H12887

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

DESCRIPTIVE REPORT

Type of Survey:	Basic Hydrographic Survey
Registry Number:	H12887

LOCALITY

State(s):	Maine
General Locality:	Penobscot Bay
Sub-locality:	Offshore Vinalhaven Island

2016

CHIEF OF PARTY
Dean Moyels

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H12887**

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):	**Maine**
General Locality:	**Penobscot Bay**
Sub-Locality:	**Offshore Vinalhaven Island**
Scale:	**10000**
Dates of Survey:	**07/11/2016 to 09/30/2016**
Instructions Dated:	**05/06/2016**
Project Number:	**OPR-A366-KR-16**
Field Unit:	**Fugro Pelagos, Inc.**
Chief of Party:	**Dean Moyels**
Soundings by:	**Multibeam Echo Sounder LiDAR SHOALS-1000T**
Imagery by:	**Multibeam Echo Sounder Backscatter Prosilica GX3300**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via http://www.ncei.noaa.gov/.

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Descriptive Report to Accompany Survey H12887

Project: OPR-A366-KR-16

Locality: Penobscot Bay

Sublocality: Offshore Vinalhaven Island

Scale: 1:10000

July 2016 - September 2016

Fugro Pelagos, Inc.

Chief of Party: Dean Moyels

A. Area Surveyed

H12887 (Sheet ID 3) is located in Penobscot Bay, ME and encompasses approximately 33.95 SNM Offshore Vinalhaven Island.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
44° 7' 35" N 69° 1' 41.02" W	43° 57' 3.78" N 68° 49' 44.33" W

Table 1: Survey Limits

The survey limits were revised to encompass the additional LiDAR data that was collected during field acquisition and were submitted as the final outlines following field operations. It should be noted that the limits were extended only to capture the extra LiDAR data and that the multibeam (MB) collection concluded at the survey limits as outlined in the project instructions.

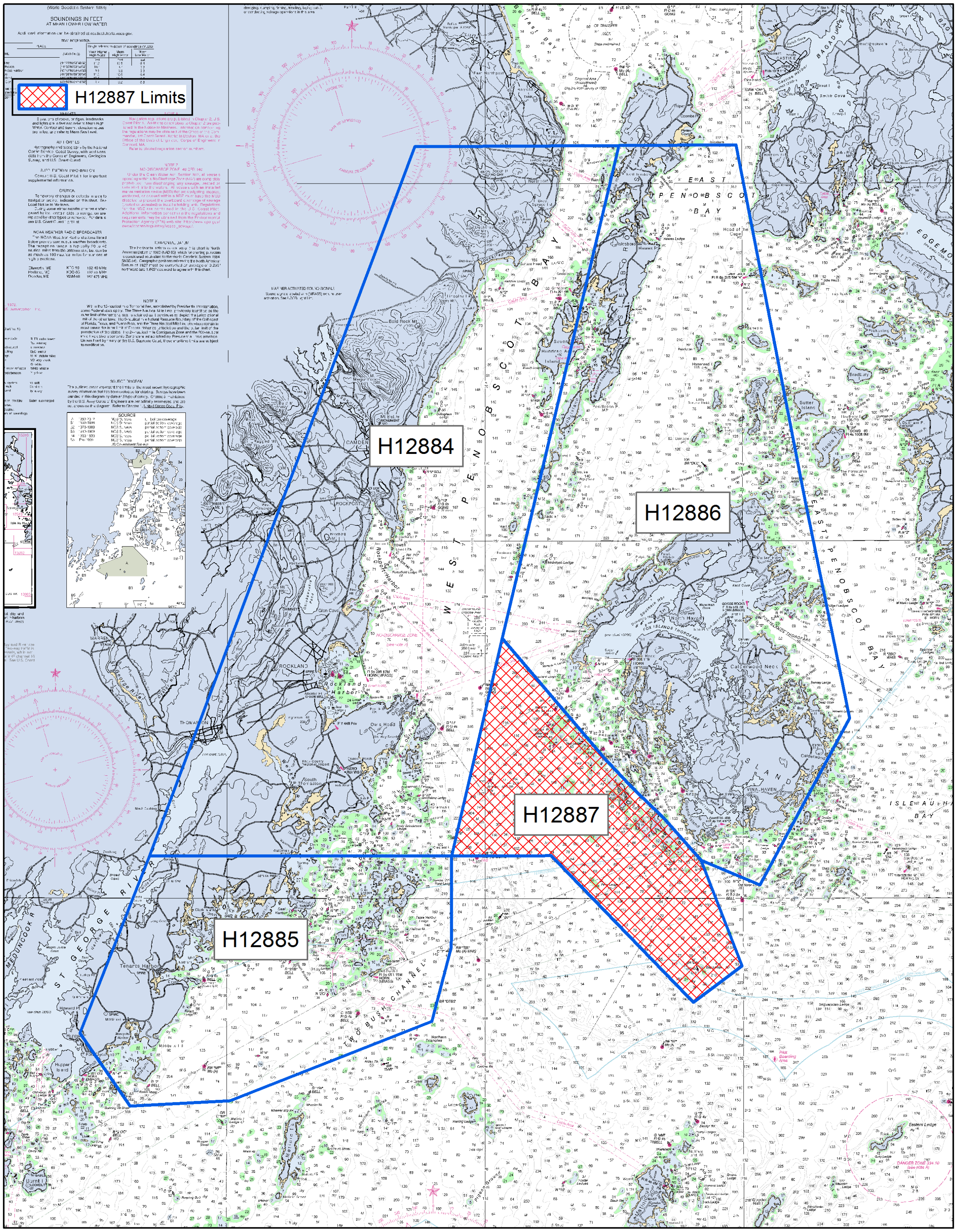


Figure 1: H12887 Sheet 3 Limits

A.2 Survey Purpose

The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products. This project area is located in a highly trafficked area and will cover approximately 96 SNM of priority 1 area, 9 SNM of priority 2 area, 2 SNM of priority 3 area, and 1 SNM of priority 4 area as identified in the 2012 NOAA Hydrographic Survey Priorities. This project is located in Penobscot Bay, ME and encompasses approximately 108 SNM of survey area.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Additional discussions regarding survey quality or data quality can be found in the Quality Control and Additional Results sections of this XML DR.

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 8 meters water depth	5 by 5 meter Lidar
Greater than 8 meters water depth	Complete coverage multibeam with backscatter

Data holidays are present in the LiDAR data due to the removal of vessels and other surface structures. A gap between the LiDAR and MB data sets exists and is due to water clarity in the area. The water clarity had a negative impact on coverage within the four to eight-meter depth range, which varied significantly both spatially and temporally across the project area. A test flight was conducted during high tide in order to eliminate the low tide timing as the issue with water clarity, due to tidal flushing. Water conditions on this test flight were consistent with those seen on the flights timed around low tide, so it was concluded that the tide level was not the cause of the poor water clarity. Though not required, since the limit for the MB was greater than an 8-meter water depth, to bridge this gap, additional nearshore lines were conducted during field operations.

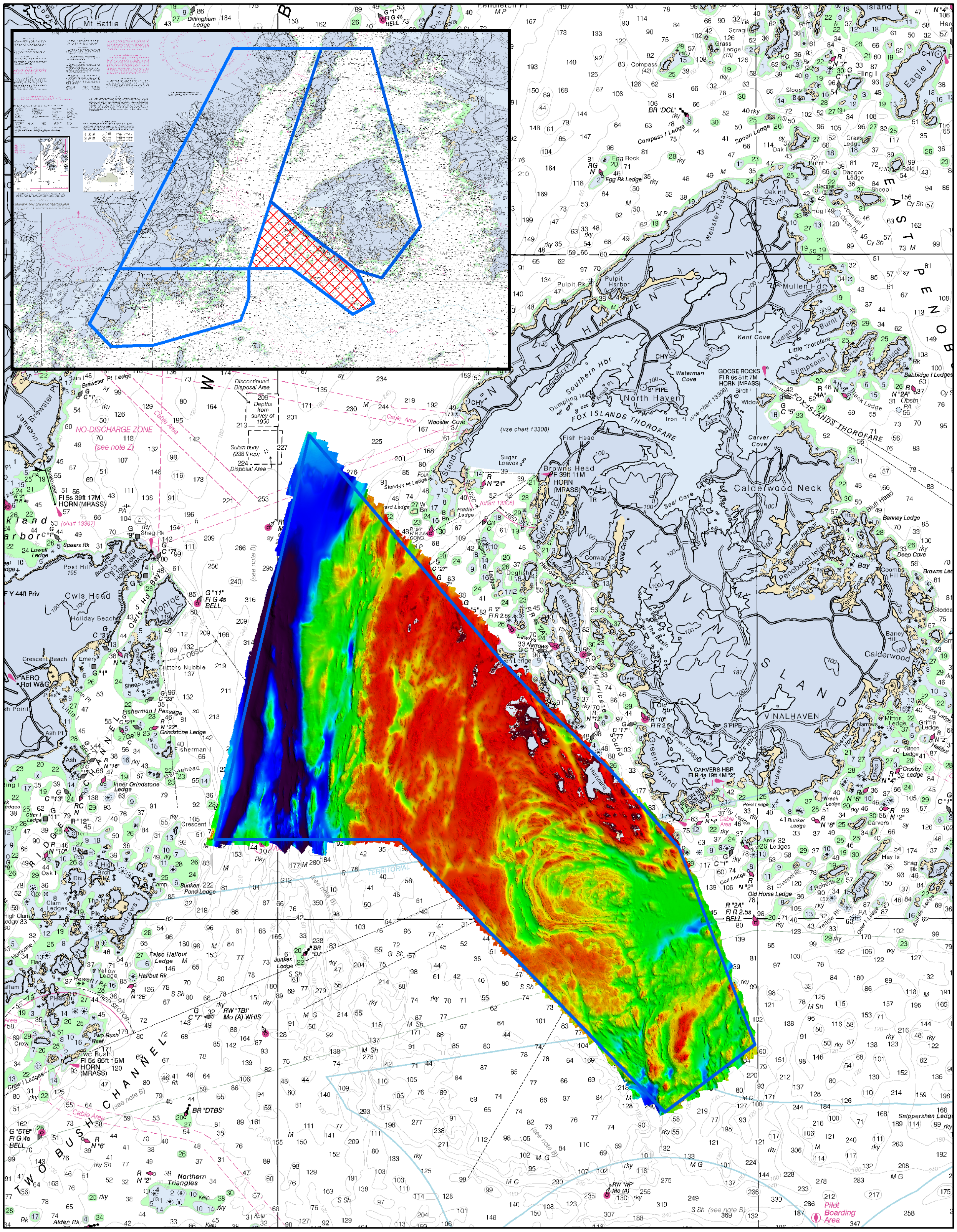


Figure 2: H12887 Survey Coverage

A.5 Survey Statistics

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

	HULL ID	*1231991*	*1229272*	*N87Q*	*Total*
LNM	**SBES Mainscheme**	0	0	0	0
	MBES Mainscheme	303.61	607.09	0	910.7
	Lidar Mainscheme	0	0	1984.37	1984.37
	SSS Mainscheme	0	0	0	0
	SBES/SSS Mainscheme	0	0	0	0
	MBES/SSS Mainscheme	0	0	0	0
	SBES/MBES Crosslines	6	33.6	0	39.6
	Lidar Crosslines	0	0	119.49	119.49
Number of Bottom Samples					12
Number Maritime Boundary Points Investigated					0
Number of DPs					0
Number of Items Investigated by Dive Ops					0
Total SNM					33.95

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
07/25/2016	207
07/26/2016	208
07/27/2016	209
07/28/2016	210
07/29/2016	211
07/30/2016	212
07/31/2016	213
08/01/2016	214
08/02/2016	215
08/03/2016	216
08/04/2016	217
08/12/2016	225
08/14/2016	227
08/15/2016	228
08/16/2016	229
08/18/2016	231
08/19/2016	232
08/20/2016	233
08/25/2016	238
08/26/2016	239
08/27/2016	240
08/28/2016	241
08/29/2016	242
08/31/2016	244
09/02/2016	246
09/03/2016	247
09/10/2016	254
09/11/2016	255
09/12/2016	256
09/13/2016	257
09/14/2016	258
09/19/2016	263

Survey Dates	Day of the Year
09/24/2016	268
09/25/2016	269
09/26/2016	270
09/30/2016	274
07/11/2016	193
07/12/2016	194
07/13/2016	195
07/14/2016	196
07/15/2016	197
07/16/2016	198
07/17/2016	199
07/18/2016	200
07/22/2016	204

Table 3: Dates of Hydrography

The area was not divided into separate surveys for LiDAR acquisition, but three smaller blocks for data management purposes. For this reason, the LiDAR survey statistics are for the entire project and not just for H12887.

The LiDAR program was proposed and planned for 100% of the area to be flown with a five by five (or better) spot spacing. A reconnaissance coverage survey would be used from the inshore limit (4-meter) to the 8-meter water depth. The actual line spacing was based on 200% coverage to try to provide maximum coverage and data density; this resulted in doubling the anticipated mainscheme linear nautical miles. In addition to this, the LiDAR area extends to the original survey limits and not to the revised survey limits as outlined in the project instructions (the area was reduced due to the allocated and available budget). For these reasons, the percentage of LiDAR mainscheme lines to LiDAR crosslines are not within the HSSD 2016 specification.

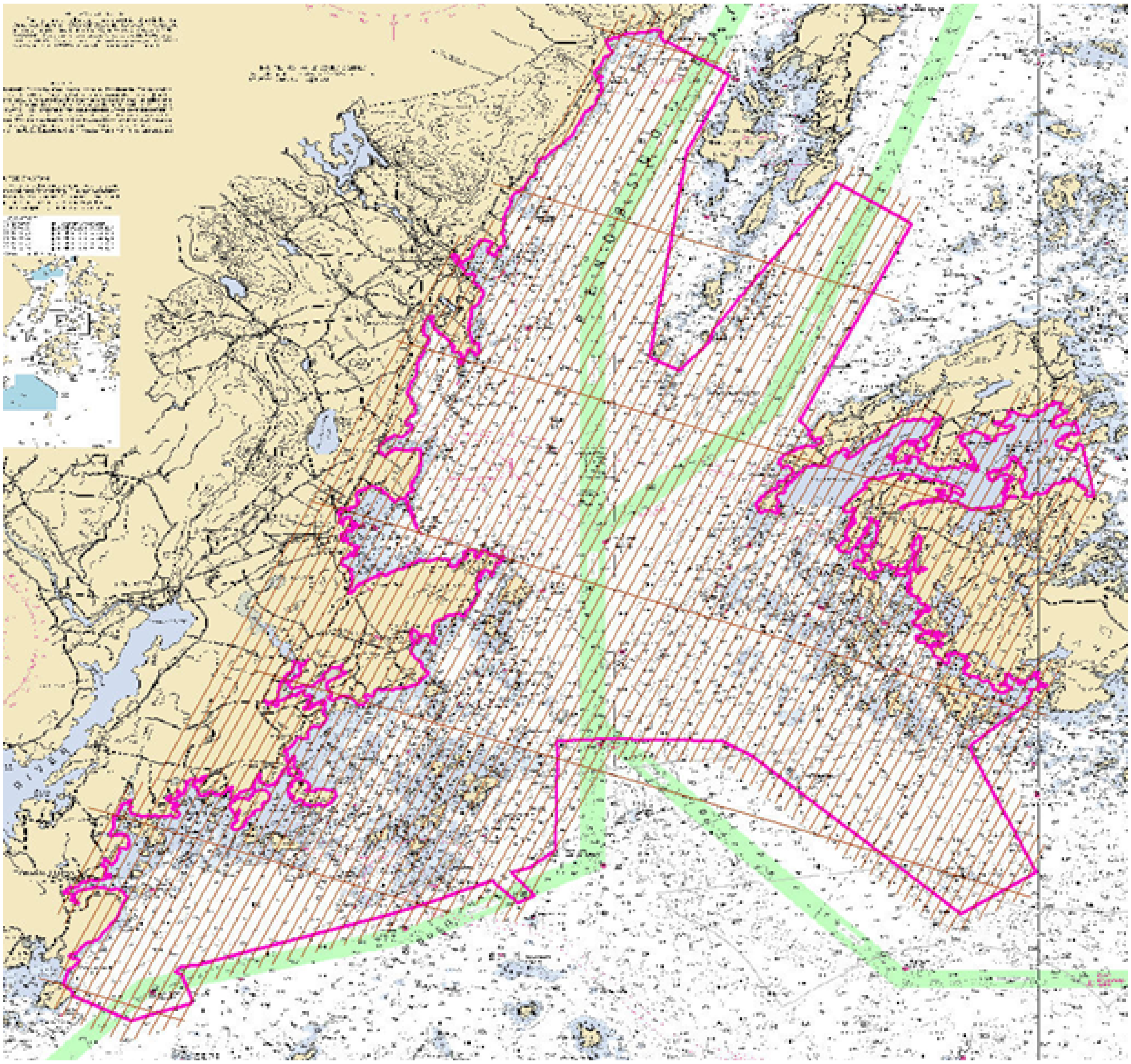


Figure 3: Proposed LiDAR Plan

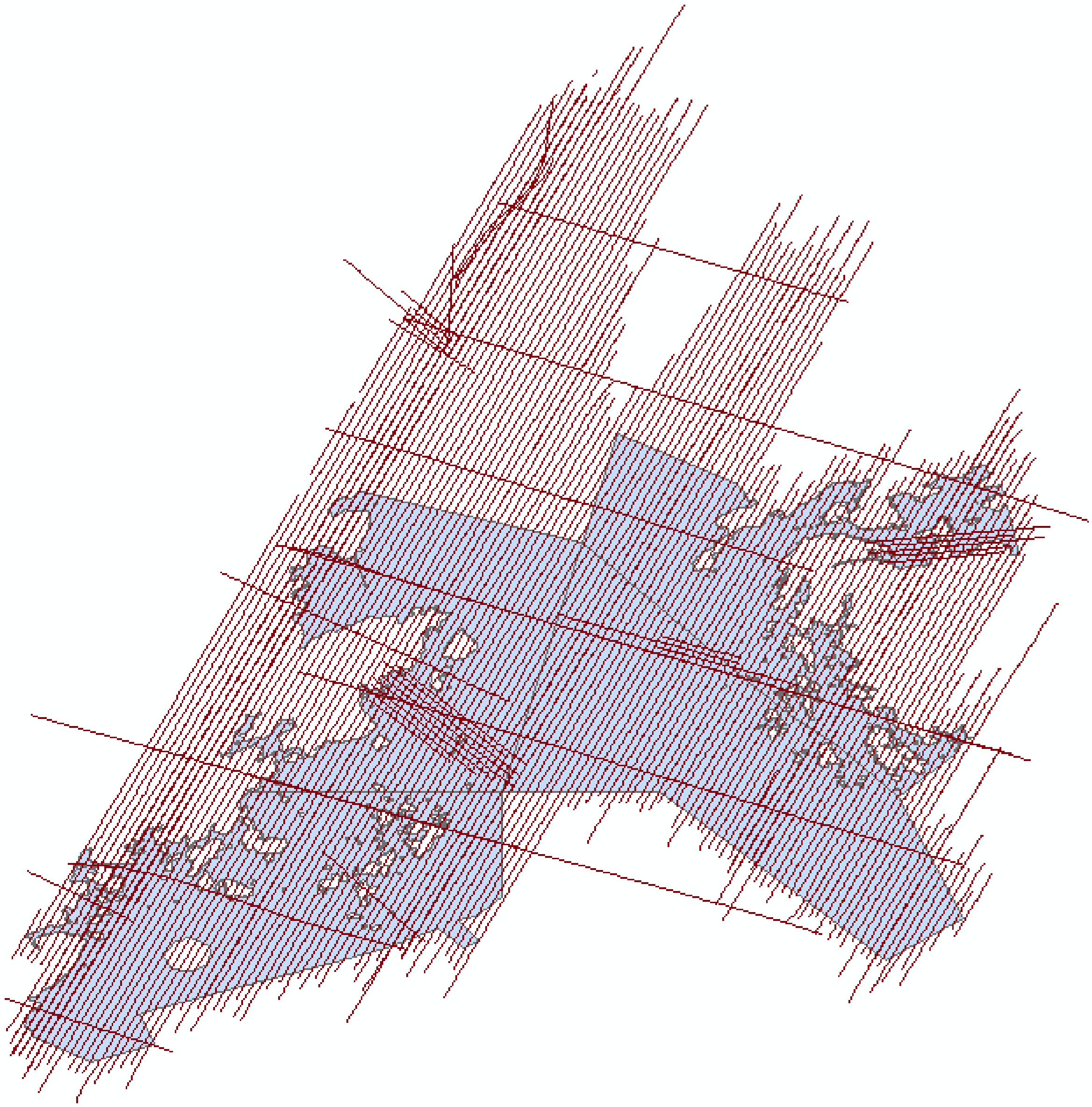


Figure 4: Actual LiDAR Plan

The following statistics were computed during office processing: Lidar MS =1045 miles, Lidar XL =94 miles (percent of XL to LIMS =9.0%).

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the OPR-A366-KR-16 Data Acquisition and Processing Report (DAPR) for a detailed description of all equipment, survey vessels, processing procedures, and quality control features. Items specific to this survey 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	*129272*	*1231991*	*N87Q*
LOA	44 feet	44 feet	10.8 meters
Draft	2 feet	2 feet	0 meters

Table 4: Vessels Used

Figure 5: R/V JAB (1229272)

Figure 6: R/V Westerly (1231991)

Figure 7: Beechcraft King Air (N87Q)

R/V JAB (1229272), R/V Westerly (1231991) and the Beechcraft King Air A90 (N87Q) systems acquired all sounding data for H12887.

Fugro Pelagos, Inc. (Fugro) mobilized two catamaran-style jet drive survey boats (JAB and Westerly), which was equipped with an over the stern pole that housed an underwater IMU and dual head Reson 7125 multibeam sonars (dual meaning two independent systems). The Reson systems and IMU were installed on a special mount, where each Reson 7125 was rotated approximately 15 degrees and the IMU was centered above the 7125s. The vessel was utilized to survey in water depths greater than eight meters. In addition to the vessel, a small aircraft was fitted with a SHOALS-1000T Airborne LiDAR Bathymetry (ALB) system to map data inshore of the 8-meter contour. It should be noted that an Allied Prosilica GX3300 down-look camera and VQ-820-G (RIEGL) LiDAR sensor were also installed. These extra systems were not part of the project instructions or a requirement, but were installed to aid with feature verification and detection.

B.1.2 Equipment

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

Manufacturer	Model	Type
Applanix	POS M/V Version 4	Positioning and Attitude System
Applanix	POS M/V Version 5	Positioning and Attitude System
Applanix	POS M/V Version 6	Positioning and Attitude System
Applied Micro-Systems	SV&P	Sound Speed System
Reson	7125	MBES
Reson	SVP70	Sound Speed System
Optech	SHOALS-1000T	Lidar System
Allied	Prosilica GX3300	Down-Look Camera
RIEGL	820G	Topo-Lidar System

Table 5: Major Systems Used

Both the R/V JAB and the R/V Westerly were equipped with dual head Reson 7125 sonars, which were operated in the full rate dual head (FRDH) mode in the Reson topside.

The Allied Prosilica GX3300 down-look camera and VQ-820-G (RIEGL) LiDAR sensor were not part of the project instructions or a requirement, but were installed to aid with feature verification and detection. By-products of these extra systems include the othro-mosaic, SHOALS-1000T reflectance, and RIEGL topo data and will be included as part of the final data deliverable. Patrick Keown (COR) approved these to be included in the multimedia folder.

B.2 Quality Control

B.2.1 Crosslines

Crosslines acquired for this survey totaled 4.35% of mainscheme acquisition.

Multibeam crosslines were planned and well distributed throughout the survey to ensure adequate quality control. Total crossline length surveyed was 39.60 nautical miles or 4.4 percent of the total mainscheme line length. Depending on depth, each crossline was compared to the entire mainscheme line plan through a 1m, 2m, 4m or 8m CUBE surface using the CARIS HIPS QC report routine.

The majority of the QC Reports fall well within the required accuracy specifications. However, crossline 1P3B00-TIE03 run by R/V JAB in the western half of H12887 contains several beams in the QC report that fall below the 95% confidence level. This is due to a very steep slope and to sound speed refraction, as illustrated in the graphic labelled “1P3B00-TIE03_Subset”. Despite the issues raised by the steep slope and the sound speed refraction, good conformity is still seen between the mainscheme lines and the crossline. Mainscheme lines are shown in purple, and the crossline (1P3B00-TIE03) is shown in light green. All data are well within the IHO Order 1a allowable error.

LiDAR crosslines were planned and well distributed throughout the survey to ensure adequate quality control. A total of 17 specific crosslines were planned and flown perpendicular to the mainscheme survey lines.

A difference analysis between the crosslines and the main survey lines was performed using the Crosscheck program within Fledermaus. A surface grid was created from the production lines at a bin size of approximately 3 meters. The crossline points were then compared to the surface, and point-to-surface statistics generated. The crossline comparison documents illustrate that elevated standard deviation of the differences occurs over rocky and high gradient seabed. In relatively featureless areas of seabed, the differences present a much lower variability.

Quality Control Results are located in Separate II Digital Data.

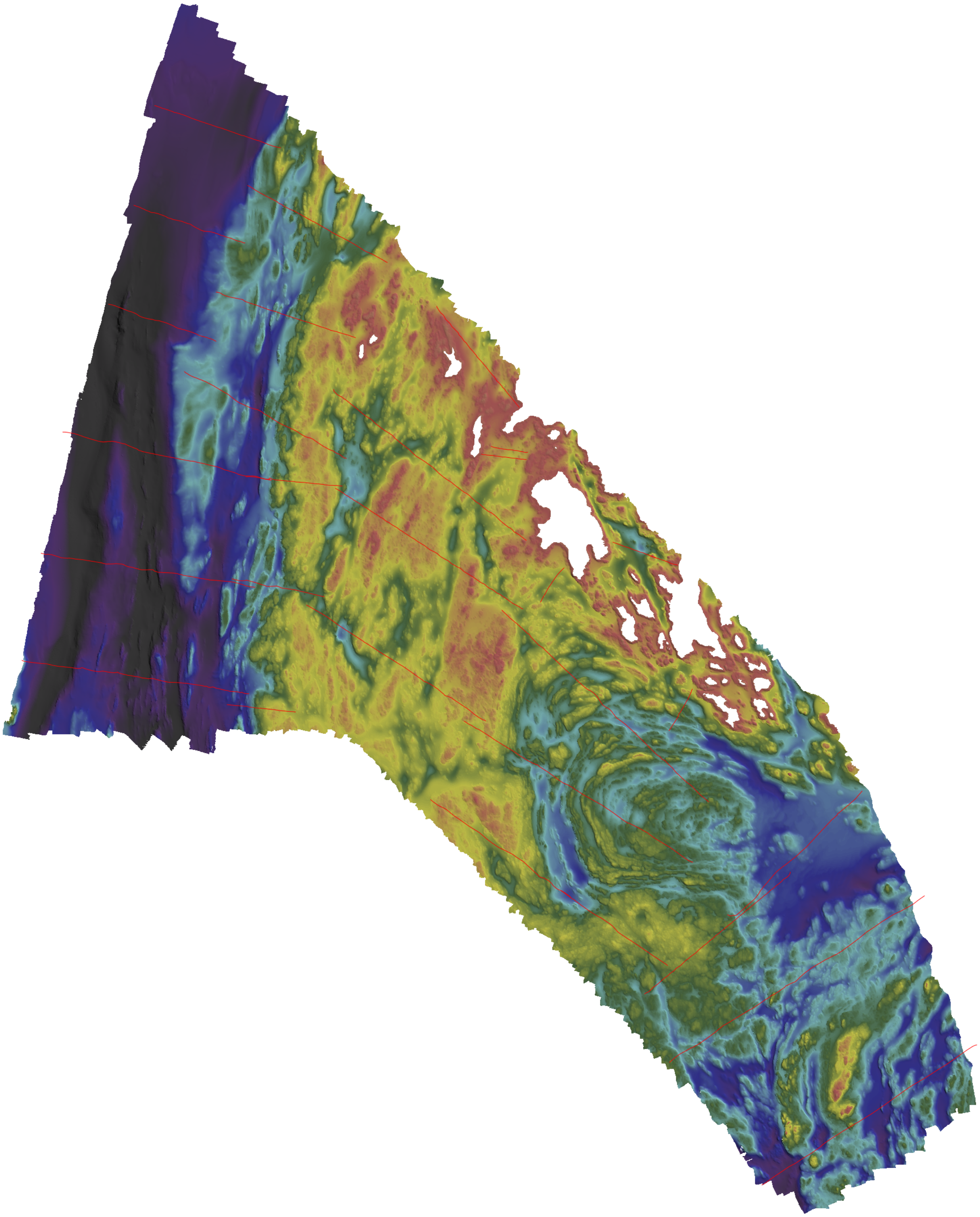


Figure 8: H12887 Crossline Overview

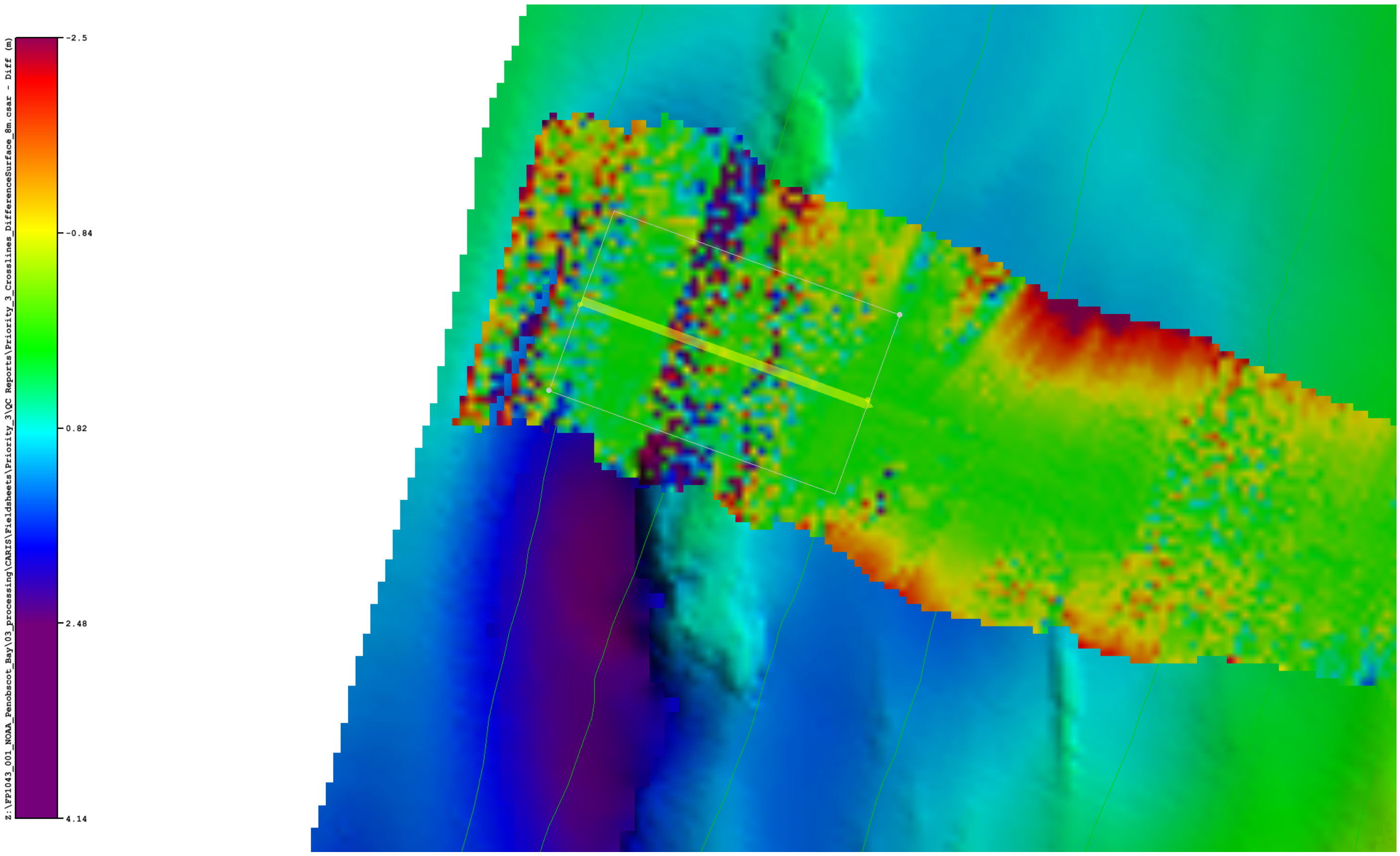


Figure 9: 1P3B00-TIE03 Subset Overview

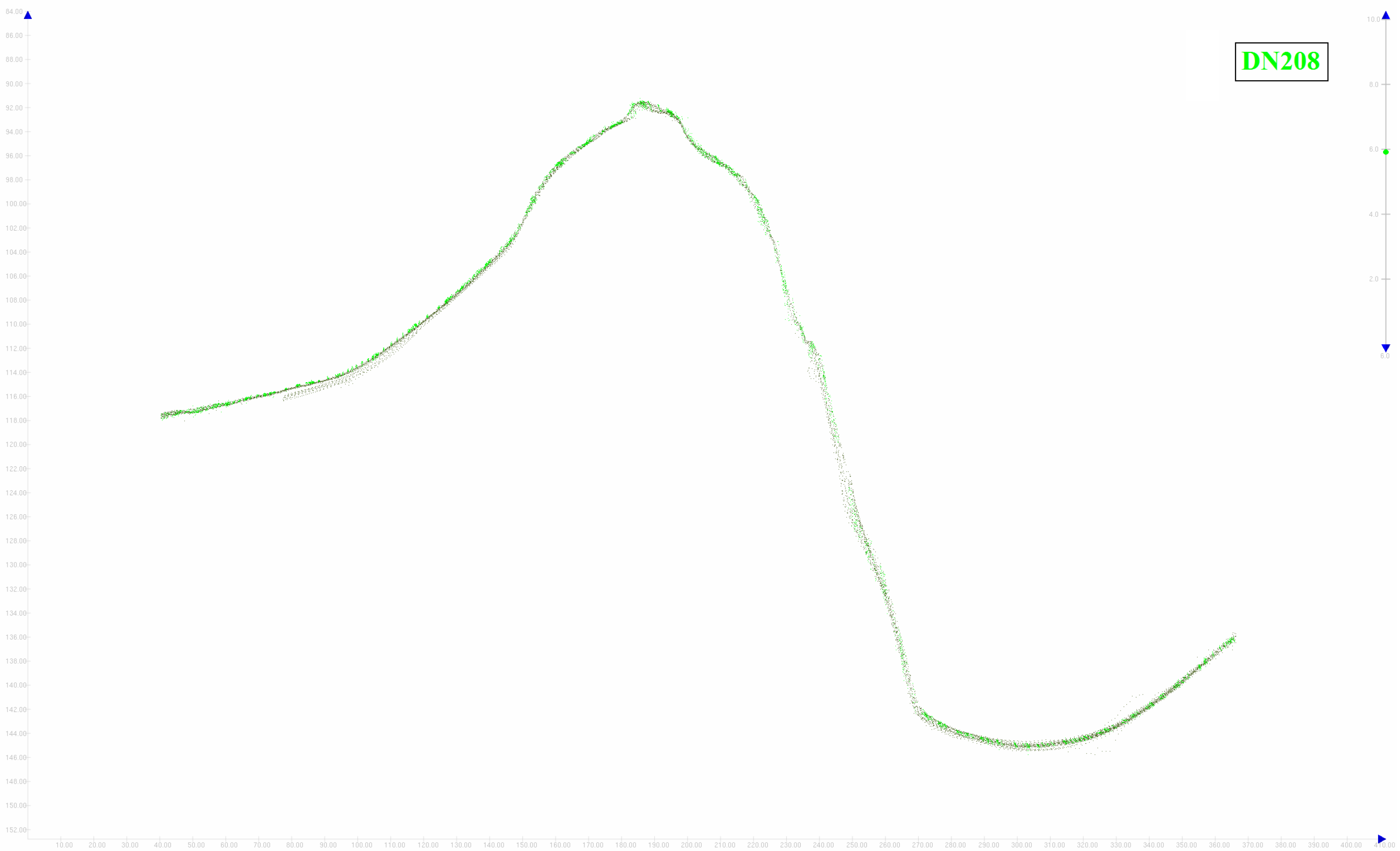


Figure 10: 1P3B00-TIE03 Subset

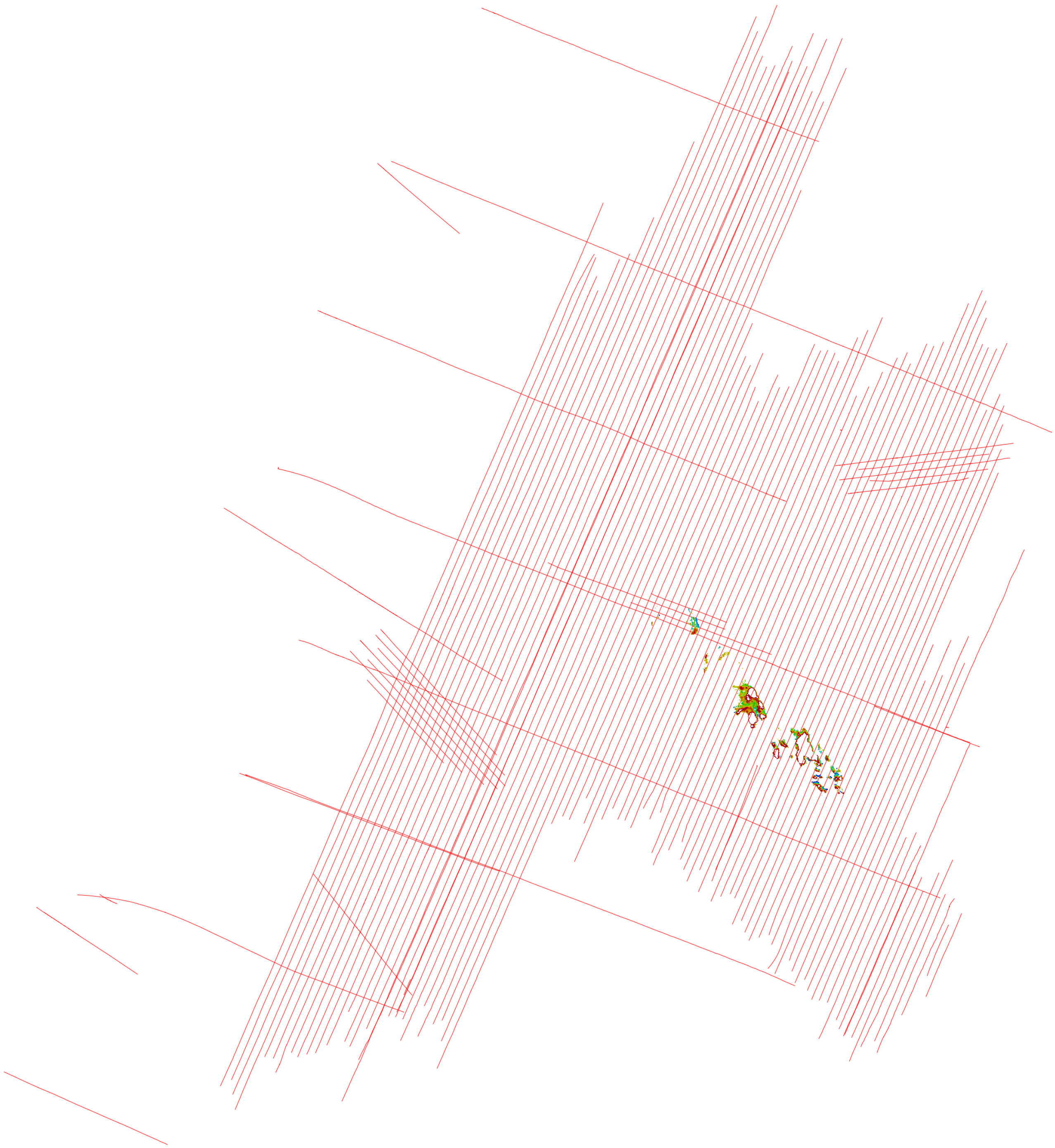


Figure 11: H12887 LiDAR Crossline Overview

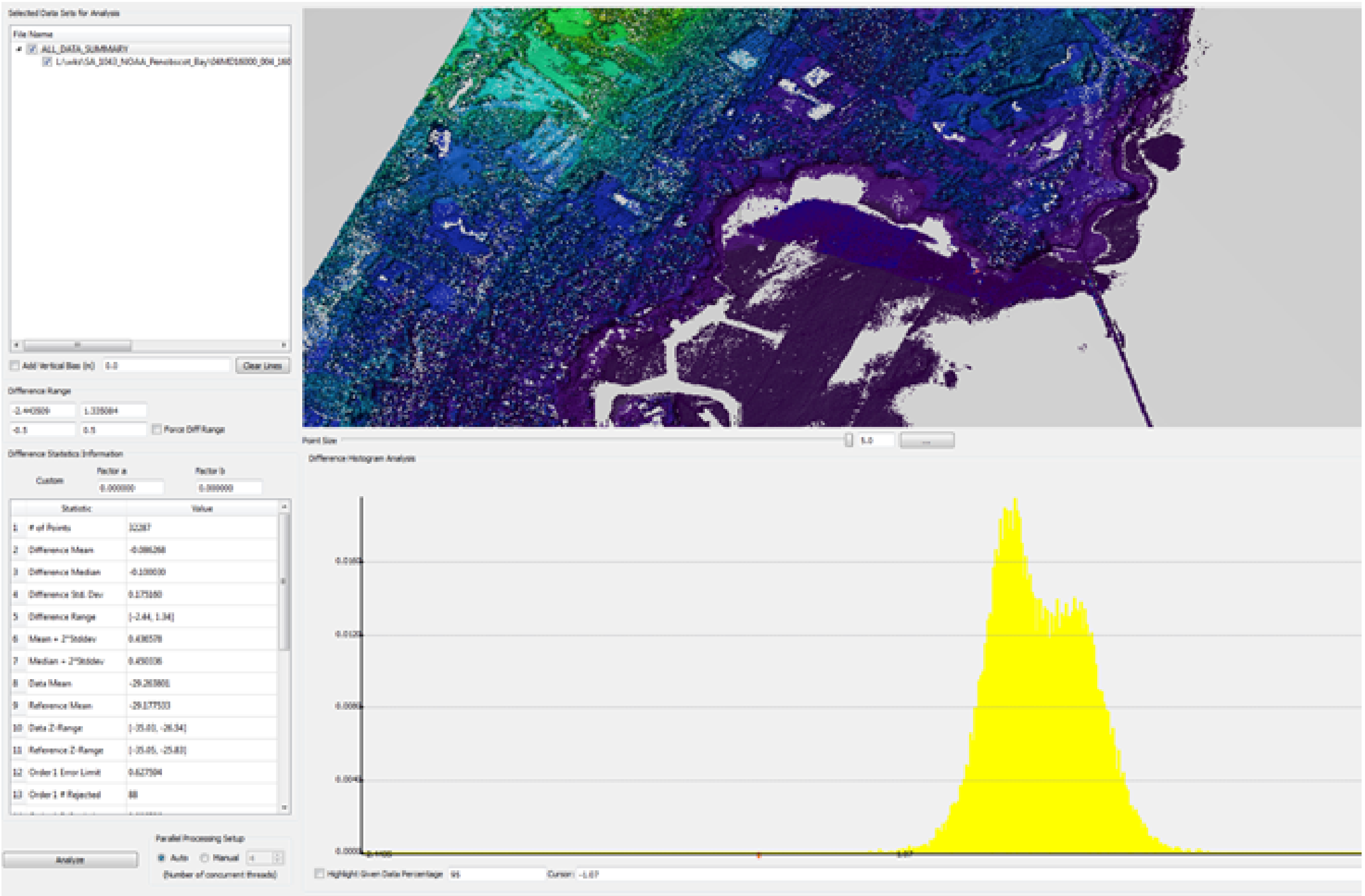
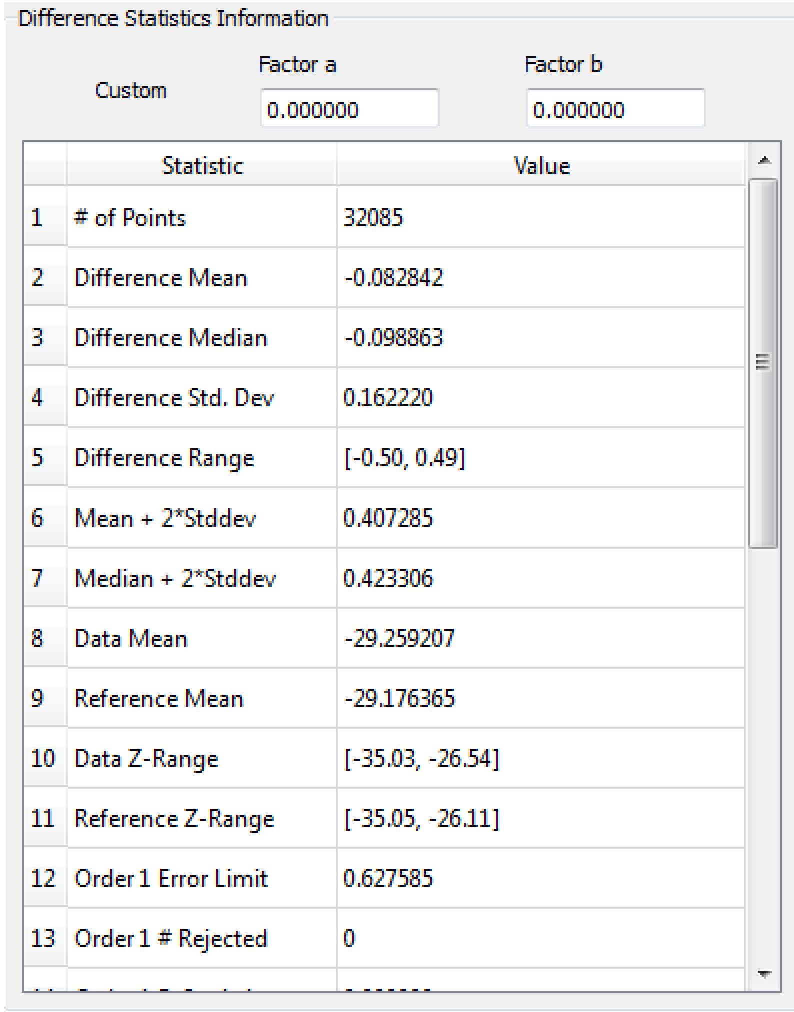


Figure 12: Flight Line 20160713 1713 01191 QC


Difference Statistics Information

Custom	Factor a	Factor b
	0.000000	0.000000

	Statistic	Value
1	# of Points	32085
2	Difference Mean	-0.082842
3	Difference Median	-0.098863
4	Difference Std. Dev	0.162220
5	Difference Range	[-0.50, 0.49]
6	Mean + 2*Stddev	0.407285
7	Median + 2*Stddev	0.423306
8	Data Mean	-29.259207
9	Reference Mean	-29.176365
10	Data Z-Range	[-35.03, -26.54]
11	Reference Z-Range	[-35.05, -26.11]
12	Order 1 Error Limit	0.627585
13	Order 1 # Rejected	0

Figure 13: Flight Line 20160713 1713 01191

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning	Method
0 meters	0 meters	TCARI

Table 6: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Surface
1229272	3.08 meters/second	0 meters/second	0.25 meters/second
1231991	2.56 meters/second	0 meters/second	0.25 meters/second

Table 7: Survey Specific Sound Speed TPU Values.

The majority of the data fell within IHO Order 1a accuracy specifications. Nodes that exceeded the allowable specifications were located in areas where the outer beams of the coverage boundaries were the single contributor to the surface, with a small portion of the nodes exceeding specifications attributable to rapid topographical changes such as rock outcrops, etc.

TPU was derived in CARIS from a combination of real-time and fixed values for equipment, vessel characteristics, sound speed, and tide and tide zoning. The percentage of nodes within IHO Order 1a, were computed by CARIS using the Surface QC Report utility and are as follows:

Surface	Depth Range (m)	% of nodes within IHO Order1a
H12887_MB_1m_MLLW	0-20	99.99%
H12887_MB_2m_MLLW	18-40	99.98%
H12887_MB_4m_MLLW	36-80	99.99%
H12887_MB_8m_MLLW	72-160	100%
H12887_MB_16m_MLLW	144-320	100%
H12887_LI_5m_MLLW	-3.04-10.63	100%

The uncertainty is generally lowest near the sonar nadir beams (in the sectors where the dual heads overlap) and increases toward the outside of each swath. This is expected and primarily a result of the sonar’s device model used within CARIS HIPS for TPU calculations. In general, TPU varies proportionally to water depth. Outer beams also have higher uncertainty values as a function of the bottom-detection algorithms within the sonar.

In addition to using the surface QC report in CARIS to derive the TPU for H12887, HydroOffice QCTools were used to compute the total propagated vertical uncertainty (TVU). Both methods yielded similar results.

Regarding LiDAR, in order to accurately determine TVU for all depth data collected as part of the project, a ‘TPU’ line was designed and flown on eight separate occasions. One area of low gradient seabed was identified across the TPU line. Once all of the depth data had been processed, cleaned, and reduced to datum by a VDatum model, Fugro’s LiDAR Total Error (LTE) tool (an extension in ArcGIS) was used to determine SHOALS uncertainty. LTE is a tool implemented in ArcGIS that uses spatial analysis of LiDAR point elevations to determine statistical variance of a significant data sample. The LTE tool application shows the common parameters for data sampling, as well as the water depth ranges being analyzed (or elevation on the ellipsoid). The inputs were the Hydrographic Output Files (HOF) files generated in the SHOALS-GCS processing software. The results of the analysis were tabulated and plotted to derive a depth-dependent model of Total Bottom Uncertainty (TBU). Refer to the Appendix II for the full report.

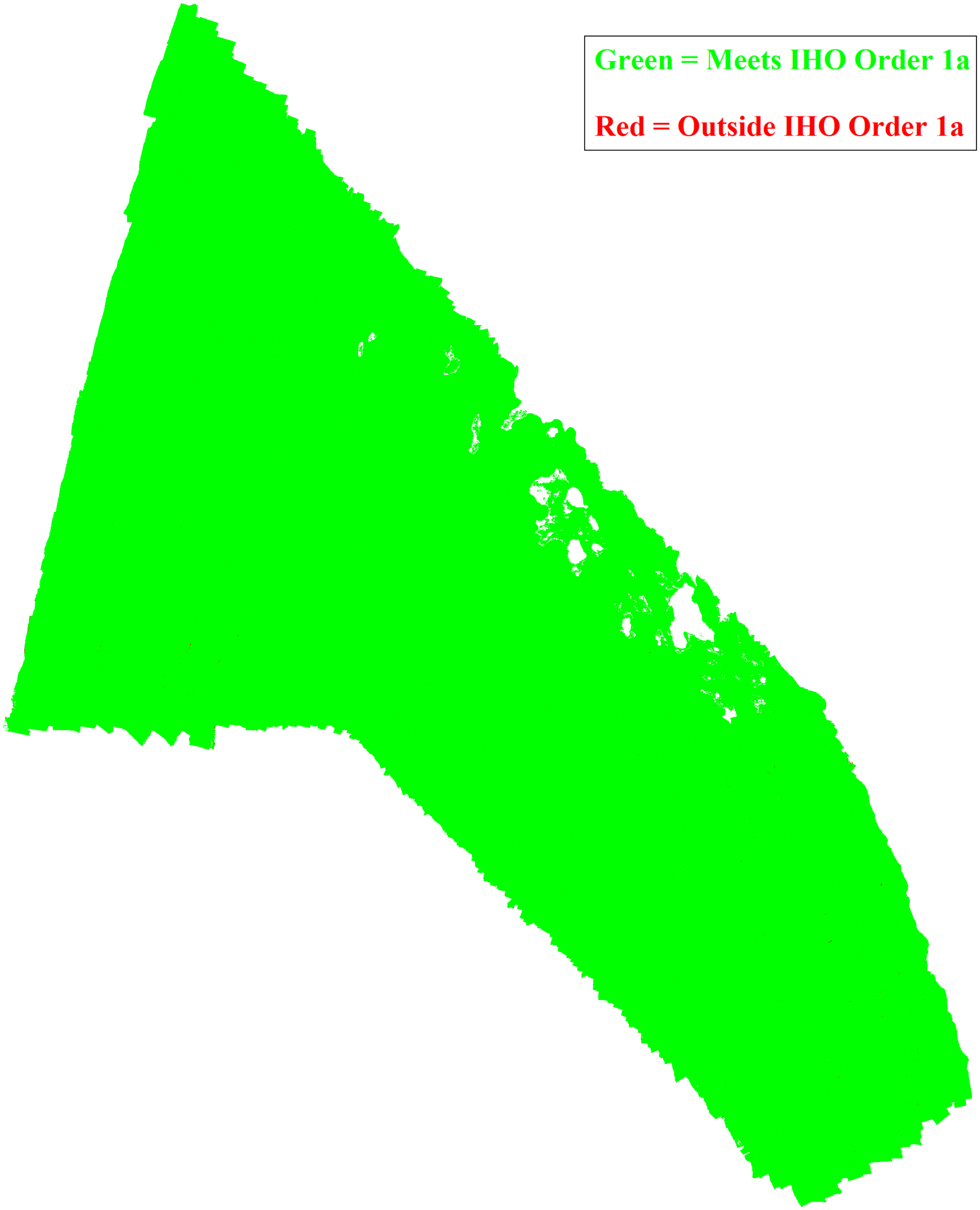


Figure 14: H12887 Uncertainty

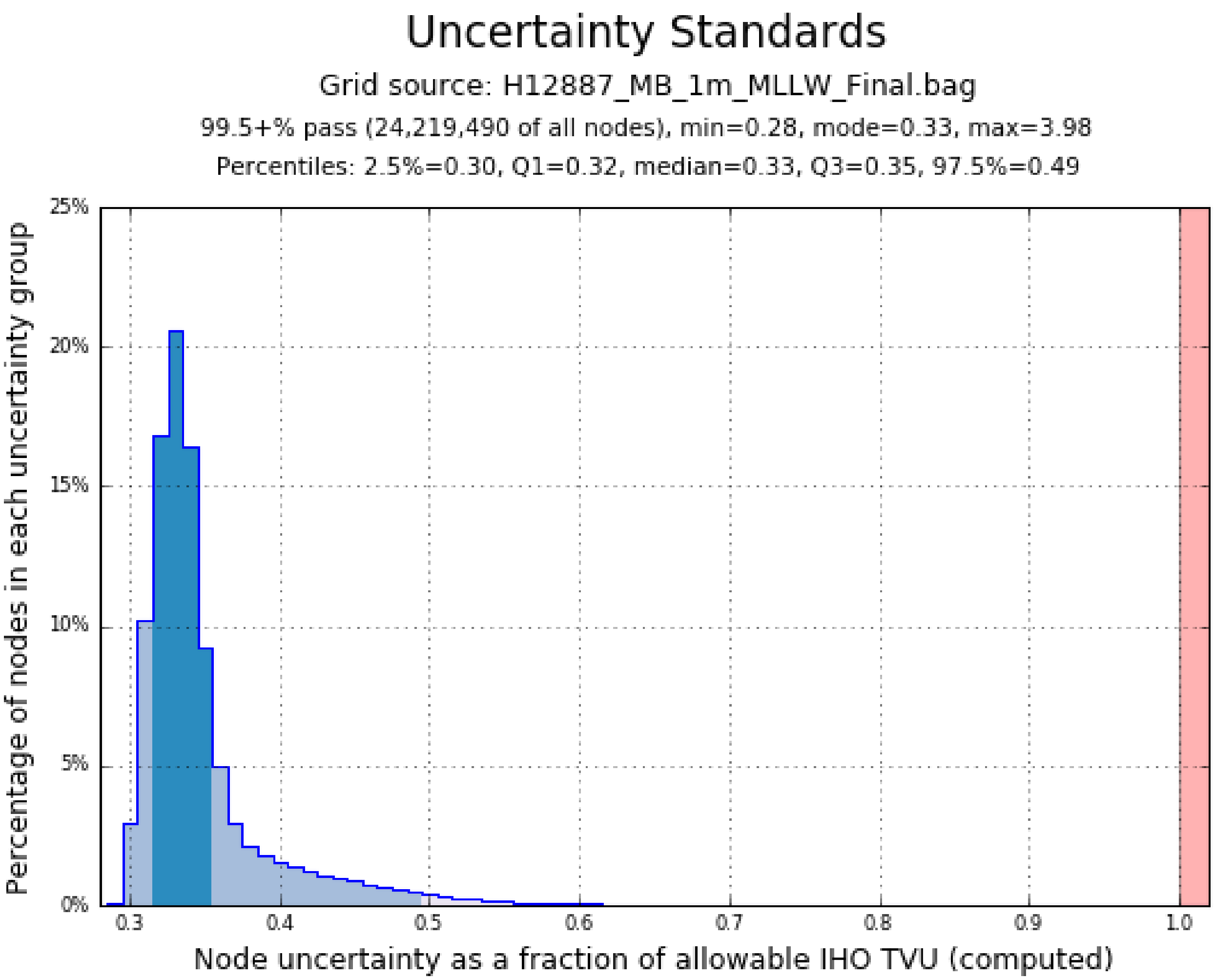


Figure 15: Hydroffice Surface Report H12887 (Priority 3) 1m Final

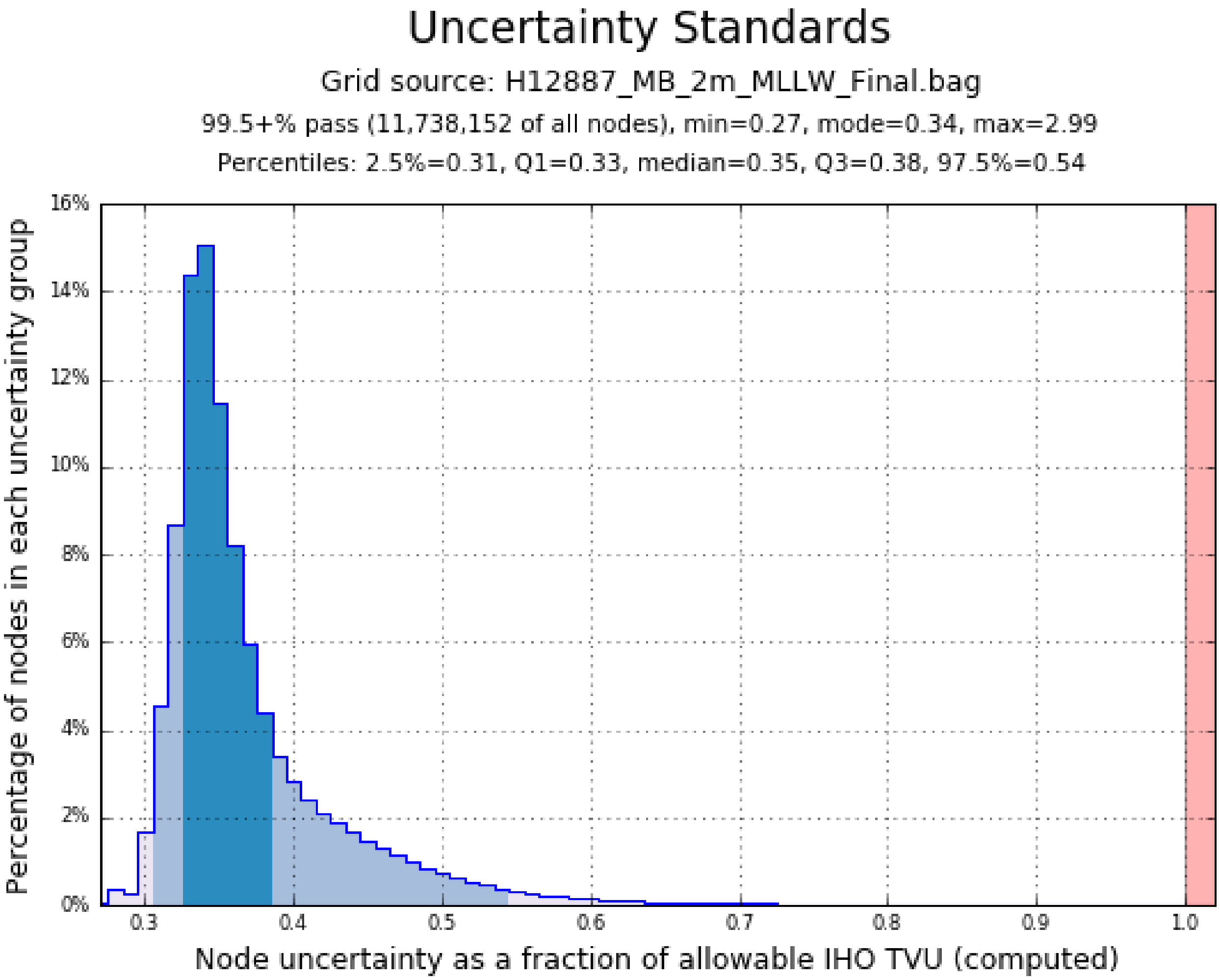


Figure 16: Hydroffice Surface Report H12887 (Priority 3) 2m Final

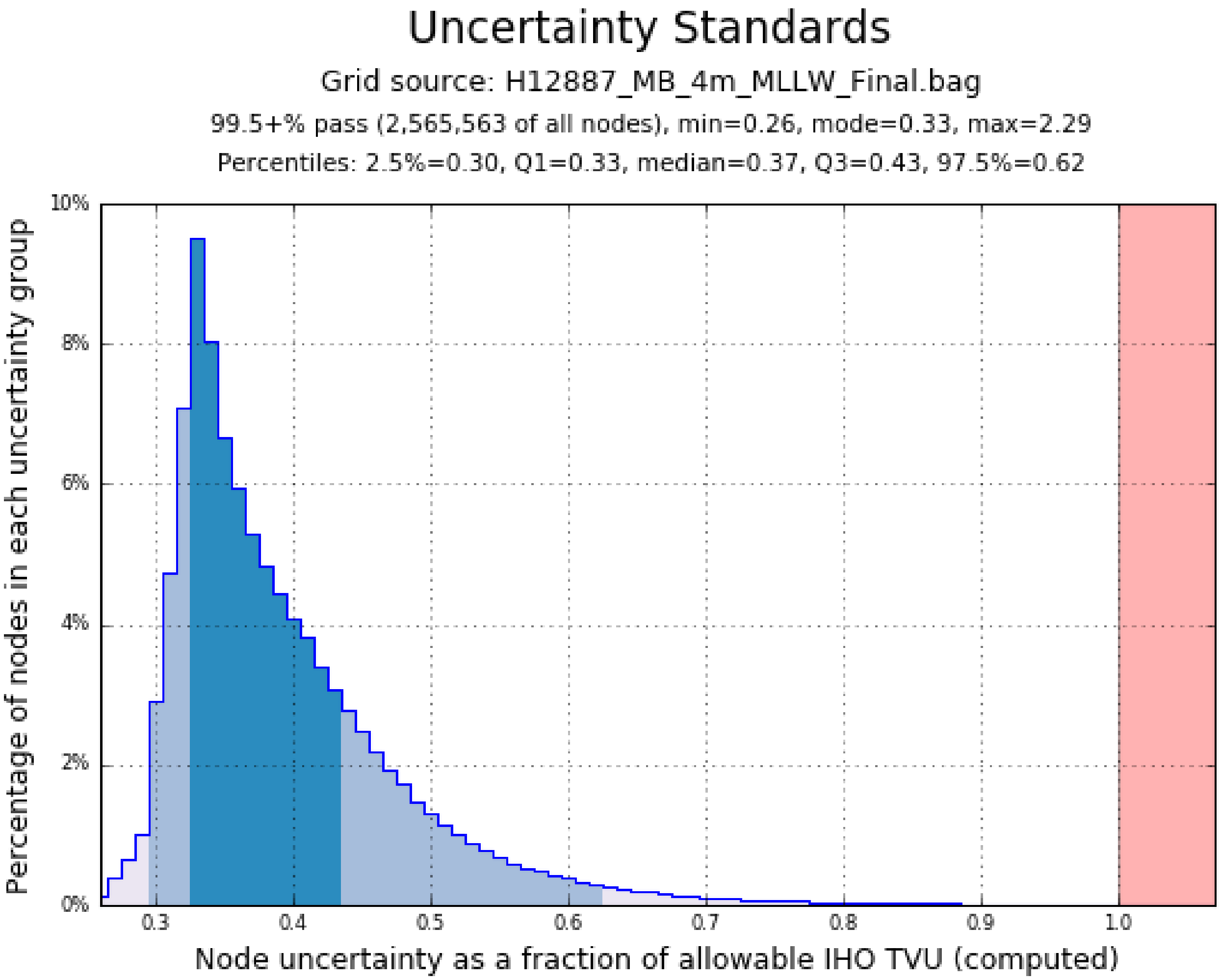


Figure 17: Hydroffice Surface Report H12887 (Priority 3) 4m Final

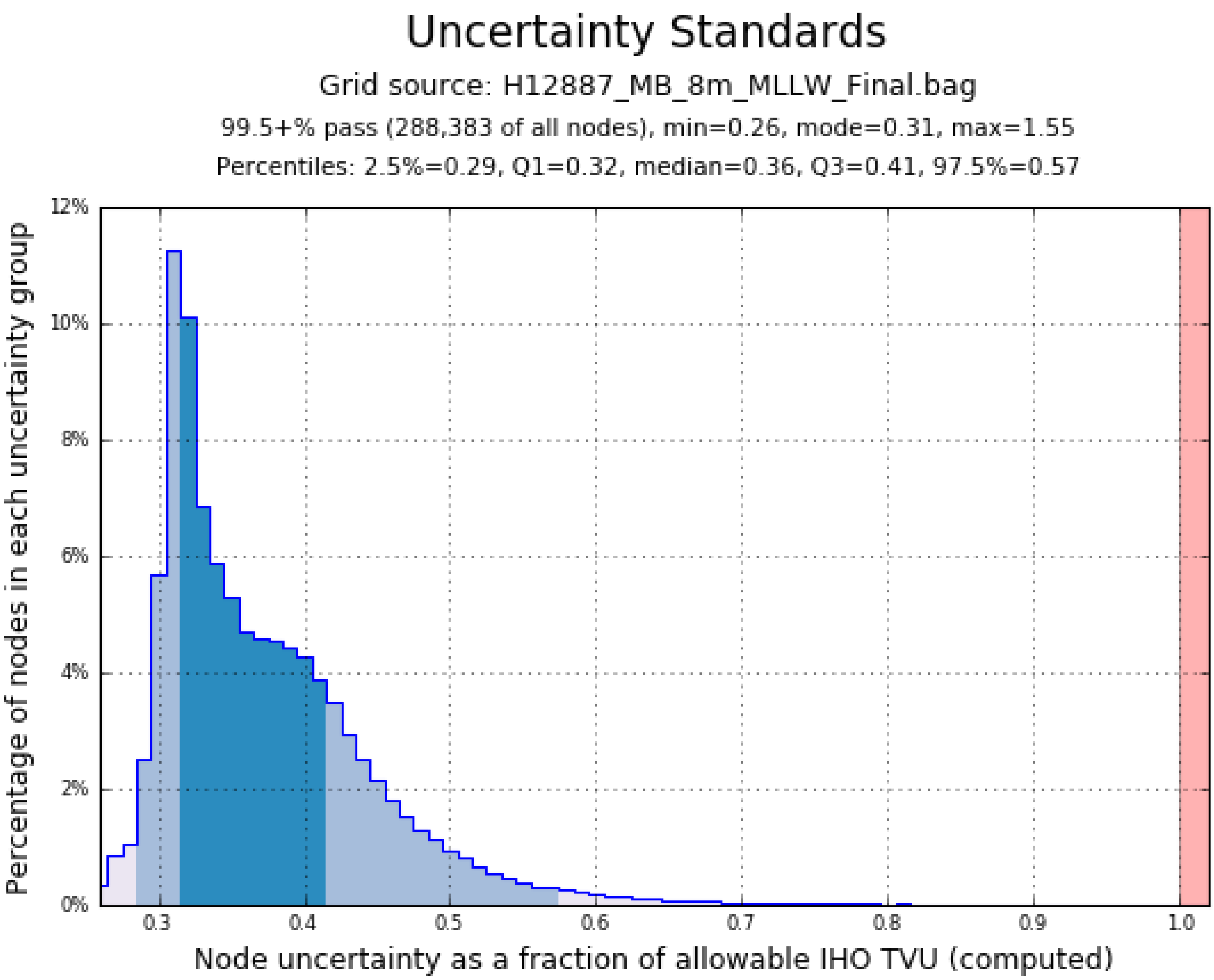


Figure 18: Hydroffice Surface Report H12887 (Priority 3) 8m Final

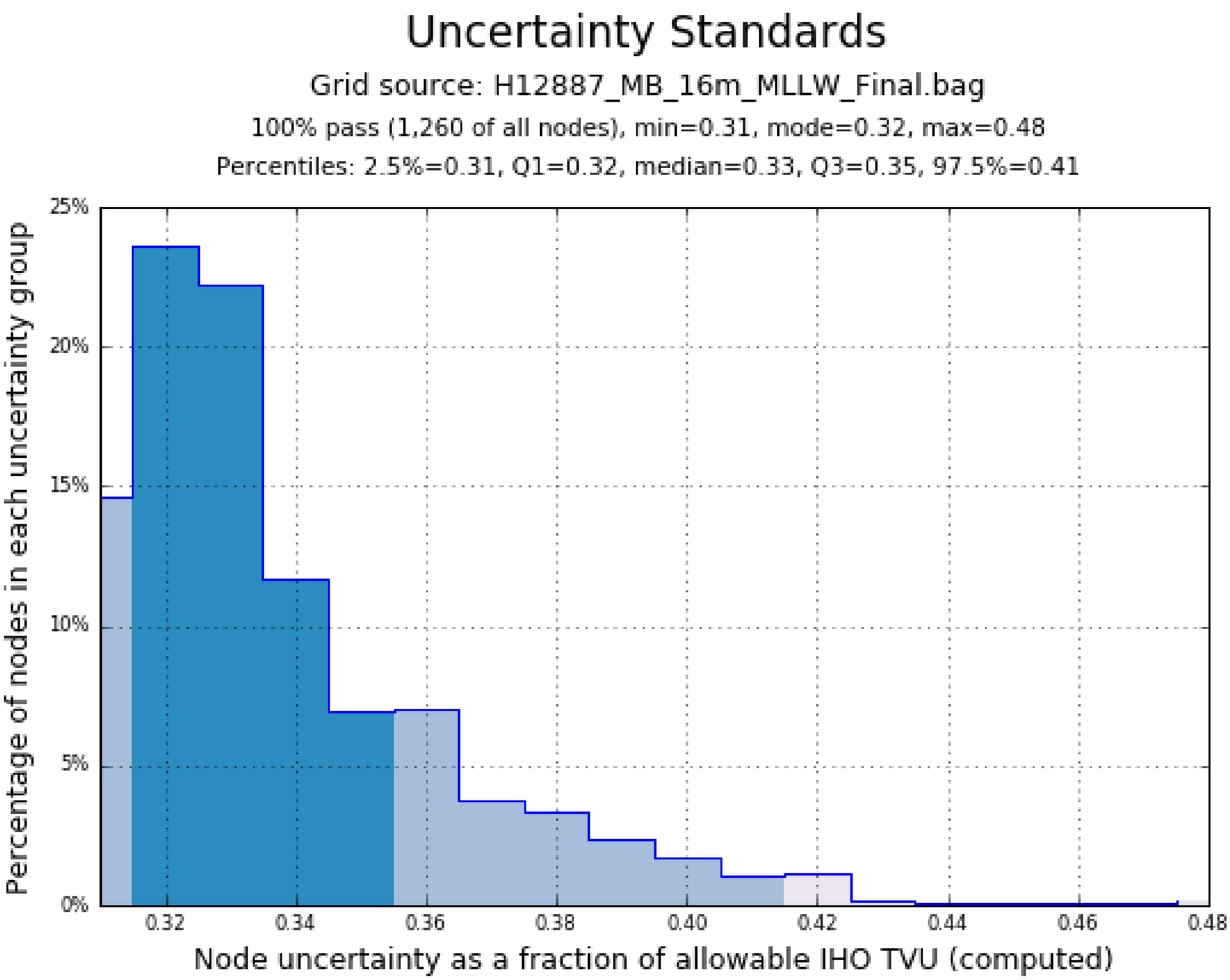


Figure 19: Hydroffice Surface Report H12887 (Priority 3) 16m Final

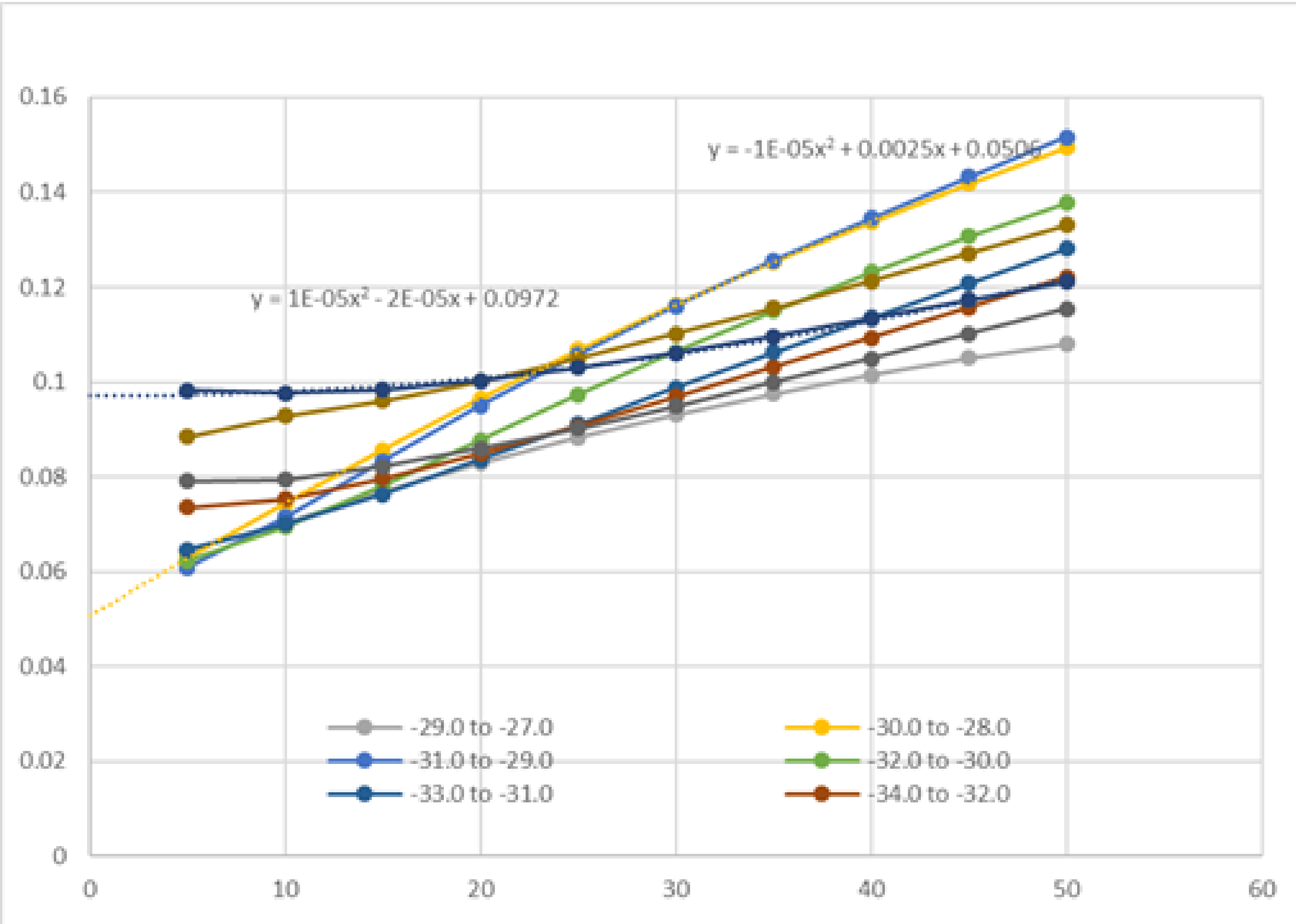


Figure 20: LTE tool results example

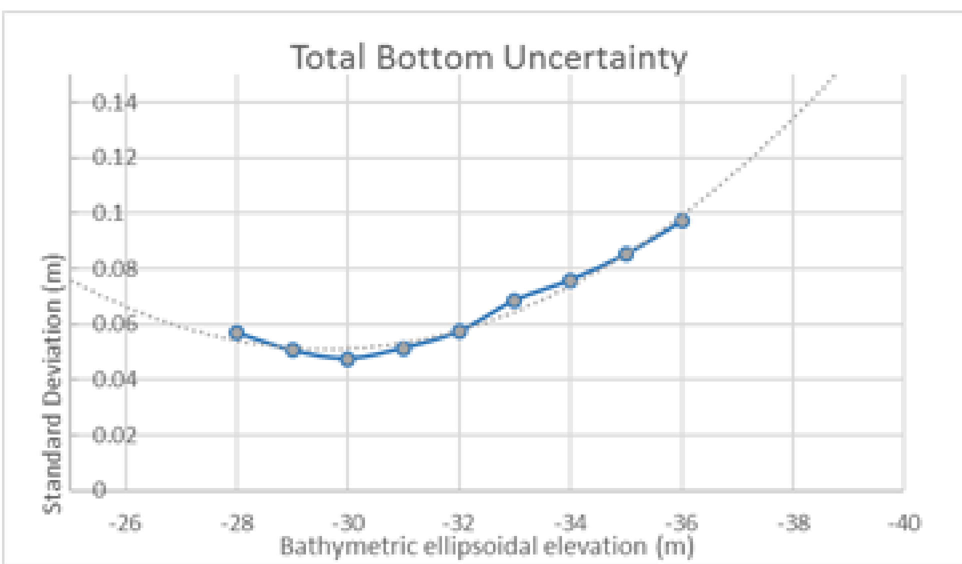


Figure 21: Total Bottom Uncertainty for SHOALS data sample

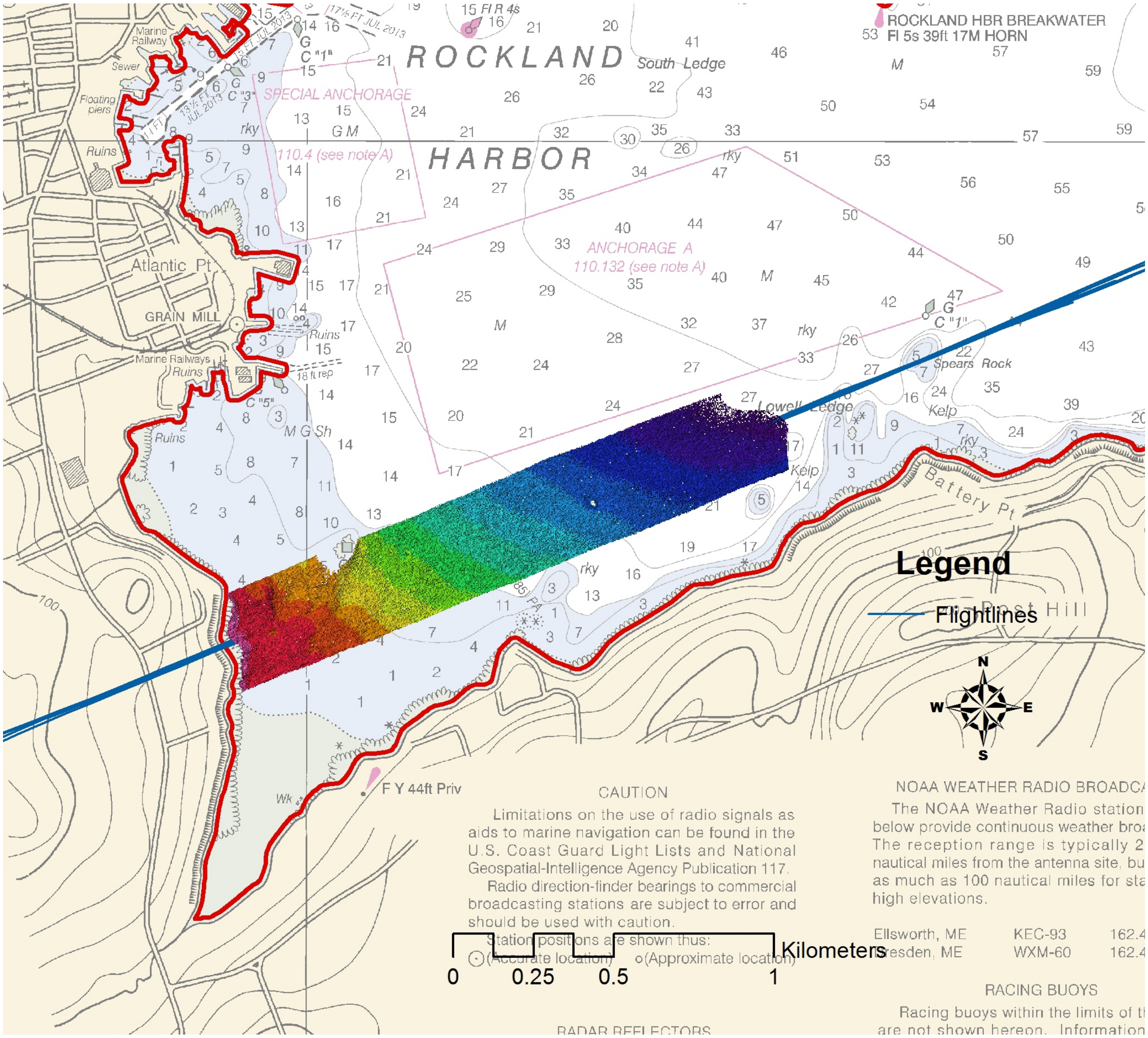


Figure 22: TPU Survey Area

Per the HSSD section 5.3.1.2 Gridded Data Specifications it states, "The uncertainty value for the grid shall be greater of the standard deviation and the a priori computed uncertainty estimate." As the field unit did not submit a finalized surface for lidar, the greater of the two was not selected for the uncertainty values. After finalization, it was found that only 57% of nodes met uncertainty standards. Though the surface does not meet uncertainty standards, the processing branch will still accept the data as it is the best data available in the area

B.2.3 Junctions

Comparisons between H12887 were made with contemporary survey H12256, and the current surveys H12884, H12885, and H12886. The results are as follows:

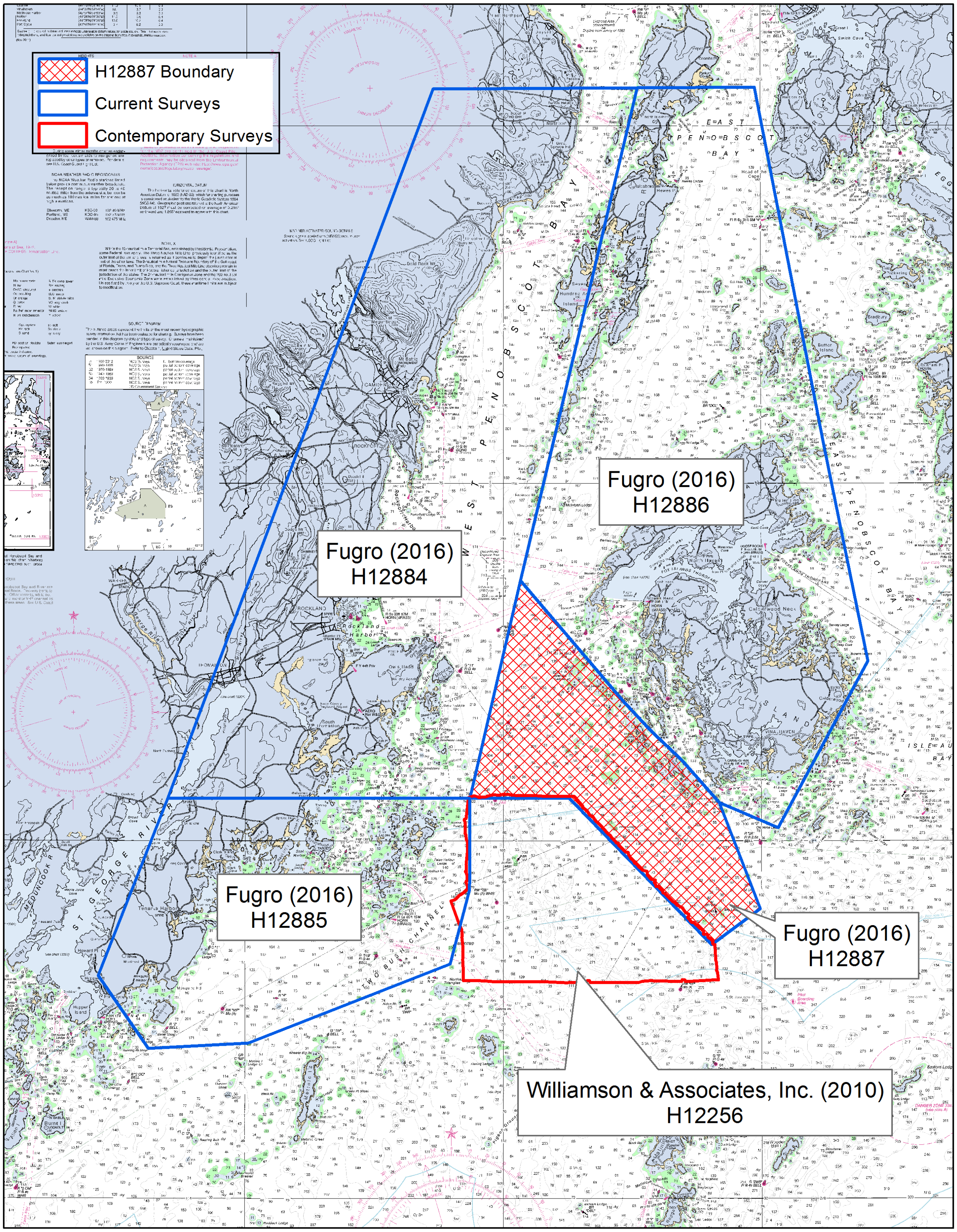


Figure 23: H12887 Junctions Overview

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H12256	1:10000	2010	Williamson & Associates, Inc.	S
H12884	1:10000	2016	Fugro	W
H12885	1:20000	2016	Fugro	SW
H12886	1:10000	2016	Fugro	N

Table 8: Junctioning Surveys

H12256

The conformity between H12887 and the junction with survey H12256 was inspected during processing using the CARIS HIPS Subset Editor routine and finalized as BASE Surfaces. A Difference Surface was generated using the CARIS HIPS Difference Surface function; comparing the depths from the H12887 survey (1, 2, 4, and 8-meter resolution) CUBE surfaces against the H12256 survey. Using the Compute Statistics function in CARIS, the difference surface yielded the following results: a standard deviation of 0.2 meters, and a mean difference of -0.1 meters for the one-meter surface, along with a standard deviation of 0.4 meters, and a mean difference of 0.0 meters for the two-meter surface, and a standard deviation of 0.8 meters, and a mean difference of 0.0 meters for the four-meter surface, and a standard deviation of 0.6 meters, and a mean difference of 0.0 meters for the eight-meter surface. The surveys are in agreement along their common borders and well within the total allowable IHO Order 1a vertical uncertainty. The majority of the difference between the two surveys can be attributed to motion artifacts in the H12256 data along with sound speed refraction and tide error accounting for a small portion of that difference.

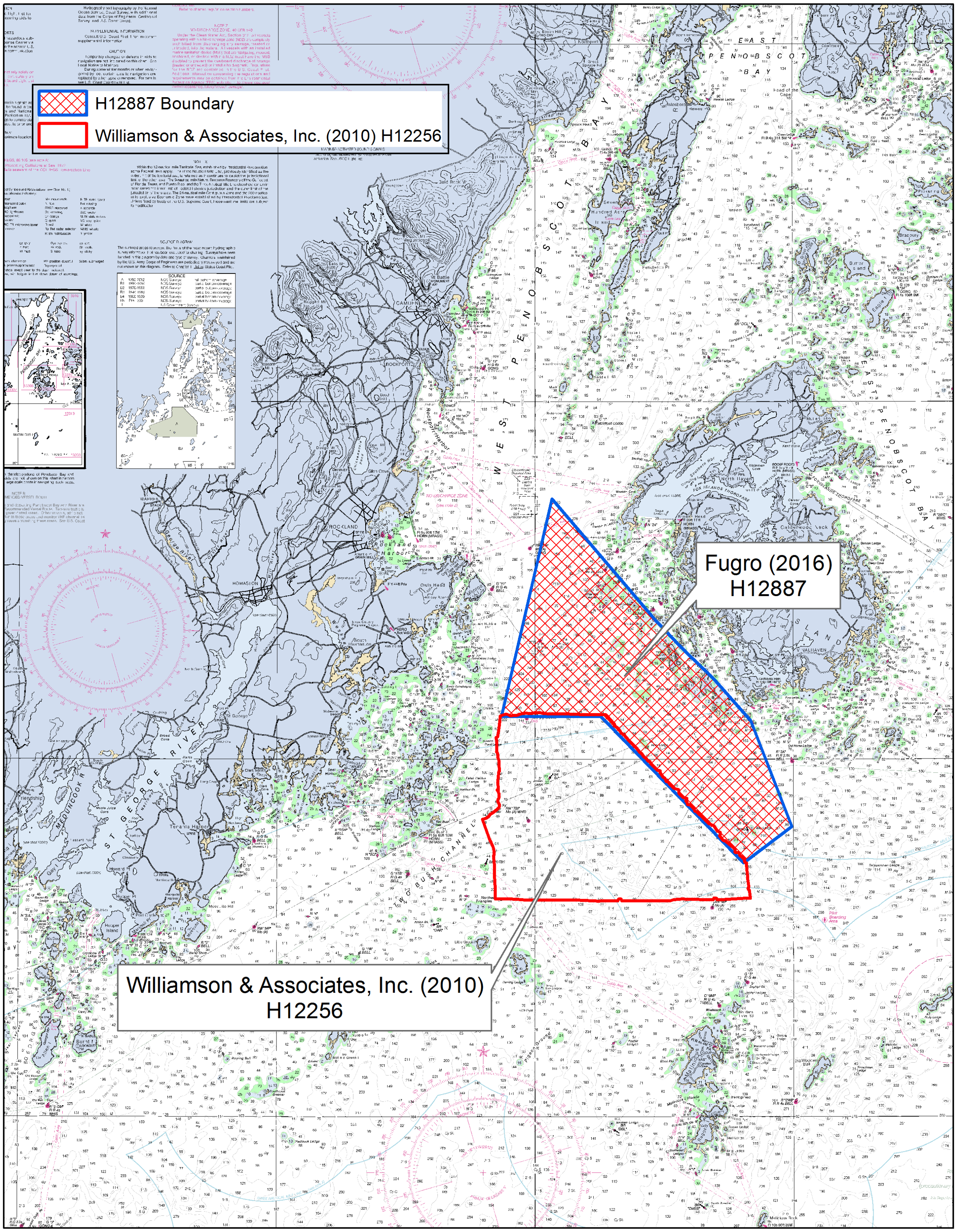


Figure 24: Junction between Survey H12887 and H12256

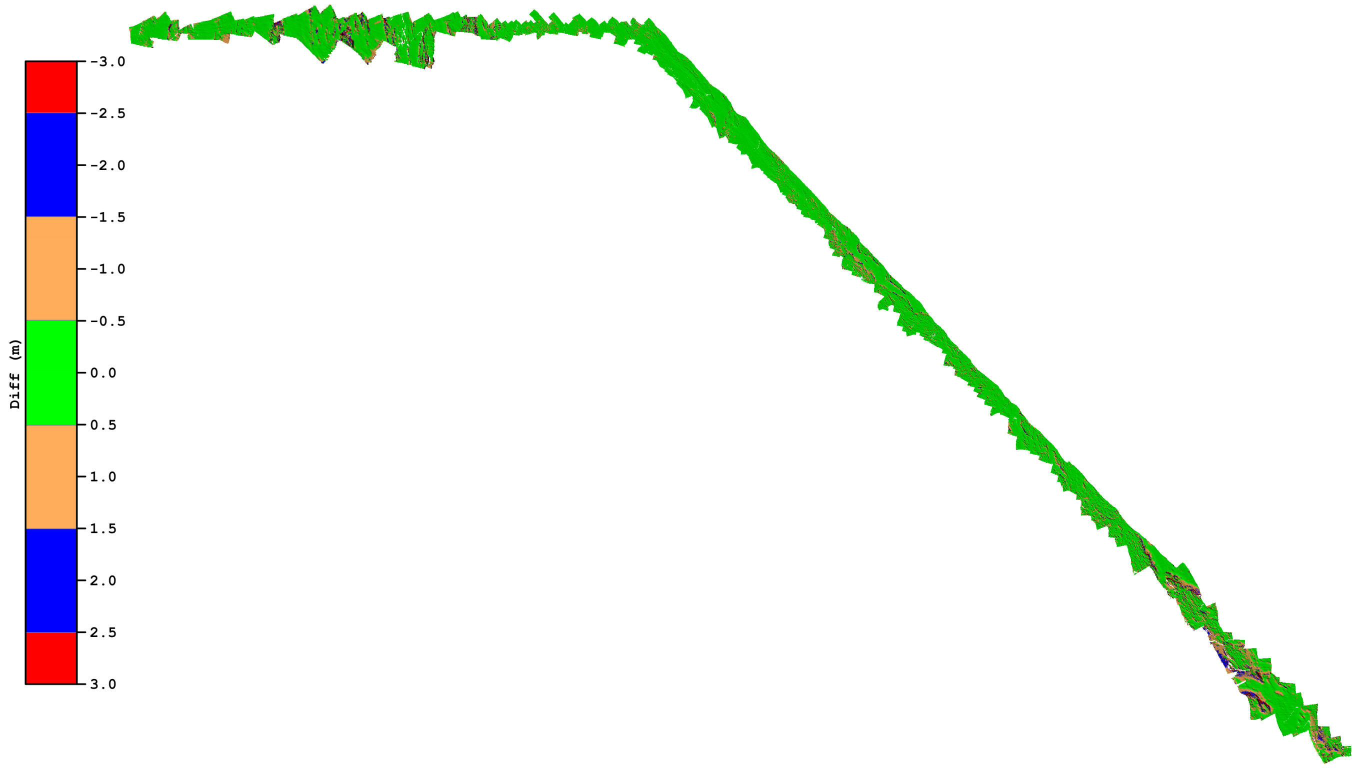


Figure 25: H12887 Minus H12256 Diff Surface

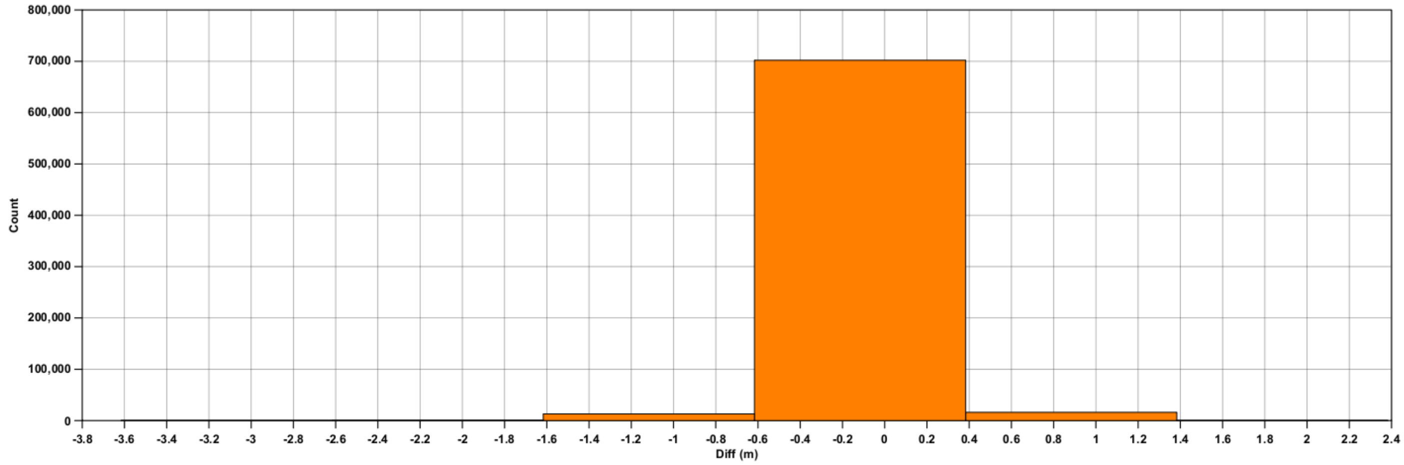


Figure 26: H12887 Minus H12256 Diff 1m Diff Histogram

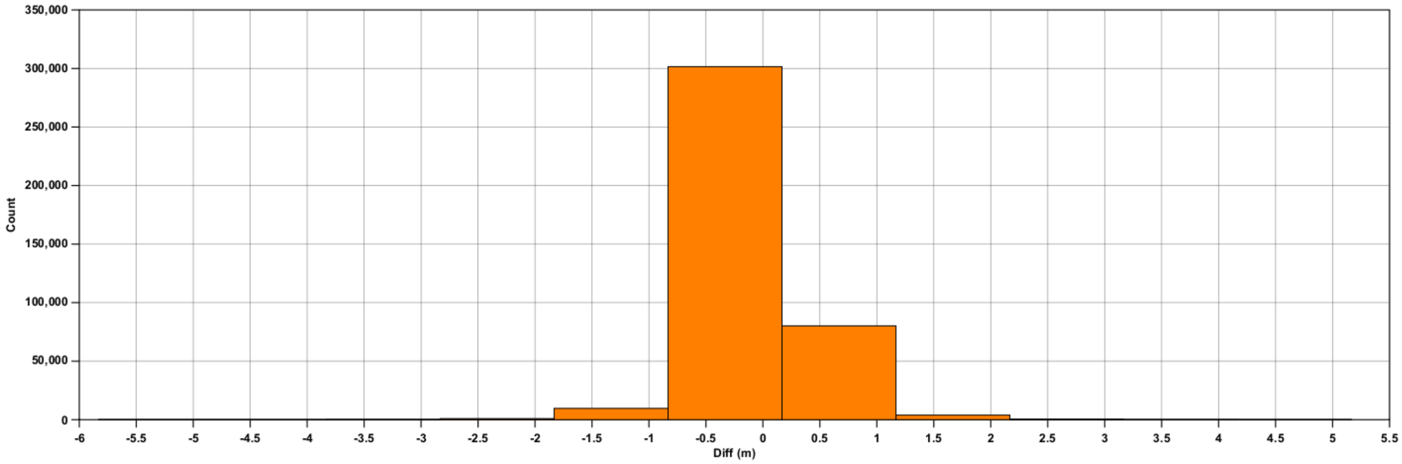


Figure 27: H12887 Minus H12256 Diff 2m Diff Histogram

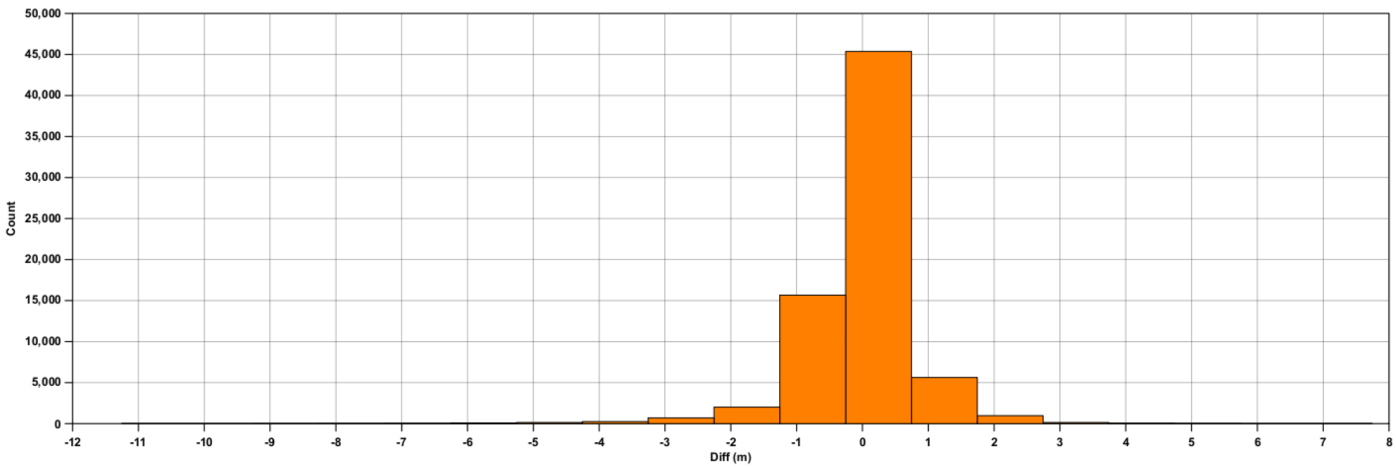


Figure 28: H12887 Minus H12256 Diff 4m Diff Histogram

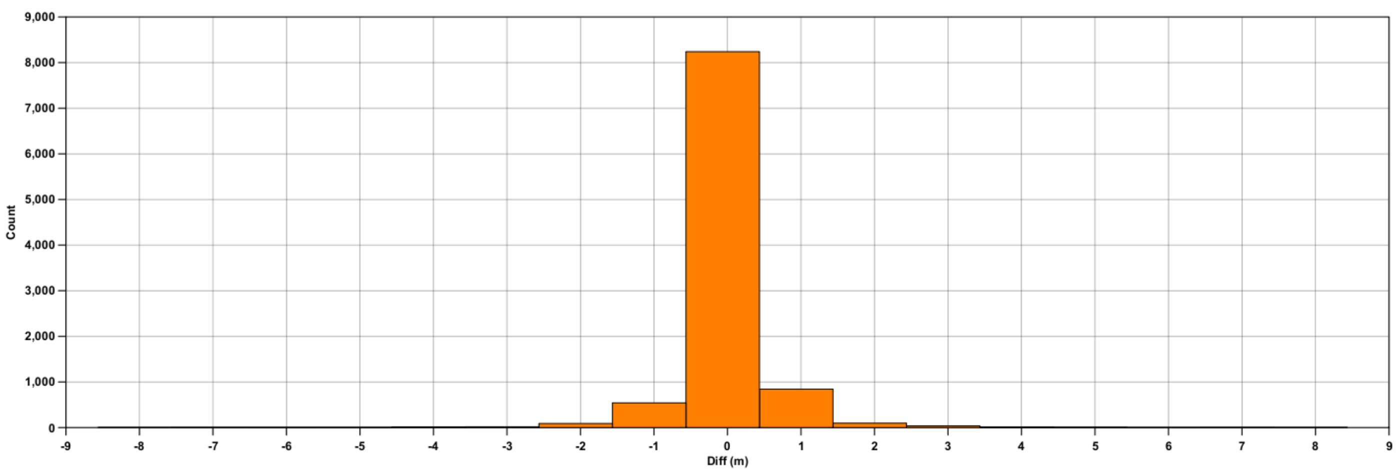


Figure 29: H12887 Minus H12256 Diff 8m Diff Histogram

H12884

The conformity between H12887 and the junction with survey H12884 was inspected during processing using the CARIS HIPS Subset Editor routine and finalized as BASE Surfaces. A Difference Surface was generated using the CARIS HIPS Difference Surface function; comparing the depths from the H12887 survey (2, 4, 8, and 16-meter resolution) CUBE surfaces against the H12884 survey. Using the Compute Statistics function in CARIS, the difference surface yielded the following results: a standard deviation of 0.4 meters, and a mean difference of 0.4 meters for the two-meter surface, a standard deviation of 0.3 meters, and a mean difference of 0.1 meters for the four-meter surface, a standard deviation of 0.5 meters, and a mean difference of 0.0 meters for the eight-meter surface, and a standard deviation of 0.8 meters, and a mean difference of 0.0 meters for the sixteen-meter surface. The surveys are in agreement along their common borders and well within the total allowable IHO Order 1a vertical uncertainty. The majority of the difference between the two surveys can be attributed to sound speed refraction with tide error also accounting for a small portion of that difference. The increased standard deviation between the higher resolution grids can also be attributed to the grid, or node placement in the CUBE surface during creation. When CARIS creates the nodes for the H12887 8-meter surface, these will differ from the position of the nodes for H12884 8-meter surface. This small horizontal shift in the grid nodes can result in a depth difference, especially in areas with an irregular seafloor.

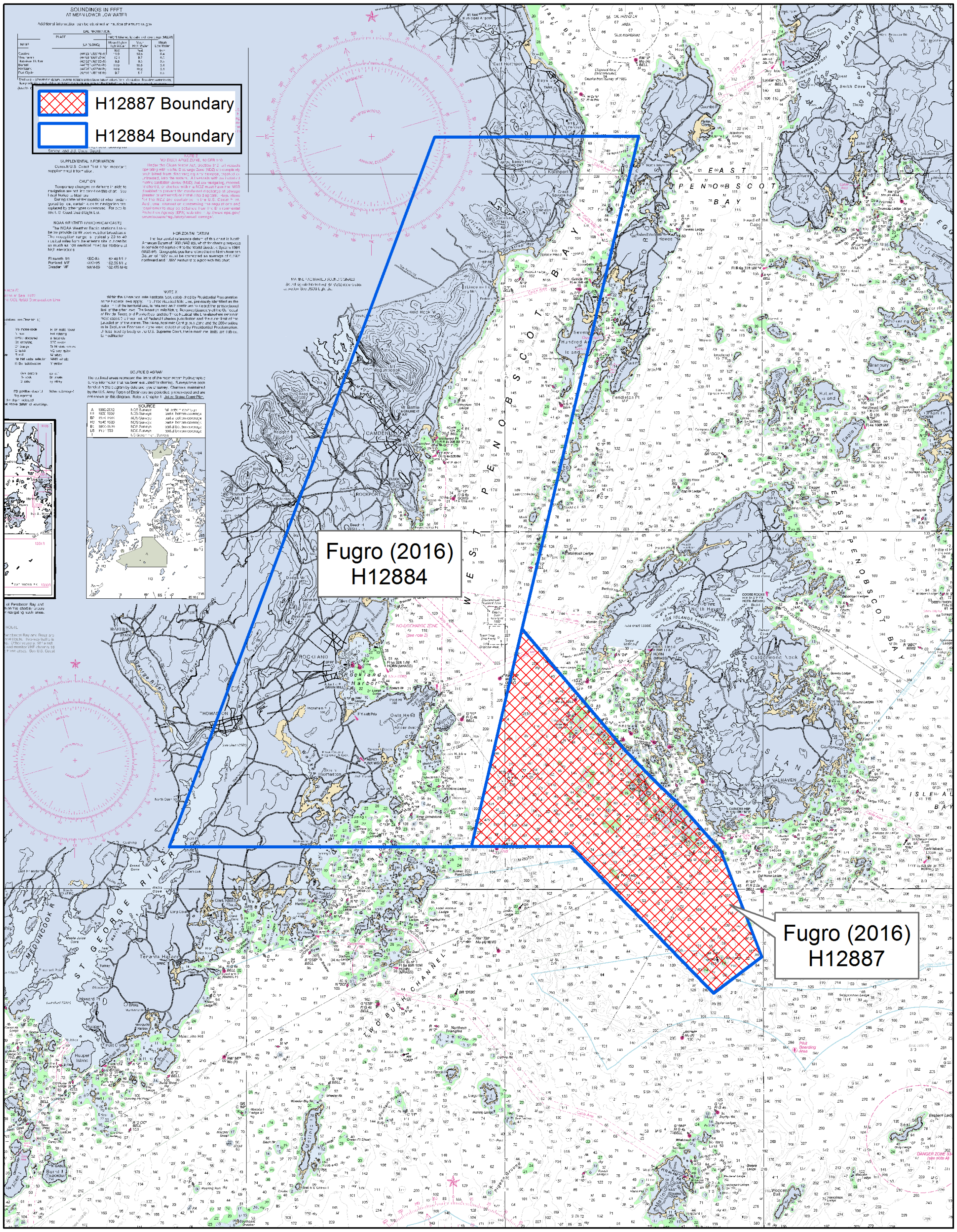


Figure 30: Junction between Survey H12887 and H12884

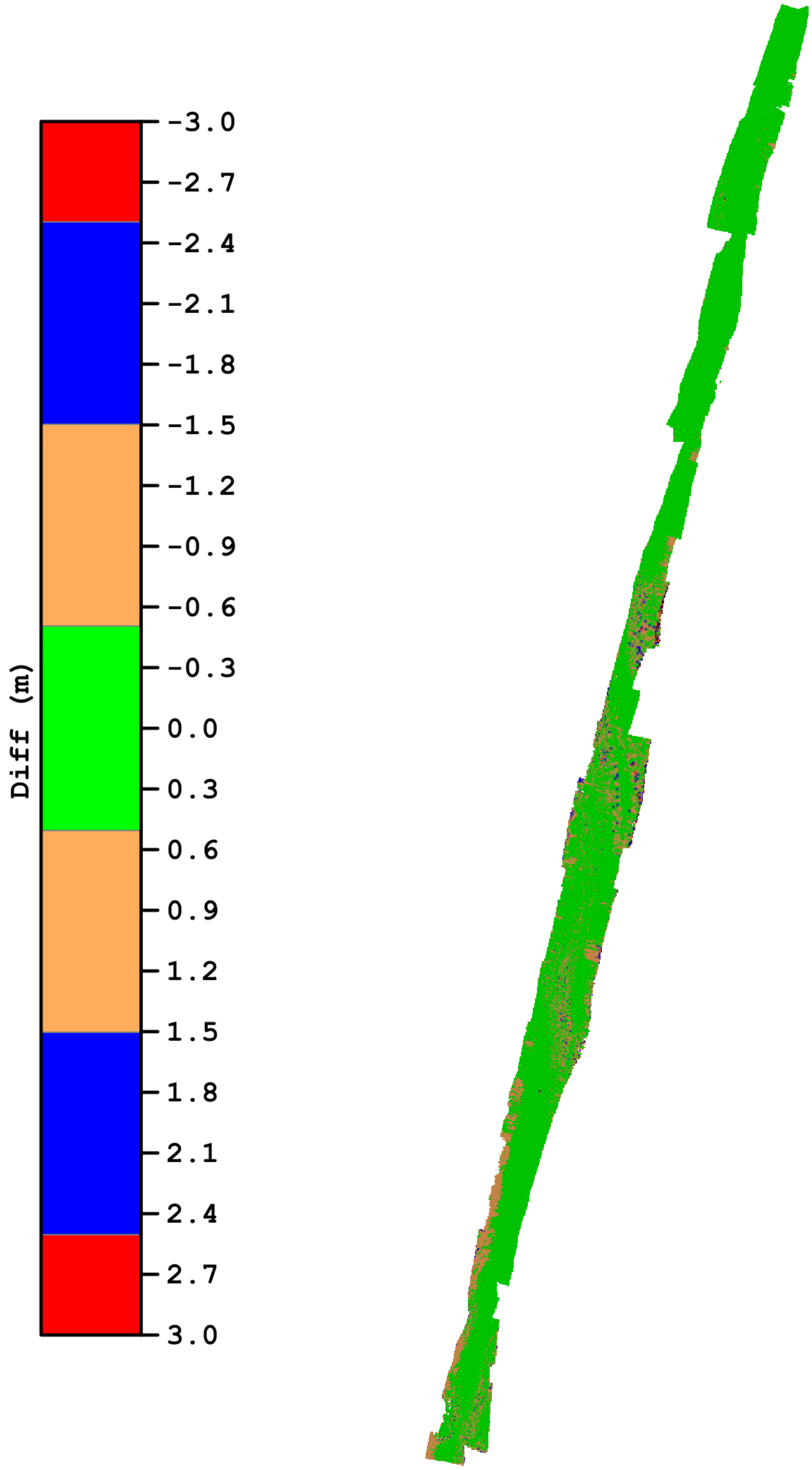


Figure 31: H12887 Minus H12884 Diff Surface

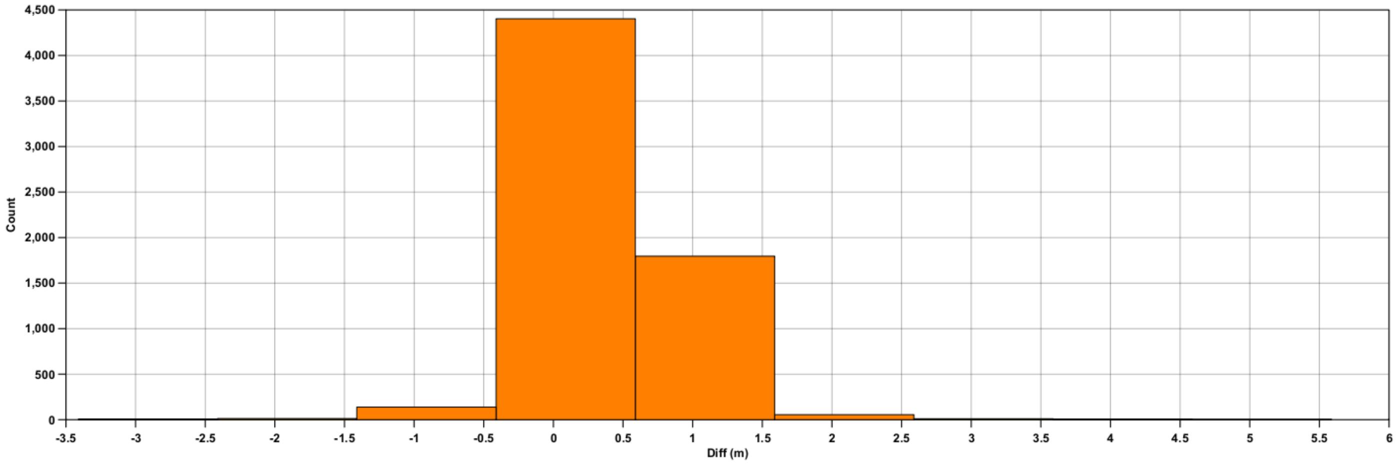


Figure 32: H12887 Minus H12884 Diff 2m Diff Histogram

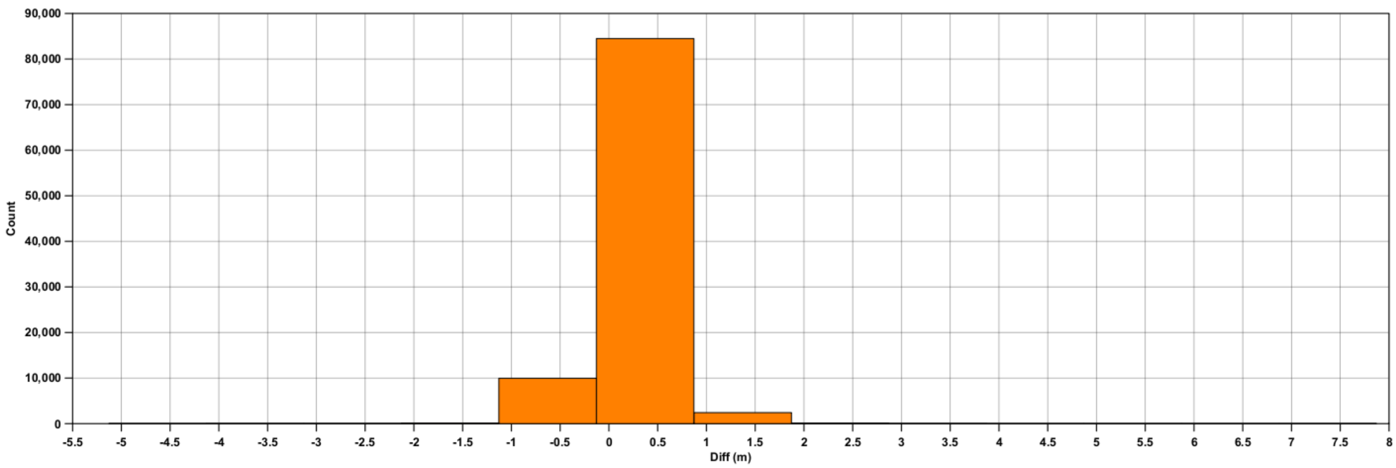


Figure 33: H12887 Minus H12884 Diff 4m Diff Histogram

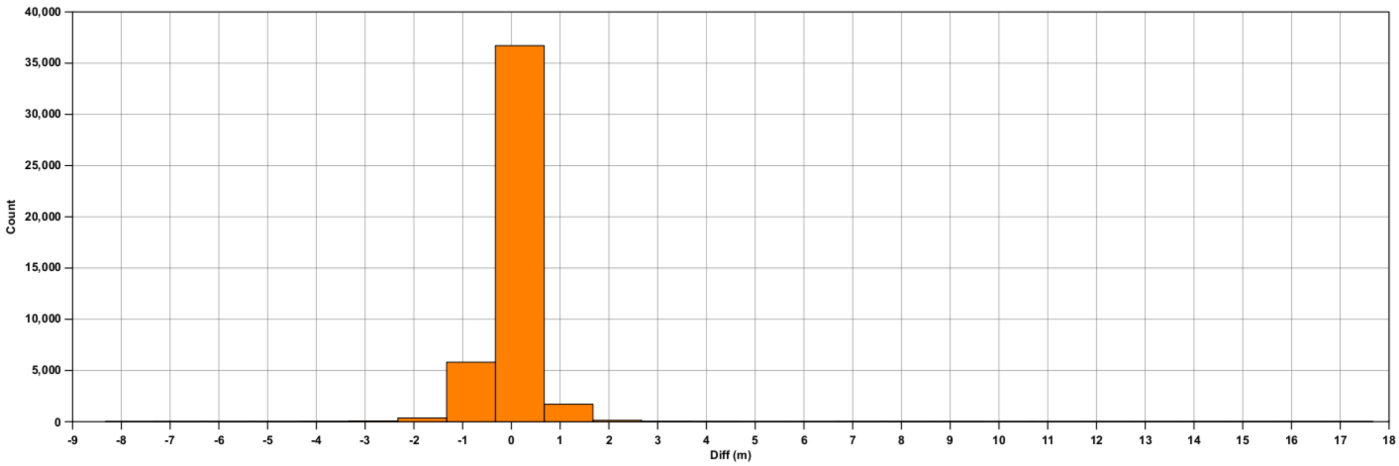


Figure 34: H12887 Minus H12884 Diff 8m Diff Histogram

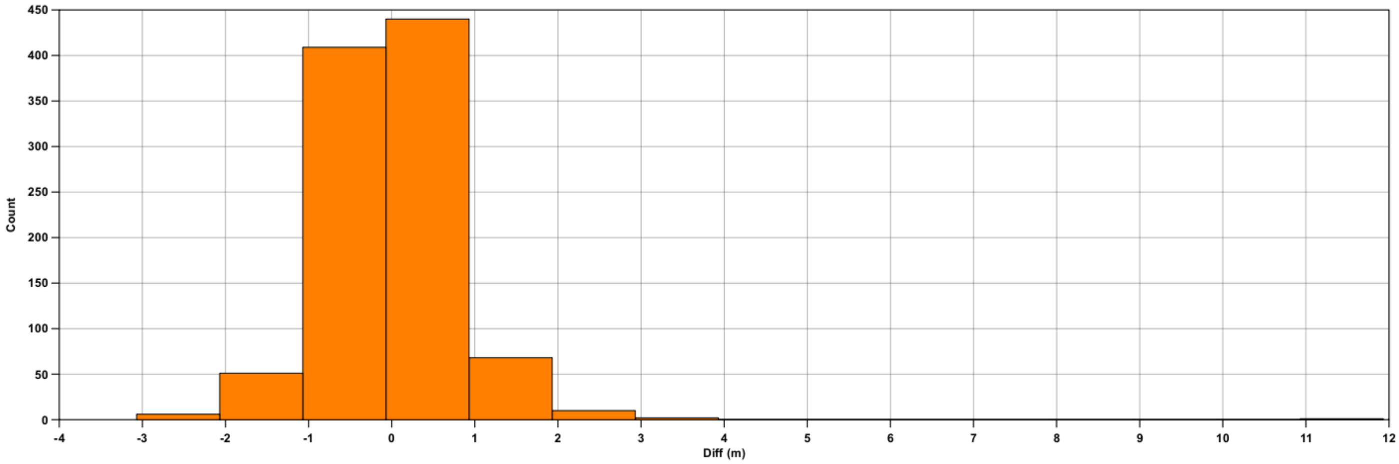


Figure 35: H12887 Minus H12884 Diff 16m Diff Histogram

<u>H12885</u>

The conformity between H12887 and the junction with survey H12885 was inspected during processing using the CARIS HIPS Subset Editor routine and finalized as BASE Surfaces. A Difference Surface was generated using the CARIS HIPS Difference Surface function; comparing the depths from the H12887 survey (2, 4, and 8-meter resolution) CUBE surfaces against the H12885 survey. Using the Compute Statistics function in CARIS, the difference surface yielded the following results: a standard deviation of 0.4 meters, and a mean difference of 0.3 meters for the two-meter surface, a standard deviation of 0.5 meters, and a mean difference of 0.2 meters for the four-meter surface, and a standard deviation of 0.6 meters, and a mean difference of 0.3 meters for the eight-meter surface. The surveys are in agreement along their common borders and well within the total allowable IHO Order 1a vertical uncertainty. The majority of the difference between the two surveys can be attributed to sound speed refraction with tide error also accounting for a small portion of that difference. The increased standard deviation between the higher resolution grids can also be attributed to the grid, or node placement in the CUBE surface during creation. When CARIS creates the nodes for the H12887 8-meter surface, these will differ from the position of the nodes for H12885 8-meter surface. This small horizontal shift in the grid nodes can result in a depth difference, especially in areas with an irregular seafloor.

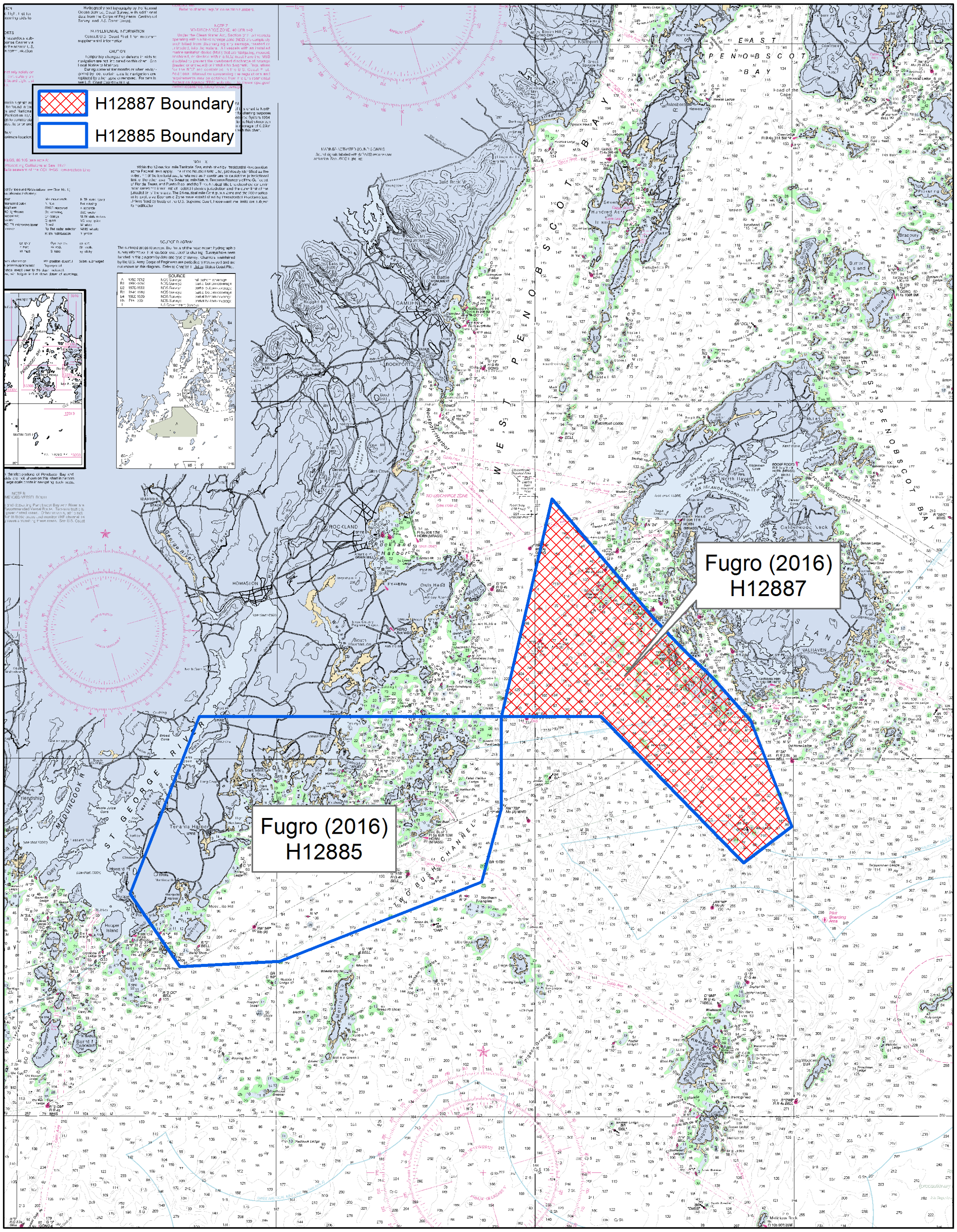


Figure 36: Junction between Survey H12887 and H12885

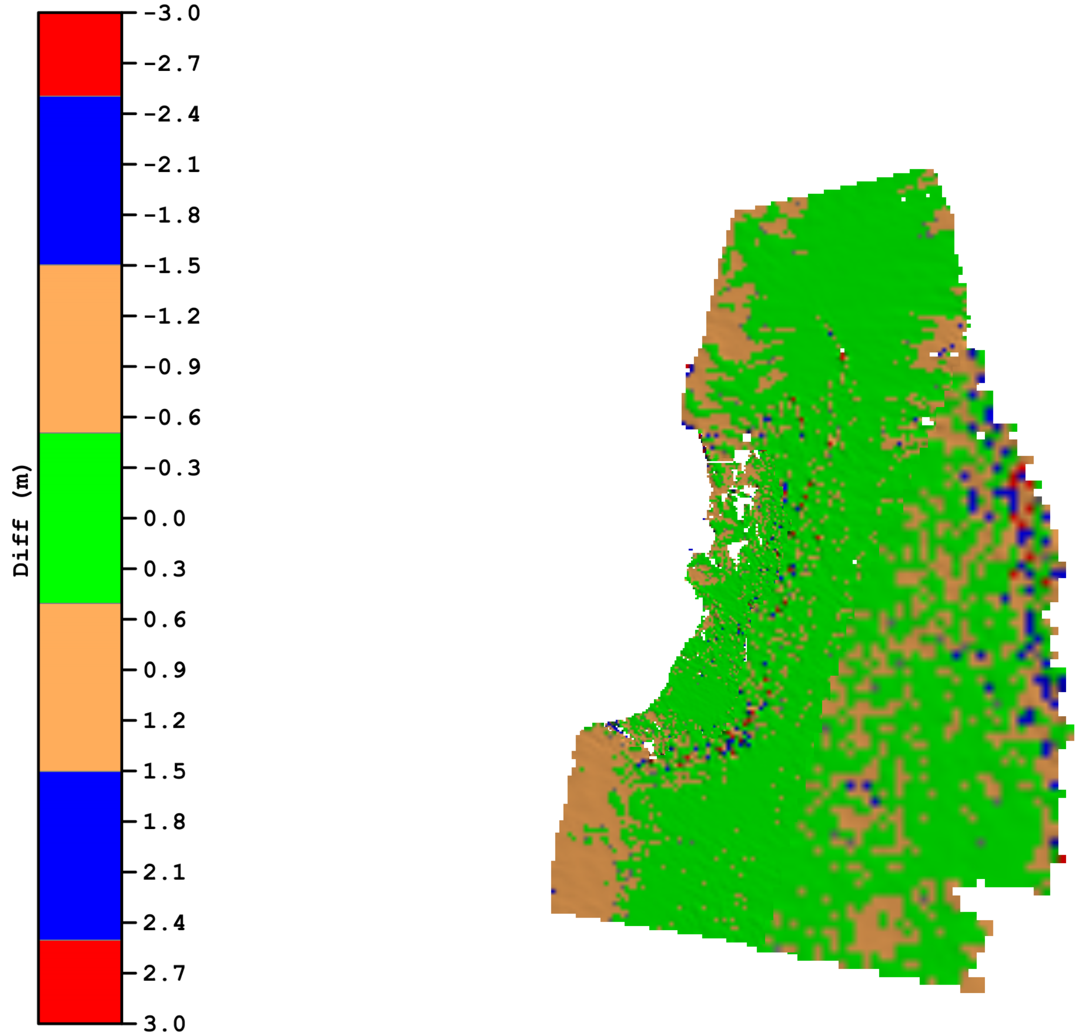


Figure 37: H12887 Minus H12885 Diff Surface

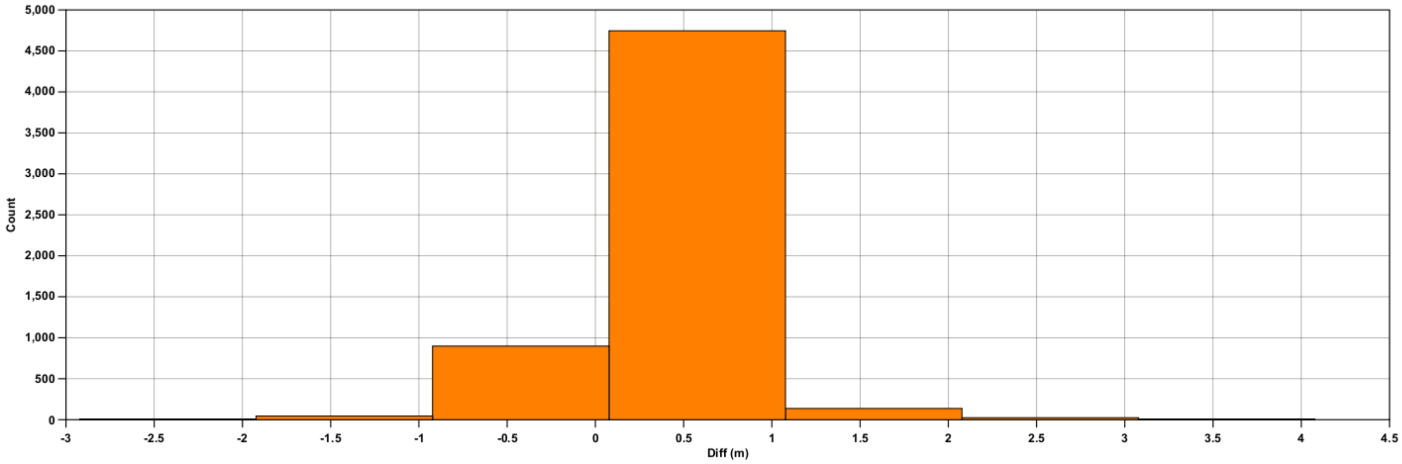


Figure 38: H12887 Minus H12885 Diff 2m Diff Histogram

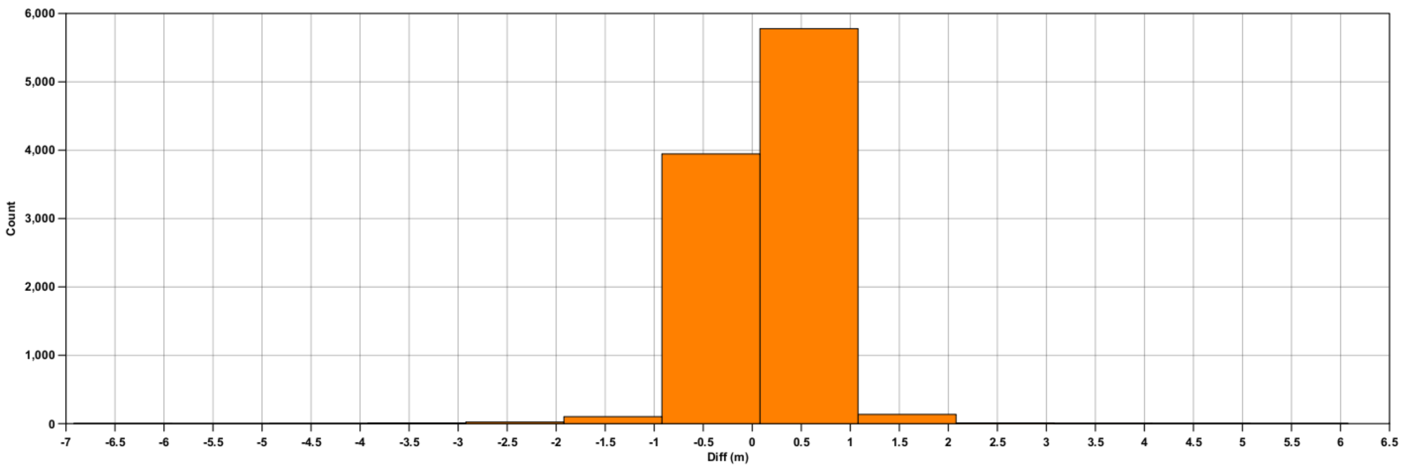


Figure 39: H12887 Minus H12885 Diff 4m Diff Histogram

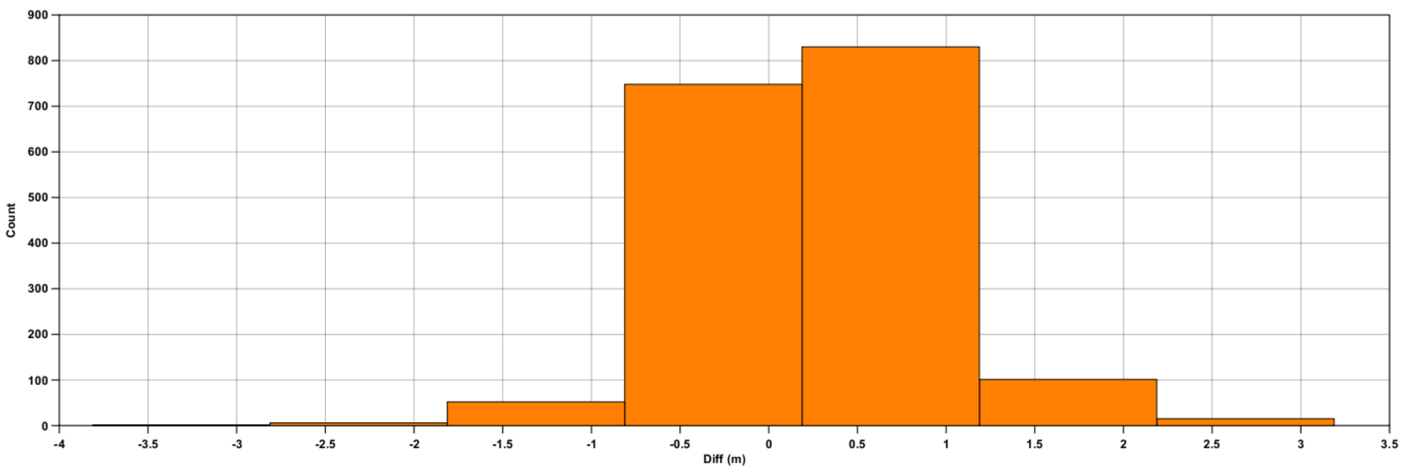


Figure 40: H12887 Minus H12885 Diff 8m Diff Histogram

H12886

The conformity between H12887 and the junction with survey H12886 was inspected during processing using the CARIS HIPS Subset Editor routine and finalized as BASE Surfaces. A Difference Surface was generated using the CARIS HIPS Difference Surface function; comparing the depths from the H12887 survey (1, 2, 4, and 8-meter resolution) CUBE surface against the H12886 survey. Using the Compute Statistics function in CARIS, the difference surface yielded the following results: a standard deviation of 0.2 meters, and a mean difference of 0.0 meters for the one-meter surface, along with a standard deviation of 0.2 meters, and a mean difference of 0.0 meters for the two-meter surface, and a standard deviation of 0.2 meters, and a mean difference of 0.0 meters for the four-meter surface, and a standard deviation of 0.2 meters, and a mean difference of 0.0 meters for the eight-meter surface. The surveys are in agreement along their common borders and well within the total allowable IHO Order 1a vertical uncertainty. The majority of the difference between the two surveys can be attributed to sound speed refraction with tide error also accounting for a small portion of that difference. The increased standard deviation between the higher resolution grids can also be attributed to the grid, or node placement in the CUBE surface during creation. When CARIS creates the nodes for the H12887 8-meter surface, these will differ from the position of the nodes for H12886 8-meter surface. This small horizontal shift in the grid nodes can result in a depth difference, especially in areas with an irregular seafloor.

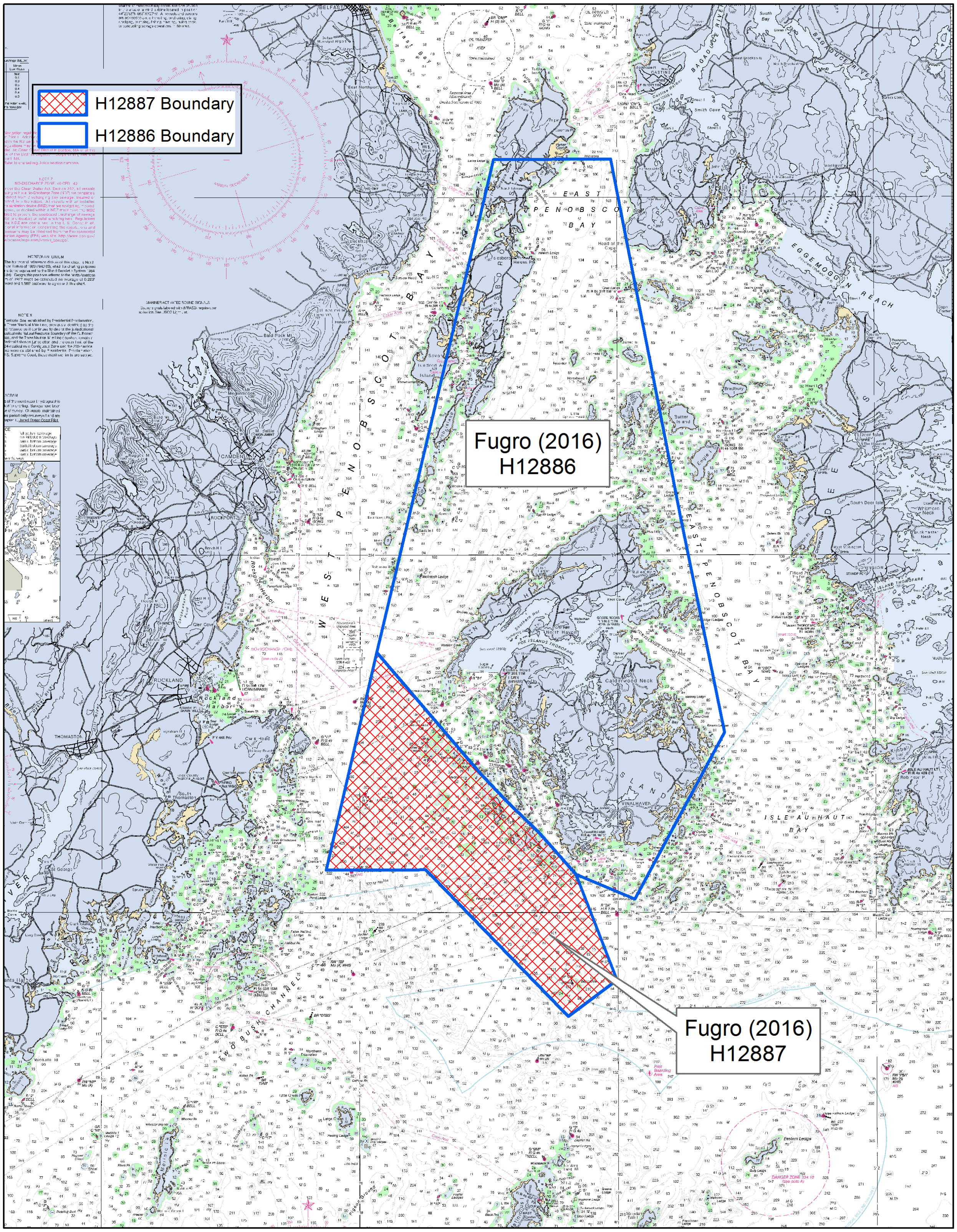


Figure 41: Junction between Survey H12887 and H12886

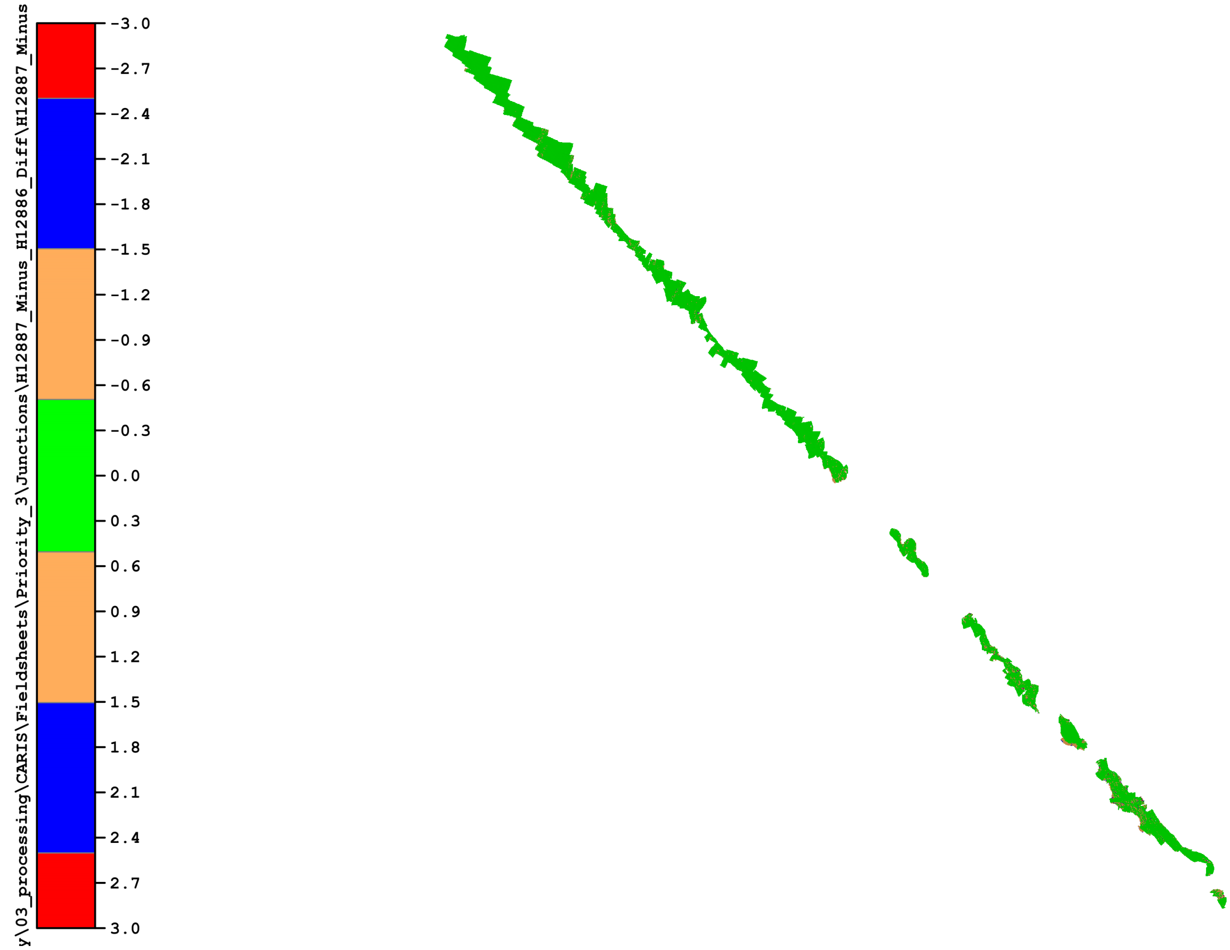


Figure 42: H12887 Minus H12886 Diff Surface

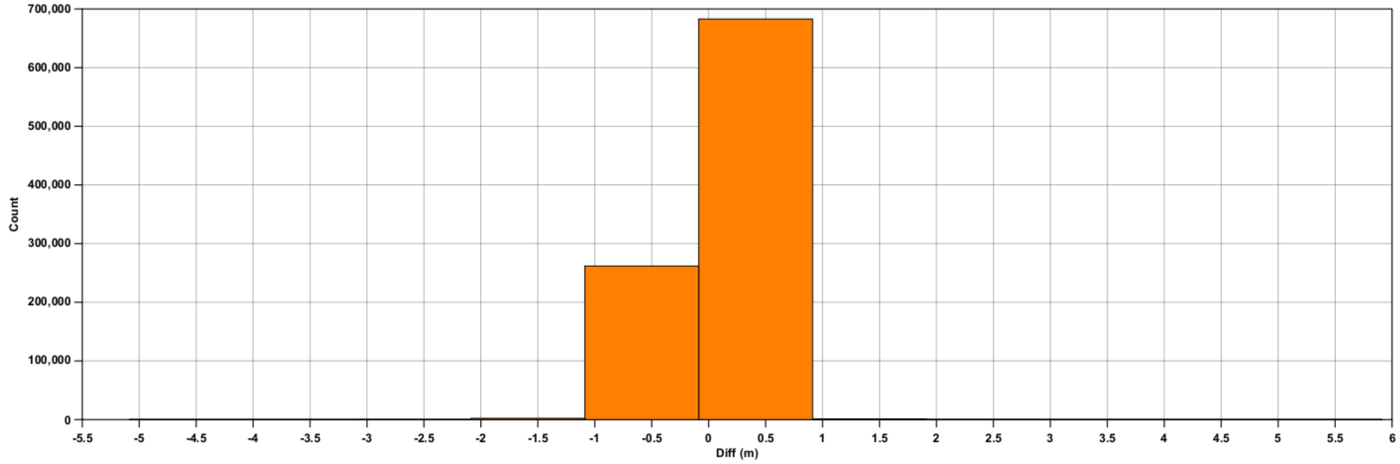


Figure 43: H12887 Minus H12886 Diff 1m Diff Histogram

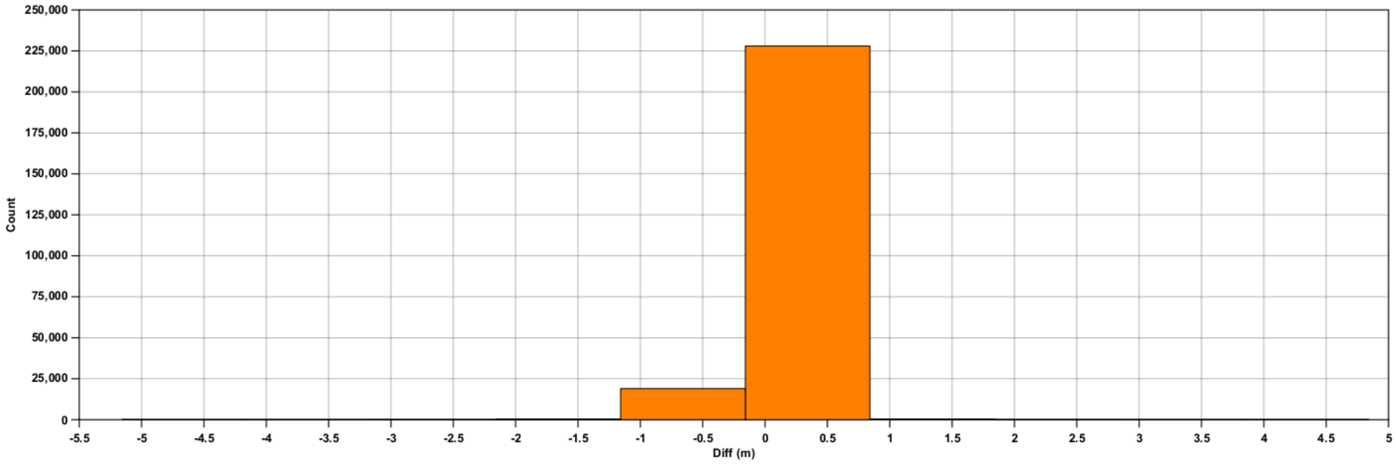


Figure 44: H12887 Minus H12886 Diff 2m Diff Histogram

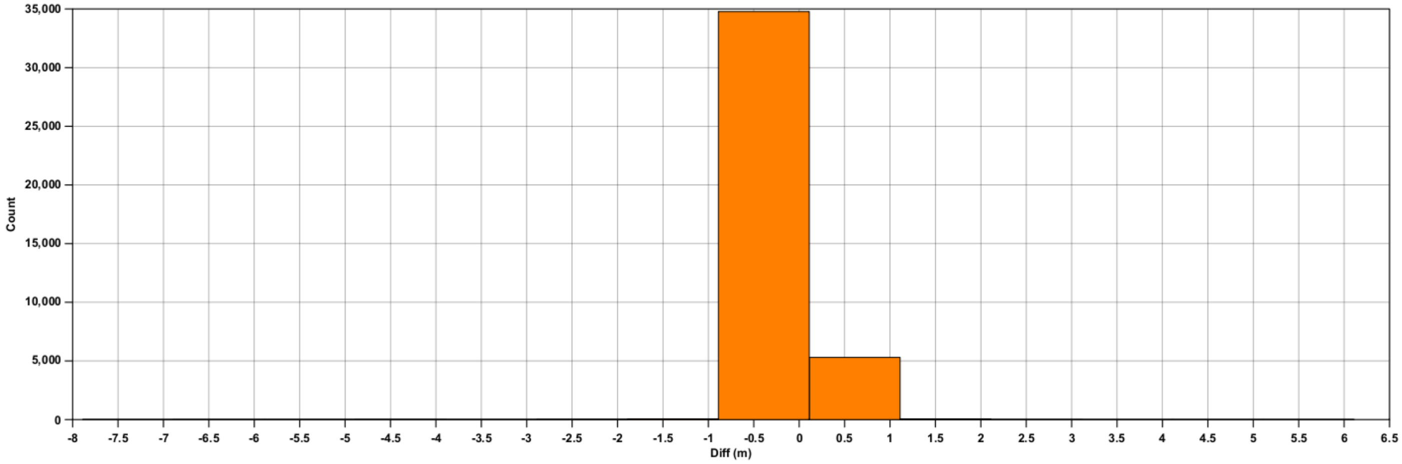


Figure 45: H12887 Minus H12886 Diff 4m Diff Histogram

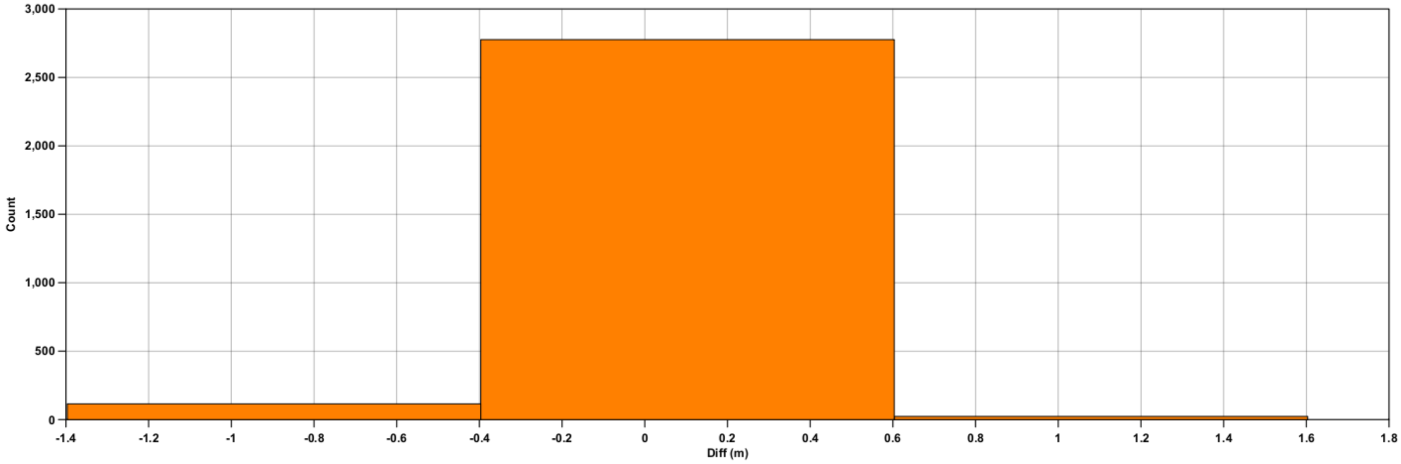


Figure 46: H12887 Minus H12886 Diff 8m Diff Histogram

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

Water Clarity

The greatest contributor to depth performance, seabed coverage, and data quality with a LiDAR system is water clarity. To address this concern, Fugro conducted water clarity assessments across the project area, from the planning phase through to the final flight, using several different techniques. Refer to the DAPR for more details.

On 13 June 2016, Fugro staff undertook an aerial reconnaissance mission in the vicinity of Penobscot Bay. Conditions of the water clarity were documented in photos and overall, found to be relatively poor. Water was seen to be clear in the very shallow depths (likely, under four meters) and murky in deeper depths.

In general, water clarity in the Penobscot Bay survey area was less than ideal for ALB acquisition. Clear water was more common in shallow areas, but water in the four to eight meter range of interest was typically murky.

Conditions were similar in the survey area around Vinalhaven Island and North Haven Island as well, with shallow depths being clearer than the depth range of interest (four to eight meters). The bathymetry in the area tends toward a steep descent into depths outside the range of ALB.

The water clarity had a negative impact on coverage within the four to eight meter depth range, a range of particular interest to this survey. A test flight was conducted during high tide in order to eliminate the low tide timing as the issue with water clarity, due to tidal flushing. Water conditions on this test flight were consistent with those seen on the flights timed around low tide so it was concluded that the tide level was not the cause of the poor water clarity.

Figure 47: Water Clarity

7125 Dual Head Transmitter and Receiver Offsets

For the first several weeks on the R/V JAB, the transmitter and receiver were inadvertently mismatched, with the port receiver using the starboard system's transmitter, and vice versa. Proper reduction of soundings measured in this configuration requires that the sonar be treated as a bi-static system, and that the absolute locations of the transmitter and receiver be accounted for. CARIS HIPS is designed to handle such a situation, and offset information in the form of a 7030 record, which was added to each dual head s7k file to enable proper processing without an adjustment to the processing pipeline used by Fugro. The methodology was validated using a postage stamp survey over a flat seafloor. Adjusted 7030 records were inserted into all applicable previously collected data and reprocessed in CARIS using Fugro's standard methodology for the processing of 7027 dual head records.

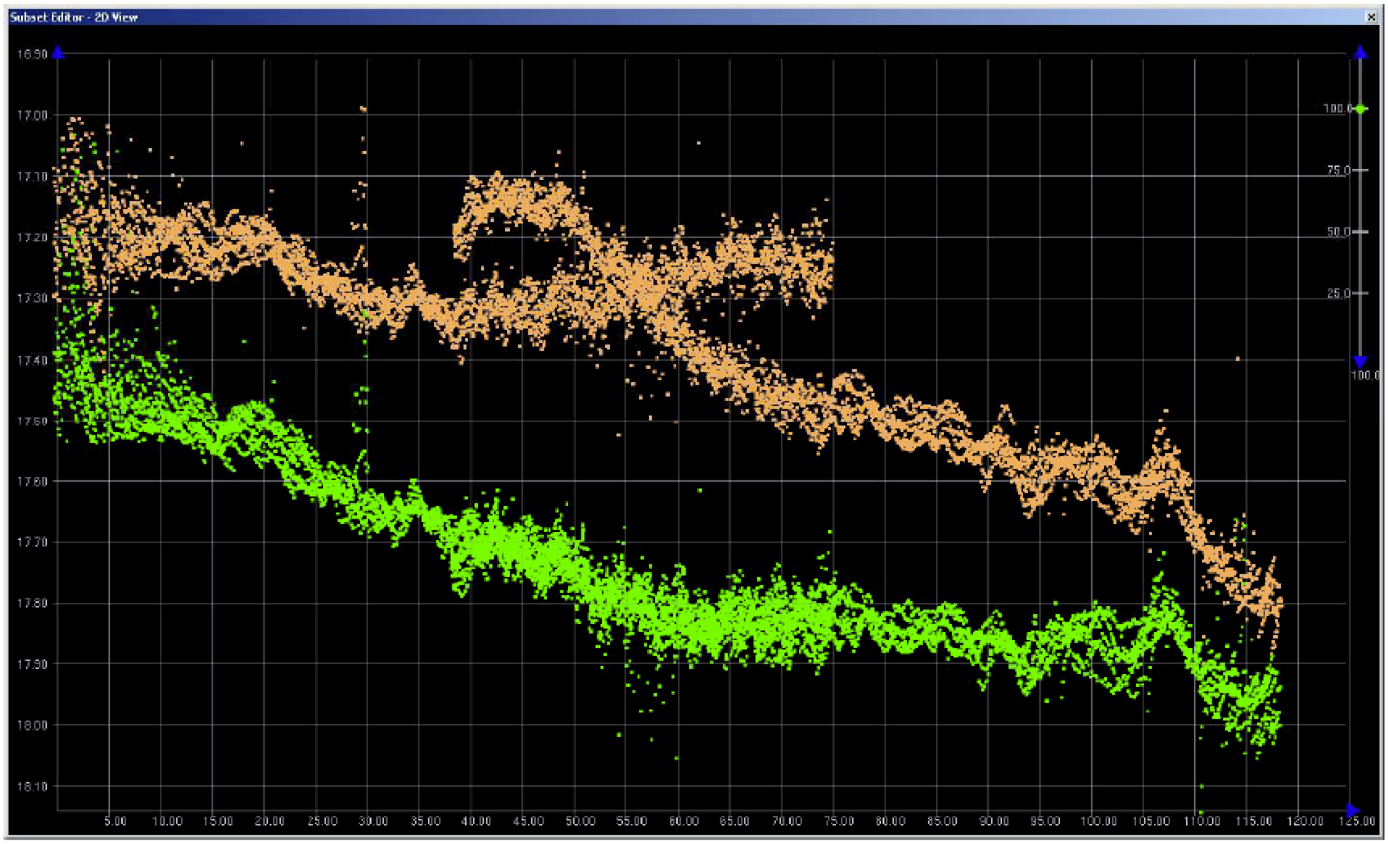


Figure 48: Uncorrected (orange) and corrected (green) with artificial vertical separation

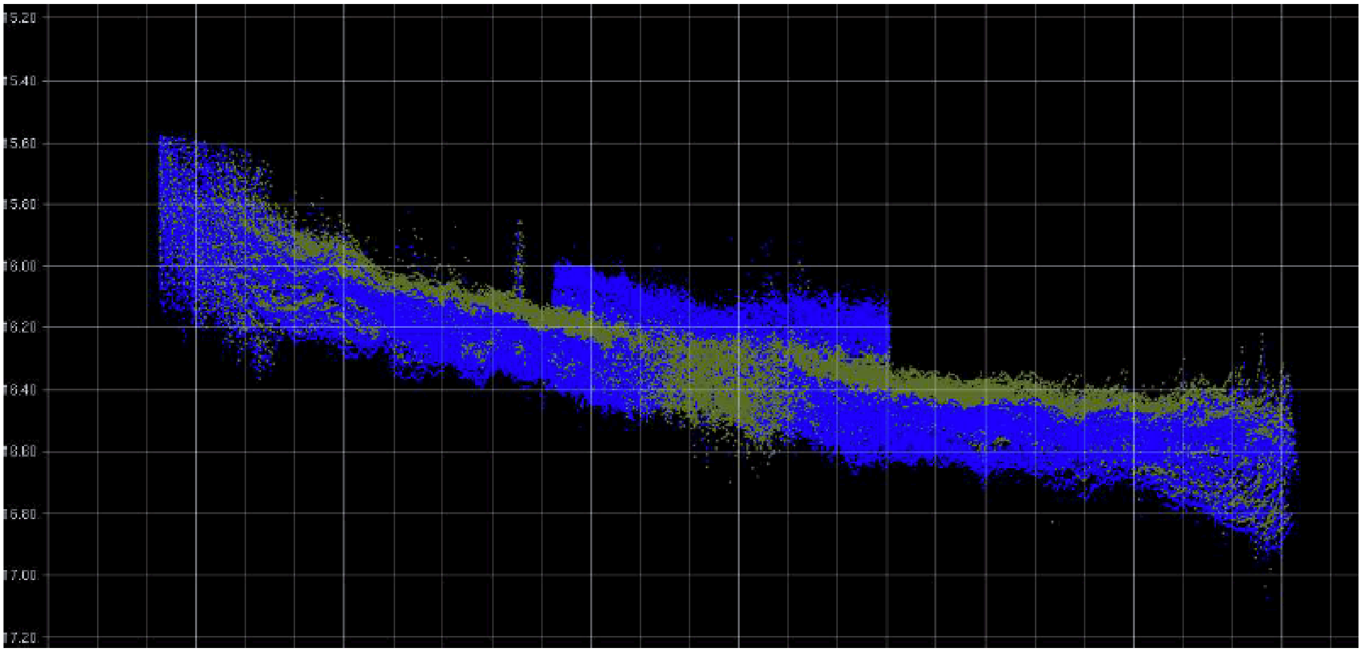


Figure 49: Uncorrected (blue) and corrected (gray) with artificial waterline removed

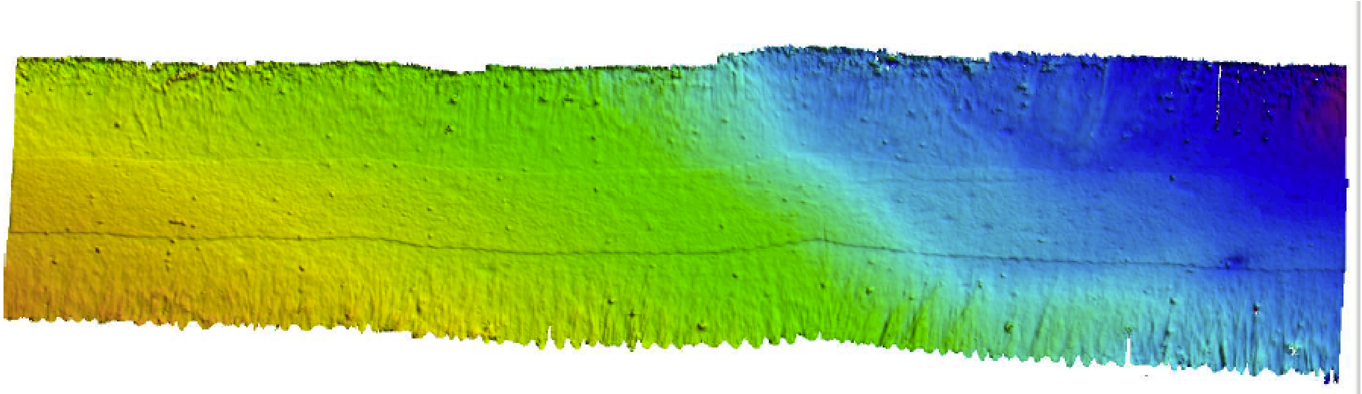


Figure 50: Gridded Surface using uncorrected data

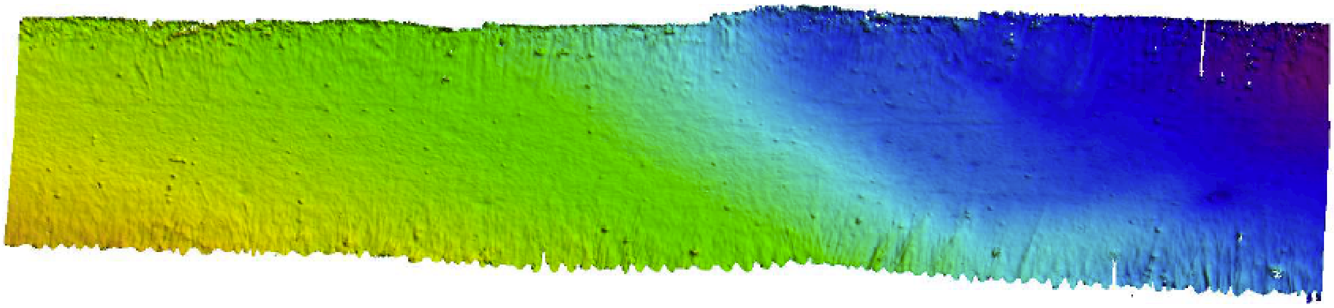


Figure 51: Gridded Surface using corrected data

B.2.6 Factors Affecting Soundings

Sound Speed Refraction (SSR)

A general downward and/or upward cupping is noticeable in the across-track sounding profiles for certain areas. Sound speed refraction errors were seen in the outer beams on the majority of survey lines conducted and were on the order of 0.10 to 0.15 meters. These errors are a result of the strong tidal mixing in the area, which not only carries sediment, but also causes a change in water surface temperature and salinity.

The sound speed profiles conducted throughout the project had an increased inconsistency throughout the water column, much more evident at the surface or near the face of the sonars. In order to mitigate these sound speed errors, the frequency of sound speed casts was increased and the line spacing reduced. Data were examined (and filtered) in CARIS HIPS Subset Editor routine to ensure the data met IHO Order 1a specifications.

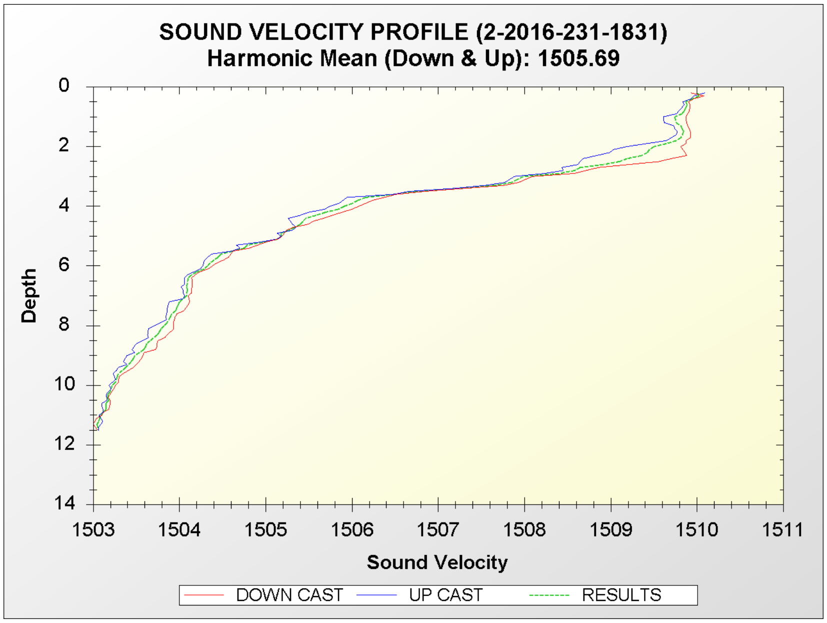


Figure 52: H12887 SVP Cast

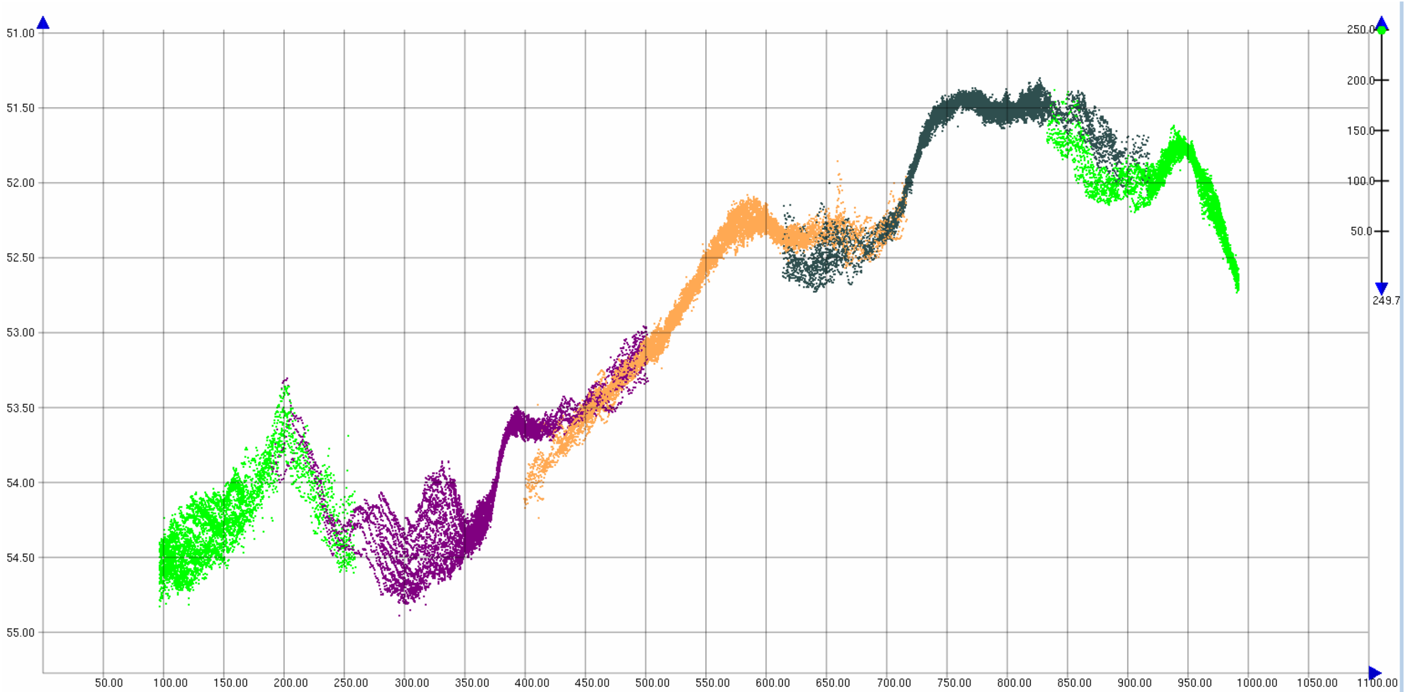


Figure 53: H12887 SSR Refraction

Fishing Gear

The survey was awarded and conducted during the peak of lobster season, resulting in an extremely high presence of fishing gear (and fishing vessels) in the survey area. This resulted in having to maneuver in and around the surface buoys and fishing vessels causing not only numerous in-fills and re-runs, but increased time spent on manually rejecting erroneous data (fishing gear in the water column) in CARIS HIPS.

Because of the density of fishing gear in the area, vessel speed was at times reduced to near idle. Entanglements between the survey vessel's deployed sonar equipment and fishing gear happened quite often, resulting in a loss of survey time. The risk of entanglement also increased before and after the high tide peaks due to submerged buoys in some areas.

Figure 54: Fishing Gear

Marine Life

There was a high presence of marine life in various locations within the survey area. This resulted in not only numerous in-fills and re-runs, but increased time spent on manually rejecting the erroneous data in CARIS HIPS.

Water Clarity

In addition to being an issue in equipment effectiveness, water clarity was a factor affecting soundings. Refer to section B.2.5 for the explanation on water clarity.

Figure 55: Water Clarity

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Figure 55: Water Clarity

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Sound velocity casts were normally performed every two to three hours on the R/V JAB and the R/V Westerly. For each cast, the probes were held at the surface for one to two minutes to achieve temperature equilibrium. The probes were then lowered and raised at a rate of 1 m/s. Between casts, the sound velocity sensors were stored inside the lab or in fresh water to minimize salt-water corrosion and to hold them at ambient water temperature.

Refer to the DAPR for additional information.

R/V Jab and R/V Westerly were equipped with two AML 1000 dbar Sound Velocity & Pressure (AML SV&P) Smart Sensors. The AML SV&P directly measures sound velocity through a time of flight calculation, and measures pressure with a temperature compensated semiconductor strain gauge at a 10Hz sample rate. The instrument has a 0.015 m/s resolution with a ± 0.05 m/s accuracy for sound velocity measurements and a 0.01 dbar resolution and a ± 0.5 m dbar accuracy for pressure.

Sound Speed quality control checks were conducted as per the HSSD 2016, Section 5.2.3.3 and can be found in Separate II.

Figure 56: AML SVP

B.2.8 Coverage Equipment and Methods

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

B.2.9 Data Density

The NOS HSSD, March 2016, require 95% of all nodes to be populated with at least five soundings. Survey H12887 met these project specifications.

Surface	Depth Range (m)	% of nodes with five soundings
H12887_MB_1m_MLLW_Final	0-20	99.86%
H12887_MB_2m_MLLW_Final	18-40	99.92%
H12887_MB_4m_MLLW_Final	36-80	99.91%
H12887_MB_8m_MLLW_Final	72-160	99.91%
H12887_MB_16m_MLLW_Final	144-320	100%

H12887_LI_5m_MLLW_Final	-3.04-10.63	60.88%

Detection requirements were met by minimizing vessel speed when necessary, using sonar range scales appropriate to the water depth to maximize ping rates, and maximizing swath overlap. These variables were adjusted in real-time by the online acquisition crew based on the WinFrog QC and coverage displays. The processing crew provided feedback after preliminary processing and coverage creation in CARIS HIPS. Infill lines were run as necessary.

The LiDAR program was proposed and planned for 100% of the area to be flown with a five by five (or better) spot spacing. In other words, a reconnaissance coverage survey would be used from the inshore limit (4 meters) to the 8-meter water depth. This explains the percentage of nodes that fall below the five sounding per bin threshold. It should be noted that per the project instructions, the final LiDAR surface was binned at five meters.

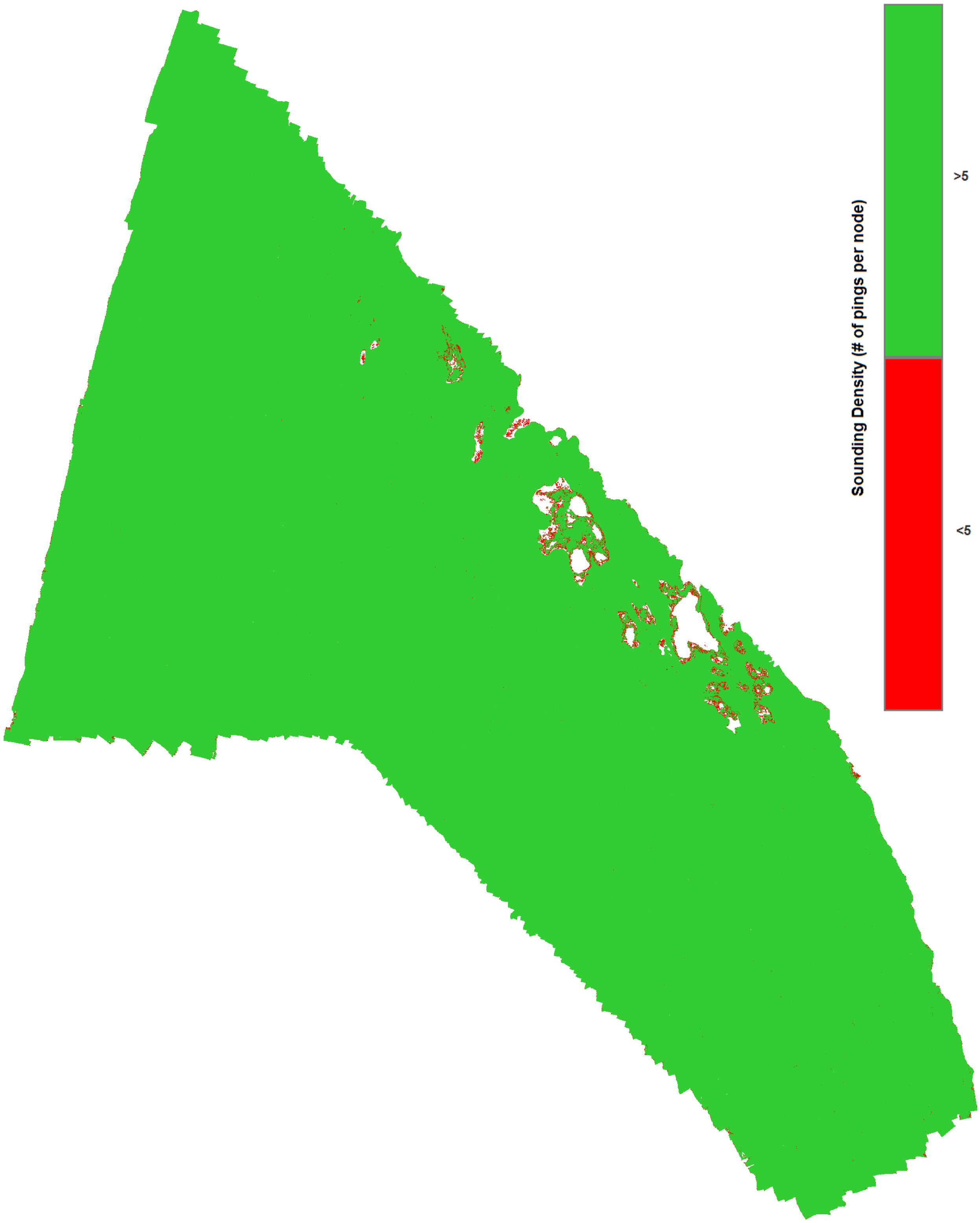

Figure 57: H12887 Final Density

B.2.10 MB Quality Control Checks

Positioning system confidence checks for the R/V JAB and R/V Westerly were conducted daily using the POS/MV controller software. The controller software had numerous real-time displays that were monitored throughout the survey to ensure the positional accuracies specified in the NOS HSSD were achieved. These include, but are not limited to the following: GPS Status, Position Accuracy, and Receiver Status, which includes Horizontal Dilution of Position (HDOP) and Precise Dilution of Position (PDOP), and Satellite Status. During periods of high HDOP and/or a low number of available satellites, survey operations were suspended.

Sonar system confidence checks were performed weekly by comparing post processed depth information collected by multiple vessels surveying over a common area. In addition, bar checks were performed to maintain a high confidence level. Sound Velocity Probe confidence checks were conducted weekly by producing comparable sound velocity data between all vessels. This check was carried out by having all sound velocity profiling equipment perform a cast in close proximity to each other in a near simultaneous time period.

B.2.11 LiDAR POS Hold Position Checks

Before each flight, a POS Hold is conducted to ensure Full Nav has been initialized. Once the Position and Orientation System for Airborne Vehicles (POS/AV) system powers up and the “Full Nav” indicator has been reached, the POS initialization hold is started for a minimum of 6 minutes in a static position. After holding the static position, the aircraft can taxi to the takeoff position. Full Nav status indicates that Global Navigation Satellite System (GNSS) position and velocities have been resolved and will aid to initialize the inertial navigation frame, which is the process of aligning the navigation frame with respect to the vertical (levelling) and orientation to North (heading).

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

A small number of lines in H12887 do not have delayed heave applied. This was due to an interruption in POS logging or a software crash during data acquisition.

B.3.2 Calibrations

The following calibrations were conducted after the initial system calibration discussed in the DAPR:

Calibration Type	Date	Reason
Multibeam Patch Test	2016-08-13	Bad Receiver
Multibeam Patch Test	2016-08-13	IMU Swapout

Table 9: Calibrations not discussed in the DAPR.

On August 13, 2016, the starboard sonar head of the R/V JAB was delivering inferior data, with what appeared to be very high side lobe levels. A health check of the receiver revealed a single electronics card within the receiver was out. The card was central to the array, which maximizes the impact of the failure. The receiver was removed and replaced with an onboard spare, thus requiring the need for an additional patch test. After replacement, all systems were health checked and found to be in perfect health with no dead channels at 400 kHz and good balance across all channels.

The R/V Westerly performed an additional patch test after needing to replace the leased IMU. The change out of the IMU with a Fugro-owned unit occurred on 10 August 2016. The patch test to calibrate the new IMU was performed on 13 August 2016.

B.4 Backscatter

Towed SideScan Sonar (SSS) operations were not required by this contract, but the backscatter and beam imagery snippet data from all multibeam systems were logged and stored in the s7k files. All beam imagery snippet data was logged in the 7028 record of the s7k file for the project.

To yield the best results when processing the backscatter from the dual head 7125 systems, we recommend using the CARIS SIPS Backscatter routine. Currently, CARIS only uses the Beam Average, but in an upcoming release in v10 CARIS will apply the Time Series backscatter data.

LiDAR reflectance was not part of the project instructions, but was processed and will be included in the final deliverables.

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/SIPS	9.1.8

Table 10: Primary bathymetric data processing software

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

Manufacturer	Name	Version
CARIS	HIPS/SIPS	9.1.9

Table 11: Primary bathymetric data processing software

The following Feature Object Catalog was used: NOAA Extended Attribute Files V5_4

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
H12887_MB_1m_MLLW	CUBE	1 meters	-0.37 meters - 164.73 meters	NOAA_1m	Complete MBES
H12887_MB_1m_MLLW_Final	CUBE	1 meters	0 meters - 20 meters	NOAA_1m	Complete MBES
H12887_MB_2m_MLLW	CUBE	2 meters	-0.31 meters - 164.65 meters	NOAA_2m	Complete MBES
H12887_MB_2m_MLLW_Final	CUBE	2 meters	18 meters - 40 meters	NOAA_2m	Complete MBES
H12887_MB_4m_MLLW	CUBE	4 meters	-0.01 meters - 164.62 meters	NOAA_4m	Complete MBES
H12887_MB_4m_MLLW_Final	CUBE	4 meters	36 meters - 80 meters	NOAA_4m	Complete MBES
H12887_MB_8m_MLLW	CUBE	8 meters	0.36 meters - 164.54 meters	NOAA_8m	Complete MBES

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12887_MB_8m_MLLW_Final	CUBE	8 meters	72 meters - 160 meters	NOAA_8m	Complete MBES
H12887_MB_16m_MLLW	CUBE	16 meters	0.88 meters - 164.38 meters	NOAA_16m	Complete MBES
H12887_MB_16m_MLLW_Final	CUBE	16 meters	144 meters - 320 meters	NOAA_16m	Complete MBES
H12887_LI_5m_MLLW	CUBE	5 meters	-3.04 meters - 10.63 meters	N/A	Complete MBES

Table 12: Submitted Surfaces

The surfaces have been reviewed for noisy data or 'fliers' that were incorporated into the gridded solution, causing the surface to be shoaler or deeper than the true seafloor. Spurious soundings that caused the gridded surface to be shoaler or deeper than the reliably measured seabed by greater than the maximum allowable TVU at that depth, have been rejected, and the surface recomputed.

The NOAA CUBE parameters mandated in HSSD were used for the creation of all CUBE BASE surfaces in Survey H12887.

Refer to the OPR-A366-KR-16 DAPR for a detailed description of the processing flow.

During office review a finalized lidar surface (H12887_LI_5m_MLLW_Final) was created for compilation purposes.

B.5.3 Hydroffice (QCTools version 1.5.2)

QCTools was used to scan each surface for potential fliers. The Detect fliers utility was initially run allowing the software to estimate heights, and it was also run where the Force flier heights value was set manually. This value varied depending on the resolution of the surface being scanned, which on occasion, yielded several false positives. Each finding from the utility was examined and checked for quality assurance.

The Detect holidays, Grid QA, Scan features, and SBDARE checks were also used for the appropriate surface and feature files.

C. Vertical and Horizontal Control

Multibeam vertical control for OPR-A366-KR-16 was provided by way of a Tidal Constituent And Residual Interpolation (TCARI) grid based on verified tide data from Portland (8418150), and Bar Harbor (8413320), ME.

During field operations, all sounding data were initially reduced to MLLW using a combination of preliminary and verified tidal data along with a zone definition file (ZDF) that was based on tidal data from the Portland, ME station. This station is owned and operated by NOAA's National Ocean Service (NOS) through the Center for Operational Oceanographic Products and Services (CO-OPS). Preliminary and verified tidal data was assembled by CO-OPS and accessed through NOAA's Tides&Currents website (http://tidesandcurrents.noaa.gov/). A cumulative file for the gauge in use was updated daily by appending the new data as it became available. It should be noted that these unverified tides were used in the field for preliminary processing only.

On December 12 2016, the final TCARI grid was acquired from CO-OPS and applied to all sounding data using the TCARI GUI (version 16.8) and merged in CARIS HIPS. Verified tidal data were used for all final CUBE Surfaces, soundings, and S-57 Feature files.
LiDAR vertical control for OPR-A366-KR-16 was GPS-derived. POS files logged during data acquisition on each flight were post-processed using Applanix POSPac SmartBase routine to create a smoothed best estimate of trajectory (SBET) file. Following creation, the SmartBase SBETs were then applied to the data in SHOALS GCS, replacing the real-time GPS navigation position with a post-processed GPS position. The separation model was created with NOAA's VDatum v3.6. This model also allowed for topographic data to be referenced to MLLW through the use of DTM-derived interpolation.

Data was initially referenced to the ITRF00 (WGS84) ellipsoid using the Applanix Smart Base routine. An SBET solution was processed using a network of CORS stations, with MEOW, as control. It should be noted that the LiDAR data was maintained on the ellipsoid during processing.

All depth soundings were eventually reduced to MLLW in CARIS using this Fugro-created VDatum model. Topographic heights detected by LiDAR were also related to MLLW through the same method. The model was applied to the data, using the compute GPS tides utility, and then merged.

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

C.1 Vertical Control

The vertical datum for this project is Mean Lower Low Water.

Traditional Methods Used:

TCARI

The following National Water Level Observation Network (NWLON) stations served as datum control for this survey:

Station Name	Station ID
Portland, ME	8418150
Bar Harbor, ME	8413320

Table 13: NWLON Tide Stations

File Name	Status
8418150_Portland_Verified	Verified Observed
8413320_Bar_Harbor_Verified	Verified Observed

Table 14: Water Level Files (.tid)

File Name	Status
A366KR2016_FINAL.tc	Final

Table 15: Tide Correctors (.zdf or .tc)

Additional information discussing the vertical control for this survey can be found in the accompanying HVCR.

ERS Methods Used:

ERS via VDATUM

Ellipsoid to Chart Datum Separation File:

Interp_ITRF00_to_MLLW
Interp_ITRF00_to_MHW

Additional information discussing the vertical control for this survey can be found in the accompanying HVCR.

C.2 Horizontal Control

The horizontal datum for this project is ITRF2000 (WGS84: G1150).

The projection used for this project is UTM (Zone 19N).

The following PPK methods were used for horizontal control:

Smart Base

Real-time corrections for both the vessels and aircraft, the POS M/V and A/V were configured to accept Fugro's Marinestar G2 corrections. Marinestar G2 service is a real-time GPS and GLObal Navigation Satellite System (GLONASS) Precise Point Positioning (PPP) service providing refined satellite 'clock and orbit' data to any GNSS receiver with a valid subscription. Signals on the L-band with corrections are broadcasted by geo-stationary satellites and are received by the integrated GNSS/L-band antenna. The unit outputs corrected positions at 1 Hz to the POS units where they are integrated with inertial data, and a position for the top-center of the IMU is generated, providing a horizontal accuracy of 10 cm and a vertical accuracy of 15 cm.

This position was logged concurrently with the bathymetry from WinFrog and the POS file using Fugro Pelagos PosMvLogger for the JAB and Westerly. For the multibeam data, the real-time solution was used for the final positioning and no post-processing was required.

Processed LiDAR point positions for the SHOALS and VQ-820-G LiDAR sensors were derived relative to the ITRF00 ellipsoid using a Post Processed Kinematic (PPK) solution during GNSS post-processing, which used aircraft positioning data and final LiDAR point positions. These positions were then reduced to MLLW using a VDatum model created for the survey area by Fugro. For each flight, a Kinematic GPS (KGPS) navigation solution was processed in Applanix POSPac software. GPS data from the airplane and ground control base stations were input into a POSPac project and post-processed to obtain an optimal inertially-aided KGPS navigation solution.

Fugro's installed base station in Rockland was only intended to be a backup and was not used in the smartbase network.

Refer to the OPR-A366-KR-16 DAPR for additional details.

The following CORS Stations were used for horizontal control:

HVCR Site ID	Base Station ID
Augusta, ME	MEOW
Waldo, ME	MEWA
Penobscot, ME	PNB6
Bar Harbor, ME	BARH
Truro, MA	MATU
U New Hampshire, NH	NHUN

Table 16: CORS Base Stations

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
Rockland, ME	RKD16P

Table 17: User Installed Base Stations

D. Results and Recommendations

D.1 Chart Comparison

A comparison of soundings was accomplished by overlaying the latest edition of the largest scale NOS charts and ENCs onto the final BASE surfaces in CARIS HIPS and SIPS. An additional check was conducted by gridding the ENC sounding data and differencing the ENC *.csar files against the H12887 *.csar files. The general agreement between the charted soundings and H12887 soundings is noted in the Charts section. A more detailed comparison was undertaken for any charted shoals or other dangerous features and is discussed in the Shoals and Hazardous Features section.

D.1.1 Raster Charts

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

Chart	Scale	Edition	Edition Date	LNM Date	NM Date
13308	1:15000	13	02/2011	02/02/2016	02/20/2016
13307	1:20000	11	06/2012	02/02/2016	02/20/2016
13305	1:40000	29	06/2012	02/02/2016	02/20/2016
13303	1:40000	14	04/2015	02/02/2016	02/20/2016

Table 18: Largest Scale Raster Charts

<u>13308</u>

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable Raster charts was within (+/-) 3 to 4. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered and special attention was given to charted and surveyed depths with a difference greater than 6 feet.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The item is a charted, 22-foot sounding in the general vicinity of (44-06-03 N) (068-57-43 W). Survey H12887 had a survey depth of 44 feet in that general location, but revealed a depth of 24 feet, 65 meters to the south.

The item is a charted, 108-foot sounding in the general vicinity of (44-05-08 N) (068-57-36 W). Survey H12887 had a survey depth of 75 feet in that general location, but revealed a deepening trend to the southeast.

The item is a charted, 38-foot sounding in the general vicinity of (44-05-05 N) (068-57-28 W). Survey H12887 had a survey depth of 54 feet in that general location.

The item is a charted, 58-foot sounding in the general vicinity of (44-05-03 N) (068-57-24 W). Survey H12887 had a survey depth of 67 feet in that general location, but revealed shoaling to the east.

The item is a charted, 39-foot sounding in the general vicinity of (44-04-52 N) (068-56-28 W). Survey H12887 had a survey depth of 60 feet in that general location, but revealed shoaling to the southwest.

The item is a charted, 24-foot sounding in the general vicinity of (44-04-46 N) (068-56-28 W). Survey H12887 had a survey depth of 35 feet in that general location, but revealed shoaling to the west.

The item is a charted, 37-foot sounding in the general vicinity of (44-04-43 N) (068-57-50 W). Survey H12887 had a survey depth of 60 feet in that general location, but revealed shoaling to the east.

The item is a charted, 31-foot sounding in the general vicinity of (44-04-20 N) (068-57-44 W). Survey H12887 had a survey depth of 38 feet in that general location, but revealed shoaling to the northeast.

The item is a charted, 49-foot sounding in the general vicinity of (44-04-21 N) (068-57-36 W). Survey H12887 had a survey depth of 58 feet in that general location, but revealed shoaling to the east.

The item is a charted, 44-foot sounding in the general vicinity of (44-04-21 N) (068-55-52 W). Survey H12887 had a survey depth of 52 feet in that general location, but revealed shoaling to the southwest.

The item is a charted, 28-foot sounding in the general vicinity of (44-04-03 N) (068-56-08 W). Survey H12887 had a survey depth of 42 feet in that general location, but revealed shoaling to the northeast.

The item is a charted, 28-foot sounding in the general vicinity of (44-04-05 N) (068-56-14 W). Survey H12887 had a survey depth of 40 feet in that general location, but revealed shoaling to the southeast.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

13307

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable Raster charts was within (+/-) 3 to 4 feet. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered and special attention was given to charted and surveyed depths with a difference greater than 6 feet.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

13305

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable Raster charts was within (+/-) 3 to 4 feet. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered; special attention was given to charted and surveyed depths with a difference greater than 6 feet.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The item is a charted, 22-foot sounding in the general vicinity of (44-03-15 N) (068-56-38 W). Survey H12887 had a survey depth of 44 feet in that general location, but revealed no shoaling in the area.

The item is a charted, 31-foot sounding in the general vicinity of (44-03-27 N) (068-58-03 W). Survey H12887 had a survey depth of 47 feet in that general location, but revealed no shoaling in the area.

The item is a charted, 356-foot sounding in the general vicinity of (44-02-56 N) (068-59-46 W). Survey H12887 had a survey depth of 368 feet in that general location, but revealed shoaling to the west and east.

The item is a charted, 60-foot sounding in the general vicinity of (44-01-56 N) (068-58-21 W). Survey H12887 had a survey depth of 76 feet in that general location, but revealed shoaling to the southeast.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

13303

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable Raster charts was within (+/-) 3 to 4 feet. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered; special attention was given to charted and surveyed depths with a difference greater than 6 feet.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The item is a charted, 73-foot sounding in the general vicinity of (43-58-12 N) (068-51-47 W). Survey H12887 had a survey depth of 92 feet in that general location, but revealed shoaling to the northeast.

The item is a charted, 92-foot sounding in the general vicinity of (43-58-04 N) (068-50-37 W). Survey H12887 had a survey depth of 133 feet in that general location, but revealed shoaling to the southeast.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

D.1.2 Electronic Navigational Charts

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

ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US5ME25M	1:15000	6	01/19/2016	02/06/2016	NO
US5ME24M	1:20000	7	01/19/2016	02/06/2016	NO
US5ME23M	1:40000	13	01/26/2016	02/06/2016	NO
US5ME22M	1:40000	12	01/26/2016	02/06/2016	NO
US5ME21M	1:40000	11	01/26/2016	02/06/2016	NO

Table 19: Largest Scale ENCs

US5ME25M

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable ENC charts was within (+/-) 1 meter. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered; special attention was given to charted and surveyed depths with a difference greater than 2 meters.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The item is a charted, 6.7-meter sounding in the general vicinity of (44-06-03 N) (068-57-43 W). Survey H12887 had a survey depth of 10.3 meters in that general location, but revealed shoaling to the south.

The item is a charted, 33-meter sounding in the general vicinity of (44-05-08 N) (068-57-36 W). Survey H12887 had a survey depth of 22.5 meters in that general location, but revealed a deepening trend to the southeast.

The item is a charted, 11.5-meter sounding in the general vicinity of (44-05-05 N) (068-57-28 W). Survey H12887 had a survey depth of 17.3 meters in that general location.

The item is a charted, 17.6-meter sounding in the general vicinity of (44-05-03 N) (068-57-24 W). Survey H12887 had a survey depth of 20.3 meters in that general location, but revealed shoaling to the east.

The item is a charted, 11.8-meter sounding in the general vicinity of (44-04-52 N) (068-56-28 W). Survey H12887 had a survey depth of 16.4 meters in that general location, but revealed shoaling to the southwest.

The item is a charted, 7.3-meter sounding in the general vicinity of (44-04-46 N) (068-56-28 W). Survey H12887 had a survey depth of 10.6 meters in that general location, but revealed shoaling to the west.

The item is a charted, 11.2-meter sounding in the general vicinity of (44-04-43 N) (068-57-50 W). Survey H12887 had a survey depth of 18.3 meters in that general location, but revealed shoaling to the east.

The item is a charted, 9.4-meter sounding in the general vicinity of (44-04-20 N) (068-57-44 W). Survey H12887 had a survey depth of 11.5 meters in that general location, but revealed shoaling to the northeast.

The item is a charted, 14.9-meter sounding in the general vicinity of (44-04-21 N) (068-57-36 W). Survey H12887 had a survey depth of 17.9 meters in that general location, but revealed shoaling to the east.

The item is a charted, 13.4-meter sounding in the general vicinity of (44-04-21 N) (068-55-52 W). Survey H12887 had a survey depth of 16 meters in that general location, but revealed shoaling to the southwest.

The item is a charted, 8.5-meter sounding in the general vicinity of (44-04-03 N) (068-56-08 W). Survey H12887 had a survey depth of 15.7 meters in that general location, but revealed shoaling to the northeast.

The item is a charted, 8.5-meter sounding in the general vicinity of (44-04-05 N) (068-56-14 W). Survey H12887 had a survey depth of 12.2 meters in that general location, but revealed shoaling to the southeast.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

<u>US5ME24M</u>

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable ENC charts was within (+/-) 1 meter. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered; special attention was given to charted and surveyed depths with a difference greater than 2 meters.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

US5ME23M

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable ENC charts was within (+/-) 1 meter. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered; special attention was given to charted and surveyed depths with a difference greater than 2 meters.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The item is a charted, 13.7-meter sounding in the general vicinity of (43-58-59 N) (068-51-00 W). Survey H12887 had a survey depth of 18.1 meters in that general location, but revealed shoaling to the northwest.

The item is a charted, 24-meter sounding in the general vicinity of (43-59-48 N) (068-50-58 W). Survey H12887 had a survey depth of 37 meters in that general location, but revealed shoaling to the northwest.

The item is a charted, 16.7-meter sounding in the general vicinity of (43-58-59 N) (068-51-00 W). Survey H12887 had a survey depth of 28.5 meters in that general location, but revealed shoaling to the east.

The item is a charted, 51-meter sounding in the general vicinity of (43-58-48 N) (068-50-55 W). Survey H12887 had a survey depth of 41 meters in that general location.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

US5ME22M

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable ENC charts was within (+/-) 1 meter. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered; special attention was given to charted and surveyed depths with a difference greater than 2 meters.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The item is a charted, 6.7-meter sounding in the general vicinity of (44-03-15 N) (068-56-38 W). Survey H12887 had a survey depth of 13.6 meters in that general location.

The item is a charted, 9.4-meter sounding in the general vicinity of (44-03-27 N) (068-58-03 W). Survey H12887 had a survey depth of 14.5 meters in that general location.

The item is a charted, 108-meter sounding in the general vicinity of (44-02-56 N) (068-59-46 W). Survey H12887 had a survey depth of 119 meters in that general location, but revealed shoaling to the west and east.

The item is a charted, 18.2-meter sounding in the general vicinity of (44-01-56 N) (068-58-21 W). Survey H12887 had a survey depth of 25 meters in that general location, but revealed shoaling to the south.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

US5ME21M

Chart information displayed is based on OPR-A366-KR-16 Project Instructions, however the charts used for final comparison were downloaded on 8 December 2016.

Given that the survey area was ensonified with 100% multibeam coverage, discrepancies were discovered between the charted and surveyed depths.

Sounding agreement between the H12887 BASE surface depths (surveyed depths) and the charted soundings for all applicable ENC charts was within (+/-) 1 meter. Since the survey area was ensonified with 100% multibeam coverage, discrepancies between charted and surveyed depths were discovered; special attention was given to charted and surveyed depths with a difference greater than 2 meters.

Contours in the area were adequate, but the 100% multibeam coverage established discrepancies between charted and observed contours and require revision from the high-resolution data.

The item is a charted, 22-meter sounding in the general vicinity of (43-58-12 N) (068-51-47 W). Survey H12887 had a survey depth of 30 meters in that general location, but revealed shoaling to the northeast.

The item is a charted, 28-meter sounding in the general vicinity of (43-58-04 N) (068-50-37 W). Survey H12887 had a survey depth of 40 meters in that general location, but revealed shoaling to the southeast.

The Hydrographer recommends that soundings within the survey limits of H12887 supersede all prior survey and charted depths.

D.1.3 Maritime Boundary Points

No maritime boundary exists for this survey.

D.1.4 Charted Features

There was one charted feature within the limits of H12887 and is as follows:

Wreck with label “Wk PA” charted in the general vicinity of 44-03-13N 68-59-05W on chart 13302. This item was not assigned in the Composite Source File (CSF). Multibeam data was used to disprove this wreck. The Hydrographer recommends item be removed.

D.1.5 Uncharted Features

No uncharted features exist for this survey.

D.1.6 Dangers to Navigation

The following DTON reports were submitted:

DTON Report Name	Date Submitted
H12887_DTON_Report_1	2016-09-15
H12887_DTON_Report_2	2017-01-30

Table 20: DTON Reports

Dangers to Navigation are included in the Final Features File (FFF) and have images associated with them. The Dangers to Navigation files listed above were submitted to MCD via AHB and PHB are included in Appendix II.

DTON Report appended. Positions and values may have changed after further processing, review, and rounding rules applied and as noted in report.

D.1.7 Shoal and Hazardous Features

A comparison of soundings was accomplished by overlaying the latest edition of the largest scale NOS charts and ENCs onto the final BASE surfaces in CARIS HIPS. An additional check was conducted by gridding the ENC sounding data and differencing the ENC *.csar files against the H12887 *.csar files. The results from this method highlight areas that differed and warranted extra attention. A unique color range pallet was developed to highlight these areas, for example, if the agreement was +/- 5 feet, the difference surface was colored green. Areas greater than +/- 5 feet were colored orange. Red was used for extreme differences.

The following are shoal features that differed, but did not warrant a danger to navigation submittal. Other Shoals and Hazardous Features exist in the survey area and were submitted as dangers to navigation; a total of 16 dangers were submitted to AHB and PHB.

The item is a charted, 39-foot sounding in the general vicinity of (44-04-27 N) (068-56-43 W). Survey H12887 had a survey depth of 29 feet in that general location.

The item is a charted, 39-foot sounding in the general vicinity of (44-04-02 N) (068-56-27 W). Survey H12887 had a survey depth of 28 feet in that general location.

The item is a charted, 41-foot sounding in the general vicinity of (44-04-10 N) (068-55-31 W). Survey H12887 had a survey depth of 29 feet in that general location.

The item is a charted, 28-foot sounding in the general vicinity of (44-04-27 N) (068-55-56 W). Survey H12887 had a survey depth of 32 feet in that general location. The Hydrographer recommends repositioning the shoal.

The item is a charted, 13-foot sounding in the general vicinity of (44-02-15 N) (068-54-31 W). Survey H12887 had a survey depth of 25 feet in that general location. The Hydrographer recommends repositioning the shoal.

The item is a charted, 26-foot sounding in the general vicinity of (44-02-12 N) (068-53-10 W). Survey H12887 had a survey depth of 20 feet in that general location. The Hydrographer recommends repositioning the shoal.

The item is a charted, 32-foot sounding in the general vicinity of (44-01-34 N) (068-55-34 W). Survey H12887 had a survey depth of 24 feet in that general location. The Hydrographer recommends repositioning the shoal.

The item is a charted, 57-foot sounding in the general vicinity of (44-01-18 N) (068-53-35 W). Survey H12887 had a survey depth of 47 feet in that general location. The Hydrographer recommends repositioning the shoal.

The item is a charted, 28-foot sounding in the general vicinity of (43-59-01 N) (068-50-36 W). Survey H12887 had a survey depth of 32 feet in that general location. The Hydrographer recommends repositioning the shoal.

The item is a charted, 29-foot sounding in the general vicinity of (44-02-48 N) (068-57-15 W). Survey H12887 had a survey depth of 35 feet in that general location. The Hydrographer recommends repositioning the shoal.

The item is a charted, 3-foot sounding in the general vicinity of (44-02-31 N) (068-53-33 W). Survey H12887 had a survey depth of 18 feet in that general location. The Hydrographer recommends repositioning the shoal.

The item is a charted, 30-foot sounding in the general vicinity of (44-02-32 N) (068-56-26 W). Survey H12887 had a survey depth of 49 feet in that general location, but revealed no shoaling in the area.

The item is a charted, 18-foot sounding in the general vicinity of (44-01-38 N) (068-53-43 W). Survey H12887 had a survey depth of 64 feet in that general location, but revealed shoaling to the southeast.

The item is a charted, 3-foot sounding in the general vicinity of (43-58-04 N) (068-51-40 W). Survey H12887 had a survey depth of 6 feet in that general location. The Hydrographer recommends repositioning the shoal.

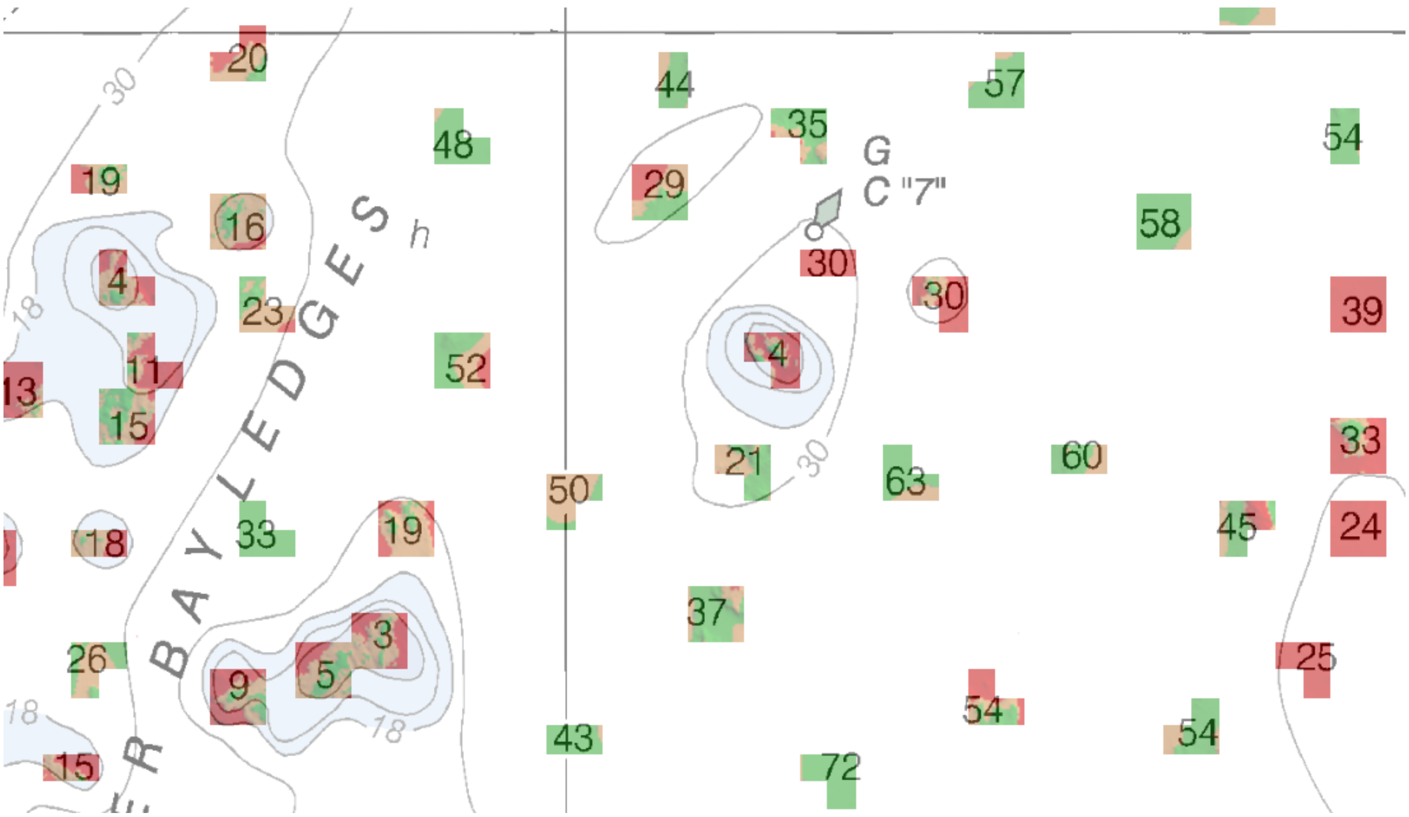

Figure 58: Sample of difference surface of H12887 and ENC

D.1.8 Channels

No channels exist for this survey. There are no designated anchorages, precautionary areas, safety fairways, traffic separation schemes, pilot boarding areas, or channel and range lines within the survey limits.

D.1.9 Bottom Samples

Samples were taken with a Van Veen grab sampler and positions and information were recorded with WinFrog Multibeam and CARIS Notebook 3.1. Samples retrieved were analyzed and then encoded with the appropriate S-57 attributes. Positions and descriptions of bottom samples for survey H12887 are found in the "H12887_FFF.000" file.

No SBDARE items were in the CSF, therefore were not investigated during field operations. Bottom samples were conducted in accordance with the project instructions and HSSD 2016. All 12 samples were discarded after the sample information was recorded.

D.2 Additional Results

D.2.1 Shoreline

Limited shoreline verification was conducted using the composite source file (CSF). All features with the attribute 'asgnmt' were address and can be found in the final feature file (FFF).

D.2.2 Prior Surveys

No prior survey comparisons exist for this survey.

D.2.3 Aids to Navigation

There were no Aids to Navigation (ATONs) specifically assigned for this project, but all ATONs within the survey limits were verified and serve their intended purpose.

D.2.4 Overhead Features

Overhead features do not exist for this survey.

D.2.5 Submarine Features

Submarine features do not exist for this survey.

D.2.6 Ferry Routes and Terminals

The Rockland Ferry Terminal services the islands of Matinicus, North Haven, and Vinalhaven. H12887 encompassed the main routes out of Rockland for these island ferry runs, and was surveyed with 100% MB coverage. H12887 had numerous dangers to navigation and shoal features, but none hinder the existing ferry routes.

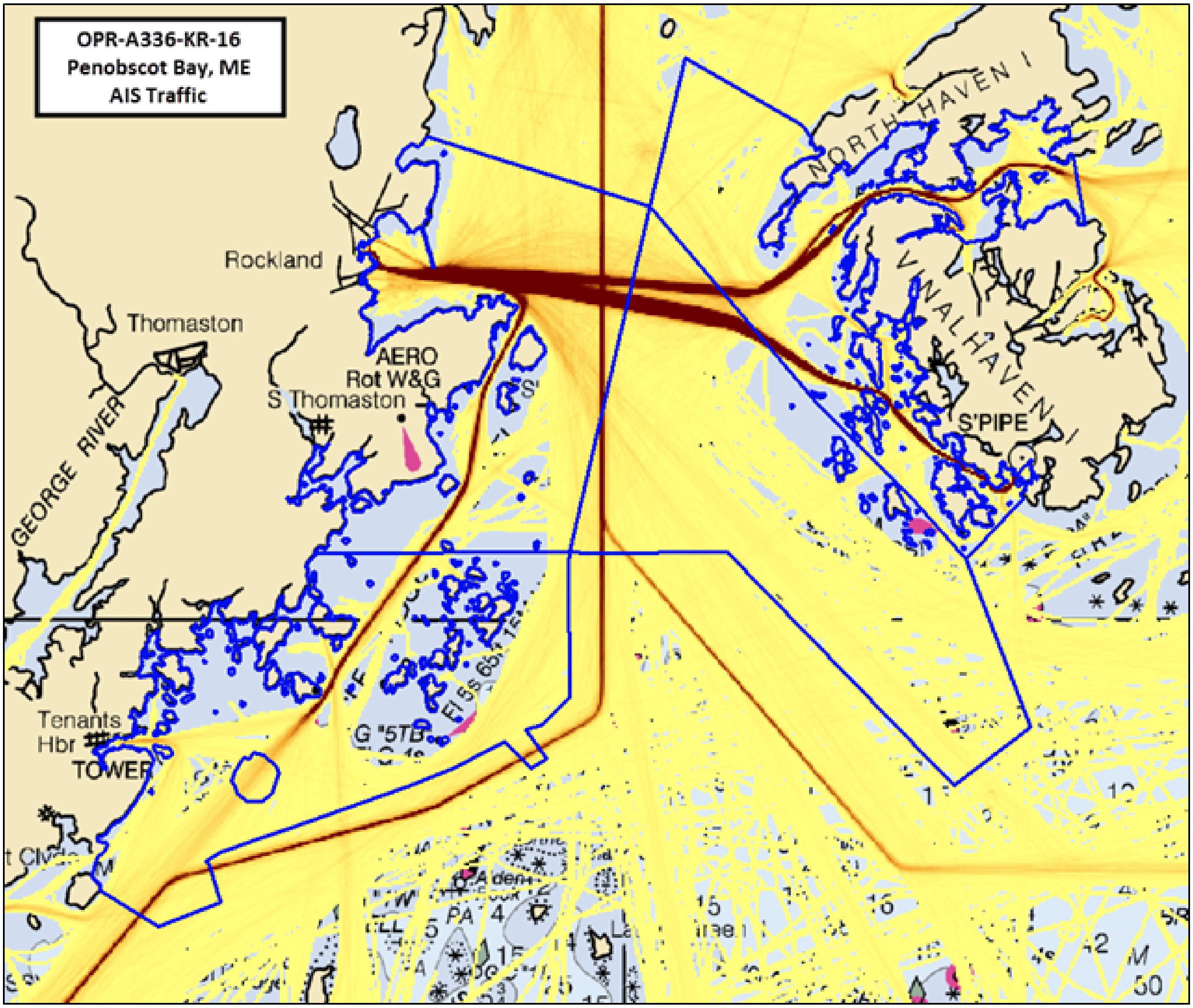

Figure 59: AIS Traffic Ferry Routes Running from Rockland to Vinalhaven

D.2.7 Platforms

No platforms exist for this survey.

D.2.8 Significant Features

No significant features exist for this survey.

D.2.9 Construction and Dredging

There is no present or planned construction or dredging within the survey limits.

D.2.10 New Survey Recommendation

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

D.2.11 Final Feature File

Fugro conducted limited shoreline verification using the CSF. All features with the Assigned attribute were addressed in accordance with the HSSD 2016. There were a total of 60 assigned features (which included the Charted Features) in the CSF provided by NOAA. All features were addressed as required with S-57 attribution and recorded in the H12887 FFF to best represent the features at chart scale.

FFF features that do not exist or were determined to be a duplicate were given a “delete”value in the “descrp” attribute. Features that were positioned incorrectly were also given the “delete” value in the “descrp” attribute, and a new feature with a “new” value in the “descrp” attribute was added in its correct location. The “primsec” field was used to distinguish deleted features from newly positioned features. For survey H12887, most of the assigned features were verified or identified in the LiDAR bathy data or ortho-mosaic. These items were labelled with “LiDAR investigations” in the “Special Feature Type” attribute. The TECSOU field was populated with the “found by multi-beam attribute” for any feature verified by multibeam.

If an assigned feature was not submerged and within 2 mm at survey scale, the position of that assigned feature was retained and only the VALSOU or ELEVAT attributes were updated. To determine the VALSOU or ELEVAT for features investigated by LiDAR, the National VDatum software developed by NOAA was used to reduce LiDAR data to MLLW. LiDAR data was then clipped to the extents of each of the survey priorities and overlaid with Fugro-acquired ortho-imagery and assigned CSF features. The LiDAR grid was then used to determine the VALSOU attribute using the height or depth on the actual features and not the height or depth of the corresponding assigned CSF features. In order to determine which features should be considered islets, a difference surface corresponding to mean high water (MHW) was created for all survey priorities. Islet elevations were derived by taking the difference between the highest SHOALS topo point and the MHW grid. See the NOS HSSD 2016, Appendix F. WATLEV Attribution encoding guidelines were used for determining points above and below MHW.

To the reviewer: some automated routines that check grid agreement to a feature file (such as HydrOffice QC Tools VALSOU Check) may reveal flags suggesting a positional error; this is because some of the charted features in this survey have depths with little or no height off the bottom, and so automated routines may not be able to distinguish the node-match from the surrounding seafloor.

The final S-57 file for this project is called “H12887_FFF.000”. This file contains the object and metadata S-57 objects as required in the HSSD 2016.

D.2.12 Inset Recommendation

No new insets 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 HSSD Manual, Field Procedures Manual, Standing and 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	2017-02-07
Horizontal and Vertical Control Report	2017-02-07
Coast Pilot Report	2016-12-20

Approver Name	Approver Title	Approval Date	Signature
Dean Moyles	Senior Hydrographer (ACSM Cert. No. 226)	02/09/2017	Moyles, Dean Digitally signed by Moyles, Dean DN: dc=com, dc=fugro, l=america, ou=fpi, ou=people_fpi, 0.9.2342.19200300.100.1.1=moylesd, cn=Moyles, Dean, email=dmoyles@fugro.com Date: 2017.02.08 08:58:48 -08'00'

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	Continually Operating Reference Staiton
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
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
HSSD	Hydrographic Survey Specifications and Deliverables

Acronym	Definition
HSTP	Hydrographic Systems Technology Programs
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	Local Notice to Mariners
LNM	Linear Nautical Miles
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NAIP	National Agriculture and Imagery Program
NALL	Navigable Area Limit Line
NM	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
PST	Physical Science Technician
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPE	Total Propagated Error
TPU	Topside Processing Unit
USACE	United States Army Corps of Engineers
USCG	United Stated Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDA	Global Positiong System timing message
ZDF	Zone Definition File

UNITED STATES DEPAMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Silver Spring, Maryland 20910

PROVISIONAL TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : December 2, 2016

HYDROGRAPHIC BRANCH: Atlantic
HYDROGRAPHIC PROJECT: OPR-A366-KR-2016
HYDROGRAPHIC SHEET: H12887

LOCALITY: Offshore Vinalhaven Island, Penobscot Bay
TIME PERIOD: July 25 - September 30, 2016

TIDE STATION USED: 8413320 Bar Harbor, ME
Lat. 44° 23.5′ N Long. 68° 12.3' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.336 meters

TIDE STATION USED: 8418150 Portland, ME
Lat. 43° 39.4' N Long. 70° 14.8' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.886 meters

REMARKS: RECOMMENDED GRID

Please use the TCARI grid "A366KR2016_FINAL.tc" as the final grid for project OPR-A366-KR-2016, Registry No. H12887, during the time period between July 25 and September 30, 2016.

Refer to attachments for grid information.

Note 1: Provided time series data are tabulated in metric units(meters), relative to MLLW and on Greenwich Mean Time on the 1983-2001 National Tidal Datum Epoch (NTDE).

Note 2: Annual leveling for Bar Harbor, ME (841-3320)was not completed in the past year. A review of the verified leveling records from August 2006 to June 2015 shows the tide station benchmark network to be stable within an allowable 0.009 m tolerance. This Tide Note may be used as final stability verification for survey OPR-A366-KR-2016, H12887. CO-OPS will immediately provide a revised Tide Note should subsequent leveling records indicate any benchmark network stability movement beyond the allowable 0.009 m tolerance.

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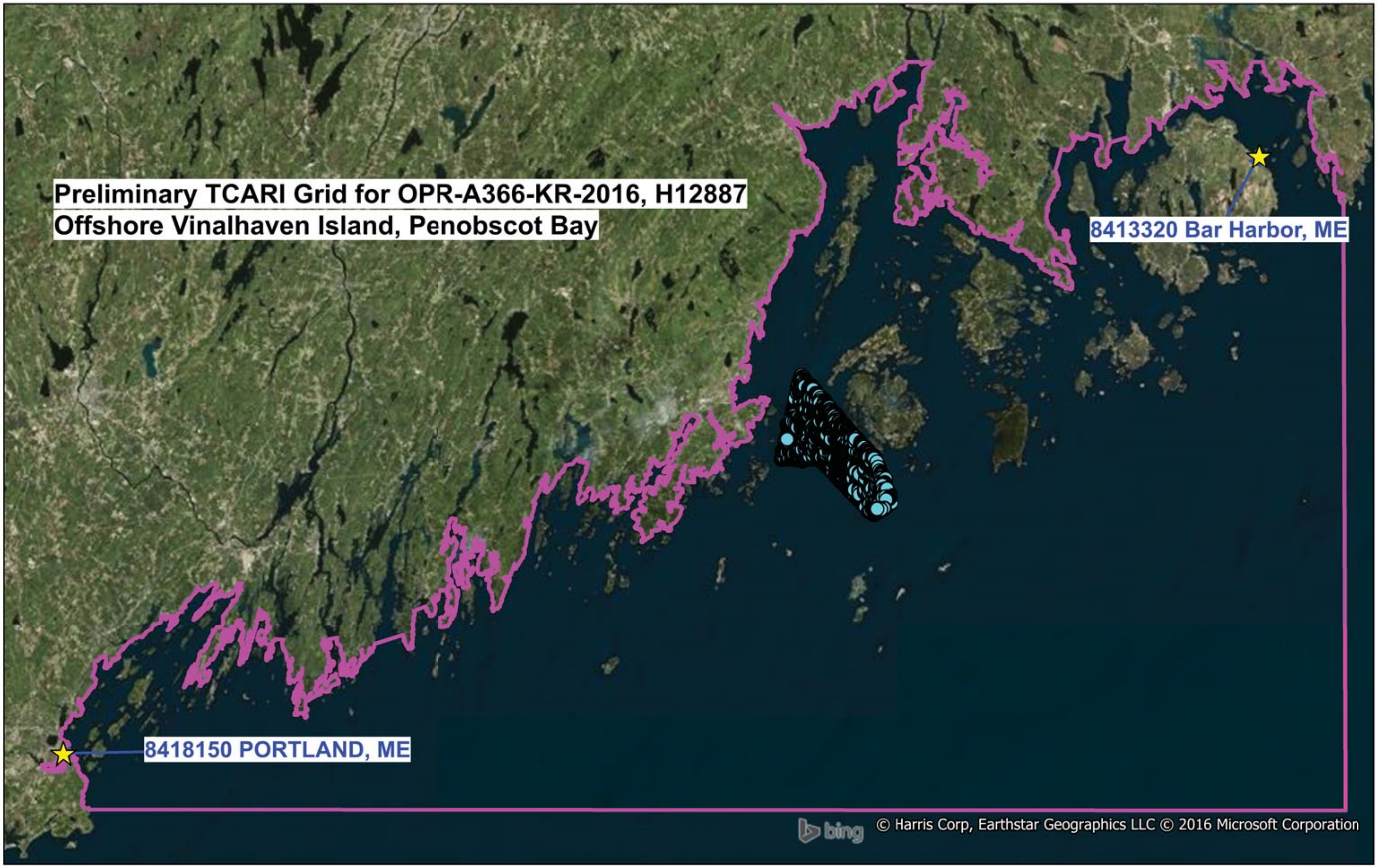
Digitally signed by HOVIS.GERALD.THOMAS.JR.1365860250
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.JR.1365860250
Date: 2016.12.06 15:00:16 -05'00'

CHIEF, PRODUCTS AND SERVICES BRANCH


Preliminary TCARI Grid for OPR-A366-KR-2016, H12887
Offshore Vinalhaven Island, Penobscot Bay
8413320 Bar Harbor, ME
8418150 PORTLAND, ME
bing
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APPROVAL PAGE

H12887

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NCEI for archive
- H12887_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12887_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications.

Digitally signed by Peter Holmberg
Reason: I am approving this document
Date: 2018.06.01 14:44:06 -07'00'

Approved:____

Peter Holmberg
Cartographic Team Lead, Pacific Hydrographic Branch

The survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

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Approved:____

Kurt Brown
Physical Scientist, Pacific Hydrographic Branch