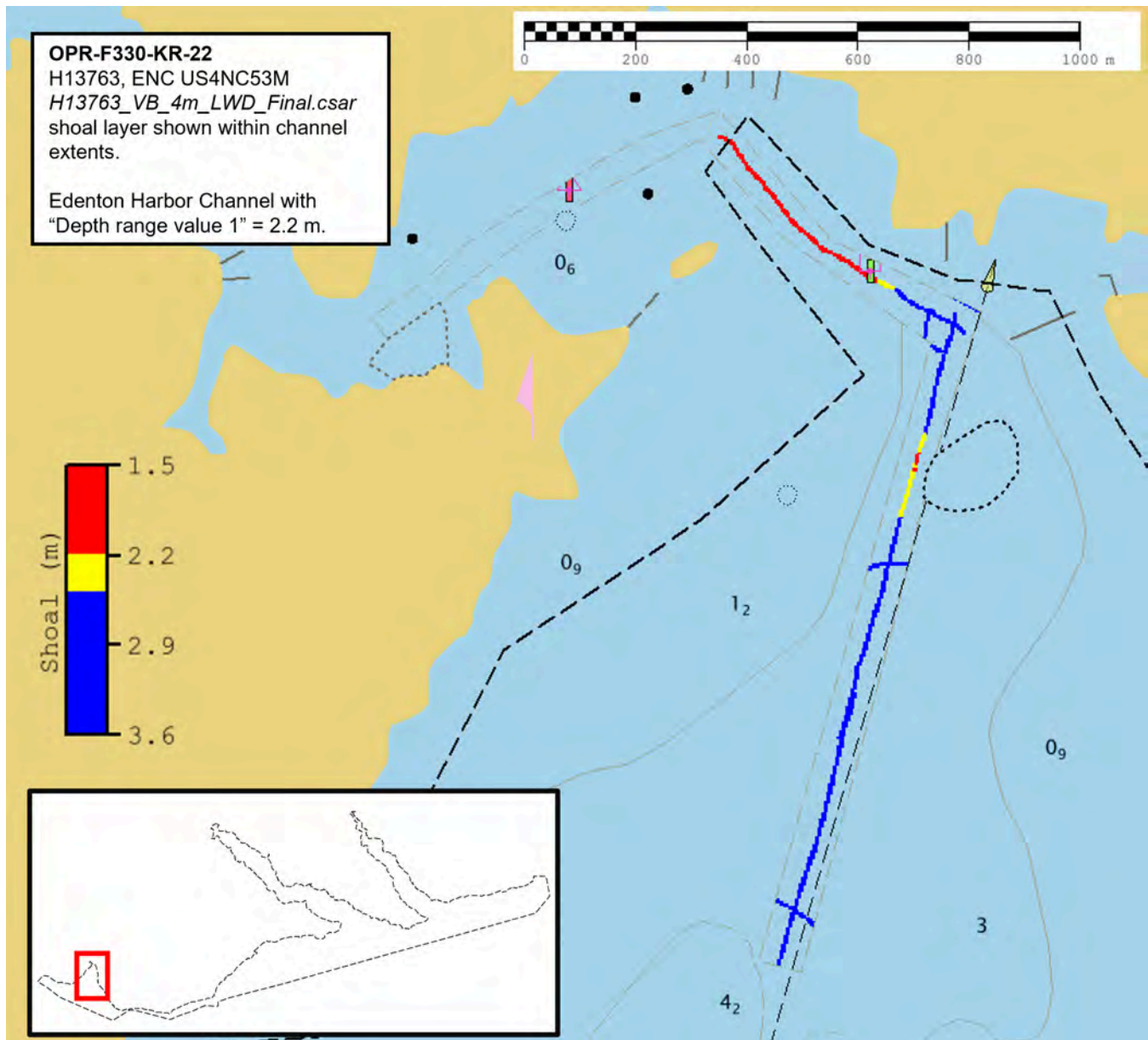


Figure 22: Image showing the portion of the Edenton Harbor channel which is contained within H13763, where the surveyed depths exceed the DRVAL1 feature attribute value of 2.2 meters.

D.2 Additional Results

D.2.1 Aids to Navigation

All ATONs in survey were found as charted.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

No bottom samples were required for this survey.

D.2.4 Overhead Features

Several bridges and overhead cables are located in H13763. It should be noted that the Pylon structure for the Overhead Cable within H13763 was slightly mischarted, as shown in Figure 23.

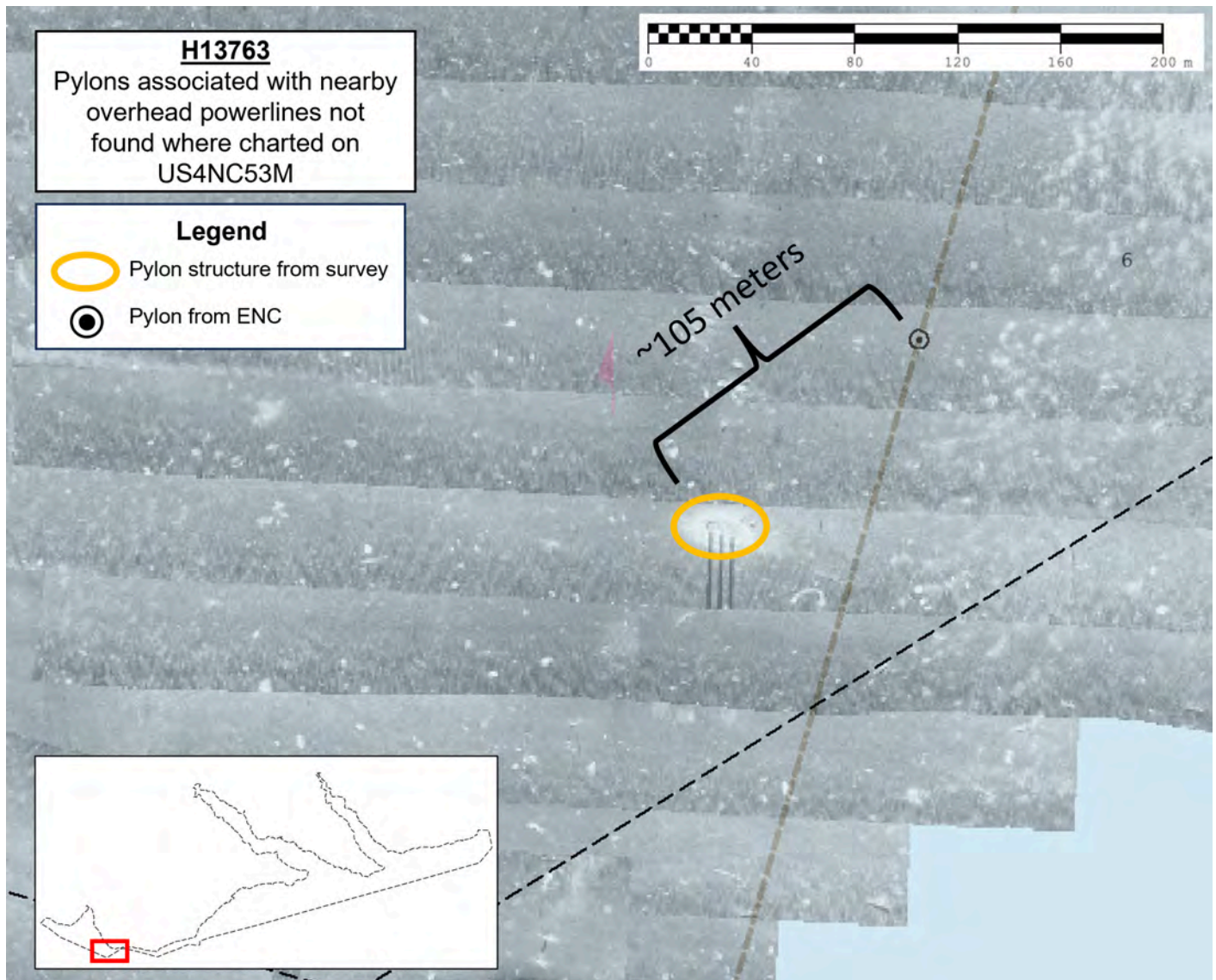


Figure 23: Overhead Cable Pylon structure observed to be slightly mischarted on US4NC53M

D.2.5 Submarine Features

No submarine features exist for this survey.

D.2.6 Platforms

No platforms exist for this survey.

D.2.7 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.8 Abnormal Seafloor or Environmental Conditions

No abnormal seafloor or environmental conditions exist for this survey.

D.2.9 Construction and Dredging

No present or planned construction or dredging exist within the survey limits.

D.2.10 New Survey Recommendations

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

D.2.11 ENC Scale Recommendations

No new ENC scales are recommended for this area.


E. Approval Sheet

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

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

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys Specifications and Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Descriptive Report.

Report Name	Report Date Sent
Data Acquisition and Processing Report	2024-03-17
Coast Pilot Report	2024-03-08

Approver Name	Approver Title	Approval Date	Signature
Nicholas Damm, CH	Chief of Party	04/27/2024	 Nicholas Damm <div style="font-size: small; margin-top: 5px;"> Digitally signed by Nicholas Damm Date: 2024.04.27 12:59:44 -0400 </div>

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