H12896

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12896

LOCALITY

State(s):	Alaska
General Locality:	South Coast of Kodiak Island
Sub-locality:	Due East of Aiaktalik Island

2016

CHIEF OF PARTY
CDR Mark Van Waes, NOAA

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Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H12896

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):	**Alaska**
General Locality:	**South Coast of Kodiak Island**
Sub-Locality:	**Due East of Aiaktalik Island**
Scale:	**40000**
Dates of Survey:	**06/25/2016 to 07/30/2016**
Instructions Dated:	**06/13/2016**
Project Number:	**OPR-P335-FA-16**
Field Unit:	**NOAA Ship *Fairweather***
Chief of Party:	**CDR Mark Van Waes, NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
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 H12896

Project: OPR-P335-FA-16

Locality: South Coast of Kodiak Island

Sublocality: Due East of Aiaktalik Island

Scale: 1:40000

June 2016 - July 2016

NOAA Ship *Fairweather*

Chief of Party: CDR Mark Van Waes, NOAA

A. Area Surveyed

The survey area is located along the South Coast of Kodiak Island, AK within the sub locality of Due East of Aiaktalik Island.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
56° 47' 27.42" N 154° 6' 40.85" W	56° 38' 28.98" N 153° 46' 29.49" W

Table 1: Survey Limits

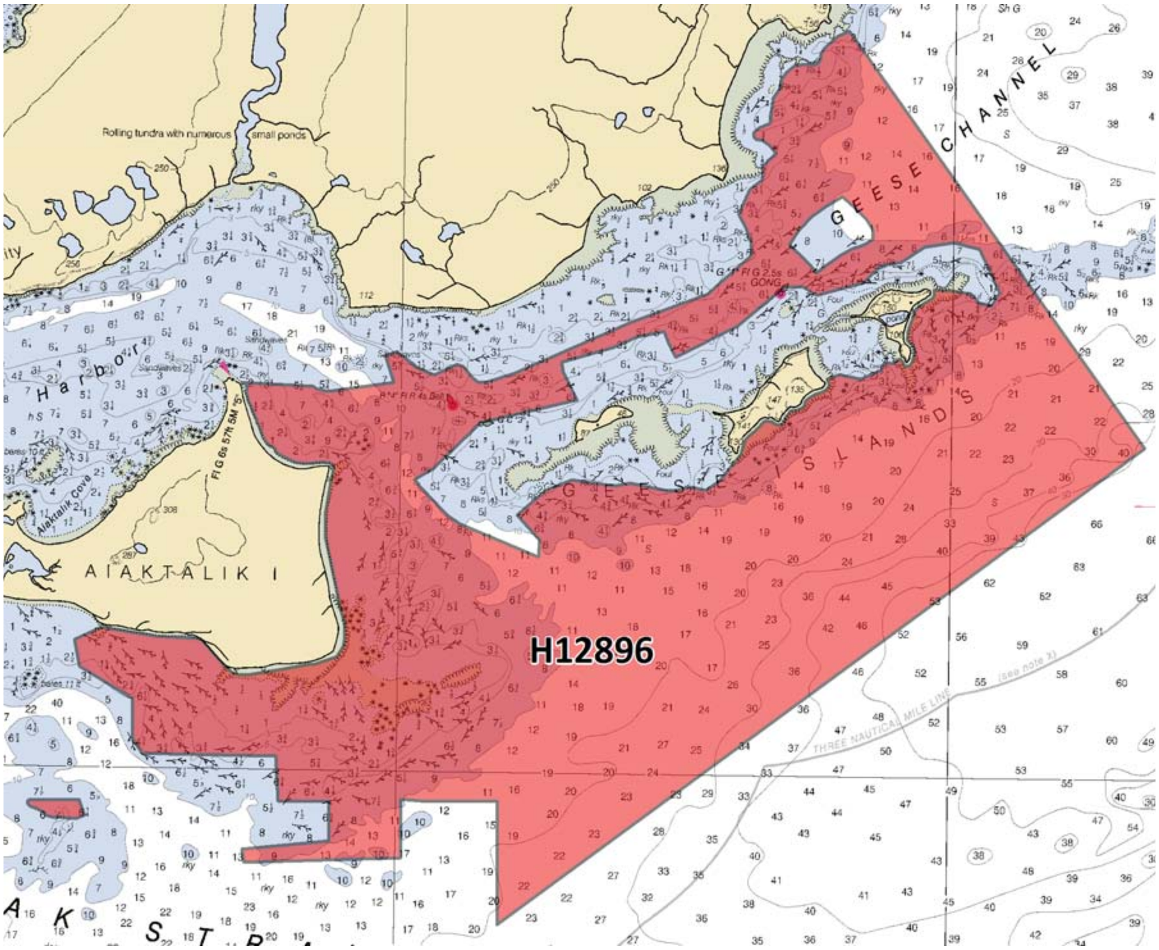


Figure 1: H12896 sheet limits (in red) overlaid onto Chart 16590.

Data were acquired to the survey limits in accordance with the requirements in the Project Instructions and the NOS Hydrographic Surveys and Specifications (HSSD) dated March 2016 as shown in Figure 1. In most areas where the 4 meter depth contour or the sheet limits were not met, the Navigable Area Limit Line (NALL) was defined as the inshore limit of bathymetry due to the risks of maneuvering the survey vessel in areas of dense kelp or in close proximity to exposed rocks. The locations where kelp prevented data acquisition to the assigned limits have been noted in the Final Feature File (FFF) as kelp areas. An example of such an area is shown in Figure 2.

In one area, the field surveyors erroneously believed they had reached 4 m depths without otherwise reaching a safe limit of navigation, as shown in Figure 3. This is the only location within the survey where the NALL was not reached, and depths encountered were within one meter of the limit along this edge.

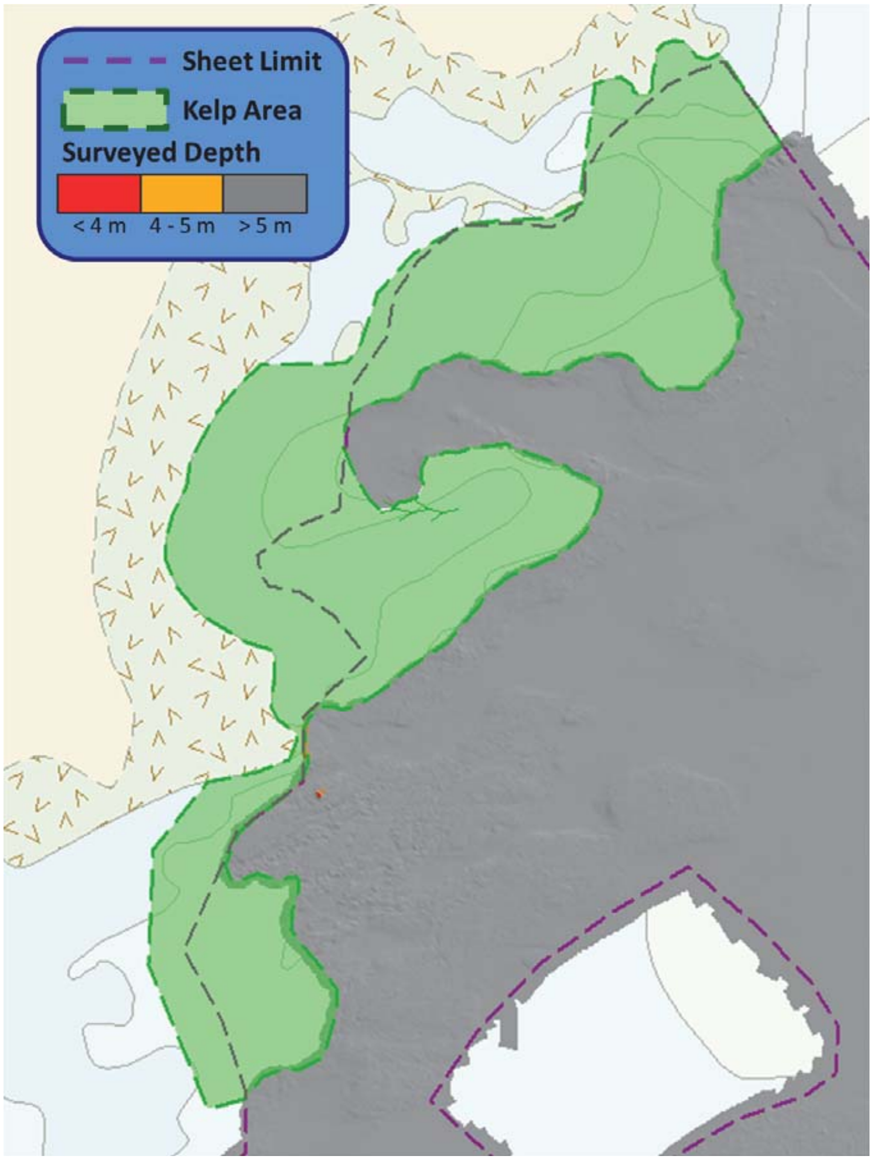


Figure 2: Example of location where the NALL was defined by areas of thick kelp. Kelp area boundaries in FFF denoted as dashed green lines with green fill. Surface shows that 4 m depths were not reached in this area.

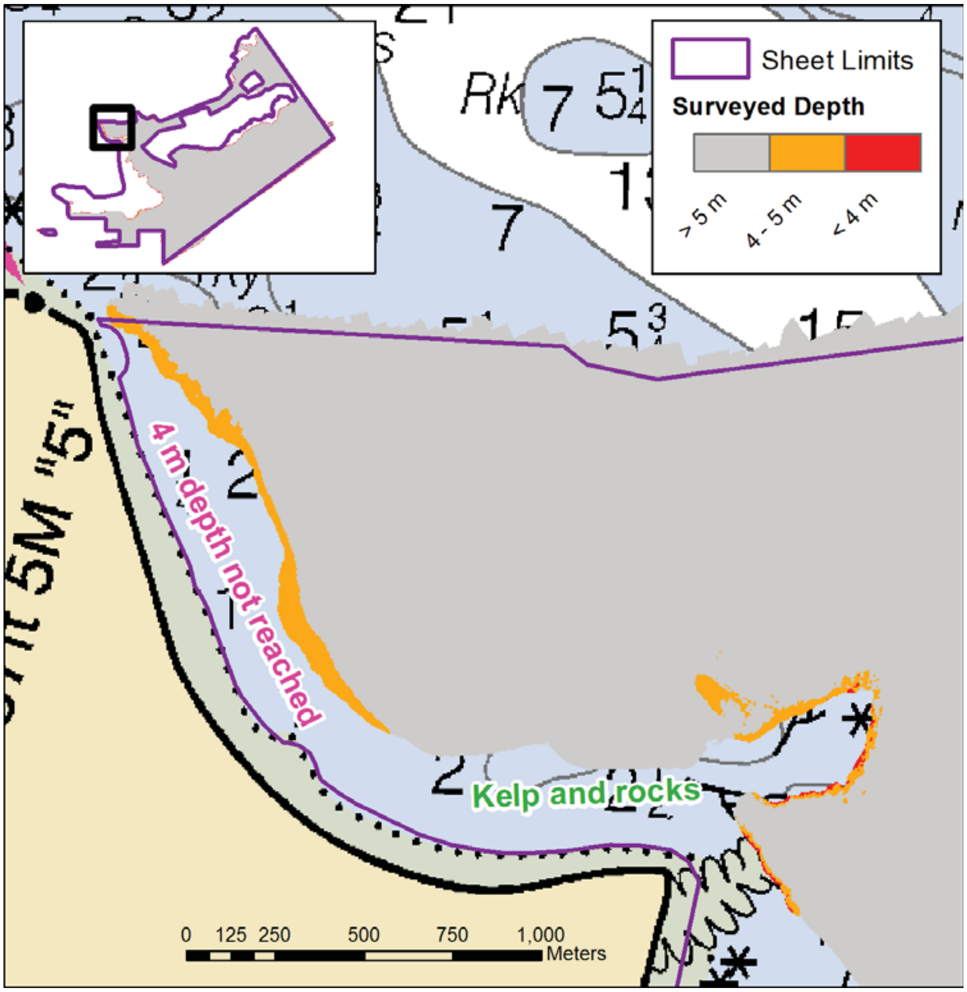


Figure 3: Detail of location where the NALL was not reached during survey operations.

A.2 Survey Purpose

The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products. This survey area addresses 32 SNM of navigationally significant waters in accordance with the National Hydrographic Survey Priorities Edition 2012. This survey will also support seismic research for tsunami risk analysis by US Geological Survey (USGS) and Alaska Department of Fish and Game (ADF&G).

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired in H12896 meet multibeam echo sounder (MBES) coverage requirements for complete coverage, as required by the HSSD. This includes crosslines (see Section B.2.1), NOAA allowable uncertainty (see Section B.2.10), and density requirements (see Section B.2.11). Additional compliance statistics can be found in the Standards and Compliance Review located in Appendix II of this report.

The compliance statistics are not appended to this report.

A.4 Survey Coverage

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

Water Depth	Coverage Required
All waters in survey area	Complete Coverage accomplished using either: A) Complete coverage MBES depth and backscatter data, or B) 100% SSS coverage with concurrent set line spacing MBES depth and backscatter data. Refer to HSSD Section 5.2.2.2

The entirety of H12896 was acquired with complete coverage MBES with backscatter meeting the requirements listed above and in the HSSD. See Figure 4 for an overview of coverage.

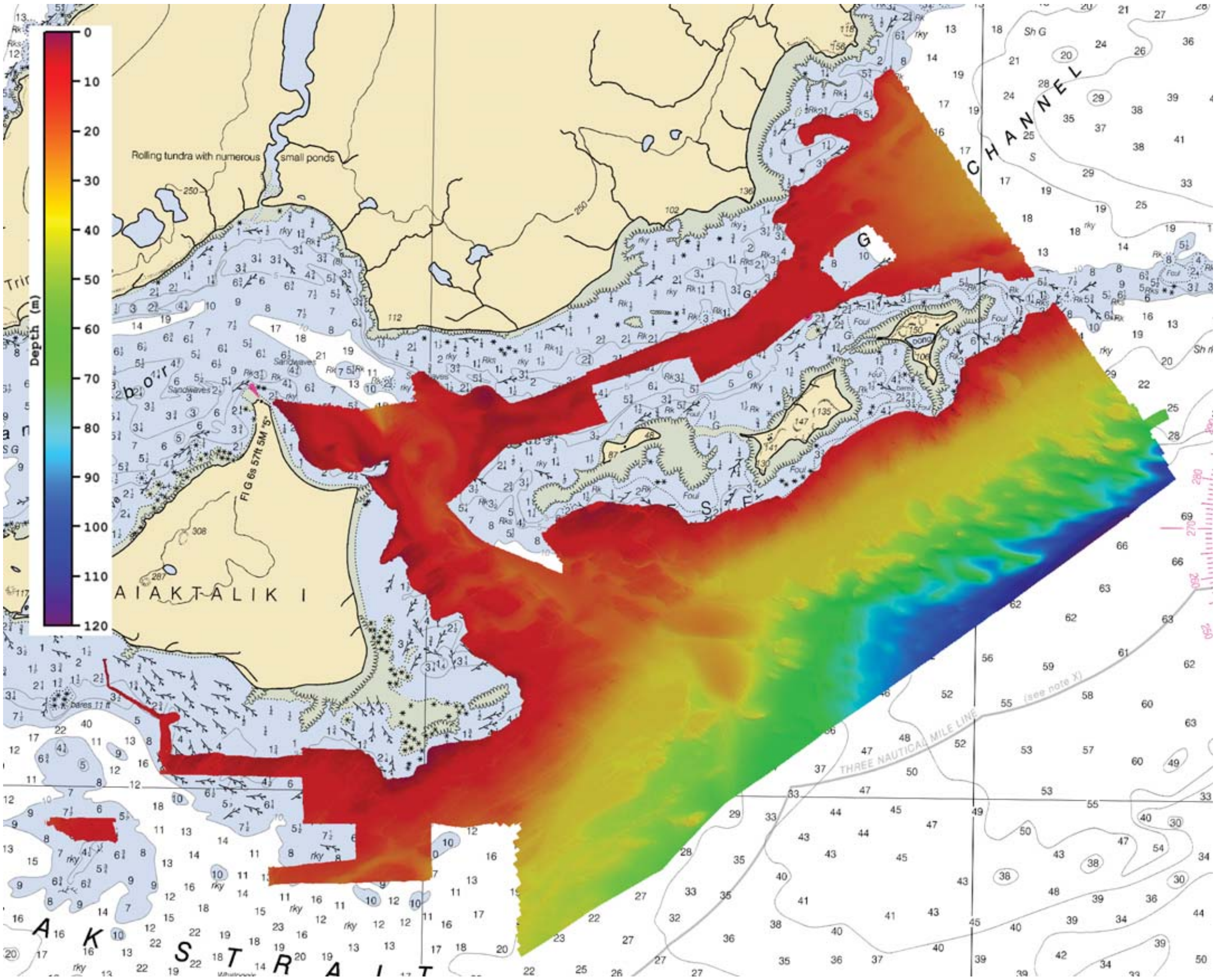


Figure 4: H12896 survey coverage (8 m surface) overlaid onto Chart 16590.

A.5 Survey Statistics

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

	HULL ID	*2805*	*2806*	*2807*	*2808*	*S220*	*Total*
LNM	SBES Mainscheme	0	0	0	0	0	0
	MBES Mainscheme	221.21	285.38	246.05	100.44	123.49	976.57
	Lidar Mainscheme	0	0	0	0	0	0
	SSS Mainscheme	0	0	0	0	0	0
	SBES/SSS Mainscheme	0	0	0	0	0	0
	MBES/SSS Mainscheme	0	0	0	0	0	0
	SBES/MBES Crosslines	8.51	35.96	0.0	0.0	0.0	44.47
	Lidar Crosslines	0	0	0	0	0	0
Number of Bottom Samples							3
Number Maritime Boundary Points Investigated							0
Number of DPs							0
Number of Items Investigated by Dive Ops							0
Total SNM							28.75

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
06/25/2016	177
06/26/2016	178

Survey Dates	Day of the Year
06/27/2016	179
07/08/2016	190
07/09/2016	191
07/10/2016	192
07/12/2016	194
07/13/2016	195
07/17/2016	199
07/18/2016	200
07/19/2016	201
07/20/2016	202
07/21/2016	203
07/28/2016	210
07/29/2016	211
07/30/2016	212
07/31/2016	213

Table 3: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the OPR-P335-FA-16 Data Acquisition and Processing Report (DAPR) for a complete description of data acquisition and processing systems, survey vessels, quality control procedures and data processing methods. Additional information to supplement sounding and survey data, and any deviations from the DAPR, are discussed in the following sections.

B.1.1 Vessels

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

Hull ID	*2805*	*2806*	*2807*	*2808*	*S220*
LOA	8.64 meters	8.64 meters	8.64 meters	8.64 meters	70.40 meters
Draft	1.12 meters	1.12 meters	1.12 meters	1.12 meters	4.88 meters

Table 4: Vessels Used

B.1.2 Equipment

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

Manufacturer	Model	Type
Reson	7125 SV1	MBES
Kongsberg	EM710	MBES
Reson	SVP 70	Sound Speed System
Reson	SVP 71	Sound Speed System
Rolls Royce	MVP 200	Conductivity, Temperature, and Depth Sensor
Sea-Bird Electronics	19plus	Conductivity, Temperature, and Depth Sensor
Applanix	POS MV V4	Positioning and Attitude System

Table 5: Major Systems Used

The equipment was installed on the survey platforms as follows: S220 utilizes the Kongsberg EM710 MBES, SVP 70 surface sound speed sensors, and Rolls Royce MVP for conductivity, temperature, and depth (CTD) casts. All launches utilize Reson 7125 SV1 MBES, SVP71 surface sound speed sensors, and Sea-Bird Electronics 19plus CTD casts.

B.2 Quality Control

B.2.1 Crosslines

Crosslines acquired for this survey totaled 4.55% of mainscheme acquisition.

Crosslines were collected, processed and compared in accordance with Section 5.2.4.3 of the HSSD. Crossline locations are shown in Figure 5. To evaluate crosslines, a 4 meter CUBE surface using strictly mainscheme lines, and a 4 meter CUBE surface using strictly crosslines were created. From these two surfaces, a difference surface (mainscheme - crosslines = difference surface) was generated at a 4 meter resolution (Figure 6), and is submitted in the Separates II Digital Data folder. Statistics show the mean difference between the depths derived from mainscheme and crosslines was -0.03 meters (with mainscheme being shoaler) and 95% of nodes falling within 0.28 meters (Figure 7). For the respective depths, the difference surface was compared to the allowable NOAA accuracy standards (Figure 8). In total, 99.56%

of the depth differences between H12896 mainscheme and crossline data were within allowable NOAA uncertainties (Figure 9).

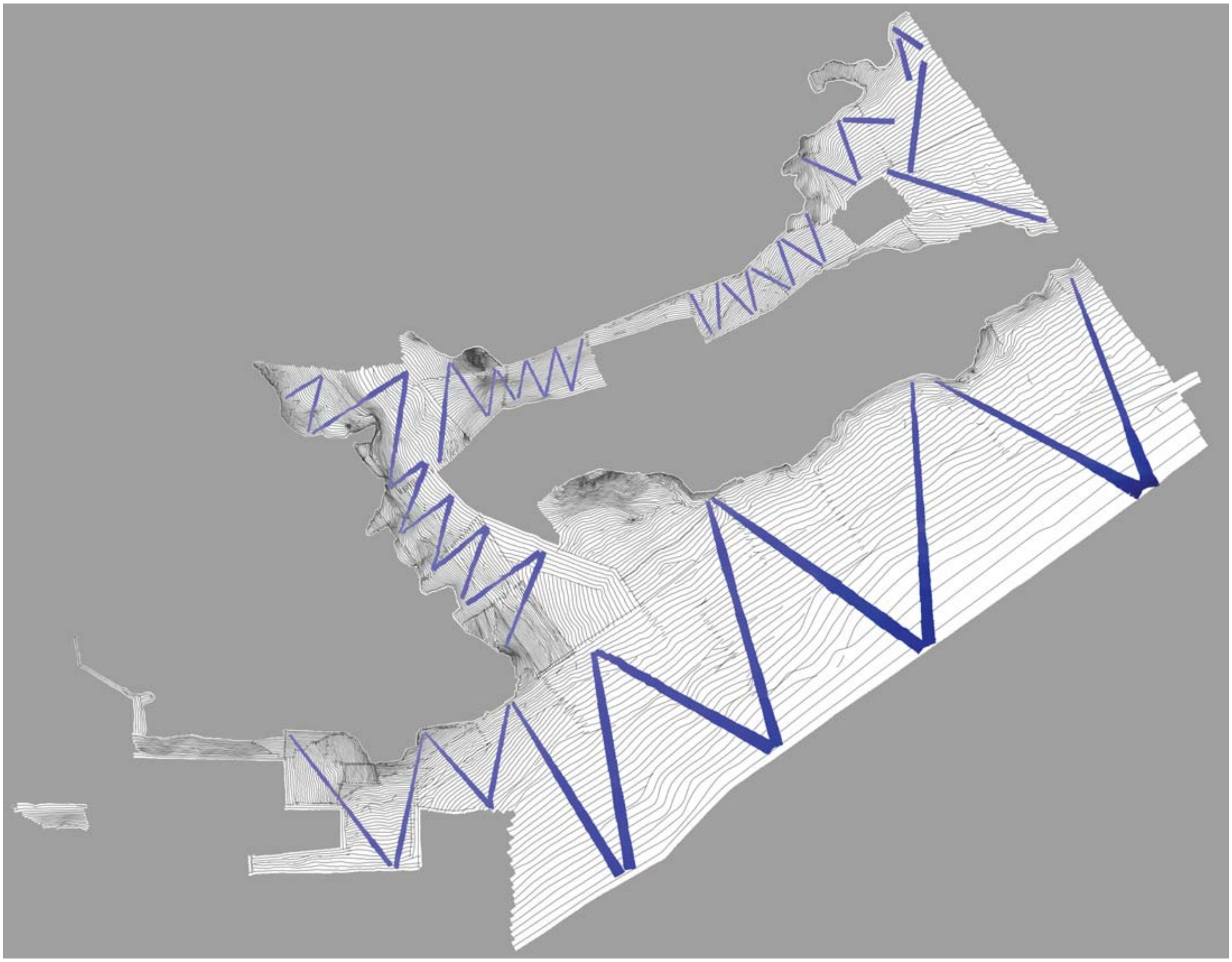


Figure 5: Crossline locations shown in blue bathymetry compared to mainscheme lines shown as black tracklines.

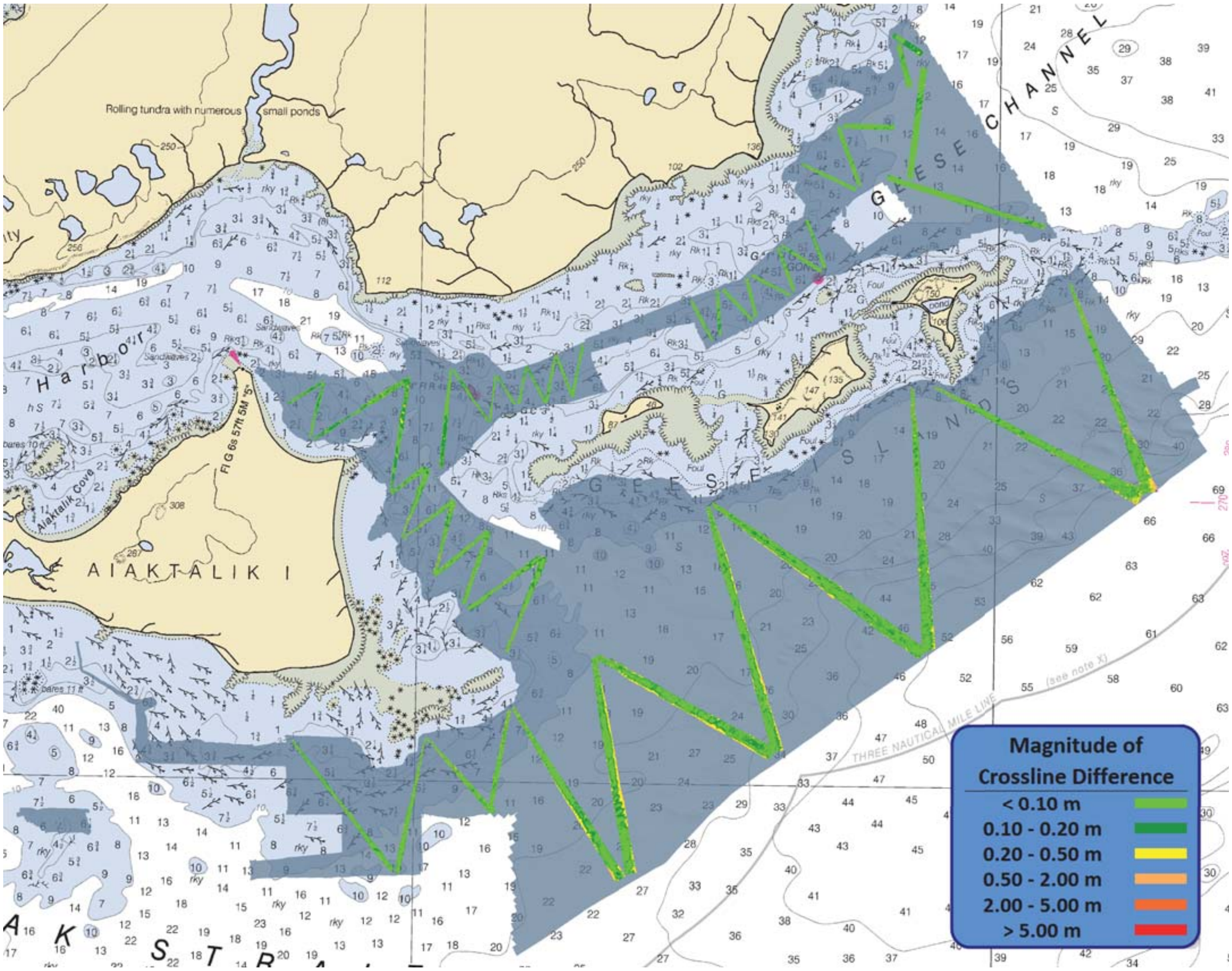
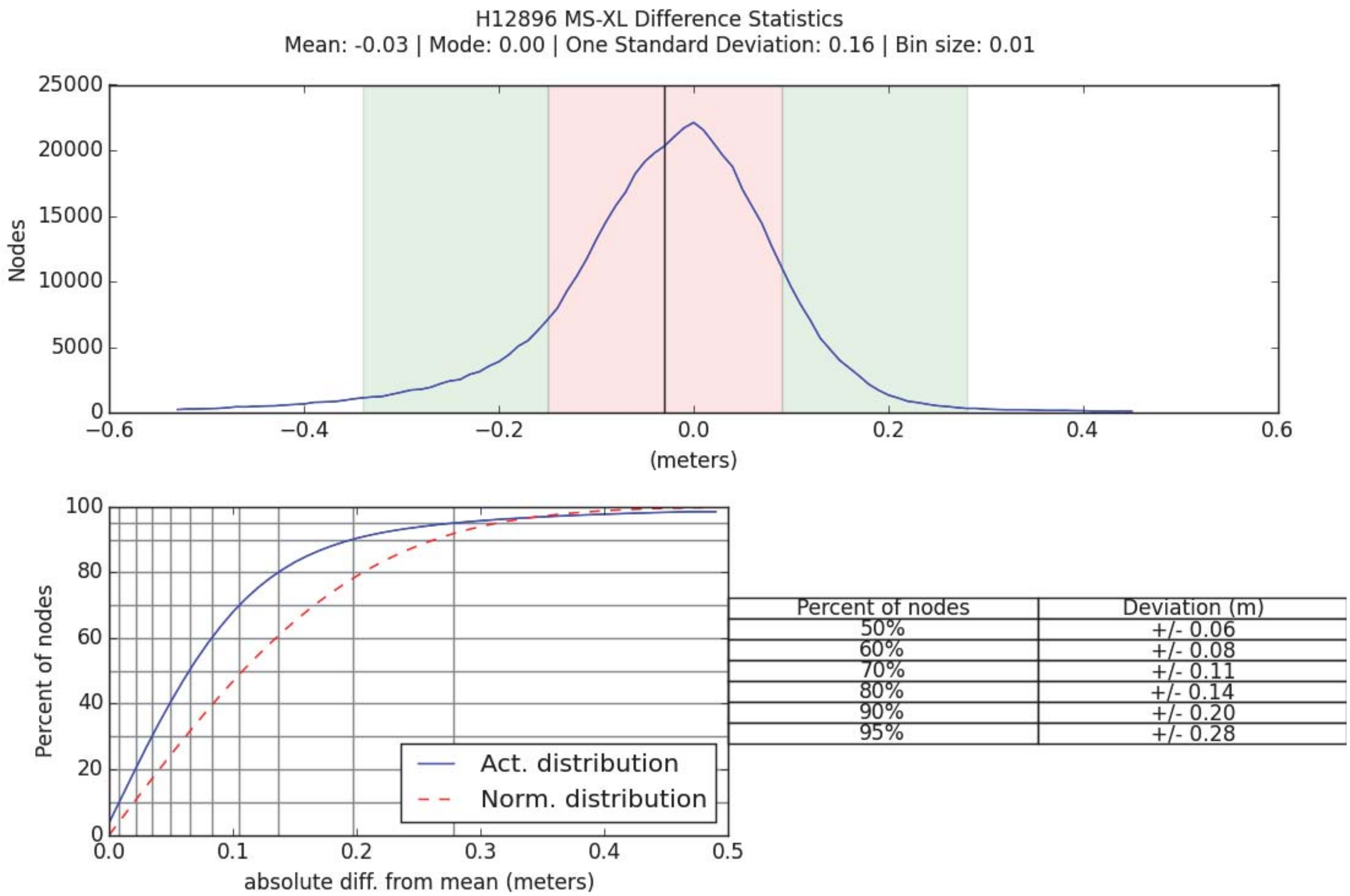


Figure 6: Overview of H12896 crosslines.



Percent of nodes	Deviation (m)
50%	+/- 0.06
60%	+/- 0.08
70%	+/- 0.11
80%	+/- 0.14
90%	+/- 0.20
95%	+/- 0.28

Figure 7: H12896 crossline and mainscheme difference statistics.

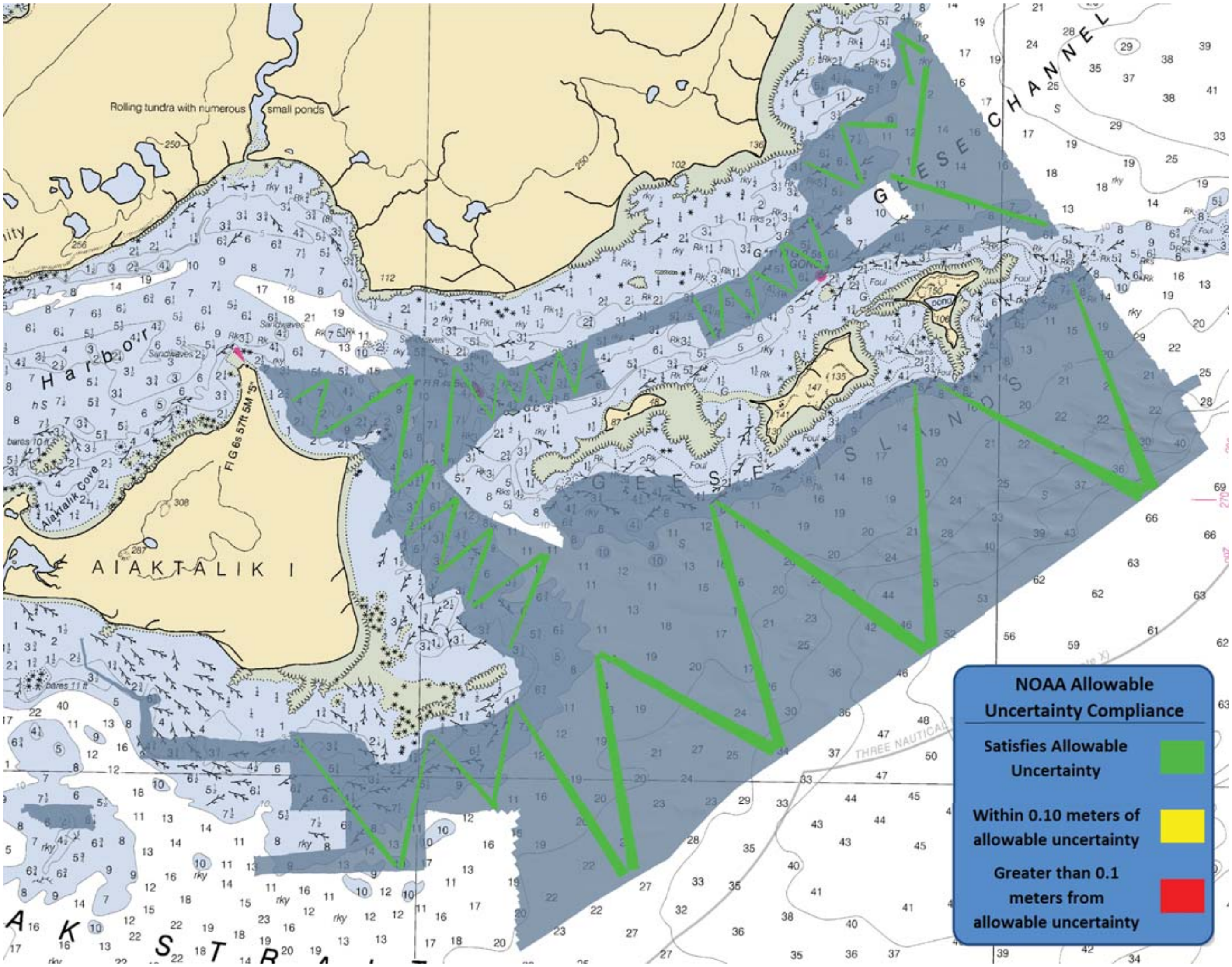


Figure 8: Depth differences between H12896 mainscheme and crossline data as compared to NOAA allowable uncertainty standards for the associated depths.

H12896 Crossline Differencing NOAA Allowable Uncertainty		
Total Nodes	**Passed Nodes**	**Failed Nodes**
532,415	530,074	2,341
Percentage Nodes Failed		0.44%
Percentage Nodes Passed		99.56%

Figure 9: Crossline surface statistics showing percentage of nodes meeting NOAA allowable uncertainty.
The crossline difference surfaces are not appended to this report.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning	Method
0 meters	0 meters	TCARI
0 meters	0.02 meters	ERS via PMVD

Table 6: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Surface
S220	N/A meters/second	1 meters/second	0.5 meters/second
2805	2 meters/second	N/A meters/second	0.5 meters/second
2806	2 meters/second	N/A meters/second	0.5 meters/second
2807	2 meters/second	N/A meters/second	0.5 meters/second
2808	2 meters/second	N/A meters/second	0.5 meters/second

Table 7: Survey Specific Sound Speed TPU Values.

In addition to the usual a priori estimates of uncertainty provided via device models for vessel motion, TCARI, Poor Man's VDatum (PMVD), real-time and post-processed uncertainty sources were also incorporated into the depth estimates of survey H12896. Real-time uncertainties were provided via EM710 and Reson 7125 MBES data, Applanix Delayed Heave RMS, and TCARI tides. Following post-processing of vessel motion, real time uncertainties of vessel roll, pitch, gyro and navigation were applied in CARIS HIPS and SIPS via a Smoothed Best Estimate of Trajectory (SBET) RMS file generated in Applanix POSPac.

B.2.3 Junctions

H12896 junctions with one adjacent survey from this project, H12897, and four surveys from prior projects, H11665, H11666, H12681 and H12683 as shown in Figure 10. Data overlap between H12896 and each adjacent survey was achieved. These areas of overlap between surveys were reviewed with CARIS HIPS and SIPS by surface differencing (at equal resolutions) to assess surface agreement. For H12897, also from OPR-P335-FA-16, the multibeam data were also examined in CARIS Subset Editor for consistency and agreement. The junctions with H12896 are generally within the NOAA allowable uncertainty in their areas of overlap. For all junctions, a negative difference indicates H12896 was shoaler, and a positive difference indicates H12896 was deeper.

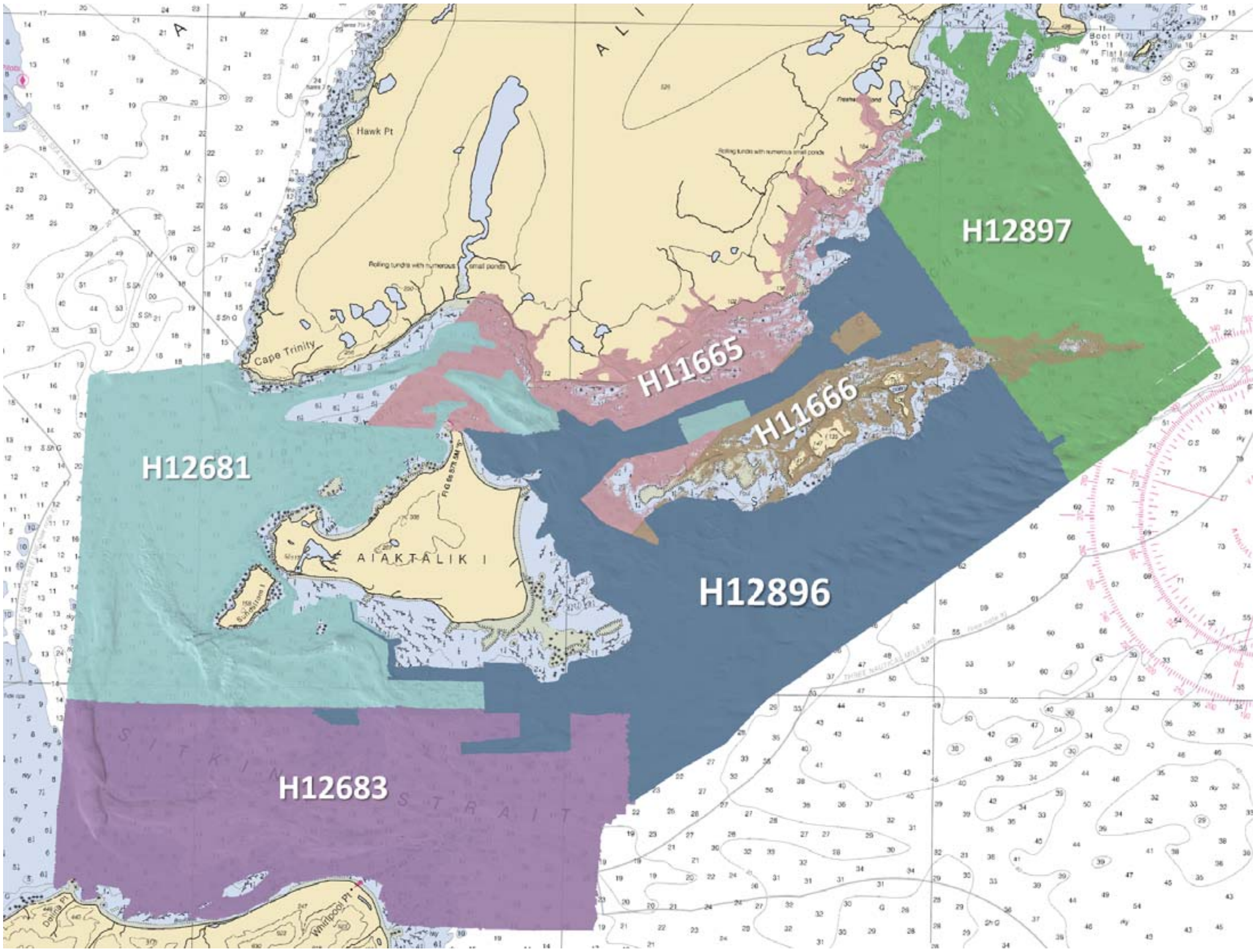


Figure 10: Overview of H12896 junction surveys.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H11665	1:10000	2007	Tenix Lads Inc.	N
H11666	1:10000	2007	Tenix Lads Inc.	N
H12681	1:40000	2014	NOAA Ship FAIRWEATHER	W
H12683	1:40000	2014	NOAA Ship FAIRWEATHER	SW
H12897	1:40000	2016	NOAA Ship FAIRWEATHER	NE

Table 8: Junctioning Surveys

H11665

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between H12896 and H11665. For comparison purposes, a 3 m surface was generated for H12896 to match the resolution of the lidar surface from H11665. For gridding at the 3 m node size, the CUBE parameters were the same as the defined NOAA resolutions with "Capture_Distance_Min" adjusted to be 1/sqrt(2) * 3 m, since this is the only parameter which changes among the other standard resolutions. The statistical analysis of the difference surface shows a mean of 0.19 meters with 95% of all nodes having a maximum deviation of +/- 0.41 meters, as seen in Figure 12. A detailed graphical overview can be seen in Figure 11. In addition, a comparison surface was created between the difference surface and the NOAA allowable uncertainty (See Figure 13). It was found that 99.74% of nodes are within NOAA allowable uncertainty (Figure 14).

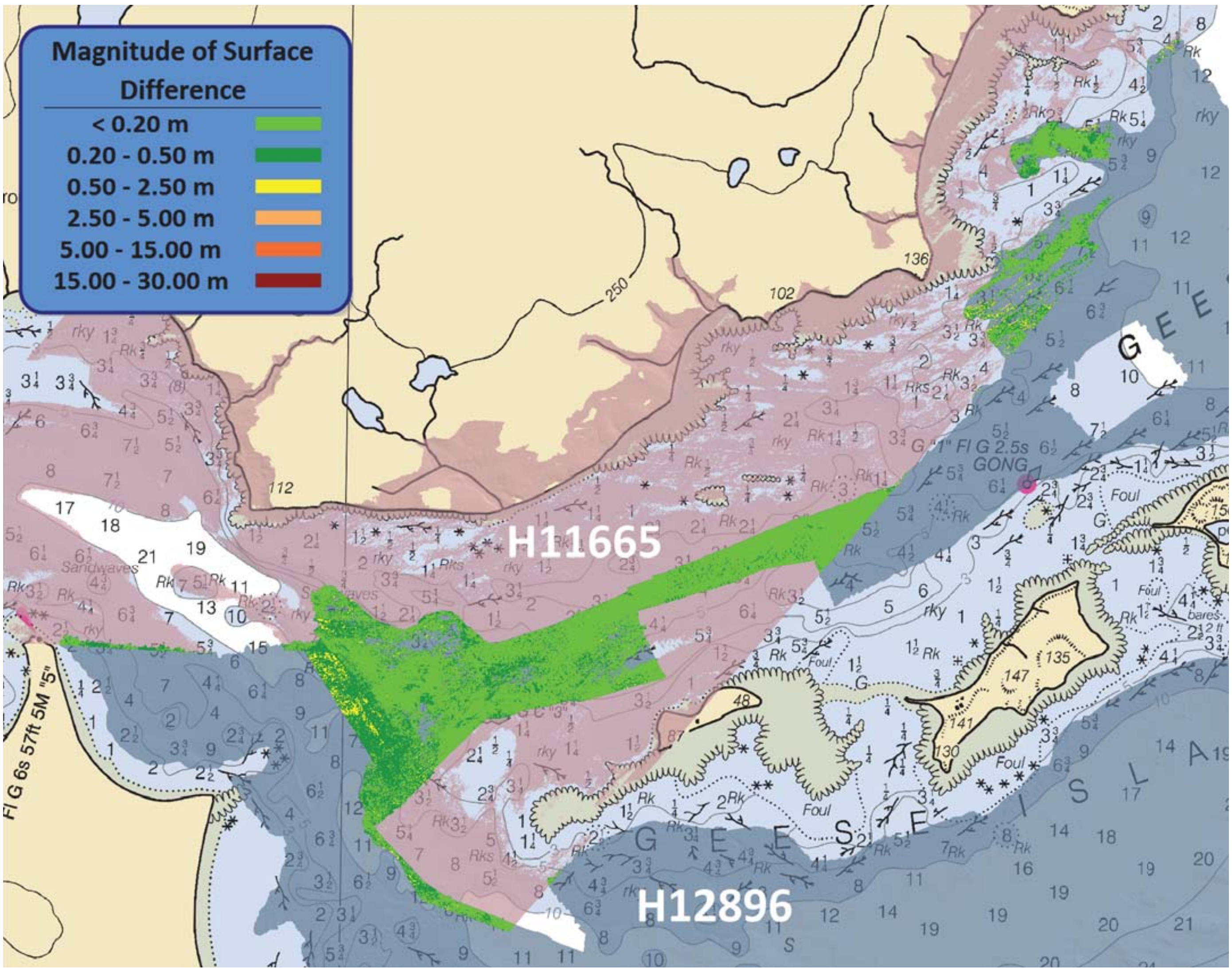
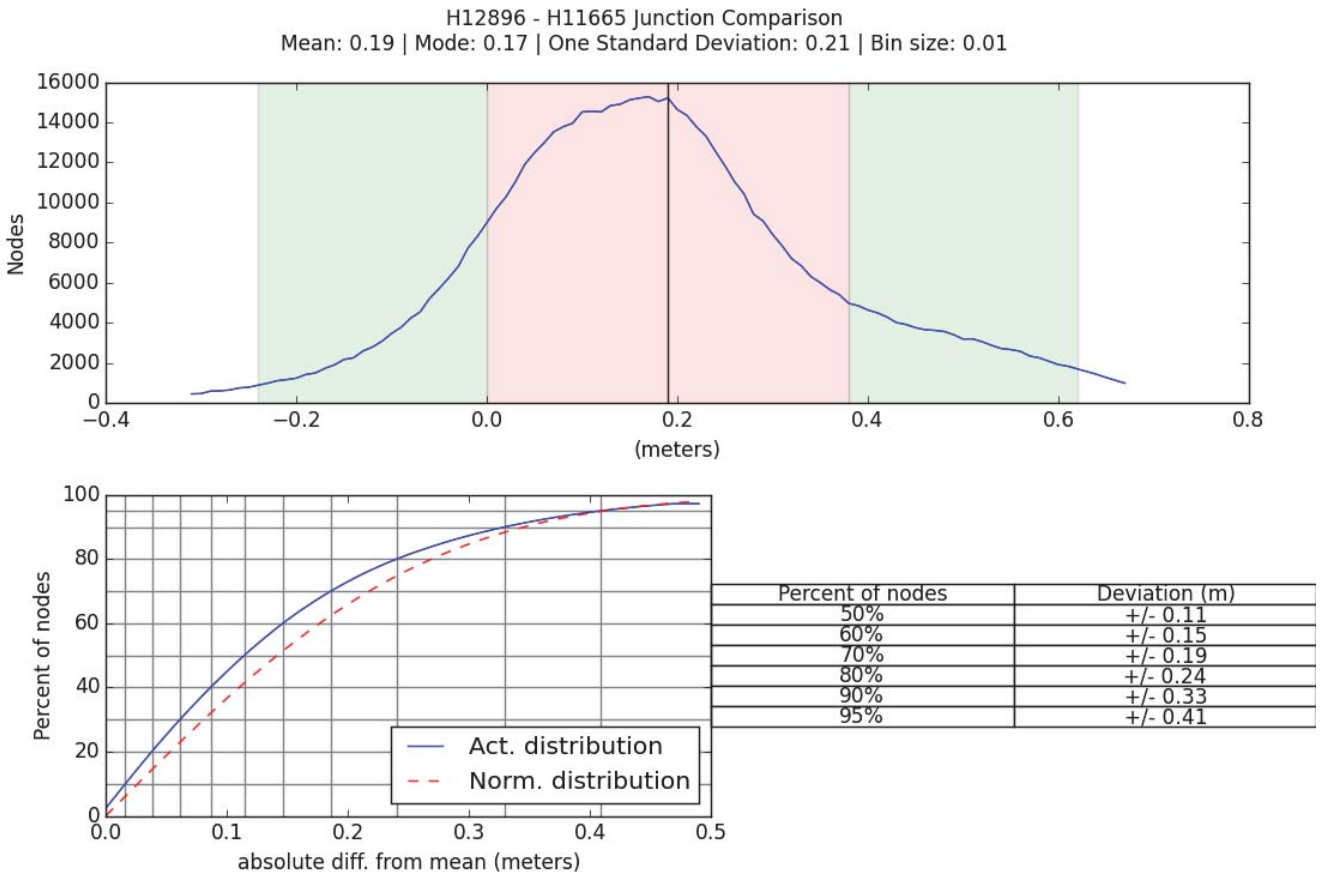


Figure 11: Difference surface between H12896 (dark blue) and junctioning survey H11665 (pink).



Percent of nodes	Deviation (m)
50%	+/- 0.11
60%	+/- 0.15
70%	+/- 0.19
80%	+/- 0.24
90%	+/- 0.33
95%	+/- 0.41

Figure 12: Difference surface statistics between H12896 and H11665 (3 meter surface).

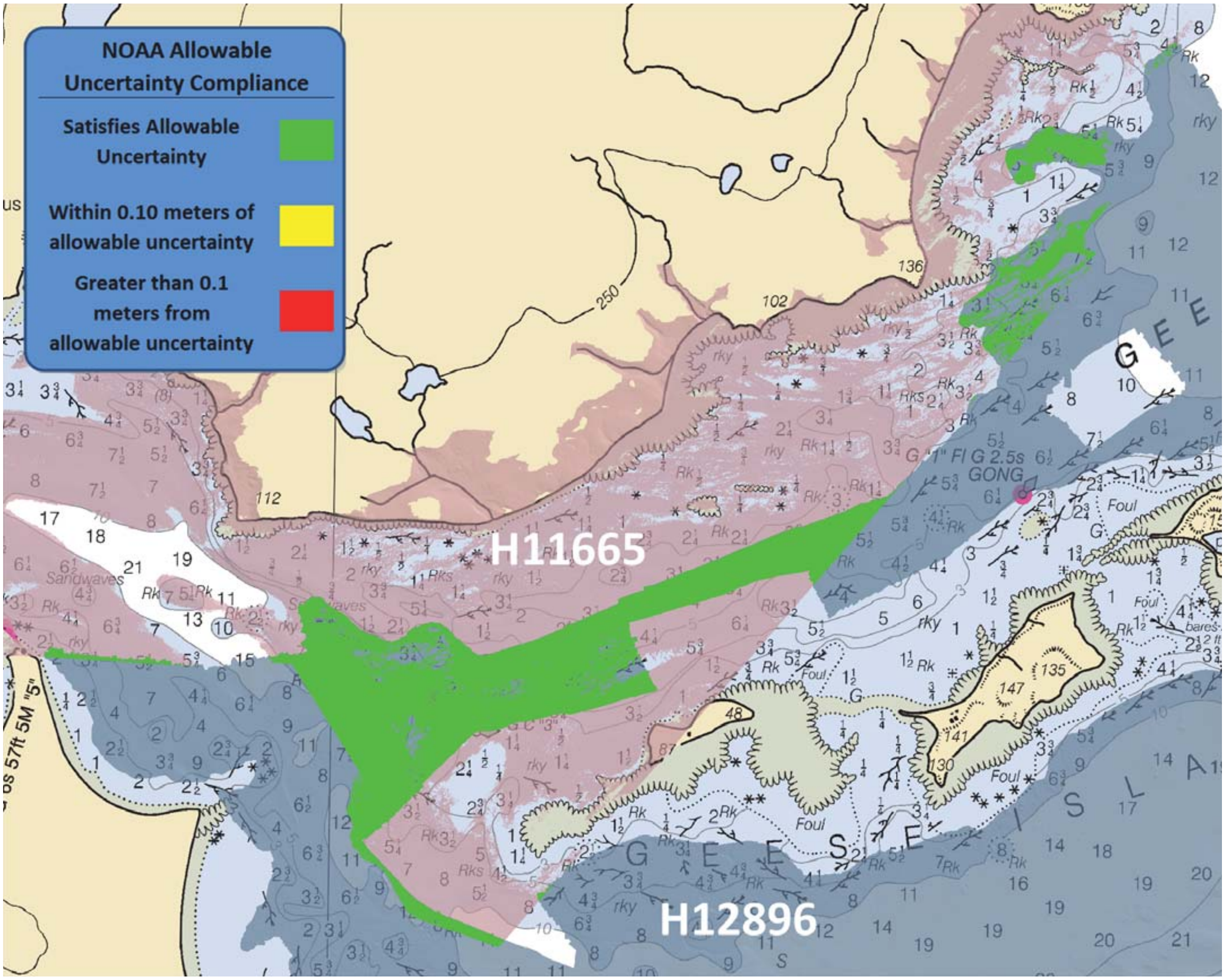


Figure 13: Difference surface compliance with regard to NOAA allowable uncertainty between H12896 (dark blue) and junctioning survey H11665 (pink).

H12896 Junction Differencing with H11665 NOAA Allowable Uncertainty		
Total Nodes	Passed Nodes	Failed Nodes
630,257	628,647	1,610
Percentage Nodes Passed		99.74%
Percentage Nodes Failed		0.26%

Figure 14: Difference surface statistics between H12896 and H11665 showing percentage of nodes meeting NOAA allowable uncertainty.

<u>H11666</u>

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between H12896 and H11666. The same procedure as for H11665 above was used to generate and perform comparison on a 3 m gridded surface for H12896. The statistical analysis of the difference surface shows a mean of -0.01 meters with 95% of all nodes having a maximum deviation of +/- 0.55 meters, as seen in Figure 16. A detailed graphical overview can be seen in Figure 15. In addition, a comparison surface was created between the difference surface and the NOAA allowable uncertainty (See Figure 17). It was found that 97.38% of nodes are within NOAA allowable uncertainty (Figure 18).

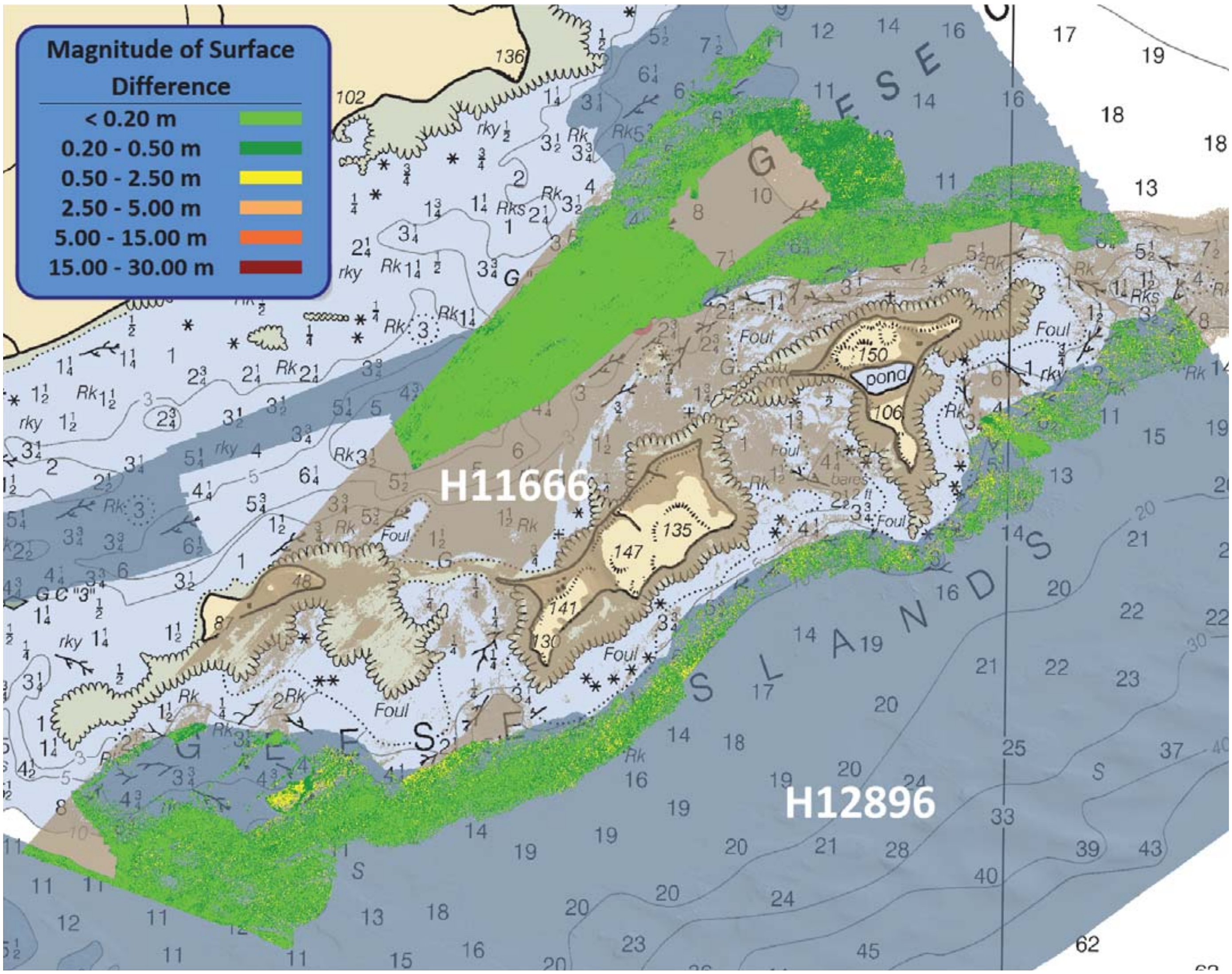
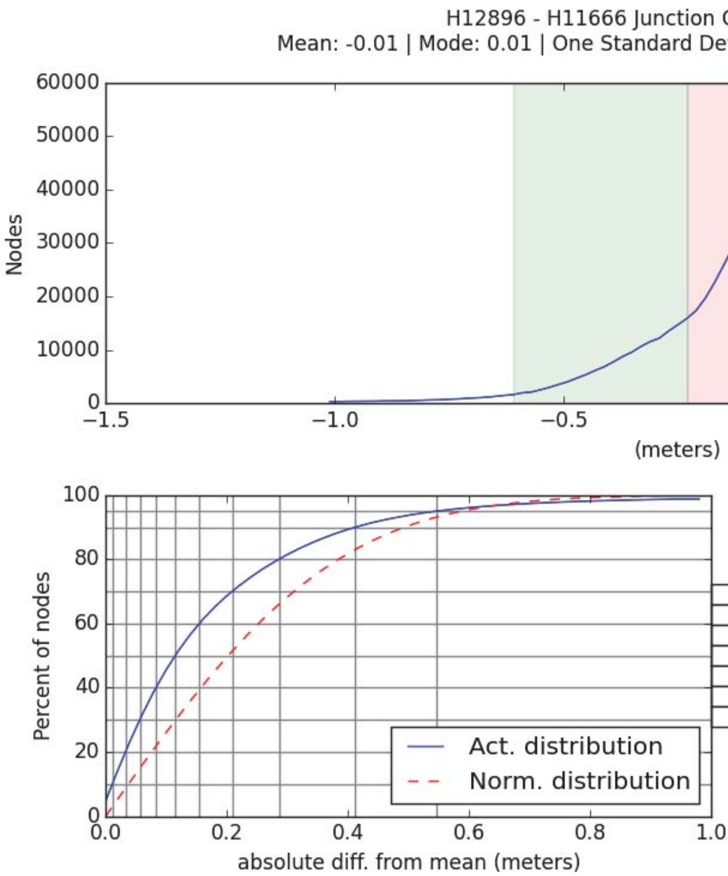


Figure 15: Difference surface between H12896 (dark blue) and junctioning survey H11666 (brown).



Percent of nodes	Deviation (m)
50%	+/- 0.11
60%	+/- 0.15
70%	+/- 0.21
80%	+/- 0.29
90%	+/- 0.41
95%	+/- 0.55

Figure 16: Difference surface statistics between H12896 and H11666 (3 meter surface).

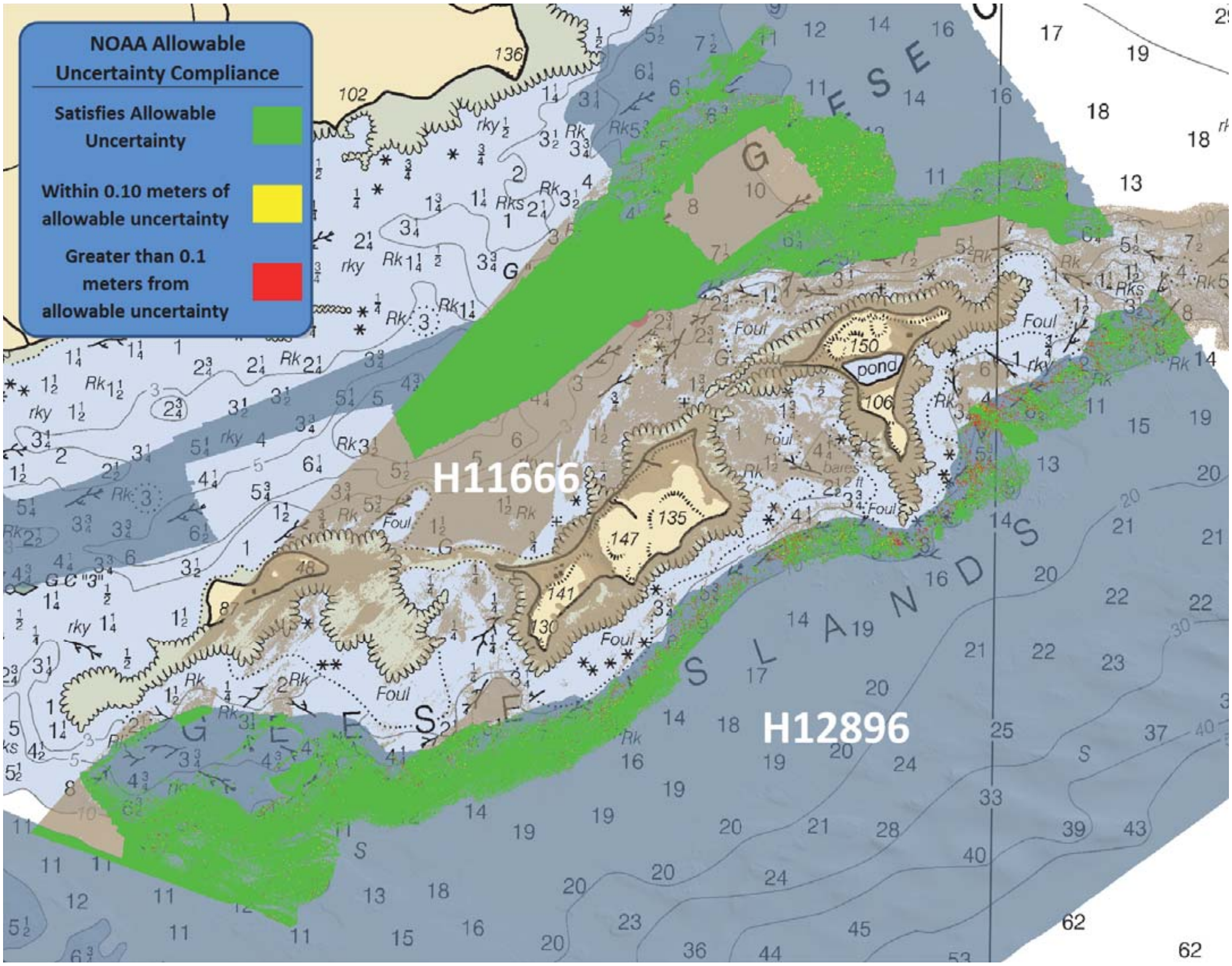


Figure 17: Difference surface compliance with regard to NOAA allowable uncertainty between H12896 (dark blue) and junctioning survey H11666 (brown).

H12896 Junction Differencing with H11666 NOAA Allowable Uncertainty		
Total Nodes	**Passed Nodes**	**Failed Nodes**
1,056,112	**1,028,487**	**27,625**
Percentage Nodes Passed		**97.38%**
Percentage Nodes Failed		**2.62%**

Figure 18: Difference surface statistics between H12896 and H11666 showing percentage of nodes meeting NOAA allowable uncertainty.

H12681

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the 8 meter combined surface from H12896 and the 8 meter combined surface from H12681. The statistical analysis of the difference surface shows a mean of 0.29 meters with 95% of all nodes having a maximum deviation of +/- 0.45 meters, as seen in Figure 20. A detailed graphical overview can be seen in Figure 19. In addition, a comparison surface was created between the difference surface and the NOAA allowable uncertainty (See Figure 21). It was found that 98.99% of nodes are within NOAA allowable uncertainty (Figure 22).

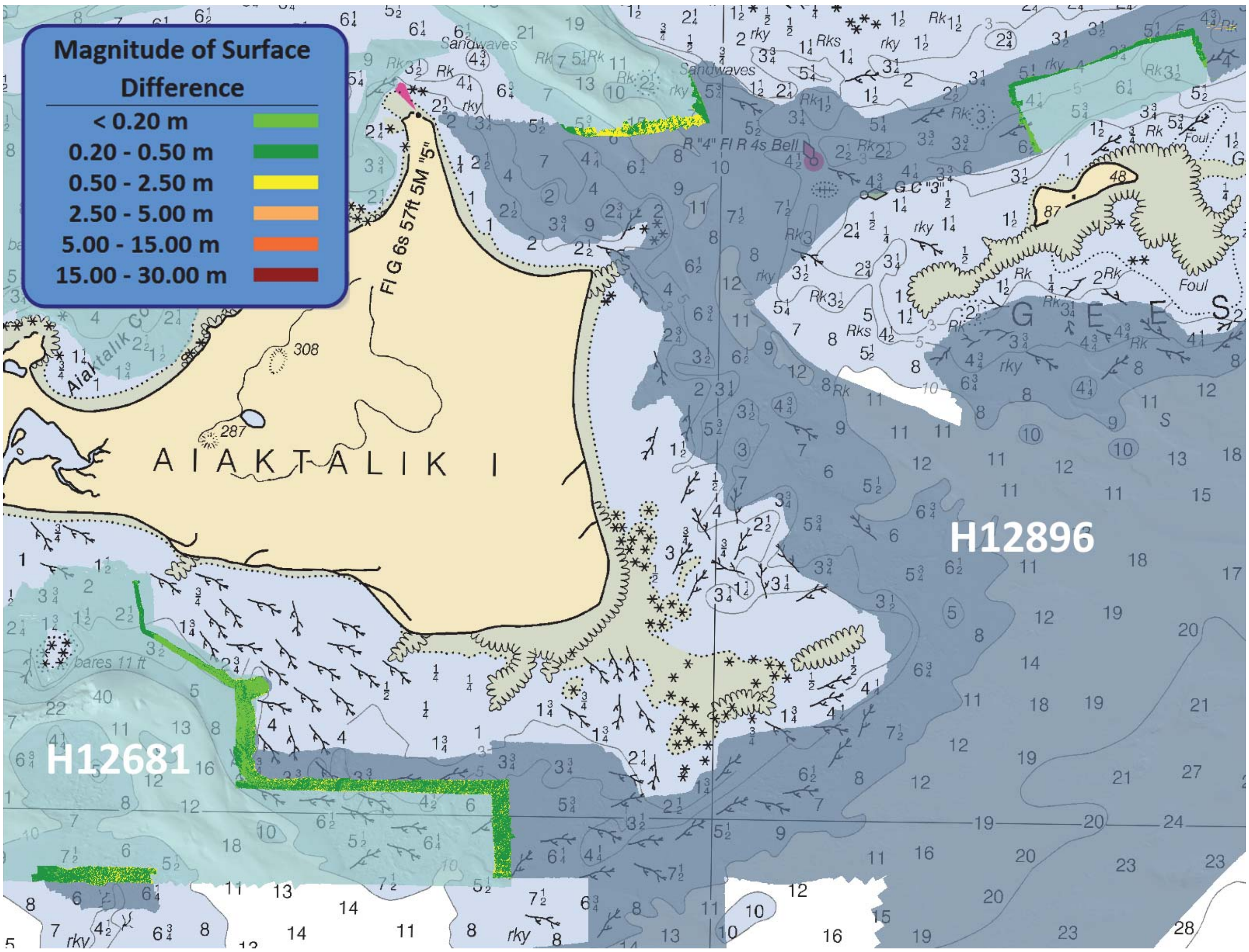
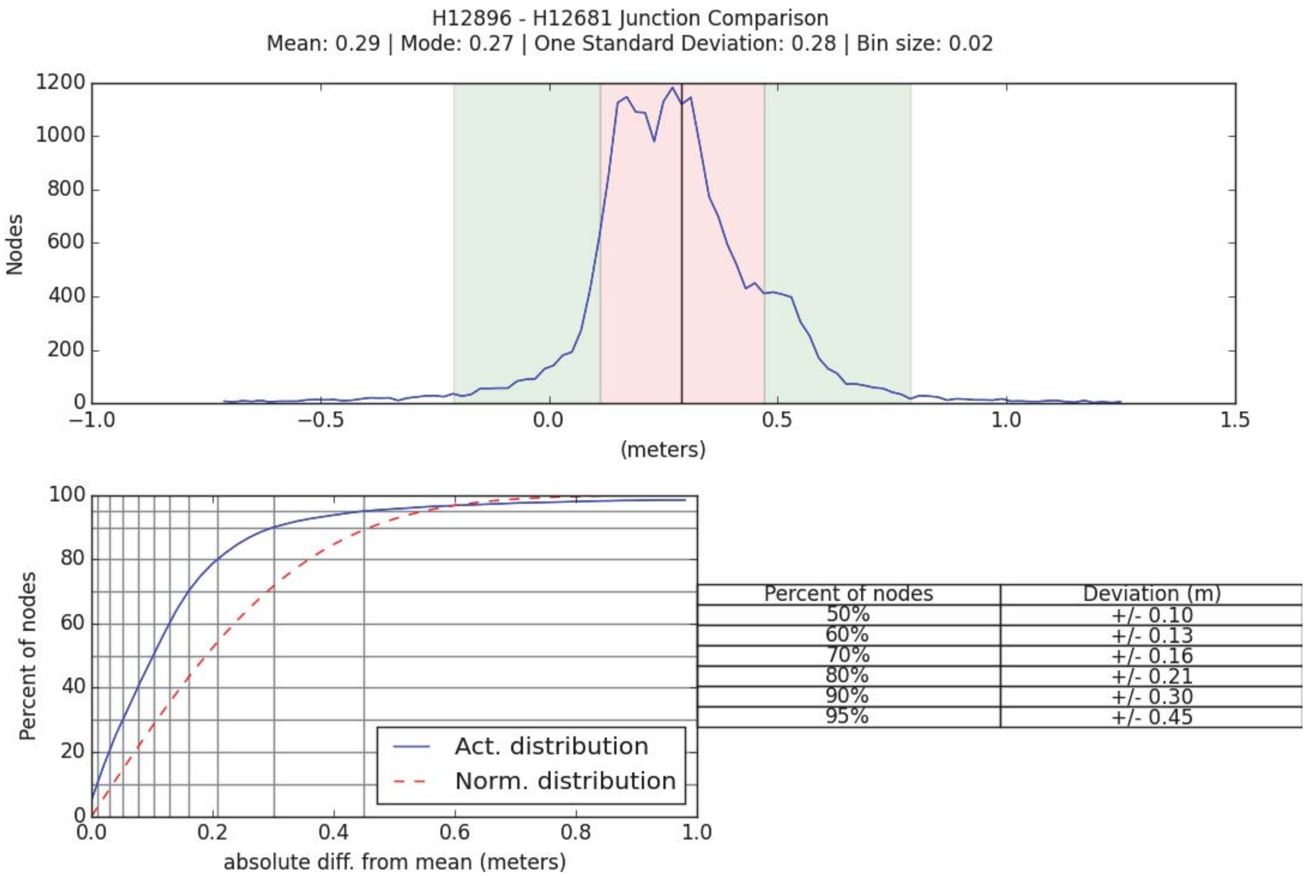


Figure 19: Difference surface between H12896 (dark blue) and junctioning survey H12681 (light teal).



Percent of nodes	Deviation (m)
50%	+/- 0.10
60%	+/- 0.13
70%	+/- 0.16
80%	+/- 0.21
90%	+/- 0.30
95%	+/- 0.45

Figure 20: Difference surface statistics between H12896 and H12681 (8 meter surface).

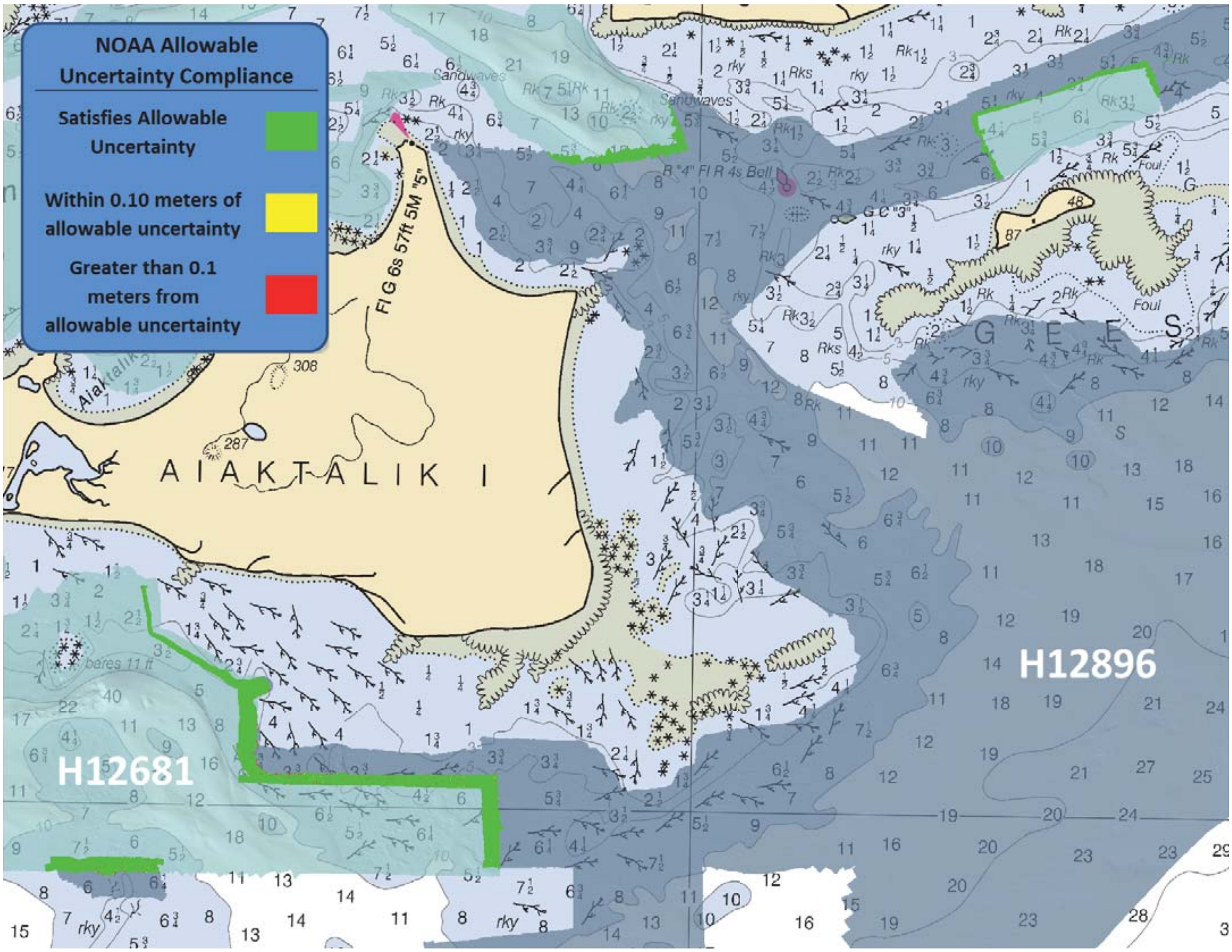


Figure 21: Difference surface compliance with regard to NOAA allowable uncertainty between H12896 (dark blue) and junctioning survey H12681 (light teal).

H12896 Junction Differencing with H12681 NOAA Allowable Uncertainty		
Total Nodes	Passed Nodes	Failed Nodes
21,784	21,565	219
Percentage Nodes Passed		98.99%
Percentage Nodes Failed		1.01%

Figure 22: Difference surface statistics between H12896 and H12681 showing percentage of nodes meeting NOAA allowable uncertainty.

H12683

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the 8 meter combined surface from H12896 and the 8 meter combined surface from H12683. The statistical analysis of the difference surface shows a mean of 0.25 meters with 95% of all nodes having a maximum deviation of +/- 0.40 meters, as seen in Figure 24. A detailed graphical overview can be seen in Figure 23. In addition, a comparison surface was created between the difference surface and the NOAA allowable uncertainty (See Figure 25). It was found that 99.43% of nodes are within NOAA allowable uncertainty (Figure 26).

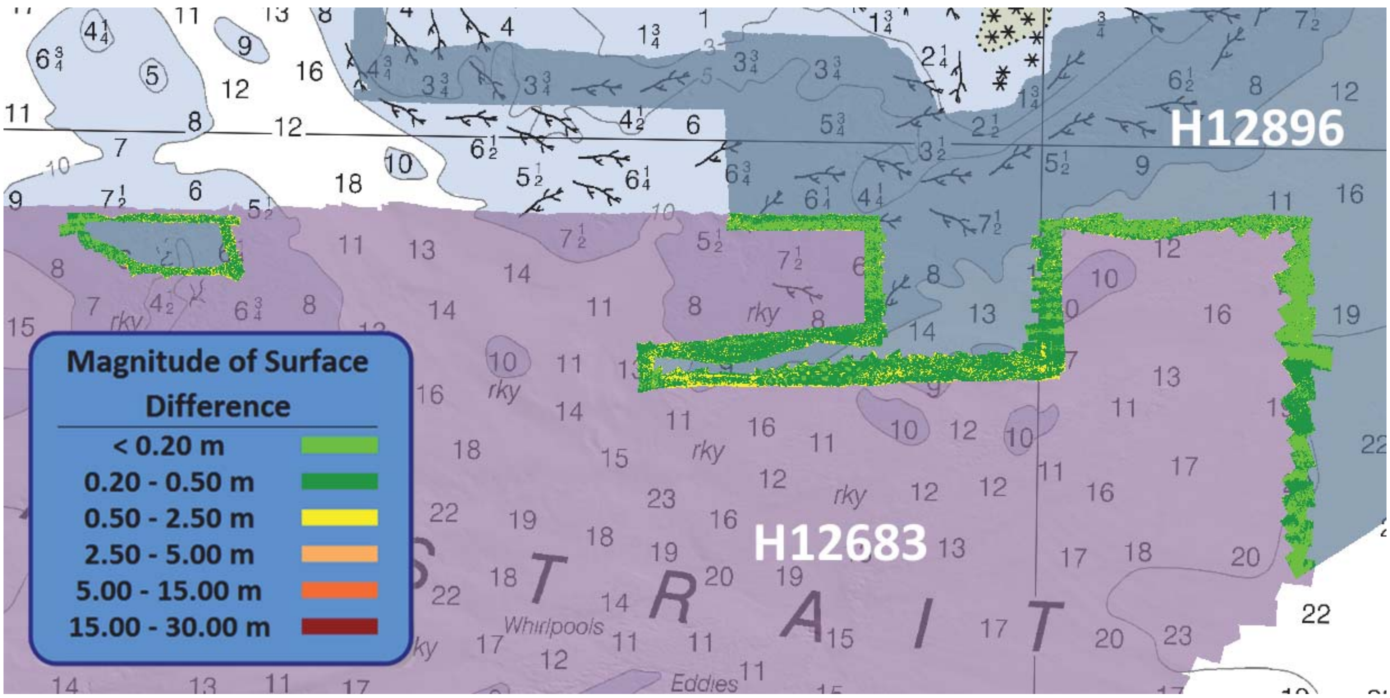
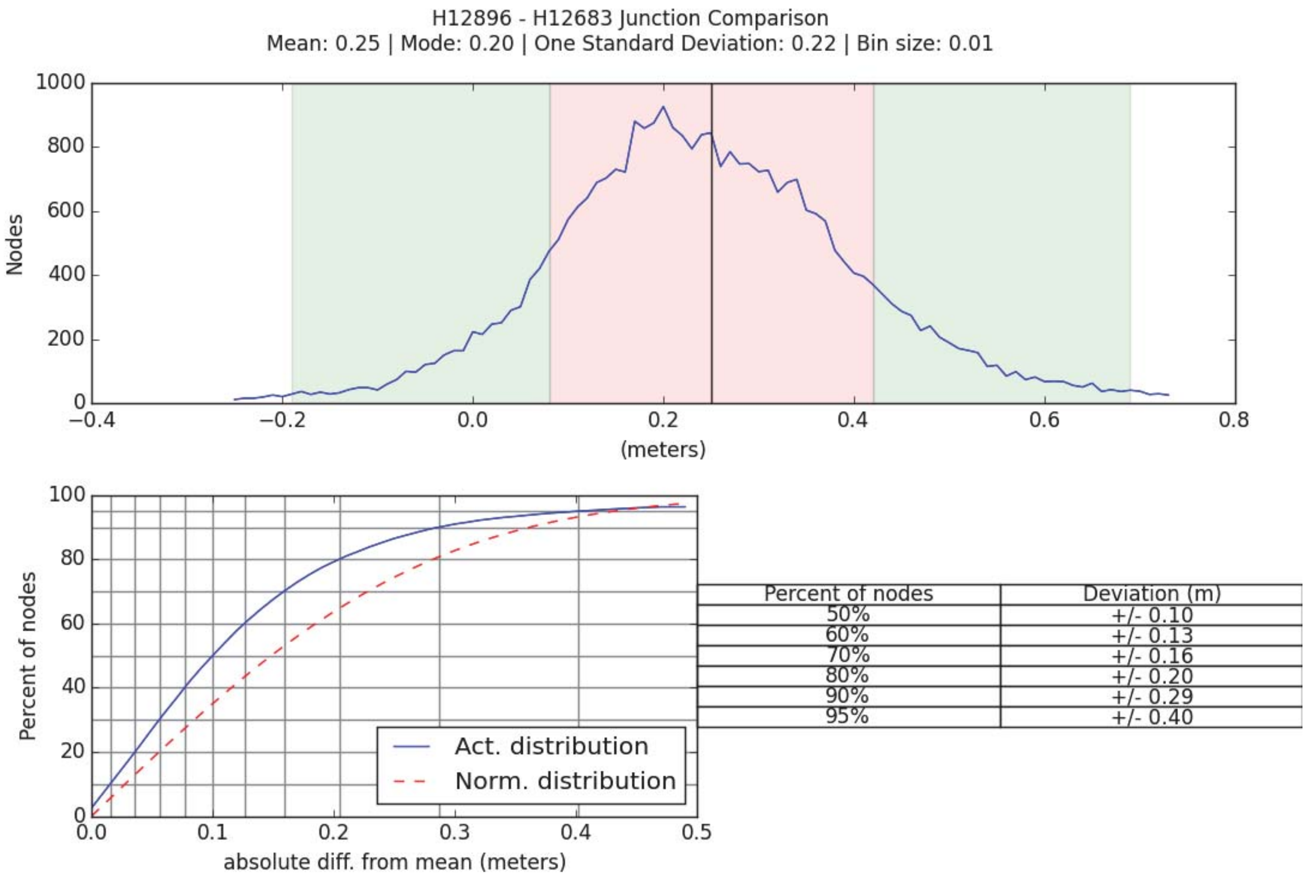


Figure 23: Difference surface between H12896 (dark blue) and junctioning survey H12683 (purple).



Percent of nodes	Deviation (m)
50%	+/- 0.10
60%	+/- 0.13
70%	+/- 0.16
80%	+/- 0.20
90%	+/- 0.29
95%	+/- 0.40

Figure 24: Difference surface statistics between H12896 and H12683 (8 meter surface).

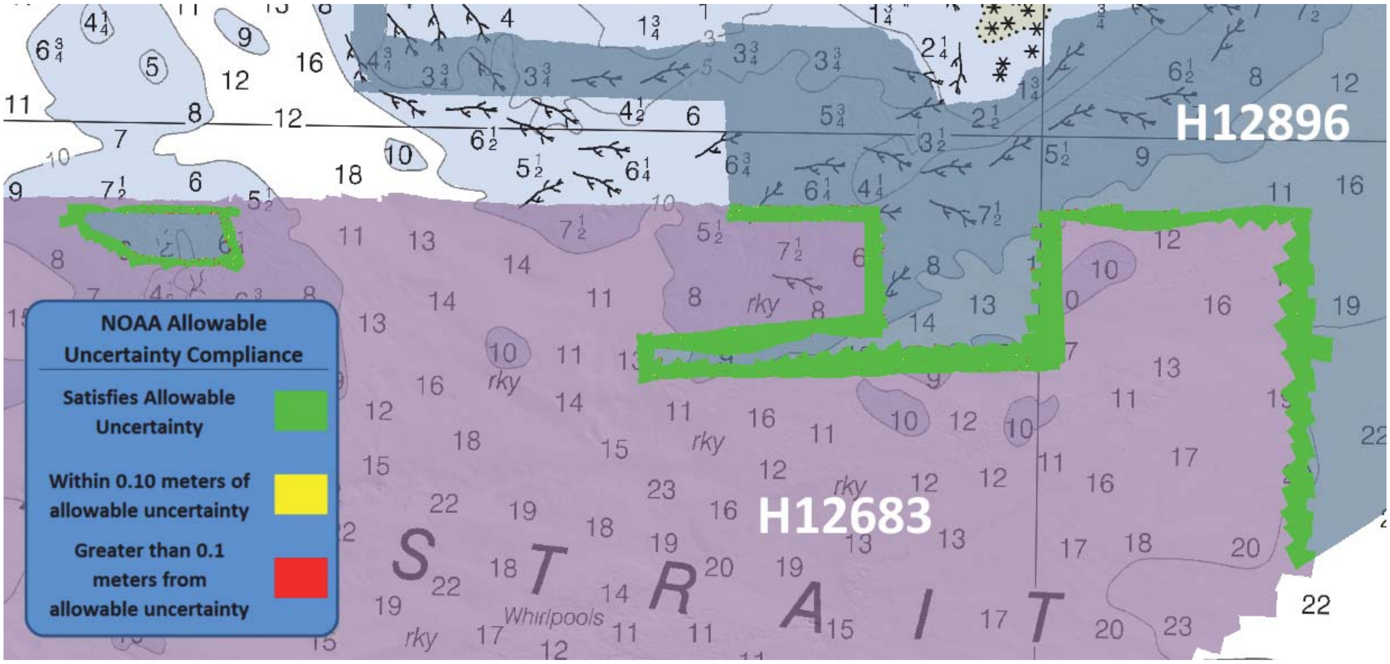


Figure 25: Difference surface compliance with regard to NOAA allowable uncertainty between H12896 (dark blue) and junctioning survey H12683 (purple).

H12896 Junction Differencing with H12683 NOAA Allowable Uncertainty		
Total Nodes	**Passed Nodes**	**Failed Nodes**
32,501	**32,315**	**186**
Percentage Nodes Passed		**99.43%**
Percentage Nodes Failed		**0.57%**

Figure 26: Difference surface statistics between H12896 and H12683 showing percentage of nodes meeting NOAA allowable uncertainty.

<u>H12897</u>

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the 8 meter combined surface from H12896 and the 8 meter combined surface from H12897. The statistical analysis of the difference surface shows a mean of 0.03 meters with 95% of all nodes having a maximum deviation of +/- 0.29 meters, as seen in Figure 28. A detailed graphical overview can be seen in Figure 27. In addition, a comparison surface was created between the difference surface and the NOAA allowable uncertainty (See Figure 29). It was found that 99.57% of nodes are within NOAA allowable uncertainty (Figure 30).

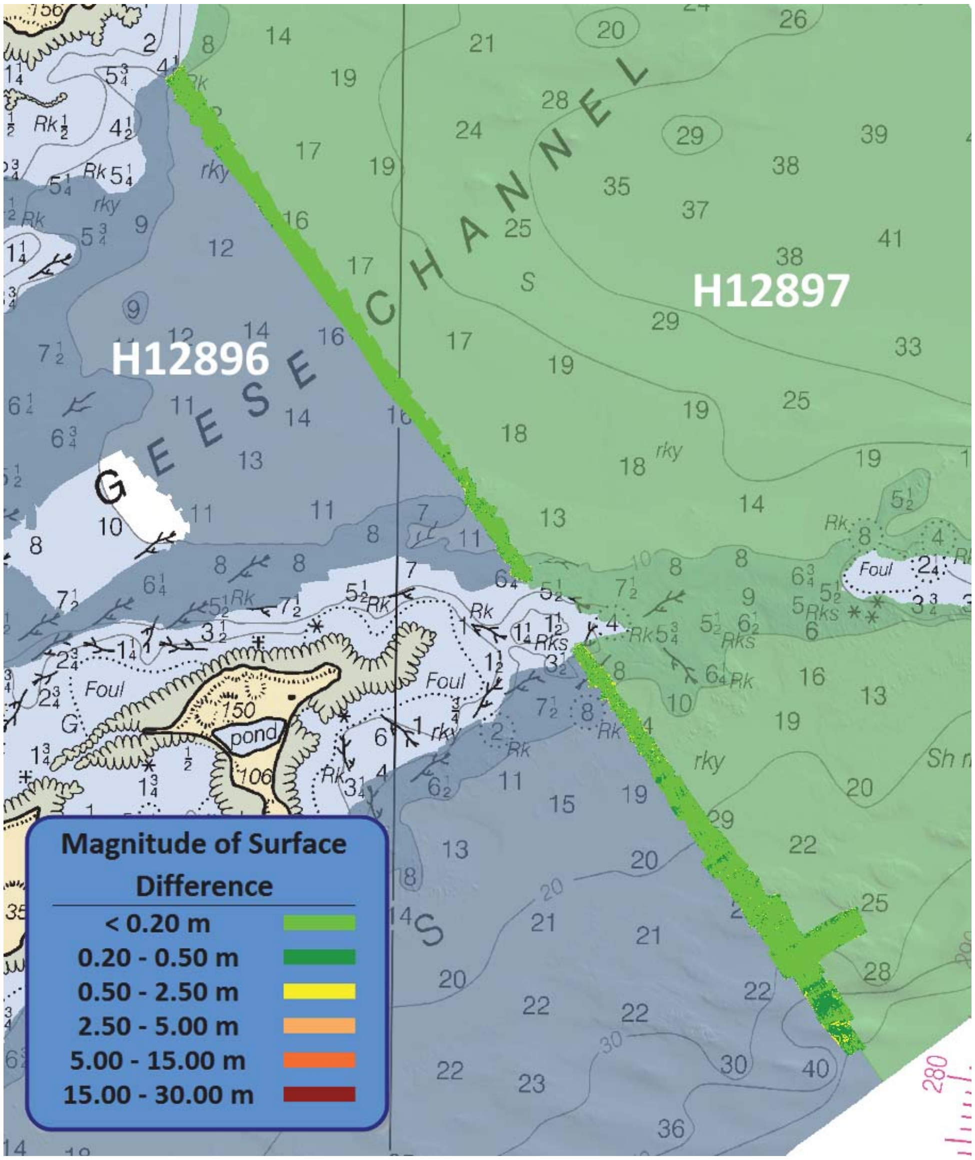


Figure 27: Difference surface between H12896 (dark blue) and junctioning survey H12896 (green).

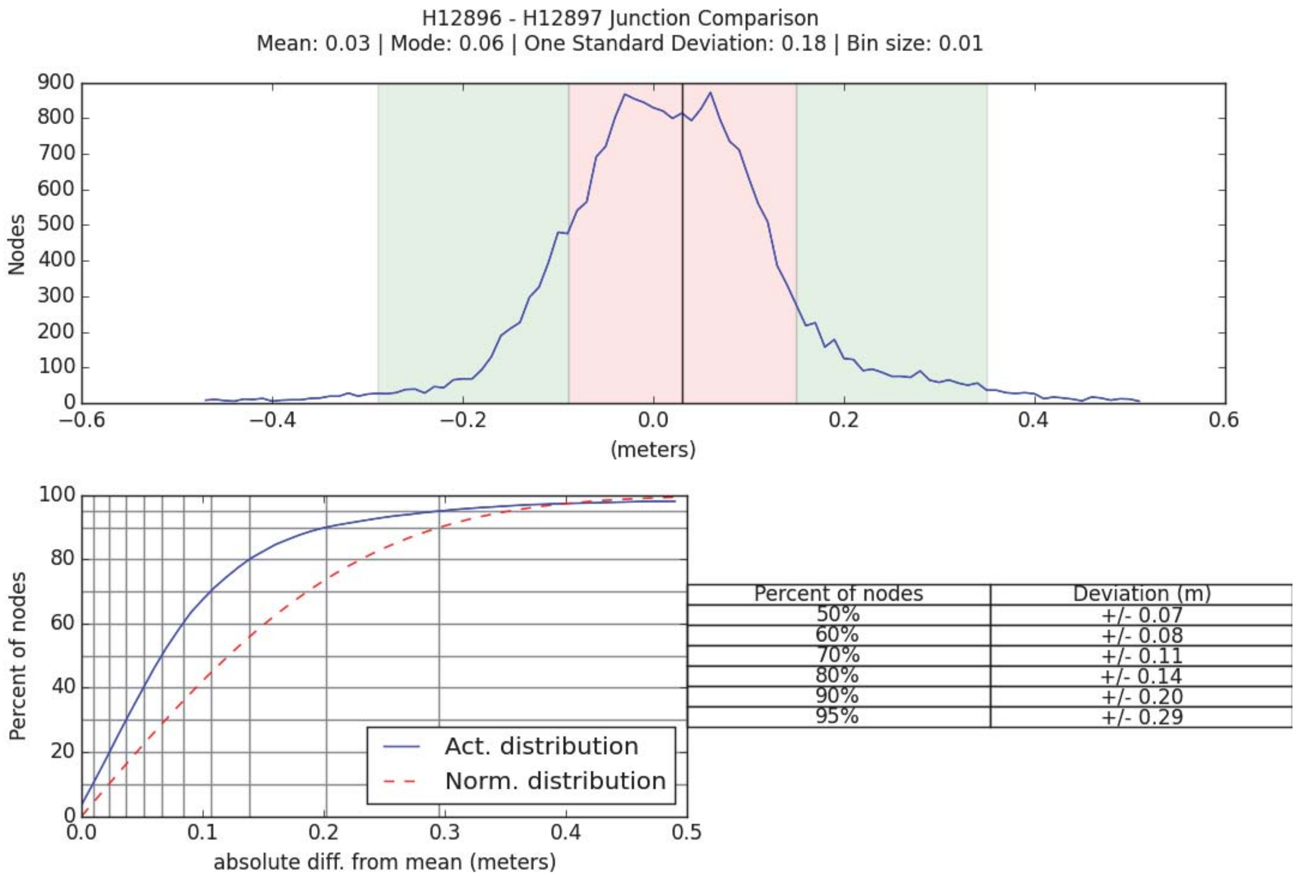


Figure 28: Difference surface statistics between H12896 and H12897 (8 meter surface).

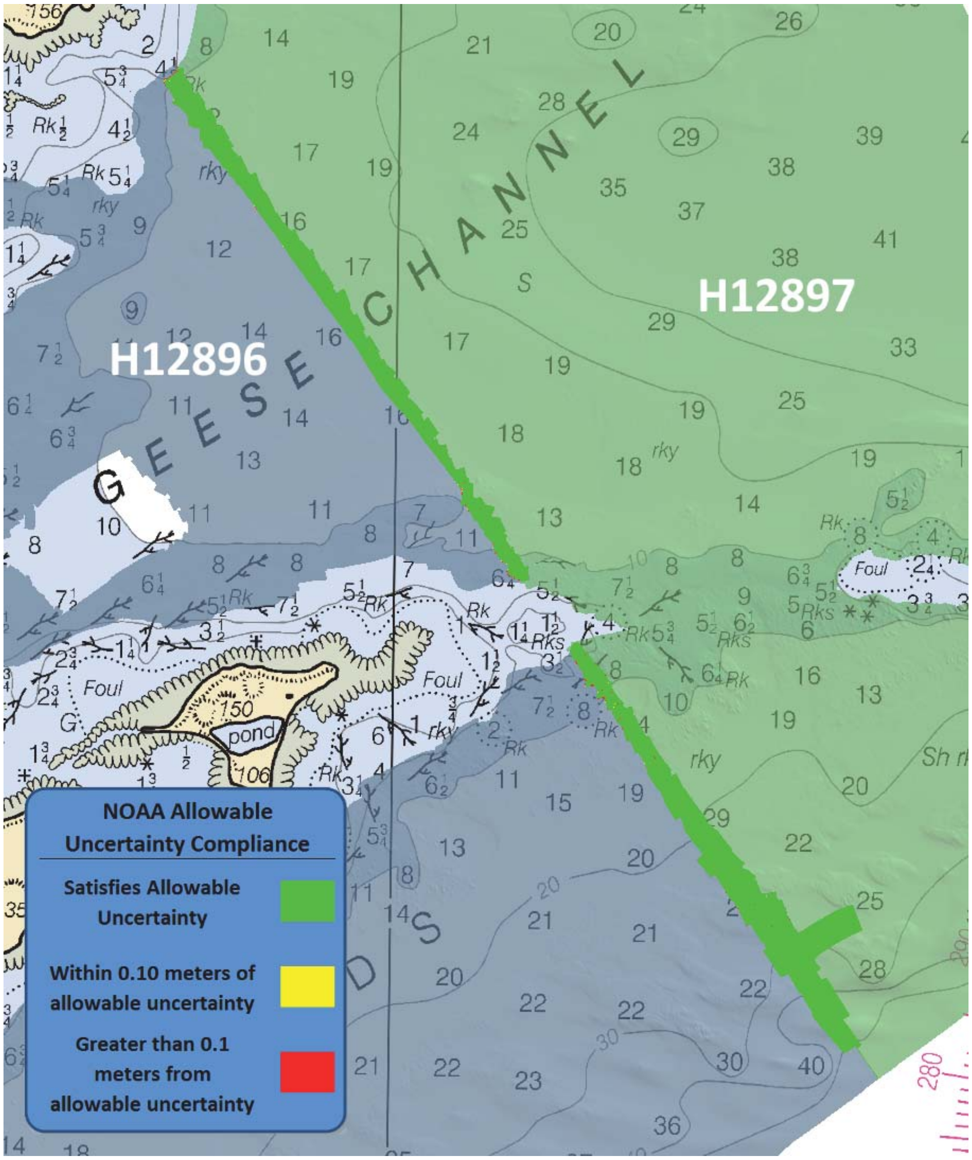


Figure 29: Difference surface compliance with regard to NOAA allowable uncertainty between H12896 (dark blue) and junctioning survey H12897 (green).

H12896 Junction Differencing with H12897 NOAA Allowable Uncertainty		
Total Nodes	Passed Nodes	Failed Nodes
22,859	22,761	98
Percentage Nodes Passed		99.57%
Percentage Nodes Failed		0.43%

Figure 30: Difference surface statistics between H12896 and H12897 showing percentage of nodes meeting NOAA allowable uncertainty.

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

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

B.2.6 Factors Affecting Soundings

Sound Speed Refraction

Incorrect calculation of refraction due to sound speed differences within areas of the survey lead to incorrect curvature in the swaths in some areas of the survey. This effect is most prominent in two regions which are highlighted in Figure 31. In these areas, there is no readily apparent reason for the discrepancies such as fresh water input, so they result from an inadequate spatial or temporal sampling of the water column. The effect of the curvature is within allowable uncertainty, as a result no soundings were rejected for this reason alone.

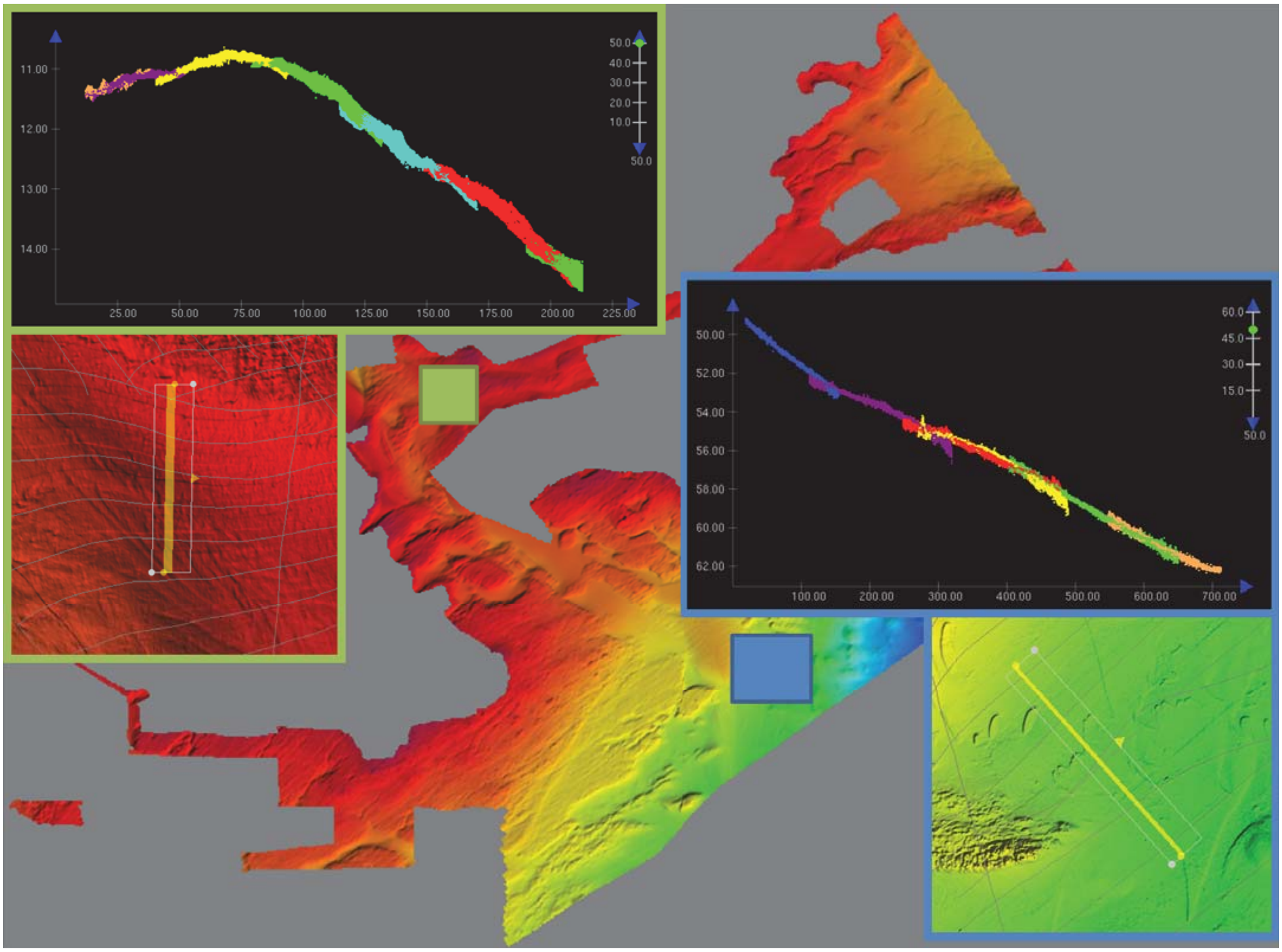


Figure 31: Locations where most noticeable effects of incorrect sound speed refraction result in curvature across swaths.

Kelp

Kelp and sea grass were present throughout the survey area and at times, indistinguishable from the seafloor or rocks (Figure 32). In areas where they were distinguishable, the soundings on the vegetation were rejected to enable more accurate representation of the true seafloor. Where vegetation was indistinguishable, soundings were rejected only when visibly separate from the seafloor. Furthermore, in some areas, patches of dense kelp prohibited safe navigation of the survey vessels. The limits of these areas were then used to define the NALL (Figure 2 in section A.1). Documentation can be found in the vessel boat sheets, which are located in the Separates I Digital Data folder.

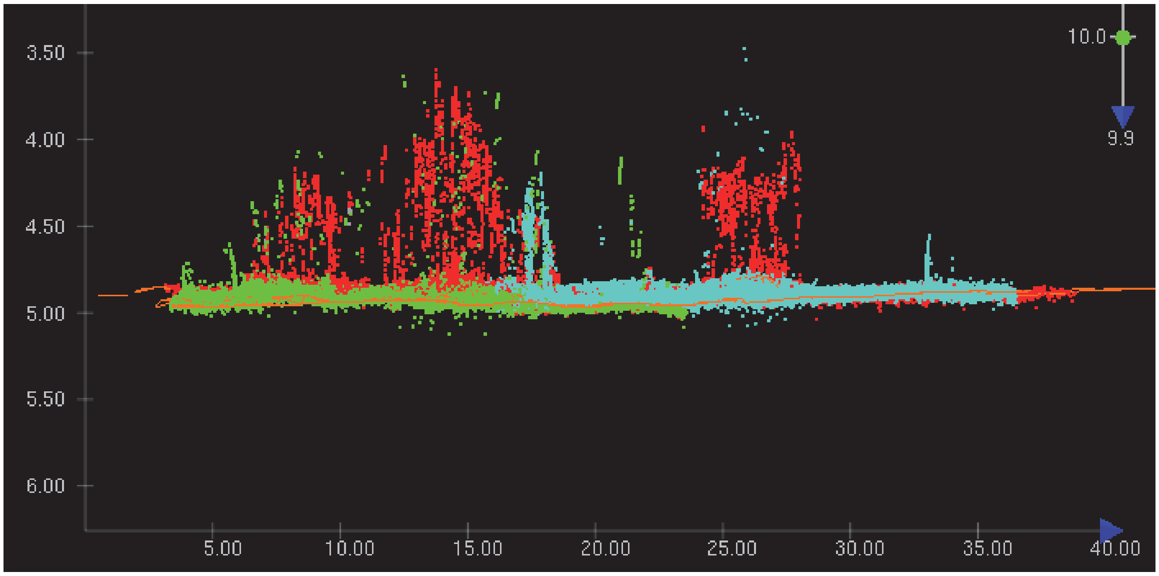


Figure 32: Location where soundings on kelp are difficult to differentiate from the seafloor and rocks.

The boat sheets are not appended to this report.

GPS Height Offsets

After application of SBET navigation solutions and referencing soundings to ellipsoidal height with PMVD reduction to MLLW, some lines were identified to exhibit offsets from the tidally referenced surface. In all cases, reprocessing and troubleshooting the SBETs did not result in proper correction of the height, so these offsets remain in the final data and surfaces. These issues are most significant in 3 locations, which are discussed separately below.

GPS Height Offset for Fairweather on DN 202

For line 0019_20160720_235114_S220_M from Fairweather on DN 202, the final 250 m of the line becomes progressively deeper than the surrounding lines. This artifact is only observed using ERS methods and does not appear using traditional tidal reduction, indicating an issue with the final portion of the SBET. Troubleshooting including reprocessing of the SBET and interpolation of suspect data was attempted, however the artifact remained. As adjacent lines overlap a significant portion of the artifact, soundings from the affected line in this area were rejected to permit the surface to better represent the seafloor, as shown in Figure 33. For the portion that was not covered with adjacent data, there is a resulting “step” in the surface of up to 0.75 m, exceeding the allowable uncertainty by approximately 0.1 m at this depth. Rather than reject this data, the Hydrographer has elected to retain it to show that no dangerous bathymetry exists in the region. Furthermore, since the artifact’s soundings are deeper when ellipsoidally referenced, these would not affect a shoal-biased sounding selection used for the creation of the chart. The area that is offset and not rejected encompasses 50-80 m of the affected line.

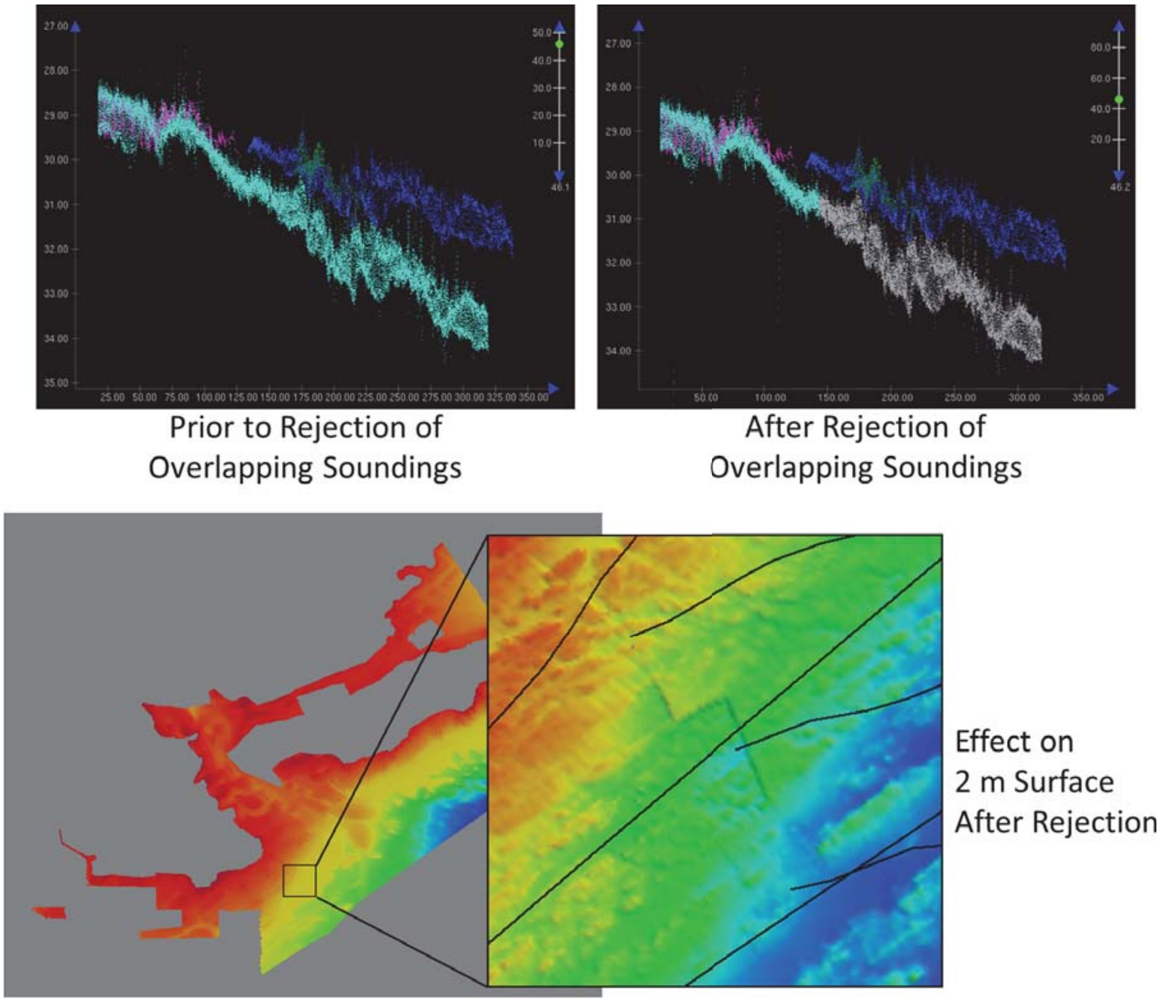


Figure 33: Locations and effects of line 0019_20160720_235114_S220_M with incorrect GPS height at the end of the line.

The data is adequate for charting despite the step artifact due to the GPS height offset.

GPS Height Offset for FA 2806 DN 211

Two lines from FA 2806 exhibit a vertical shift throughout the lines. Line 2016M_2110009 from FA 2806 on UTC DN 211, and line 2016M_2111759 in the same area and from the same boat and next local calendar day (still UTC DN 211), also exhibits a similar, but smaller shift as seen in Figure 34. Standard troubleshooting including reprocessing of the SBET was attempted, however the offset remained. The observed offset is at most about 0.25 m between soundings, pulling the surface by approximately 0.13 m and falling within allowable vertical uncertainty. Data in this area remains adequate to supersede previous data.

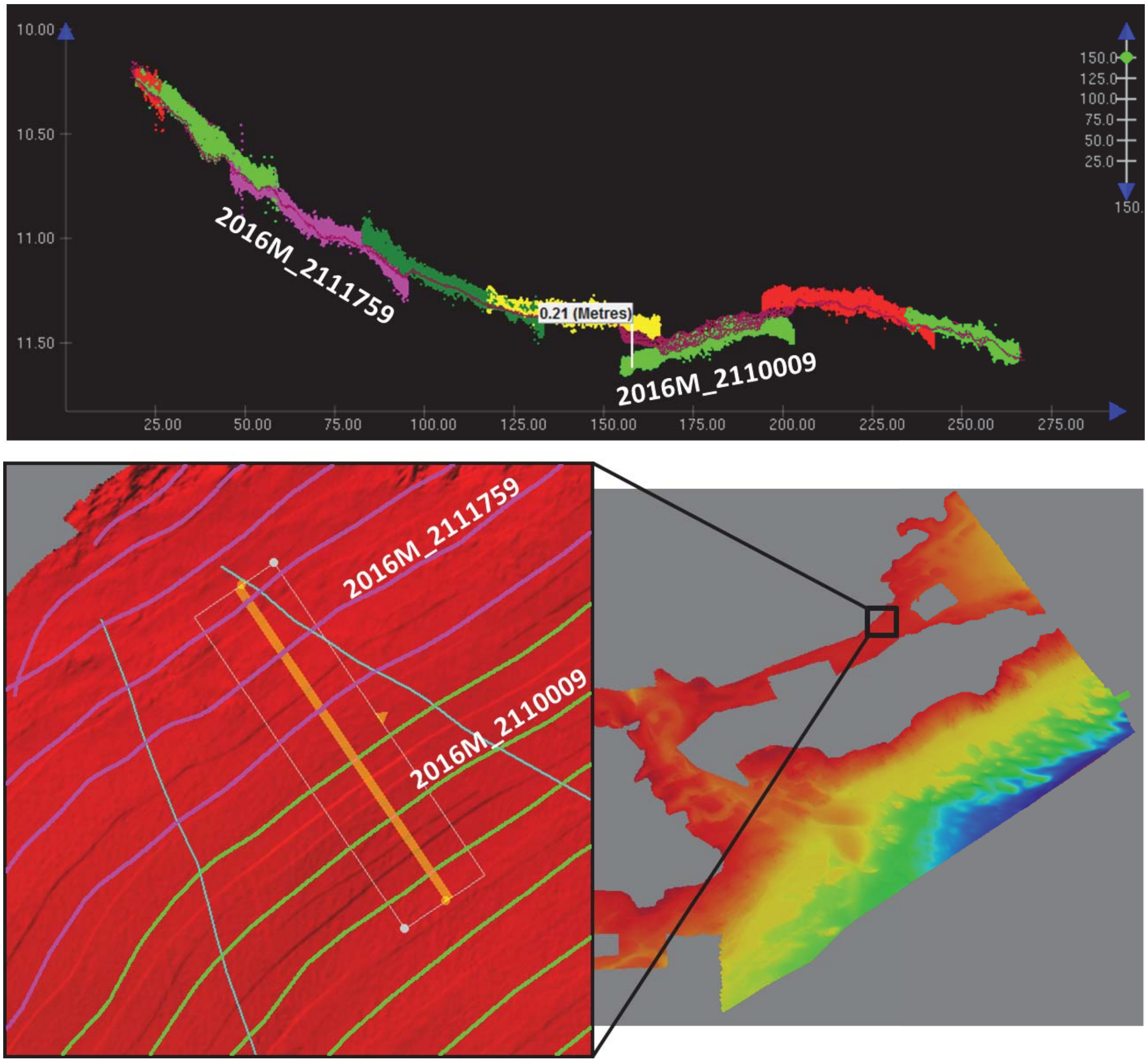


Figure 34: Offsets in lines 2016M_2110009 (green in subset plot) and 2016M_2111759 (purple in subset plot) due to ellipsoidally referenced height. Surface shown with 10x vertical exaggeration to emphasize offset.

<u>GPS Height Offset for FA 2807 DN 179</u>

All lines from FA 2807 on DN 179 exhibit an offset from adjacent data. In Figure 35, the offset is shown compared to acquisition by the same platform on a previous day as well as a crossline by a different platform. Standard troubleshooting including reprocessing of the SBET was attempted, however the offset remained. A small sound speed refraction error in this location also compounds the mismatch between lines. The total offset when referenced via the ellipse is on the order of 0.2 m, within allowable vertical uncertainty for the given depth. Data from FA 2807 on DN 179 remains adequate to supersede previous data.

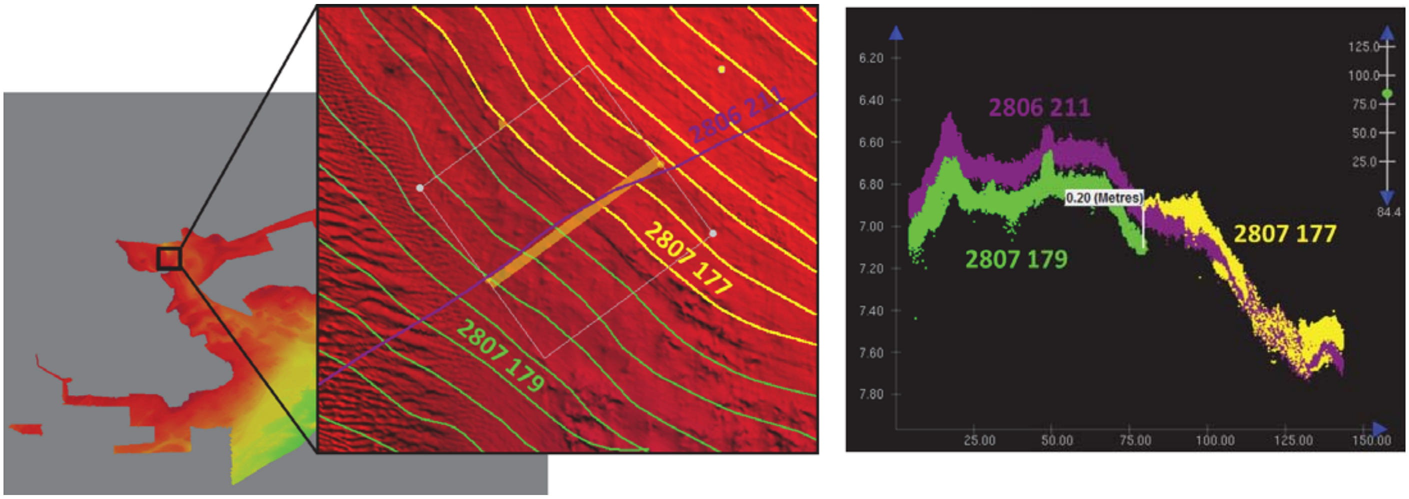


Figure 35: Offset in data from FA 2807 on 6/27/2016 (DN 179), compared to previous acquisition and crossline. Surface shown with 10x vertical exaggeration to emphasize offset.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Casts were conducted at a minimum of one every 4 hours during launch acquisition. Casts were conducted more often when there were changes in surface sound velocity greater than two meters per second. MVP casts on S220 were conducted at an average interval of 14 minutes and maximum of 42 minutes as recommended by Pydro's CastTime software, which determines optimum cast frequency based on the observed sound speed variations from previous casts. All sound speed methods were used as detailed in the DAPR.

B.2.8 Coverage Equipment and Methods

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

B.2.9 Holidays

H12896 data were reviewed in CARIS HIPS and SIPS for holidays in accordance with Section 5.2.2.3 of the HSSD. Using the depth range filtered finalized surfaces, one holiday which meets the 3 by 3 node definition was identified via Pydro QC Tools Holiday Finder tool. This tool automatically scans finalized surfaces for holidays as defined in the HSSD and was run in conjunction with a visual inspection of all surfaces by the Hydrographer. Although numerous apparent holidays were flagged by Holiday Finder, all were examined and most were determined to be from areas where an adjoining finalized surfaces covered the gap (e.g., a holiday in the 2 m finalized surface was covered by the 1 m finalized surface due to the area being shoaler than the depth range for the 2 m surface) as shown in Figure 36. Gaps in coverage are present at the inshore limits of H12896 and are a result of sparse outer beam data while launches developed the inshore limit of safe navigation (NALL). These gaps are most prevalent in the exposed, rocky areas of H12896 as kelp and nearshore topography made it too dangerous to acquire additional bathymetry, as shown in Figure 37.

Reasonable attempts were made to cover all gaps in coverage that resulted from lack of coverage over the tops of features and underwater rocks when it was safe and prudent to do so. For two instances where it was unsafe to do so the feature was added to the Final Feature File accompanying this submission. These rocks are shown in Figure 38.

A single holiday results from a survey line where the SBET was unable to cover the end of the line due to premature halting of POS data collection, which is shown in Figure 39. This occurred around UTC midnight on Saturday, when POS M/V data logging is stopped over the transition between GPS weeks. This break in acquisition is a standard practice, however, the logging of POS M/V data was stopped less than 4 minutes after the end of sonar data collection as opposed to the standard wait of at least 5 minutes. This provided insufficient data to process and create an SBET solution for the full line, causing the holiday.

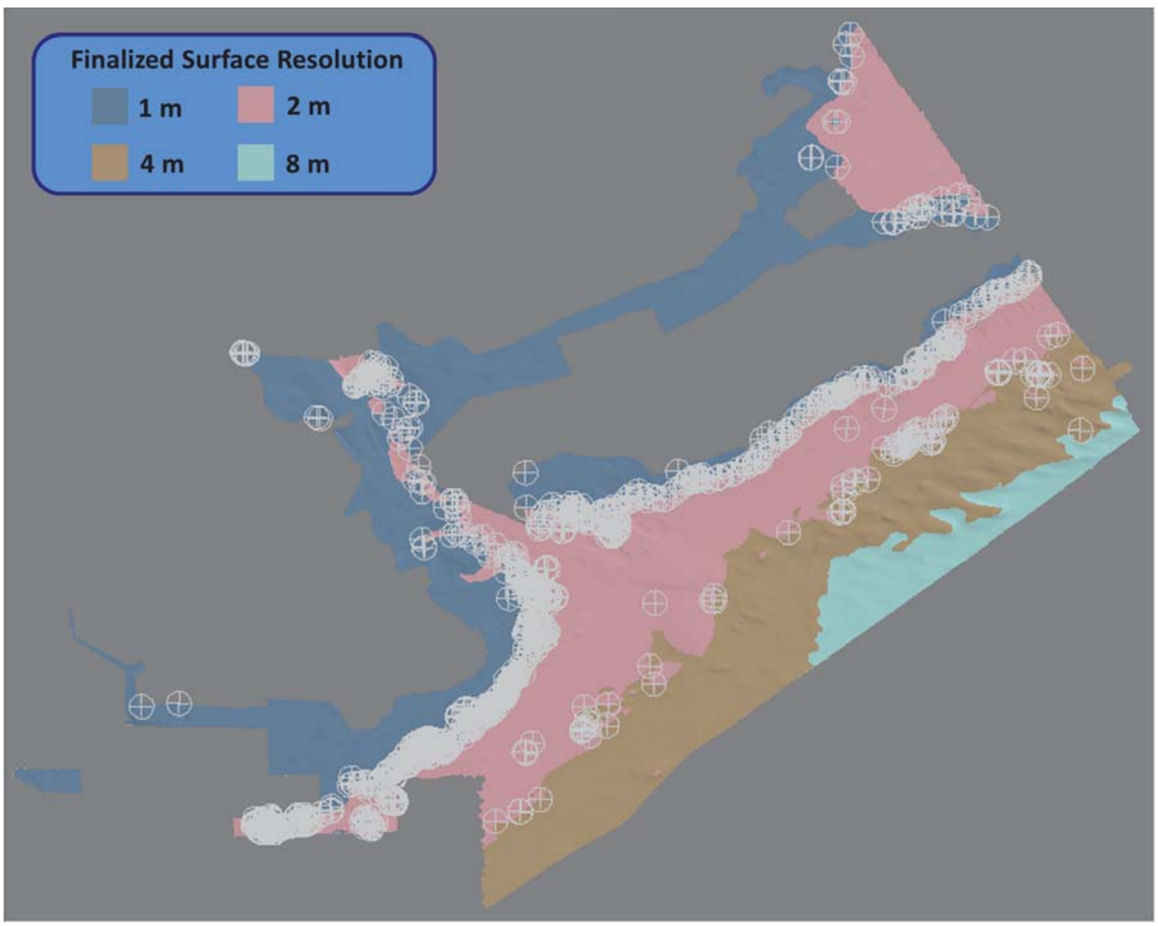


Figure 36: Holiday Finder identified locations, showing that the majority are found at borders between resolutions.

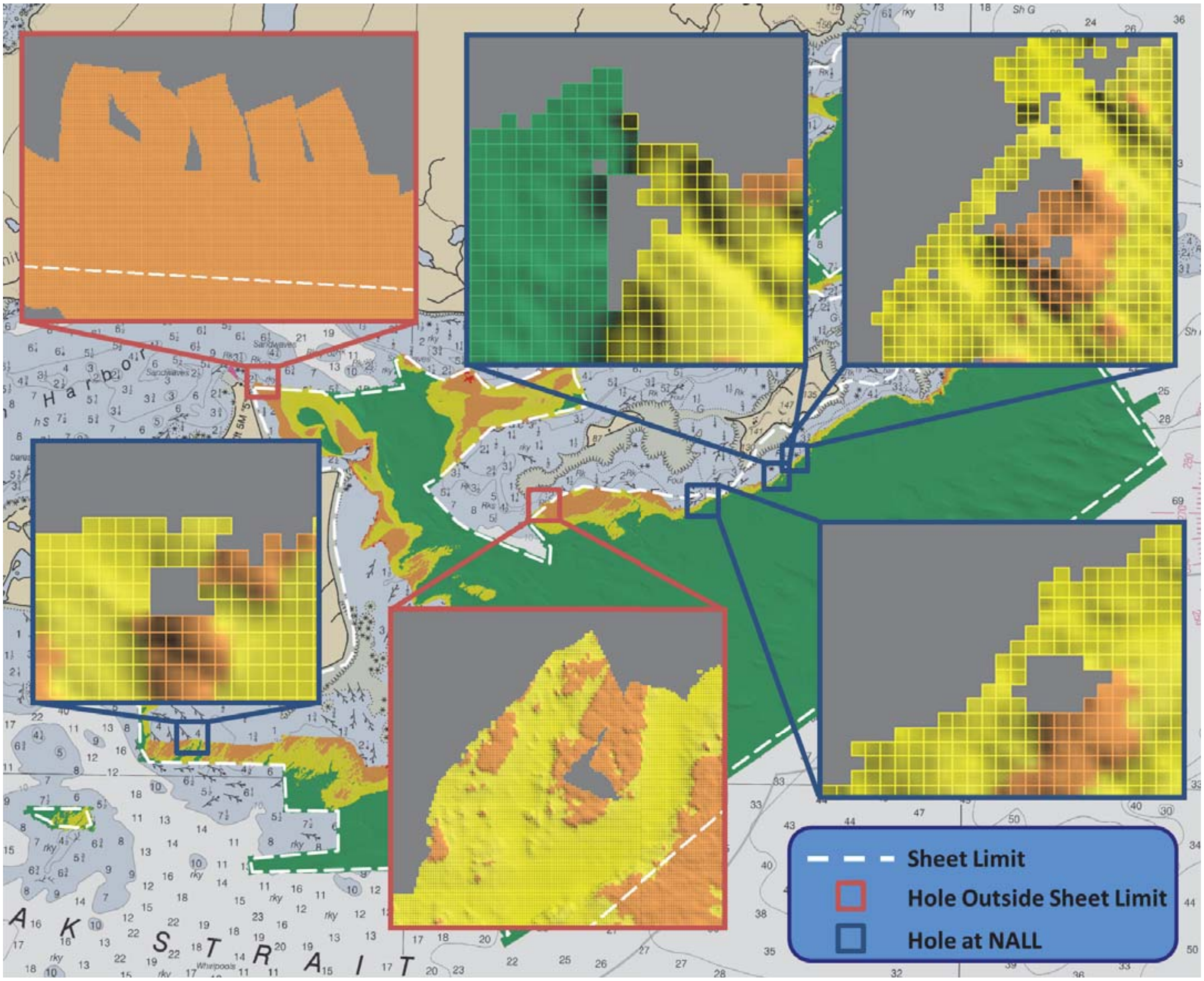


Figure 37: Locations where cessation of acquisition at the safe navigation limit or sheet limit created holes in coverage.

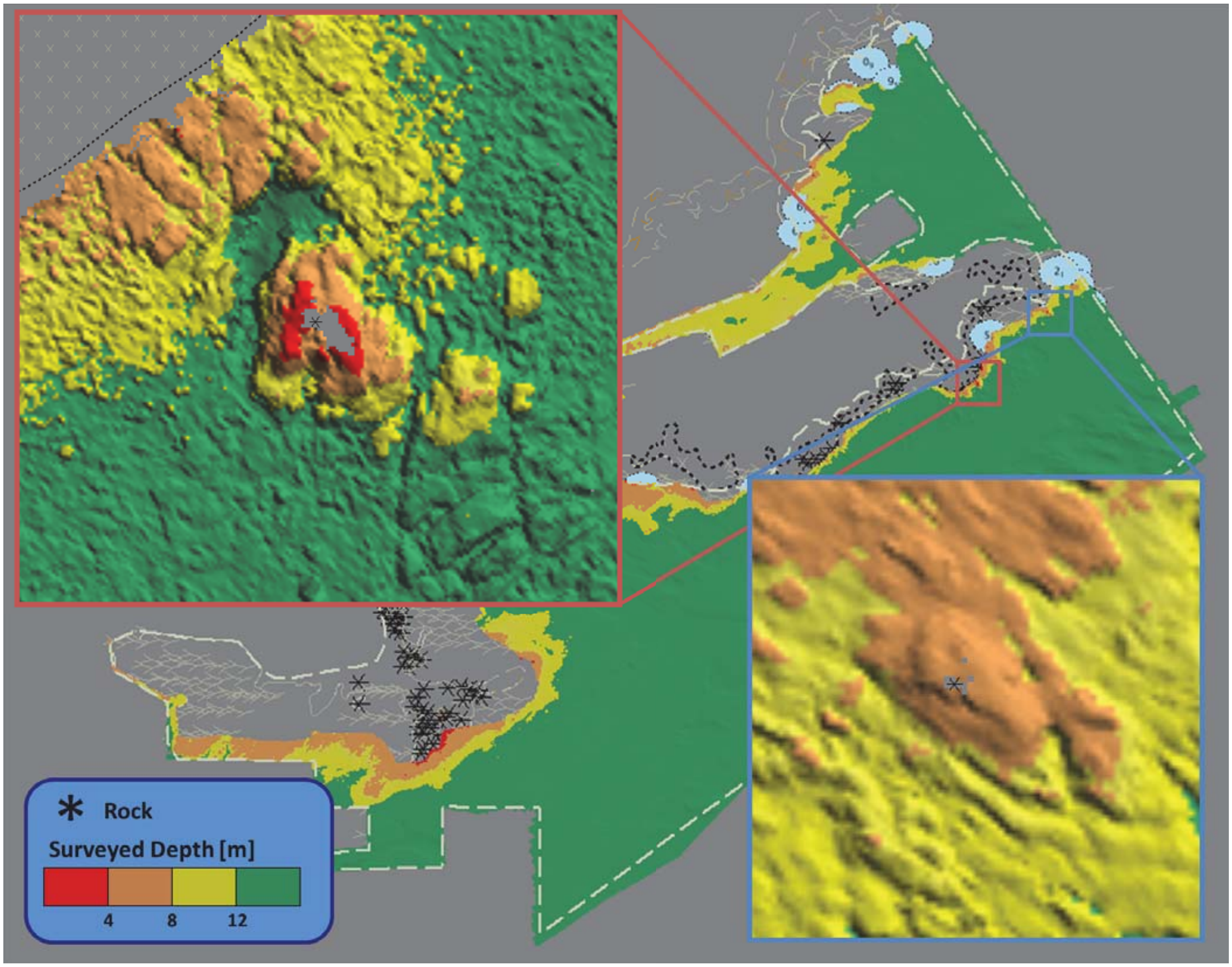


Figure 38: Location where an underwater rock prevented safe acquisition of coverage.

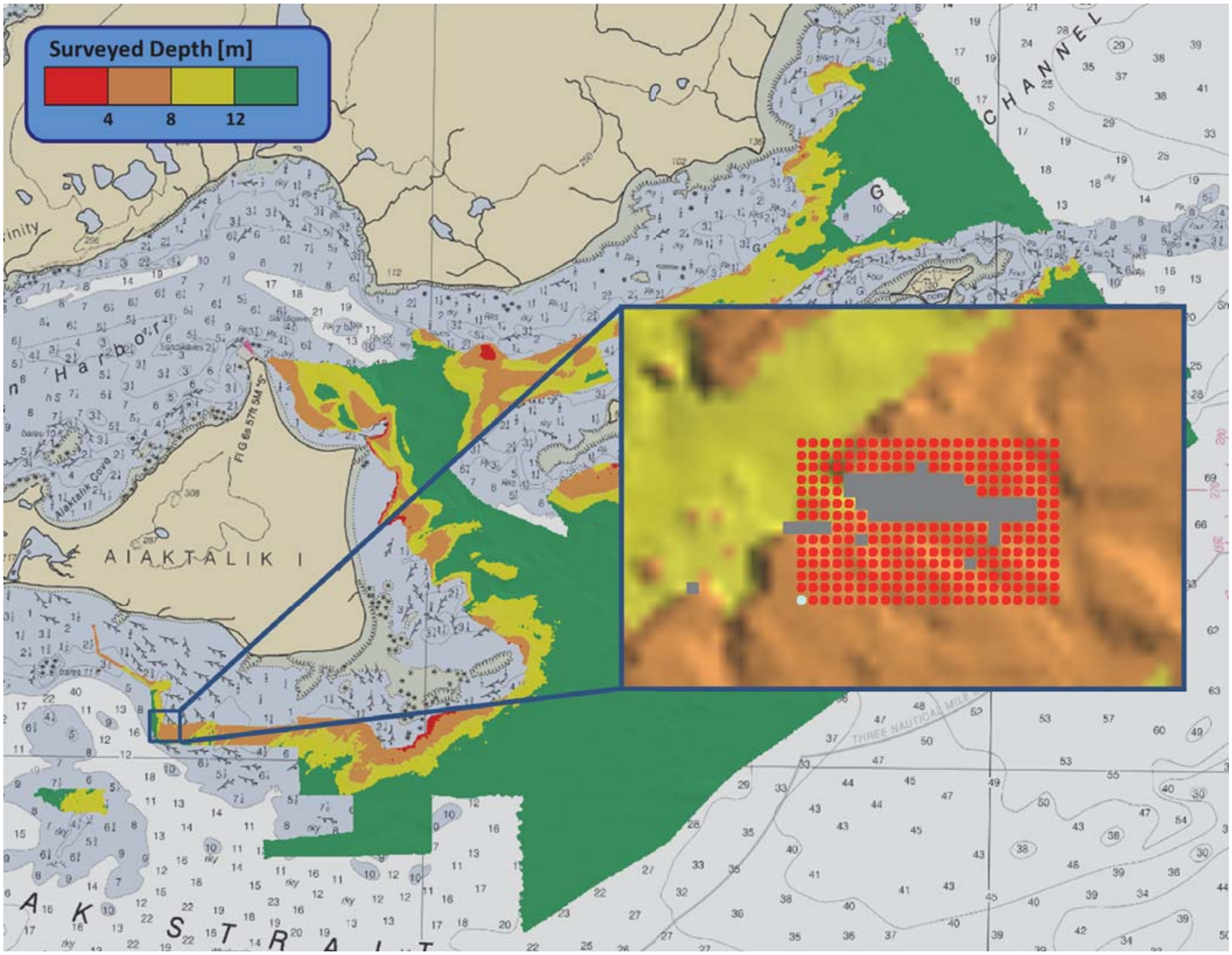


Figure 39: Location of a holiday in H12896, contained in the 1 m finalized surface.

The final feature file is not appended to this report.

B.2.10 NOAA Allowable Uncertainty

To verify that all data meets the accuracy specifications as stated in HSSD Section 5.1.3, a child layer titled “NOAA_Allowable_1” was created for each of the 1 meter, 2 meter, 4 meter, and 8 meter (72-100m) and "NOAA_Allowable_2" for the 8 meter (100-160m) finalized surfaces using the equations stated in Section C. 2.1 of the DAPR. These surfaces were then analyzed using the Pydro QC Tools Grid QA feature to determine what percentage of each surface meets specifications. Figure 40 shows an overview of the NOAA Allowable Uncertainty layers for all surfaces. Figure 41 shows the corresponding statistics for each individual surface. Overall, 99.98% of nodes with all surfaces meet or exceed NOAA Allowable Uncertainty specifications for H12896. For individual graphs per surface of density requirements, see the Standards and Compliance Review located in Appendix II.

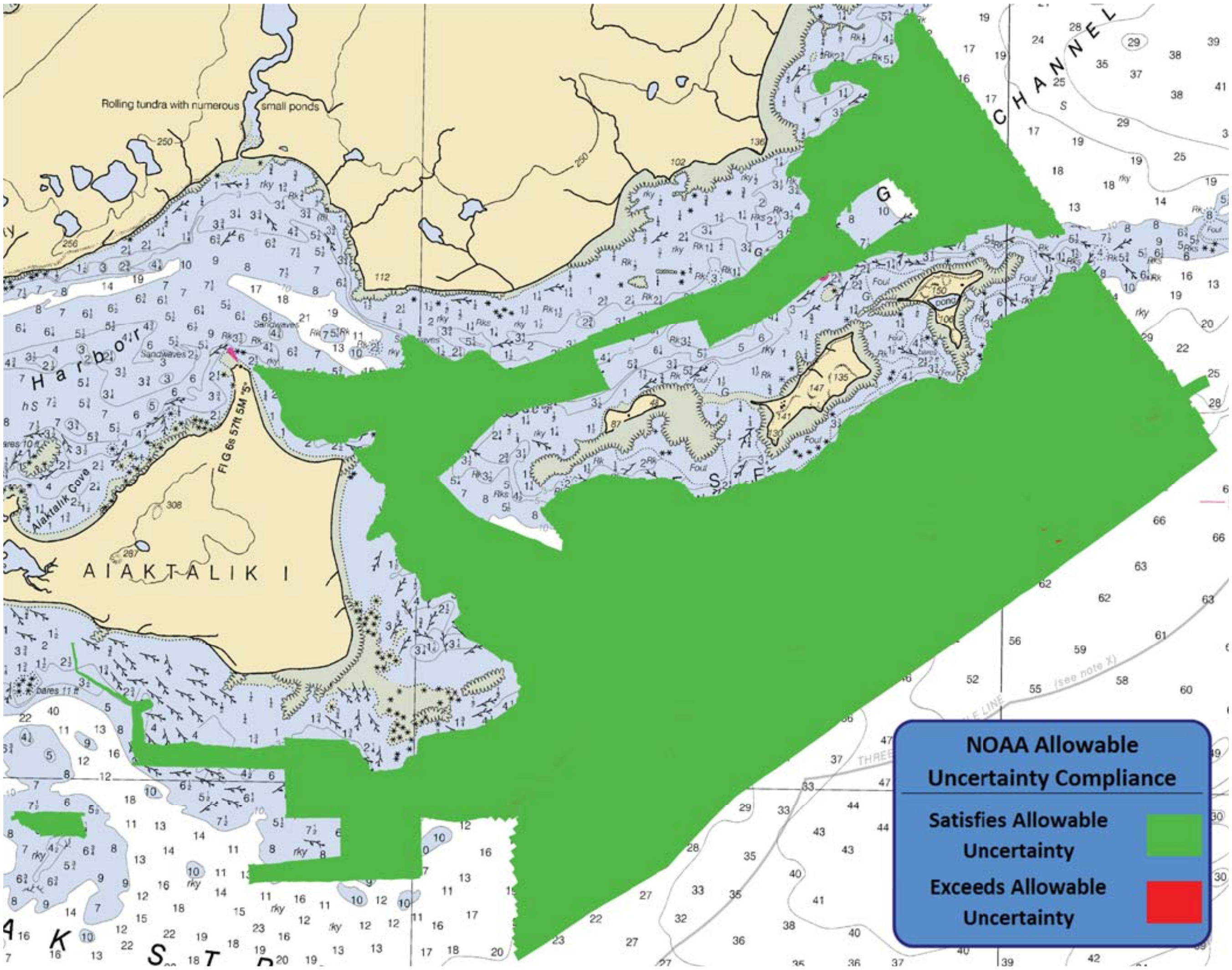


Figure 40: H12896 NOAA Allowable Uncertainty overview.

H12896 NOAA Allowable Uncertainty			
	Total Nodes	Passed Nodes	Percent Pass
1m	33,956,638	33,954,438	**99.99%**
2m	9,894,693	9,891,757	**99.97%**
4m	2,198,032	2,196,839	**99.95%**
8m	132,371	131,617	**99.43%**
	Total Nodes		46,181,734
	Total Nodes Pass		46,174,651
	Total Percent Pass		**99.98%**

Figure 41: H12896 NOAA Allowable Uncertainty statistics.

The Standards and Compliance Review is not appended to this report.

B.2.11 Density

Finalized surfaces were analyzed using the Pydro QC Tools Grid QA feature and the results are shown in Figure 43 below. Density requirements for H12896 were achieved with at least 99.94% of finalized surface nodes containing five or more soundings as required by HSSD Section 5.2.2.3. The few nodes that did not meet density requirements are due to sparse data in the outer beams, especially near steep slopes and rocky areas where acoustic shadowing occurred, and at the edges of the survey limits as shown in Figure 42. For individual graphs (per surface) of density requirements, see the Standards and Compliance Review located in Appendix II.

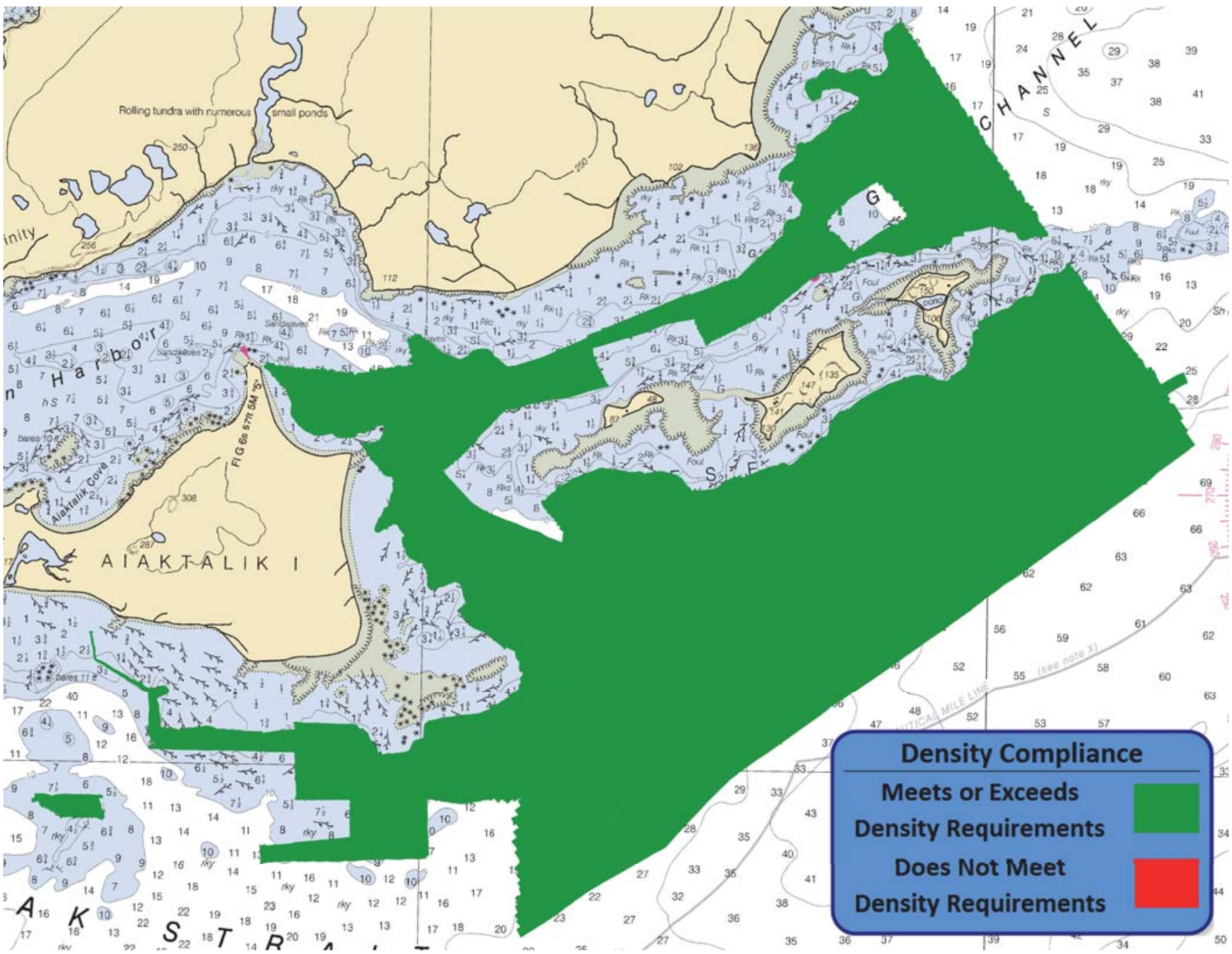


Figure 42: H12896 density overview.

H12896 Density Statistics			
	Total Nodes	Passed Nodes	Percent Pass
1m	33,956,638	33,934,562	**99.93%**
2m	9,894,693	9,890,696	**99.96%**
4m	2,198,032	2,197,665	**99.98%**
8m	132,371	132,226	**99.89%**
	Total Nodes		46,181,734
	Total Nodes Pass		46,155,149
	Total Percent Pass		**99.94%**

Figure 43: H12896 density statistics.

The Standards and Compliance Review is not appended to this report.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

All data reduction procedures conform to those detailed in the DAPR.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Raw Backscatter data were logged as .7K files for Reson 7125 data. Kongsberg EM710 stores the backscatter data in the .all file. The data have been sent to the Pacific Hydrographic Branch for processing. One line per vessel per day of acquisition was processed by the field unit for quality control, and no irregularities were observed in the processed backscatter.

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
Teledyne CARIS	HIPS and SIPS	9.1

Table 9: Primary bathymetric data processing software

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

Manufacturer	Name	Version
QPS	Fledermaus FMGT	7.5.3

Table 10: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Extended Attribute Files version 5.4.

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
H12896_MB_1m_MLLW	CUBE	1 meters	-	NOAA_1m	Complete MBES
H12896_MB_1m_MLLW_Final	CUBE	1 meters	0 meters - 20 meters	NOAA_1m	Complete MBES
H12896_MB_2m_MLLW	CUBE	2 meters	-	NOAA_2m	Complete MBES
H12896_MB_2m_MLLW_Final	CUBE	2 meters	18 meters - 40 meters	NOAA_2m	Complete MBES
H12896_MB_4m_MLLW	CUBE	4 meters	-	NOAA_4m	Complete MBES
H12896_MB_4m_MLLW_Final	CUBE	4 meters	36 meters - 80 meters	NOAA_4m	Complete MBES
H12896_MB_8m_MLLW	CUBE	8 meters	-	NOAA_8m	Complete MBES
H12896_MB_8m_MLLW_Final	CUBE	8 meters	72 meters - 160 meters	NOAA_8m	Complete MBES

Table 11: Submitted Surfaces

The NOAA CUBE parameters defined in the HSSD were used for the creation of all CUBE surfaces in Survey H12896. The surfaces have been reviewed where noisy data, or "fliers," are incorporated into the gridded solutions causing the surface to be shoaler or deeper than the true sea floor. Where these spurious soundings cause the gridded surface to be shoaler or deeper than the reliably measured seabed by greater than the maximum allowable Total Vertical Uncertainty at that depth, the noisy data have been rejected by the Hydrographer and the surface recomputed.

Flier Finder v3, part of the QC Tools package within HydrOffice, was used to assist the search for spurious soundings following gross cleaning. Flier Finder was run multiple times for each surface, reducing the flier height value for each consecutive run. This allowed Flier Finder to accurately and quickly identify gross fliers, but as the flier height was reduced the effectiveness of the tool diminished. With smaller heights, Flier Finder began to incorrectly flag dynamic aspects of the seafloor such as steep drop offs and rocky areas as fliers resulting in hundreds of false positives. At this point, the hydrographer ceased using the tool and returned to manual cleaning for these dynamic regions of seafloor.

B.5.3 Data Logs

Data acquisition and processing notes are included in the acquisition and processing logs, and additional processing such as final tide and sound velocity application are noted in the H12896 Data Log spreadsheet. All data logs are submitted digitally in the Separates I folder.

The data logs are not appended to this report.

B.5.4 Designated Soundings

H12896 contains four designated soundings in accordance with HSSD Section 5.2.1.2.3. One designated sounding represents a DTON (see Section D.1.6), and the other three were selected to accurately represent the seafloor. Figure 44 shows an overview of the survey area and the location of designated soundings.

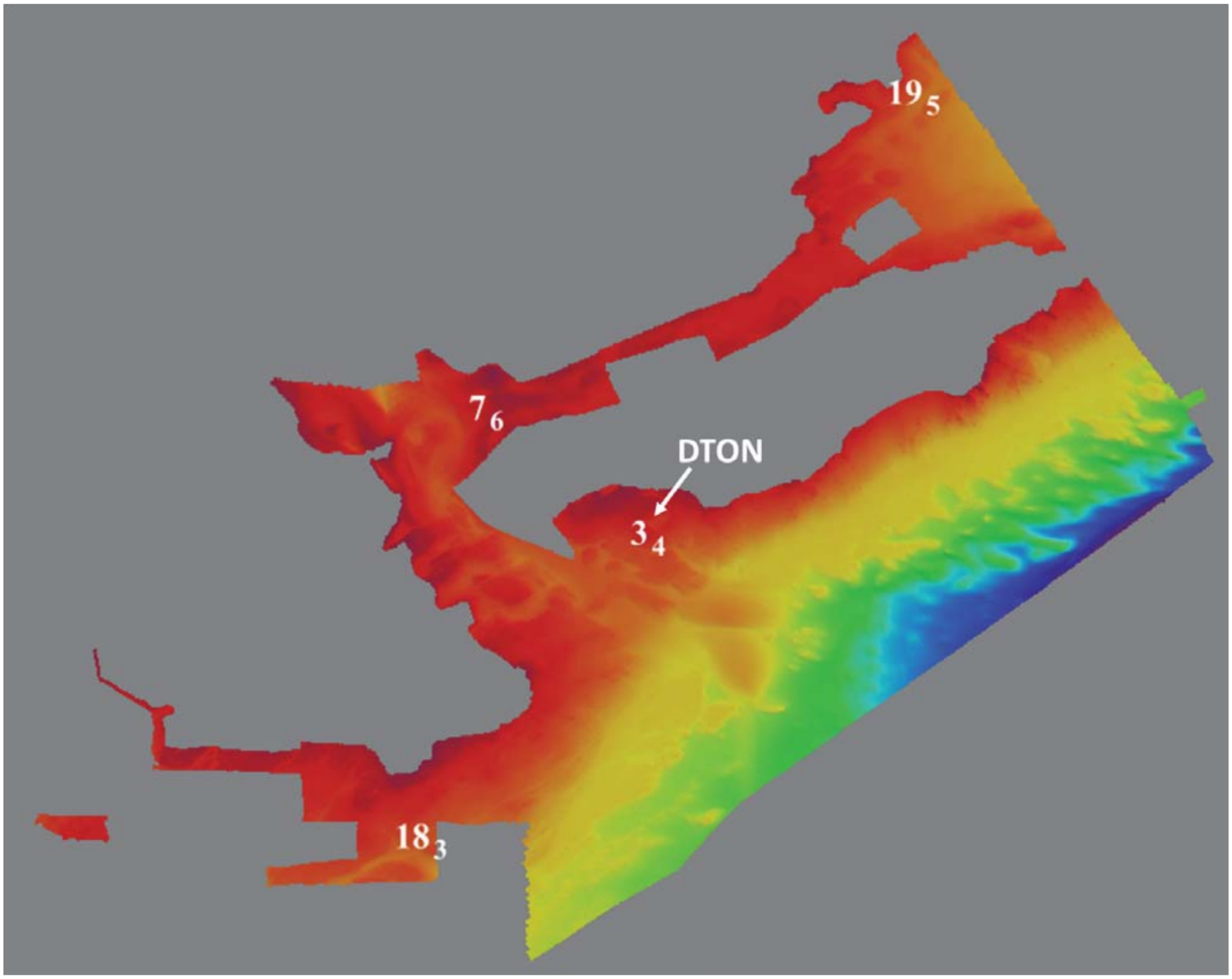


Figure 44: H12896 designated sounding locations.

See attached DTON Report.

C. Vertical and Horizontal Control

Additional information discussing the vertical or horizontal control for this survey can be found in the accompanying Horizontal and Vertical Control Report (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
Alitak	9457804
Kodiak Island	9457292

Table 12: NWLON Tide Stations

The following subordinate water level stations were established for this survey:

Station Name	Station ID
Offshore Sitkalidak Island GPS Buoy	945AAAA
Offshore Geese Islands GPS Buoy	945BBBB

Table 13: Subordinate Tide Stations

File Name	Status
9457292.tid	Verified Observed
9457804.tid	Verified Observed

Table 14: Water Level Files (.tid)

File Name	Status
P335FA2016_Verified.tc	Preliminary

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

A request for final approved tides was sent to N/OPS1 on 07/31/2016. The final tide note was received on 12/02/2016.

Initial reduction of acquired data to MLLW was accomplished via traditional tidal means using the Tidal Constituent And Residual Interpolation (TCARI) grid provided by the Hydrographic Surveys Division Operations Branch (HSD-OPS). Following the successful application of SBETs and computation of an Ellipsoidally Referenced Zone Tide (ERZT) separation model, ERS methods were used for reducing data to MLLW.

As ERS methods were successful for the reduction to MLLW, final tides were not necessary for H12896. As processing was completed prior to receiving final tides, a waiver was obtained from HSD-OPS for the submission of H12896 without final tides applied. This correspondence has been included in Appendix II, accompanying this submission.

See attached correspondence regarding the final tides application waiver. See attached Tide Note dated December 2, 2016.

ERS Methods Used:

ERS via Poor Mans VDATUM

Ellipsoid to Chart Datum Separation File:

P335FA2016_PMVD_UTM-NAD83-5N_WGS84-MLLW_Composite

ERS methods were used as the final means of reducing H12896 to MLLW for submission. Data were initially reduced via traditional tidal means until an ERZT separation model could be calculated. This empirically derived model was then checked for consistency and compared to the Poor Man's VDatum (PMVD) separation model provided with the Project Instructions. The PMVD separation model was then vertically shifted such that the average difference between these two separation models is zero. This vertical shift de-biases the PMVD separation model, correcting for local offsets that cannot be effectively modeled by the PMVD. In areas where the PMVD model did not have sufficient coverage such as near shore areas, the ERZT separation model was appended to the PMVD model creating the composite ERZT/PMVD separation model listed above and used to reduce H12896 to MLLW. For further information see the ERS Capability Memo, submitted under separate cover.

See attached ERS Capability Approval Memo dated October 20, 2016.

C.2 Horizontal Control

The horizontal datum for this project is World Geodetic System 1984 (WGS84).

The projection used for this project is UTM Zone 5 North.

The following PPK methods were used for horizontal control:

Single Base

Vessel kinematic data were post-processed using Applanix POSPac processing software and Single Base Positioning methods described in the DAPR. Smoothed Best Estimate of Trajectory (SBET) and associated error (RMS) data were applied to all MBES data in CARIS HIPS and SIPS. The WGS84 horizontal datum was used for the entirety of H12896, based on the most recent guidance at the start of the survey.

Hydrographic Technical Directive (HTD) 2016-3, which revises the horizontal datum requirement to NAD83, was released after acquisition had commenced for OPR-P335-FA-16. The field unit conferred with HSD-OPS and determined no waiver was required to maintain WGS84 as the datum for submission. This correspondence has been included in Appendix II.

For further details regarding the processing and quality control checks performed, see the H12896 POSPac Processing Logs spreadsheet located in the Separates folder. See also the OPR-P335-FA-16 Horizontal and Vertical Control Report (HVCR), submitted under separate cover.

The following CORS Stations were used for horizontal control:

HVCR Site ID	Base Station ID
AC45	Sitkinak Island

Table 16: CORS Base Stations

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
9677	PZ 2014

Table 17: User Installed Base Stations

See attached correspondence regarding Hydrographic Technical Directive (HTD) 2016-3.

Differential correctors from the US Coast Guard beacon at Kodiak, AK (313 kHz) were used in real time for acquisition when not otherwise noted in the acquisition logs, and were the sole method of positioning for bottom samples.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Kodiak, AK (313 kHz)

Table 18: USCG DGPS Stations

D. Results and Recommendations

D.1 Chart Comparison

A comparison was performed between survey H12896 and Chart 16590 as well as ENC US4AK5LM using CARIS HIPS and SIPS sounding and contour layers derived from the 8 meter combined surface. The contours and soundings were overlaid on the charts to assess differences between the surveyed soundings and charted depths. ENCs were compared to a 8 meter combined grid by extracting all soundings from the chart and creating an interpolated TIN surface which could be differenced with the combined surface from H12896.

All data from H12896 should supersede charted data. In general, surveyed soundings agree with the majority of charted depths. A full discussion of the disagreements follows below.

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
16590	1:81529	12	09/2014	09/13/2016	09/10/2016

Table 19: Largest Scale Raster Charts

16590

The charted soundings and contours of Chart 16590 are identical to those found on ENC US4AK5LM. As such, all discussions regarding comparisons between surveyed soundings and charted depths are covered under the ENC US4AK5LM discussion below.

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?
US4AK5LM	1:81529	9	10/27/2015	10/27/2015	NO

Table 20: Largest Scale ENCs

US4AK5LM

Soundings from H12896 are in general agreement with charted depths on ENC US4AK5LM, with most depths agreeing within 2 fathoms as shown in Figure 46. The largest differences are seen in the deeper southeast portion where differences range to 17.5 fathoms.

To more accurately visualize trends within these differences, an 8 meter TIN surface was interpolated from the ENC sounding layer. This surface was then differenced with a corresponding 8 meter combined surface from H12896 and visualized in Figure 45. In this difference surface red colors indicate H12896 was shoaler than the ENC US4AK5LM, green colors indicate agreement, and blue colors indicate H12896 was deeper than ENC US4AK5LM. Statistical analysis of the difference surface shows a mean of 3.30 m, with the survey deeper and 95% of all nodes having a maximum deviation of +/- 5.69 meters, as shown in Figure 46. The area of largest variation is the southeast portion of the survey, where the sounding spacing of the prior surveys was insufficient to capture depth variations. In this area, soundings are deeper than 20 fathoms and therefore not navigationally significant. An area where H12896 is shown to be shoaler that the charted soundings in the channel between Aiaktalik Island and the Geese Islands is an artifact of the TIN creation process and general agreement is shown on the sounding comparison in Figure 51.

Agreement in the immediate vicinity of sounding locations on the ENC was analyzed through creating a 10 meter buffer around each sounding and comparing to the average depth from the H12896 8 meter combined surface within that circle. From the 290 charted soundings which fall within the survey outline of H12896, the mean difference is 2.41 m and most common difference is around 1.29 m as shown in Figure 48. A geographic plot is shown in Figure 47. The mean difference corresponds closely to the 2.40 m mode of the TIN comparison difference surface, as expected. The cause of this mean shift is unknown.

Contours from H12896 are in general agreement with charted contours on ENC US4AK5LM as shown in Figure 49. The largest differences are seen in the 20 fathom contour in the southern portion of the survey where surveyed and charted contours differ by up to 1 kilometer as seen in Figure 50. The surveyed contours are inshore of those on the charts, and therefore this difference does not present a danger to navigation.

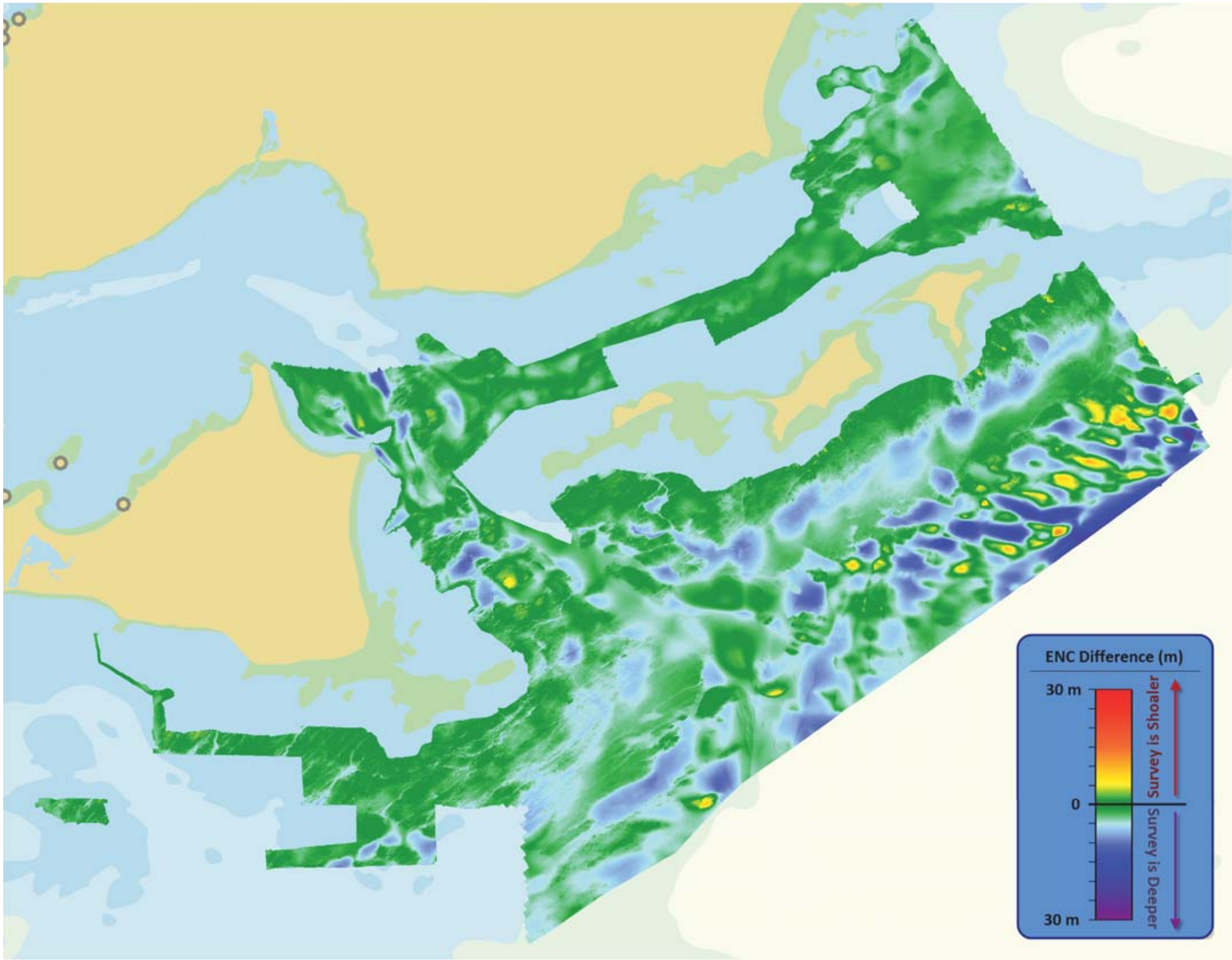
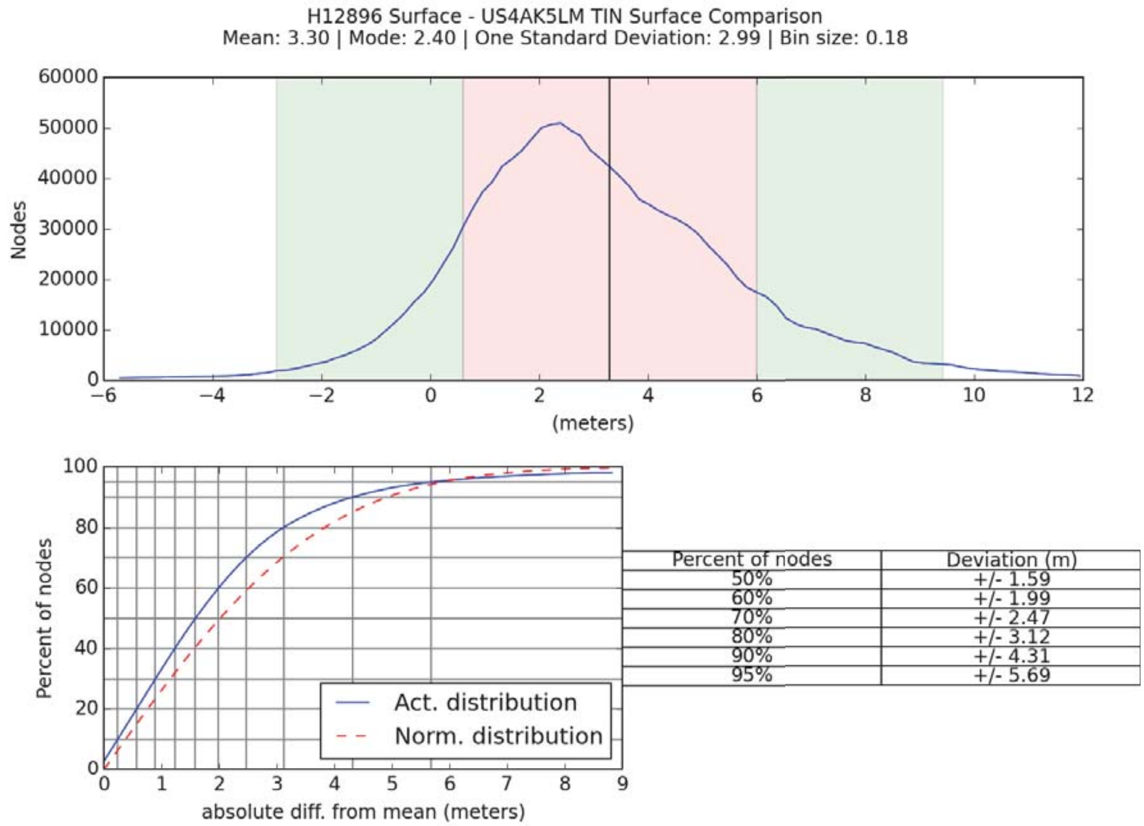


Figure 45: Difference surface between H12896 and interpolated natural neighbor interpolated TIN surface from soundings and contours of US4AK5LM.



Percent of nodes	Deviation (m)
50%	+/- 1.59
60%	+/- 1.99
70%	+/- 2.47
80%	+/- 3.12
90%	+/- 4.31
95%	+/- 5.69

Figure 46: Difference surface statistics between H12896 and interpolated TIN surface from US4AK5LM.

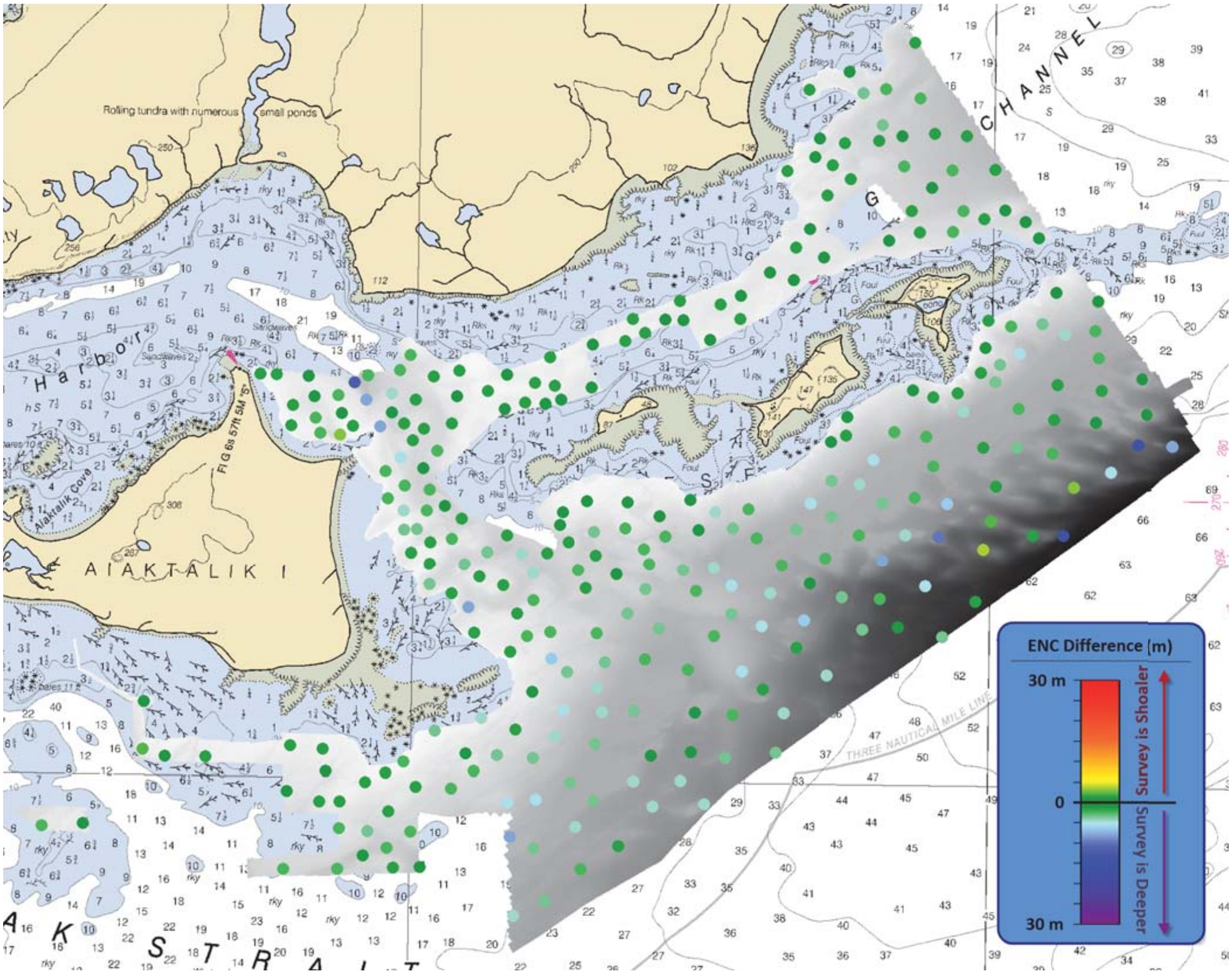
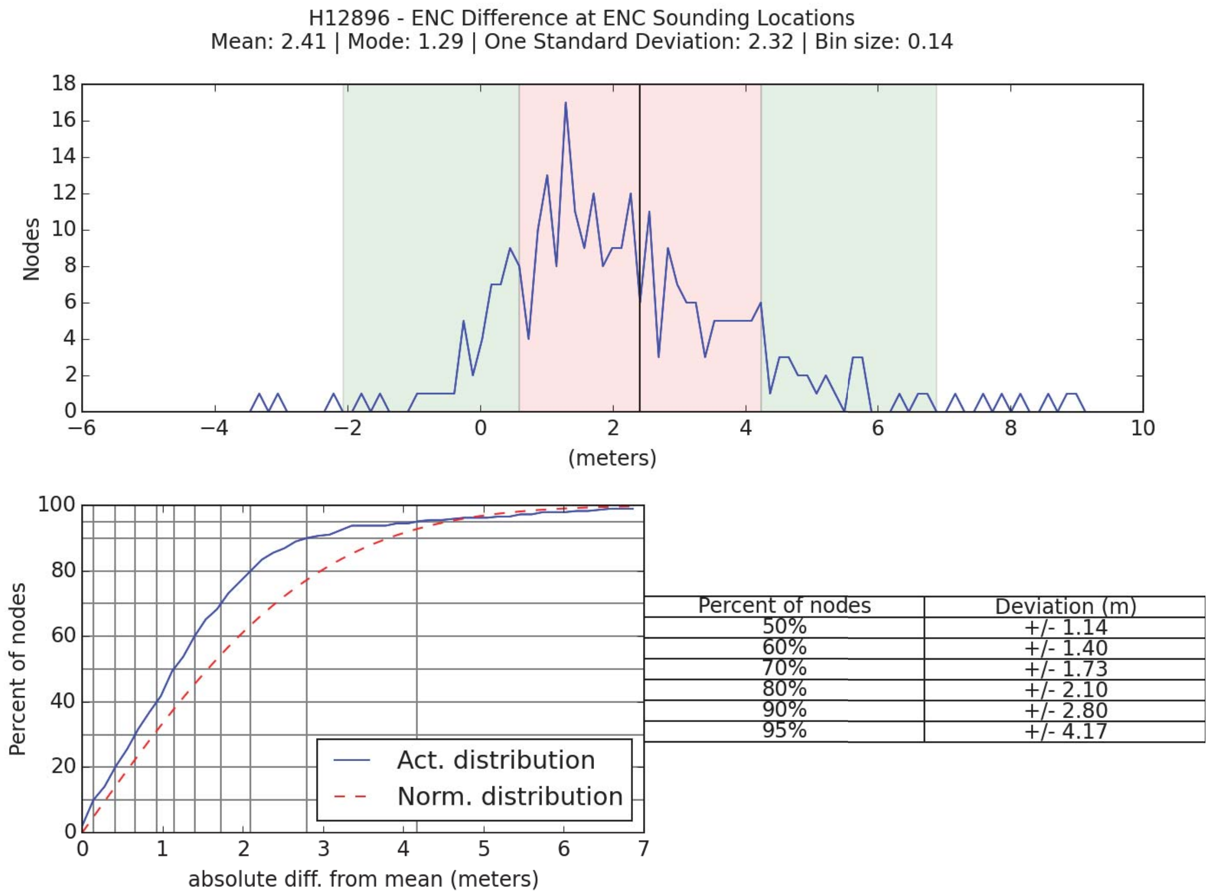


Figure 47: Comparison between ENC US4AK5LM soundings and average H12896 depths within a 10 m radius surrounding each ENC sounding.



Percent of nodes	Deviation (m)
50%	+/- 1.14
60%	+/- 1.40
70%	+/- 1.73
80%	+/- 2.10
90%	+/- 2.80
95%	+/- 4.17

Figure 48: Difference statistics between H12896 and soundings of US4AK5LM, using the average surveyed depth within a 10 m radius around each sounding.

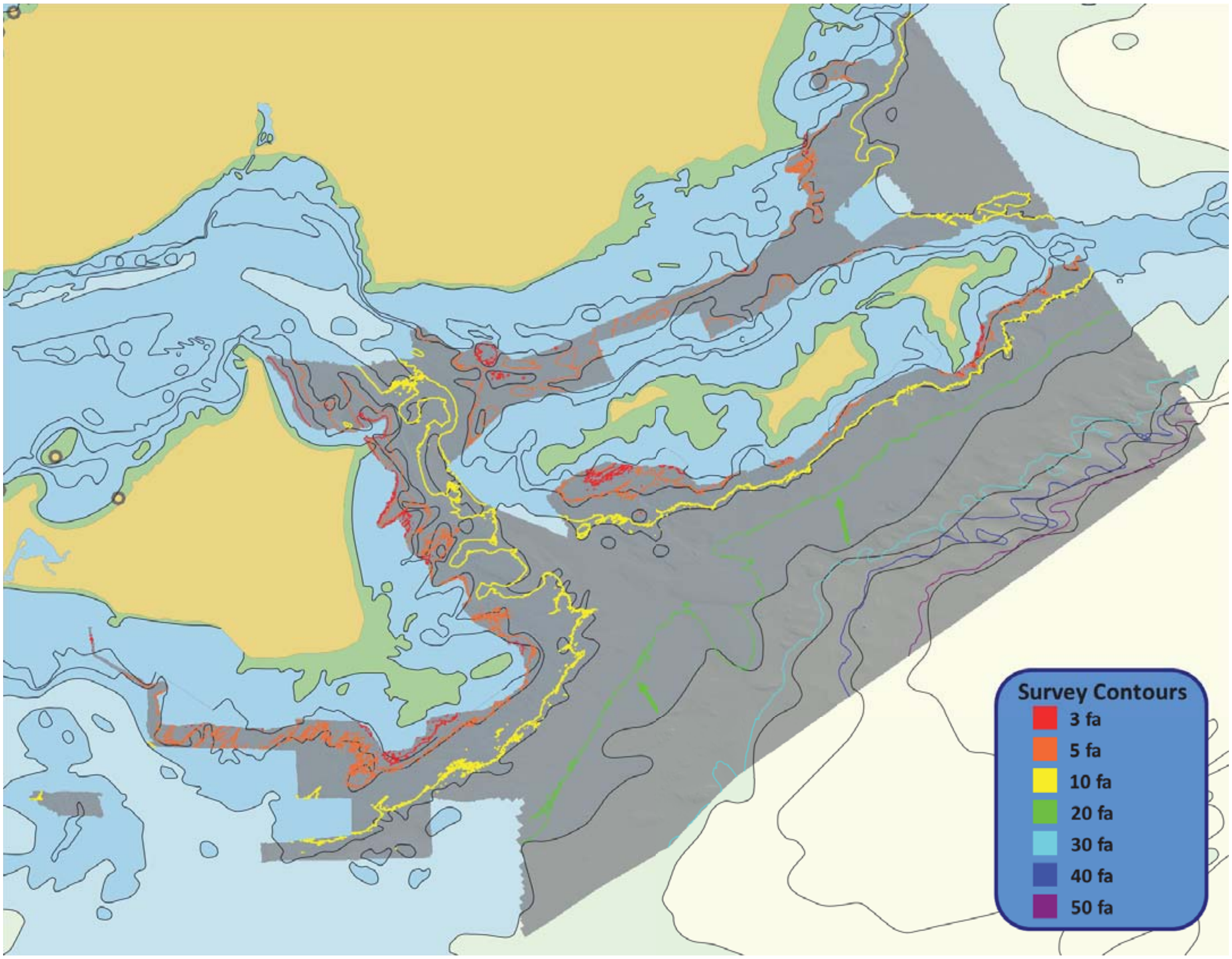


Figure 49: Overview of H12896 contours overlaid onto ENC US4AK5LM, with ENC contours shown in black.

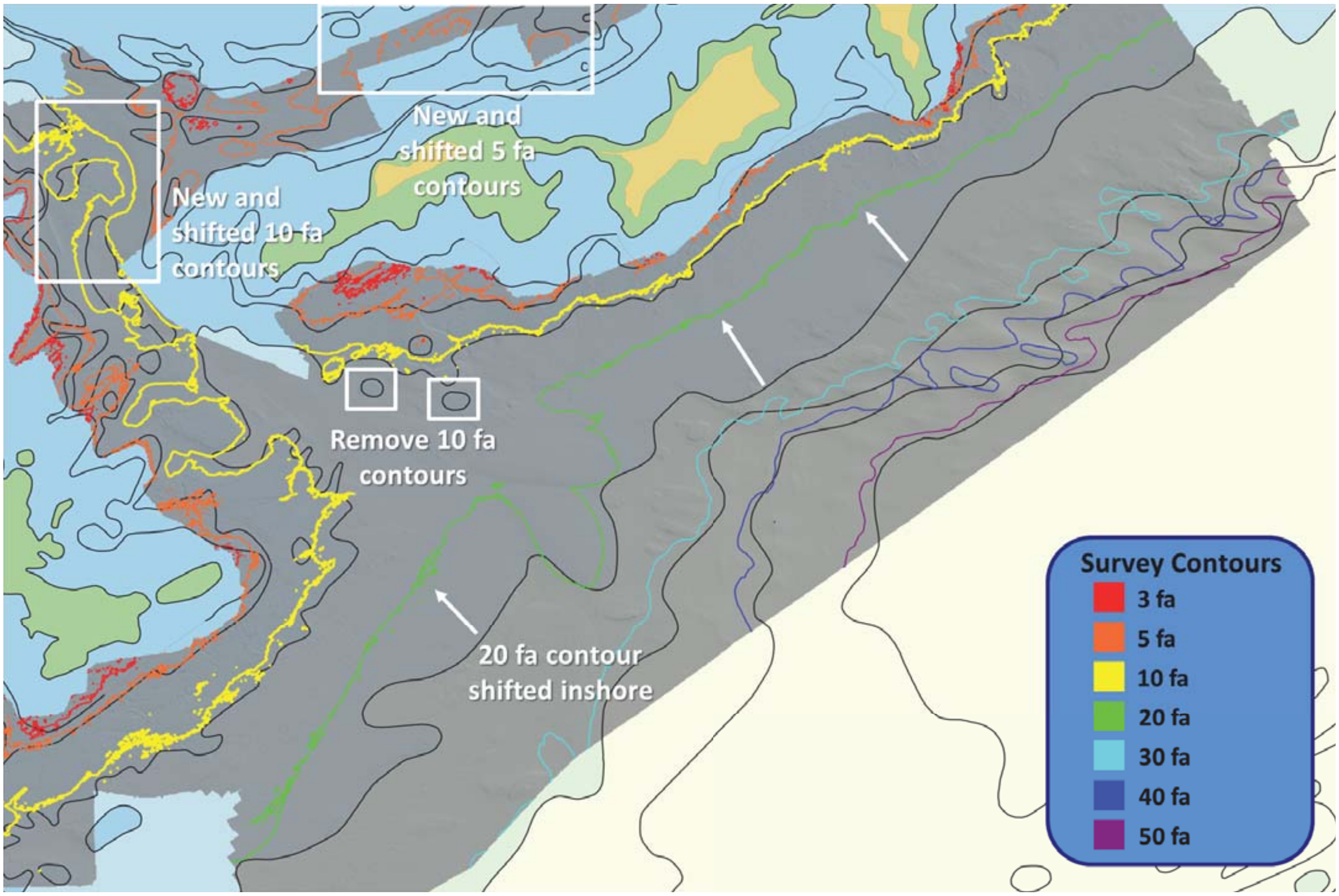


Figure 50: Close up of portions of the survey where significant differences exist between H12896 contours and ENC US4AK5LM contours.

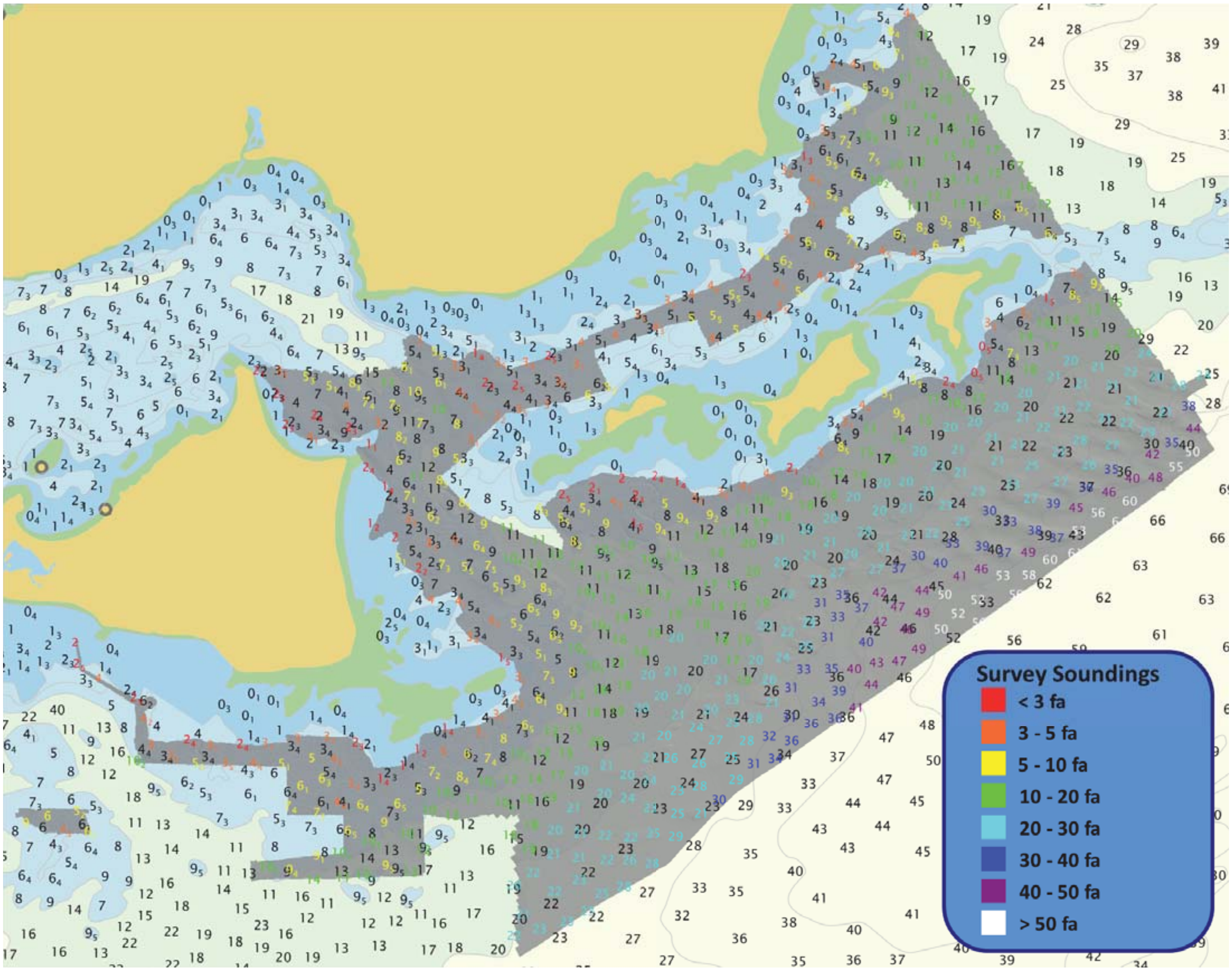


Figure 51: Overview of H12896 generated sounding selection overlaid onto ENC US4AK5LM, with ENC soundings shown in black.

D.1.3 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.4 Charted Features

No charted features labeled as PA, ED, PD or Rep exist for this survey.

D.1.5 Uncharted Features

Survey H12896 has 12 new features that are addressed in the H12896 Final Feature File. Of these features, there are 2 new Seabed Areas, 3 new Underwater Rocks of which 1 is submitted as a DTON, and 8 new Kelp features.

The Final Feature File is not appended to this report. See attached DTON Report.

D.1.6 Dangers to Navigation

The following DTON reports were submitted:

DTON Report Name	Date Submitted
H12896 Danger To Navigation Report	2016-07-13

Table 21: DTON Reports

One Danger to Navigation Report, with one identified danger was submitted on 7/13/2016. The danger is a rocky protrusion from the seafloor with a least depth of 1.9 fathom in the area of a charted 4.25 fathom sounding, located due south of the westernmost of Geese Islands. The DTON Report is included in Appendix II of this report.

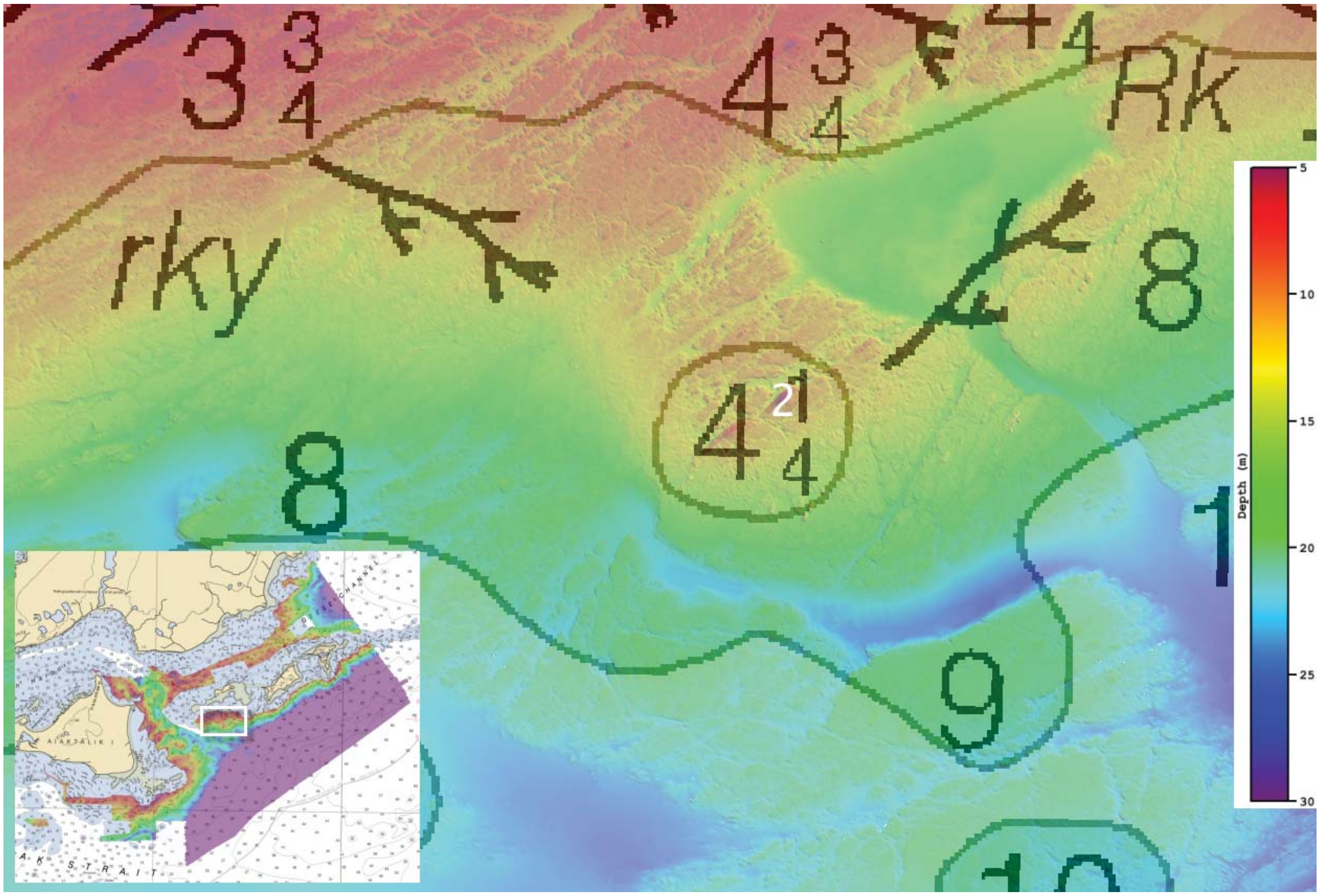


Figure 52: Overview of DTON found south of Geese Islands in H12896.

See attached DTON Report.

D.1.7 Shoal and Hazardous Features

The assigned area for H12896 contains numerous charted ledges and reefs. However, most fell inshore of the surveyed NALL, as kelp prevented close approach to shore throughout the sheet and dedicated shoreline acquisition was not performed. One ledge was partially covered by MBES and its extents modified to the edge of coverage as the inshore extents are unknown. This ledge is shown in Figure 53.

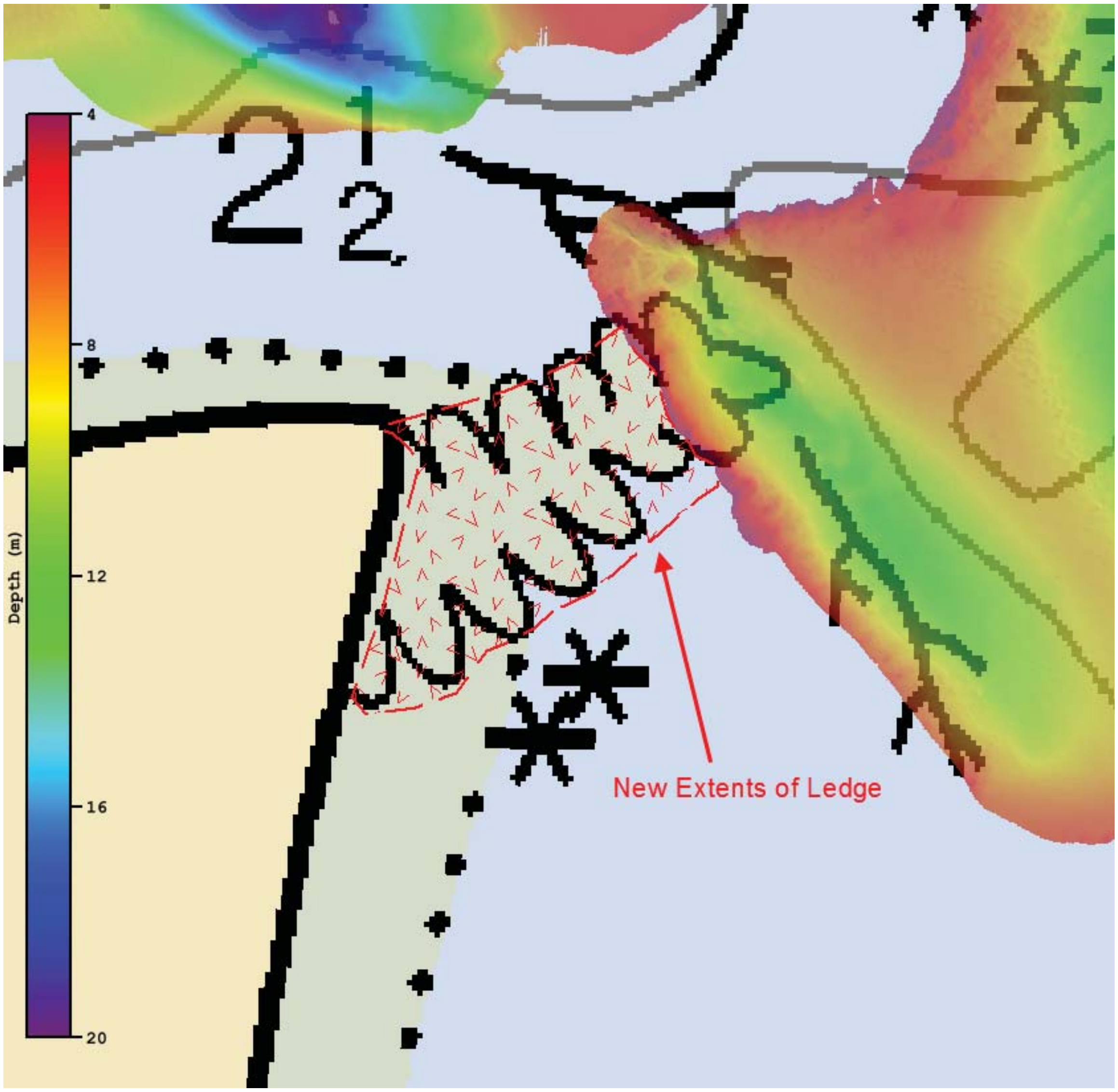


Figure 53: Ledge partially covered by MBES with updated extents shown in red.

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

Three bottom samples were attempted in accordance with the Project Instructions for survey H12896, of which 2 successfully retrieved samples. All bottom samples were entered in the H12896 Final Feature File. See Figure 54 for a graphical overview of sample locations.

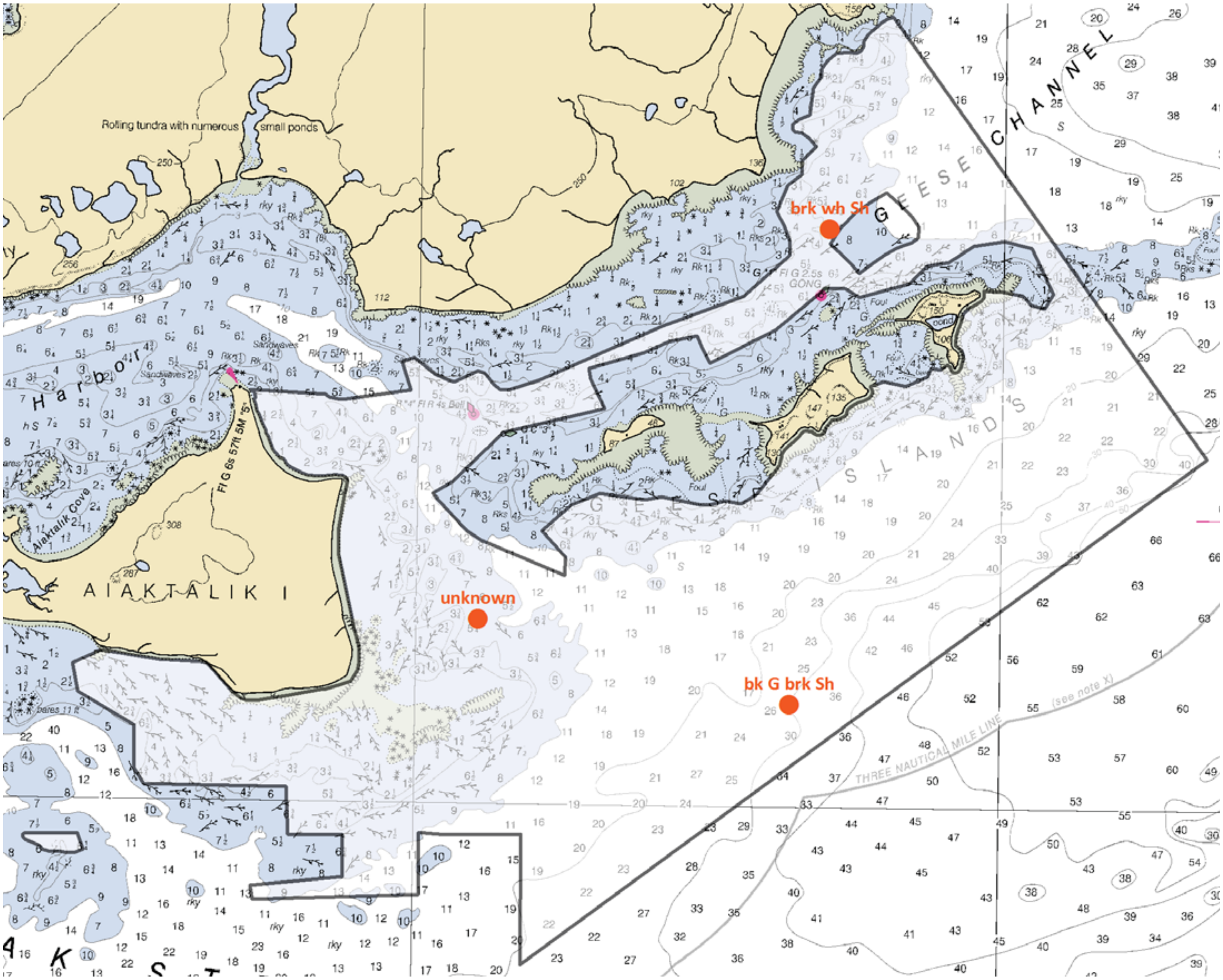


Figure 54: Bottom sample locations and characteristics.

The Final Feature File is not appended to this report.

D.2 Additional Results

D.2.1 Shoreline

H12896 survey limits extended to the NALL (see Section A.1) and all features within these limits were addressed and attributed in the H12896 Final Feature File. All features inshore of the NALL were included in the Final Feature File with the description of "Not Addressed" and remarks of "Retain as charted, not investigated due to being inshore of NALL" as per HSSD Section 7.3.1. Annotations, information, and diagrams collected on DP forms and boat sheets during field operations are scanned and included in the Separates I Detached Positions folder.

The Final Feature File, DP forms and boat sheets are not appended to this report.

D.2.2 Prior Surveys

Four prior surveys overlap the area of H12896, H0580 and H0586 from 1930, and H05161 and H05182 from 1931. Their locations are shown in Figure 55. These surveys were conducted primarily by leadline in nearshore areas, and fathometer in offshore areas, particularly H05182. When imported directly from the HYD93 format files provided by NCEI, there is an offset in the prior survey soundings, which do not account for the incorrect position of Kodiak Island in NAD27 at that time. To correct this, the smooth sheets from the surveys were georeferenced to current charts , then the offset between the sounding location on the smooth sheet and the digitized soundings measured. Using 5 soundings offset samples per prior survey, a mean correction of 440.89 m east and 341.90 m north was applied to all sounding positions. A TIN surface was then created from the shifted prior survey soundings, and subtracted from the H12896 8 meter combined surface. The results are shown in Figure 56.

The mean difference between the TIN and H12896 is 0.54 meters, with the prior survey being shoaler overall. A summary of statistics for the difference surface is given in Figure 57. This smaller difference than the ENC comparison shows the effect of the shoal biased sounding selection on that comparison. The low sampling density from the southeast offshore section of the prior surveys still results in the largest differences in that area, where the ridges are not fully characterized. The launch surveyors of H12896 were generally denied by dense kelp at very similar limits to the prior surveys, with exceptions that the modern survey reached closer to the south side of the western most Geese Island but was unable to approach as close to the southeast side of Aiaktalik Island and the easternmost Geese Island.

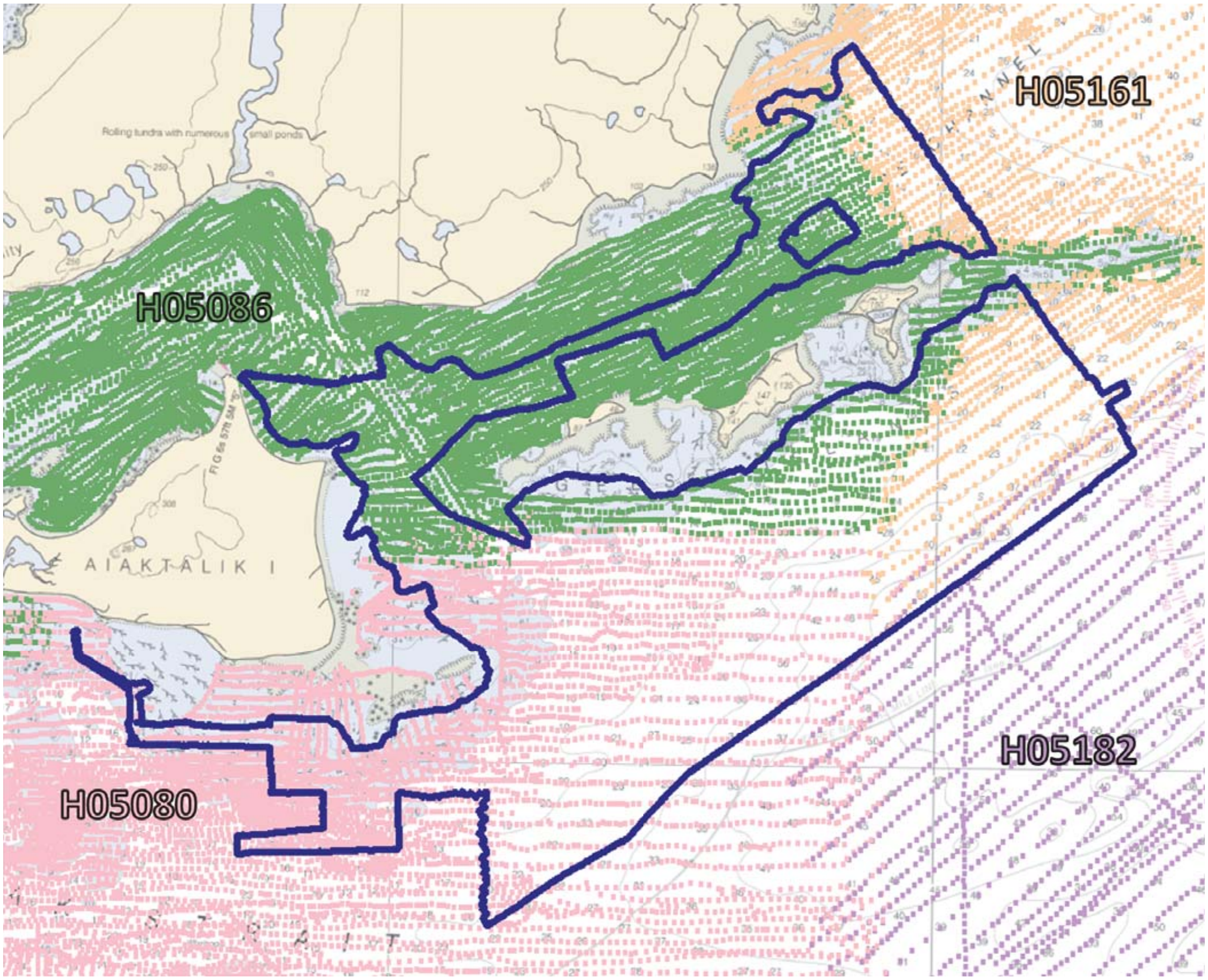


Figure 55: Overview of locations for prior surveys, show with sounding points from the surveys.

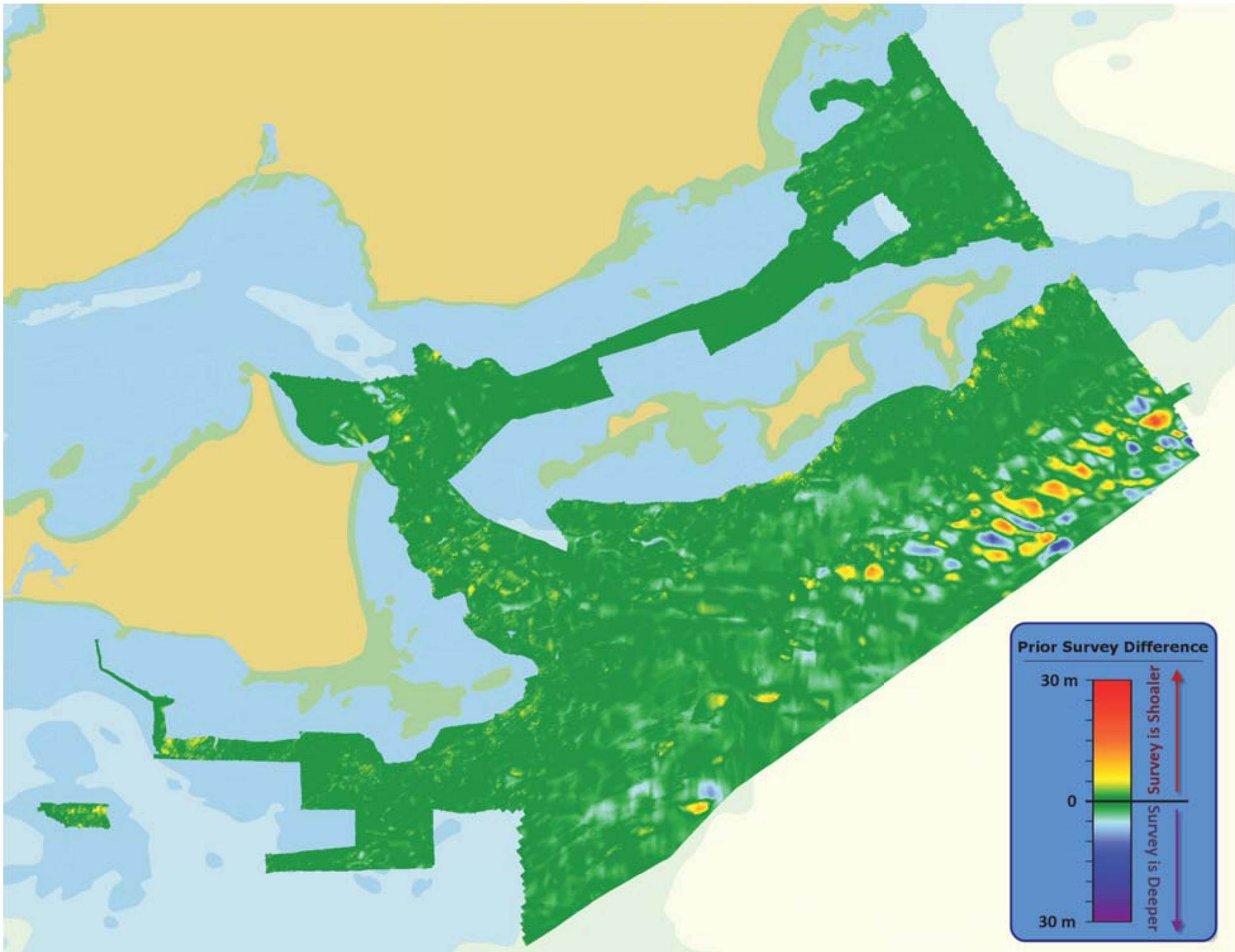


Figure 56: Comparison between H12896 and TIN of prior survey soundings.

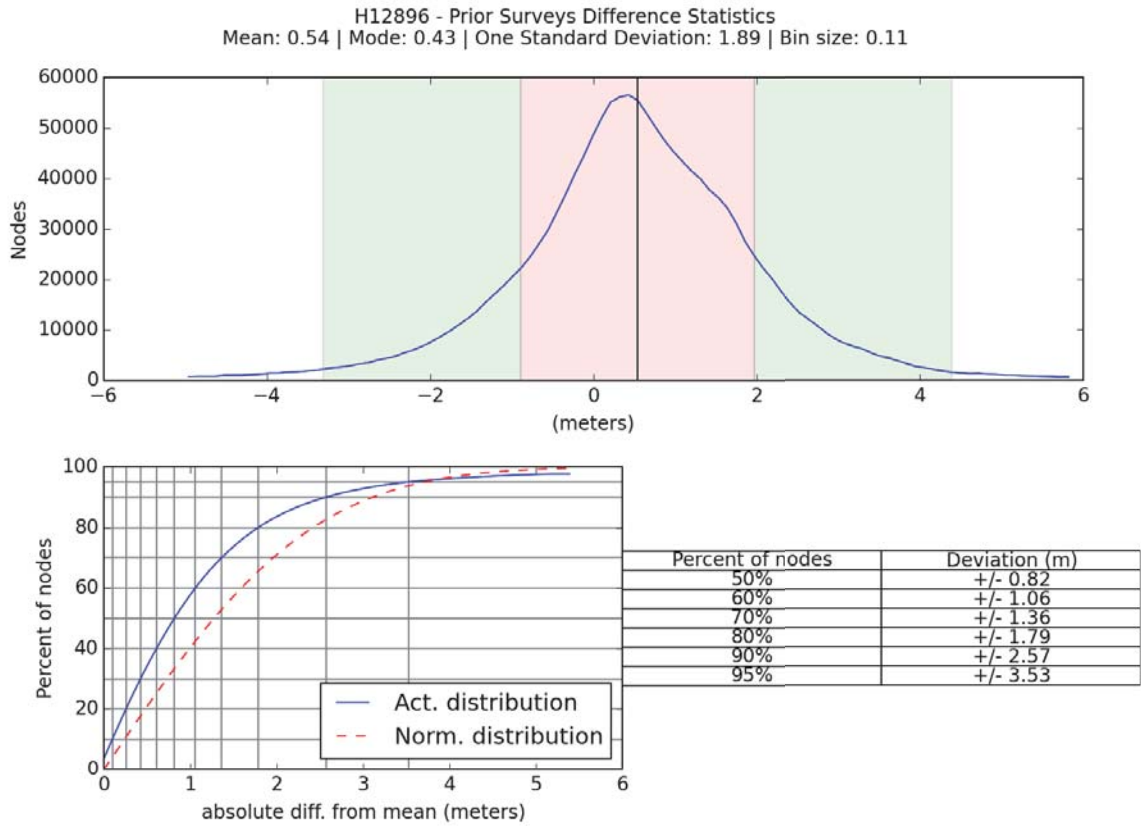


Figure 57: Statistics of difference between H12896 and TIN of prior survey soundings.

D.2.3 Aids to Navigation

Aids to navigation (ATONs) exist for this survey, but were not formally investigated. The Red "4" and Green "1" and "3" buoys were observed to be on station and serving their intended purpose.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

No submarine features exist for this survey.

D.2.6 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

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

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

D.2.10 New Survey Recommendation

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

D.2.11 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 Hydrographic Surveys Specifications and Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives, except as noted in the Descriptive Report. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required unless otherwise noted herein.

Report Name	Report Date Sent
Data Acquisition and Processing Report	2016-11-08
Horizontal and Vertical Control Report	2016-11-14
Coast Pilot Report	2016-11-10

Approver Name	Approver Title	Approval Date	Signature
CDR Mark Van Waes, NOAA	Chief Of Party	11/19/2016	VAN WAES.MARK.1240076329 2016.11.21 12:24:50 -08'00'
LT Bart O. Buessler, NOAA	Field Operations Officer	11/19/2016	Digitally signed by BUESSELER.BART.OWEN.1396600559 Date: 2016.11.21 09:39:32 -08'00'
HCST Douglas Bravo	Chief Survey Technician	11/19/2016	Douglas Bravo 2016.11.19 13:41:59 -08'00'
HSST John Doroba	Acquisition Sheet Manager	11/21/2016	DOROBA.JOHN.G.JR.1368066989 Digitally signed by DOROBA.JOHN.G.JR.1368066989 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=DOROBA.JOHN.G.JR.1368066989 Date: 2016.11.21 07:31:43 -05'00'
LT Damian Manda, NOAA	Processing and Delivery Sheet Manager	11/19/2016	MANDA.DAMIAN.CURTIS.1396610660 2016.11.19 13:16:34 -08'00'

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 DEPARMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Silver Spring, Maryland 20910

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : December 2, 2016

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-P335-FA-16
HYDROGRAPHIC SHEET: H12896

LOCALITY: Due East of Aiaktalik Island, South Coast of Kodiak Island
TIME PERIOD: June 25 to July 31, 2016

TIDE STATION USED: Kodiak Island, AK 9457292
Lat. 57° 43.8' N Long. 152° 30.8' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.400 meters

TIDE STATION USED: Alitak, AK 9457804
Lat. 56° 53.8' N Long. 154° 14.9' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.311 meters

Tide STATION USED: Sitkalidak Island GPS Tide Buoy, AK 9457512
Lat. 56° 57.9' N Long. 153° 15.1' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.307 meters

Tide STATION USED: Geese Island GPS Tide Buoy, AK 9457726
Lat. 56° 35.7' N Long. 153° 59.8' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.483 meters

REMARKS: RECOMMENDED GRID

Please use the TCARI grid "P335FA2016Final.tc" as the final grid for project OPR-P335-FA-16, during the time period between June 25 to July 31, 2016.

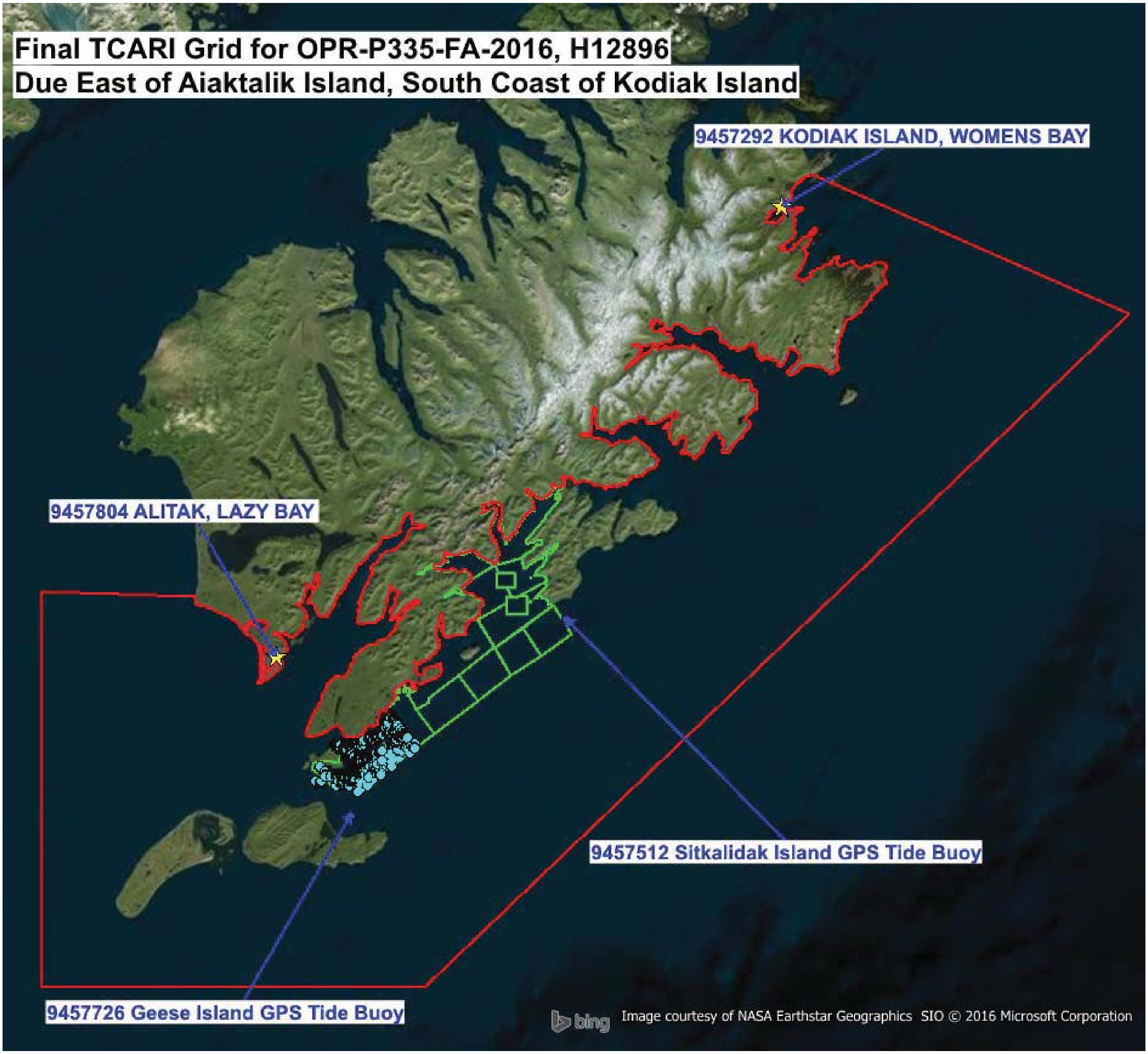
Refer to attachments for grid information.

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).

BURKE.PATRICK.B.1365830335

Digitally signed by BURKE.PATRICK.B.1365830335
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=BURKE.PATRICK.B.1365830335
Date: 2016.12.02 14:40:31 -05'00'

CHIEF, OCEANOGRAPHIC DIVISION



Final TCARI Grid for OPR-P335-FA-2016, H12896
Due East of Aiaktalik Island, South Coast of Kodiak Island
9457292 KODIAK ISLAND, WOMENS BAY
9457804 ALITAK, LAZY BAY
9457512 Sitkalidak Island GPS Tide Buoy
9457726 Geese Island GPS Tide Buoy
Image courtesy of NASA Earthstar Geographics SIO © 2016 Microsoft Corporation

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

October 20, 2016

MEMORANDUM FOR: Commander Mark Van Waes, NOAA
Commanding Officer, NOAA Ship *Fairweather*

FROM: Lieutenant Russell Quintero, NOAA
Chief, Hydrographic Surveys Division

SUBJECT: OPR-P335-FA-16 ERS Capability
Memorandum, South Coast of Kodiak
Island

Hydrographic surveys H12896, H12897, H12898, H12910, H12911, and H12913 of OPR-P335-FA-16 South Coast of Kodiak Island are approved for vertical reduction to chart datum, Mean Lower Low Water (MLLW), using the NOAA's composite Poor Man's VDatum (PMVD) as developed in conjunction with HSTB.

Approval composite PMVD, in lieu of the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) TCARI tides package or ERZT tides package as per the Project Instructions, is based on your recommendation and the review of comparison results you included in your attached email from November 4, 2016.

The results of the data analysis show that ellipsoidally referenced survey (ERS) techniques with the composite PMVD used as the vertical datum reducer meet or exceed horizontal and vertical specifications for hydrographic surveys.

The comparison techniques are in line with the procedures outlined in the NOS Hydrographic Surveys Specifications and Deliverables document.

You shall include a description of your ERS processing procedures and the comparisons you conducted between ERS and traditional tides in the appropriate Descriptive Report (DR), Horizontal and Vertical Control Report and/or Data Acquisition and Processing Report. As appropriate in the DR, document specific vessel day(s) or line(s) that have not been processed using ERS techniques as the vertical reducer to MLLW, where discrete zoning provides better results and/or where vertical uncertainties of your post processed vertical positional data are out of the range determined by the HSSD 2016.

Include this memo in the supplemental correspondence Appendix of the DR.

Damian Manda - NOAA Federal <damian.manda@noaa.gov>

Final Tides for South Kodiak Island

FA OPS <ops.fairweather@noaa.gov> Wed, Nov 9, 2016 at 3:18 PM
To: Damian Manda <Damian.Manda@noaa.gov>, Lander Verhoef <Lander.Verhoef@noaa.gov>, Tyler Fifield <tyler.p.fifield@noaa.gov>, Jeffrey Douglas <jeffrey.douglas@noaa.gov>, Hannah Marshburn - NOAA Federal <Hannah.Marshburn@noaa.gov>, Samuel Candio - NOAA Federal <samuel.candio@noaa.gov>
Cc: CST Fairweather <chiefst.fairweather@noaa.gov>

South Kodiak Sheet Managers,

Please include the following email correspondence in Appendix II of your DR. This serves as our waiver for submitting these surveys to PHB without final tides applied. Please let me know if you have any questions.

Very Respectfully,

LT Bart Buesseler, NOAA

-------- Forwarded Message --------
Subject: Re: Final Tides for South Kodiak Island
Date: Wed, 09 Nov 2016 15:07:39 -0800
From: CO Fairweather (CDR Mark Van Waes) <co.fairweather@noaa.gov>
To: Russell Quintero - NOAA Federal <russell.quintero@noaa.gov>
CC: Ben Evans <benjamin.k.evans@noaa.gov>, Richard T Brennan <Richard.T.Brennan@noaa.gov>, FA OPS <ops.fairweather@noaa.gov>, ChiefST.Fairweather <chiefst.fairweather@noaa.gov>, Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov>

Great. Thanks Russ!

Mark

On 11/9/2016 14:48, Russell Quintero - NOAA Federal wrote:

> Mark,
>
> As per our previous discussion, with the approved ERS capability memo, there's no reason to delay submission while waiting on tides. PHB has said they are fine with applying that when it is available.
>
> Consider that requirement waived, and include this email in your correspondence folder.
>
> V/r,
> Russ
>
> On Wednesday, November 9, 2016, CO Fairweather (CDR Mark Van Waes) <co.fairweather@noaa.gov> wrote:
>
>> Russ,
>>
>> We've received the ERS Capability Approval Memo that Katy sent us on 11/7. Is there any further waiver/statement required for us to submit the SKI surveys without final tides, or are we good to go on that?
>>
>> Thanks,
>> Mark
>>
>> On 11/4/2016 12:14, CO Fairweather (CDR Mark Van Waes) wrote:

Roger. Thank you both for the quick response. We have our ERS report and memo being finalized and will submit it today. We are indeed confident in our reduction of the data to chart datum via ERS, so there should be no re-processing.

Thanks,
Mark

On 11/4/2016 11:03, Russell Quintero - NOAA Federal wrote:

> CDR Van Waes,
>
> As CDR Evans spoke to, an ERS capability memo should be sent to Ops after completion of acquisition, at which point a final determination will be made for how to reduce the data to chart datum.
>
> Katy, the PM for this project has reached out to CO-OPS on the state of final tides. They have the data and are reviewing it.
>
> She has not, however, yet received the ERS capability memo from FA for this project.
>
> Once she has that memo, if all looks good, since PHB doesn't mind applying it later, I'm happy to include a waiver of final tides with our response so you can move the survey along asap.
>
> V/r,
> Russ
>
> On Friday, November 4, 2016, Ben Evans <benjamin.k.evans@noaa.gov> wrote:
>
>> Mark,
>>
>> That's great news that those surveys are just about ready to go! It's also a great example of how ERS methods will start saving us time.
>>
>> The point of applying final tides in the field is to avoid duplicative re-computation of grids at the branch, re-checking for the inevitable fliers which crop up when new CUBE solutions are generated, and the potential for changed attribution on features (rocks bumping up to islets and vice-versa, etc.). However, if in this case FA is confident that you have successfully reduced to chart datum through ERS methods, we would not be re-processing here and there is no reason to wait.
>>
>> Was an Ops-approved ERS capability memo required for this project? If so, does that require final tides for the comparison? If not, and Ops has approved your ERS approach, I think PHB would be happy to take the surveys and receive final tides later.
>>
>> (To be clear, though, this represents a deviation from the HSSD, and therefore Ops has the final say.)
>>
>> Ben
>>
>> On 11/4/2016 09:13, CO Fairweather (CDR Mark Van Waes) wrote:
>>
>>> Ben, Russ,
>>>
>>> We are reviewing and preparing for submission our surveys from OPR-P335-FA-16, South Kodiak Island. We have not, however, received the final tides data for them. This delay, should we continue to wait for the data, will prevent us from meeting the 120-day submission timeframe.

Strictly speaking, final tides are not needed for this survey. We employed ERS methods and therefore do not require final tide data, though we would normally have applied the final tides to our data for completeness.

How would HSD like for us to proceed? Should we submit the survey data without final tides? Or should we wait for the tide data and request a waiver of the 120-day requirement?

Thanks,
Mark

--
CDR Ben Evans, NOAA
Chief, Pacific Hydrographic Branch (N/CS34)
NOAA Office of Coast Survey
7600 Sand Point Way NE
Seattle, WA 98115
(206) 526-6835

--
Lieutenant Russell Quintero, NOAA
Chief, Hydrographic Surveys Division Operations Branch
National Oceanic & Atmospheric Administration
1315 East-West Hwy, SSMC3 6217
Silver Spring, MD 20910
Cell: 970-481-2030

--
Lieutenant Russell Quintero, NOAA
Chief, Hydrographic Surveys Division Operations Branch
National Oceanic & Atmospheric Administration
1315 East-West Hwy, SSMC3 6217
Silver Spring, MD 20910
Cell: 970-481-2030

Re: Hydrographic Technical Directive 2016-3: Horizontal Datums for hydrographic surveys

Michael Gonsalves - NOAA Federal <michael.gonsalves@noaa.gov> Fri, Jul 22, 2016 at 8:13 AM
To: Michael Gonsalves - NOAA Federal <michael.gonsalves@noaa.gov>
Cc: Eric Berkowitz - NOAA Federal <eric.w.berkowitz@noaa.gov>, Richard Brennan - NOAA Federal <Richard.T.Brennan@noaa.gov>, Lorraine Robidoux - NOAA Federal <lorraine.robidoux@noaa.gov>, John Nyberg - NOAA Federal <John.Nyberg@noaa.gov>, Mike Aslaksen - NOAA Federal <mike.aslaksen@noaa.gov>, Samuel Greenaway <Samuel.Greenaway@noaa.gov>, Russell Proctor - NOAA Federal <russell.proctor@noaa.gov>, _OMAO MOP CO Rainier <CO.Rainier@noaa.gov>, _OMAO MOP CO Fairweather <co.fairweather@noaa.gov>, "CO.Thomas Jefferson - NOAA Service Account" <co.thomas.jefferson@noaa.gov>, "CO.Ferdinand Hassler - NOAA Service Account" <co.ferdinand.hassler@noaa.gov>, "Evans, Rod E." <RHODRI.E.EVANS@leidos.com>, George Reynolds <ggr@oceansurveys.com>, Andrew Orthmann <aorthmann@terrasond.com>, Arthur Wright <artw@wassoc.com>, David Neff <david@etracinc.com>, "Millar, David FPI" <dmillar@fugro.com>, Deam Moyles <dmoyles@fugro.com>, Jon Dasler <jld@deainc.com>, Tara Levy <tlevy@oceaneering.com>, _NOS OCS HSD OPS <hsd.ops@noaa.gov>, _NOS OCS HSD AHB <nos.ahb.allpersonnel@noaa.gov>, _NOS OCS HSD PHB <nosphb@noaa.gov>, "ops.fairweather" <ops.fairweather@noaa.gov>, "OPS.Rainier" <ops.rainier@noaa.gov>, "OPS.Thomas Jefferson - NOAA Service Account" <OPS.Thomas.Jefferson@noaa.gov>, "OPS.Ferdinand Hassler - NOAA Service Account" <OPS.Ferdinand.Hassler@noaa.gov>, _OMAO MOP ChiefST Fairweather <chiefst.fairweather@noaa.gov>, Chief ST Rainier <ChiefST.Rainier@noaa.gov>, "ChiefST.Thomas Jefferson - NOAA Service Account" <chiefst.thomas.jefferson@noaa.gov>, "ChiefST.Ferdinand Hassler - NOAA Service Account" <chiefst.ferdinand.hassler@noaa.gov>, Chief NRB OCS - NOAA Service Account <chief.nrb.ocs@noaa.gov>, Christopher Hare - NOAA Federal <Christopher.Hare@noaa.gov>, Megan Greenaway - NOAA Federal <Megan.Greenaway@noaa.gov>

Greetings folks,

My apologies if I've induced a datum-related panic throughout the fleet - I should have provided a little more clarifying language.

First of all: relax! Don't cease acquisition, don't reconfigure your base stations, don't start transforming your data, don't reprocess all your SBETs.

The moral of the story is that HSD is fine with whichever horizontal datum you choose (NAD83 or WGS84), all we ask is that you document which datum was used. If you've already acquired half of a sheet in WGS84, then continue to do so, document the datum within your metadata and the Descriptive Report -- there isn't a need for HSD to issue any waiver to the HSSD because you're following the HSSD as written at the time of the issuance of your Project Instructions. All of AHB and PHB are CC'd on this email chain -- no field unit will get a demerit for submitting in one datum versus another. If you've completed one sheet of a project in WGS84 and would like to continue the rest of the project in WGS84 - go for it (in fact, for the purposes of DAPR documentation, I suspect the branches would prefer that).

Some of you may wonder why we made this change mid-season -- if you're one of those people, read the next three sentences (if you aren't, have a great weekend and remember to document your datums). The reason we made the change in language is strictly to satisfy an administrative requirement. As a civilian federal agency, we in the Office of Coast Survey could not publish an official technical specification that was in direct conflict with the Office of Management and Budget Circular A-16. The government is a little sensitive when it comes to having conflicting requirements out in the public space; as such, we were legally obliged to clean up the language.

We're only a few years away from the next realization of NAD83 which will be functionally indistinguishable from WGS84; so, eventually, these differences will truly be imperceptible.

Remember: relax, keep doing what you're doing, and document what you did.

Very respectfully,
~~ michael.gonsalves, LCDR/NOAA
HSD Operations Branch, Chief

On Thu, Jul 21, 2016 at 5:09 PM, Michael Gonsalves - NOAA Federal <michael.gonsalves@noaa.gov> wrote:

> Greetings,

The attached Hydrographic Technical Directive (HTD) provides a revision to the horizontal datum requirement, as stated in the 2016 Hydrographic Surveys Specifications and Deliverables. This HTD changes the requirement from WGS84 to NAD83, which brings us into compliance with other civilian federal agencies (see the document for further details).

If there are any questions or concerns about meeting this specification, please consult with your HSD Project Manager or Contracting Officer's Representative.

Very respectfully,
~~ michael.gonsalves, LCDR/NOAA
HSD Operations Branch, Chief

H12896 DTON Report

Registry Number: H12896
State: Alaska
Locality: South Coast of Kodiak Island
Sub-locality: Due East of Aiaktalik Island
Project Number: OPR-P335-FA-16
Survey Dates: 06/25/2016 - 07/30/2016

Charts Affected

Number	Edition	Date	Scale (RNC)	RNC Correction(s)*
16590	11th	09/01/2007	1:81,529 (16590_1)	[L]NTM: ?
16580	14th	01/01/2008	1:350,000 (16580_1)	[L]NTM: ?
16013	30th	07/01/2006	1:969,761 (16013_1)	[L]NTM: ?
531	24th	07/01/2007	1:2,100,000 (531_1)	[L]NTM: ?
500	8th	06/01/2003	1:3,500,000 (500_1)	[L]NTM: ?
530	32nd	06/01/2007	1:4,860,700 (530_1)	[L]NTM: ?
50	6th	06/01/2003	1:10,000,000 (50_1)	[L]NTM: ?

* Correction(s) - *source: last correction applied (last correction reviewed--"cleared date")*

Features

No.	Name	Feature Type	Survey Depth	Survey Latitude	Survey Longitude
1.1	US 0000023304 00001	Rock	3.47 m	56° 42' 27.6" N	153° 56' 16.1" W

1 - Dangers To Navigation

1.1) US 0000023304 00001 / H12896_DTON.000

DANGER TO NAVIGATION

Survey Summary

Survey Position: 56° 42' 27.6" N, 153° 56' 16.1" W

Least Depth: 3.47 m (= 11.37 ft = 1.895 fm = 1 fm 5.37 ft)

TPU (±1.96σ): **THU (TPEh)** [None] ; **TVU (TPEv)** [None]

Timestamp: 2016-212.00:00:00.000 (07/30/2016)

Dataset: H12896_DTON.000

FOID: US 0000023304 00001(022600005B080001/1)

Charts Affected: 16590_1, 16580_1, 16013_1, 531_1, 500_1, 530_1, 50_1

Remarks:

SOUNDG/remrks: Shoal area with least depth of 2.10 fathoms (3.83 meters) was ensonified over a charted "4 1/4" fathom sounding 5.35 km E of Aiatalik Island and 1.97 km S of the western-most island of the Geese Islands.

Hydrographer Recommendations

Chart sounding as surveyed.

Arithmetically-Rounded Depth (Unit-wise Affected Charts):

2fm (16590_1, 16580_1, 16013_1, 530_1)

1fm 5ft (531_1)

3.5m (500_1, 50_1)

S-57 Data

Geo object 1: Underwater rock / awash rock (UWTROC)

Attributes: QUASOU - 6:least depth known

SORDAT - 20160730

SORIND - US,US,graph,H12896

TECSOU - 3:found by multi-beam

VALSOU - 3.466 m

WATLEV - 3:always under water/submerged

Office Notes

Concur with clarification. Chart DTON as submerged rock with least depth of 1.895 fathoms (1 fm 5 ft).

Feature Images

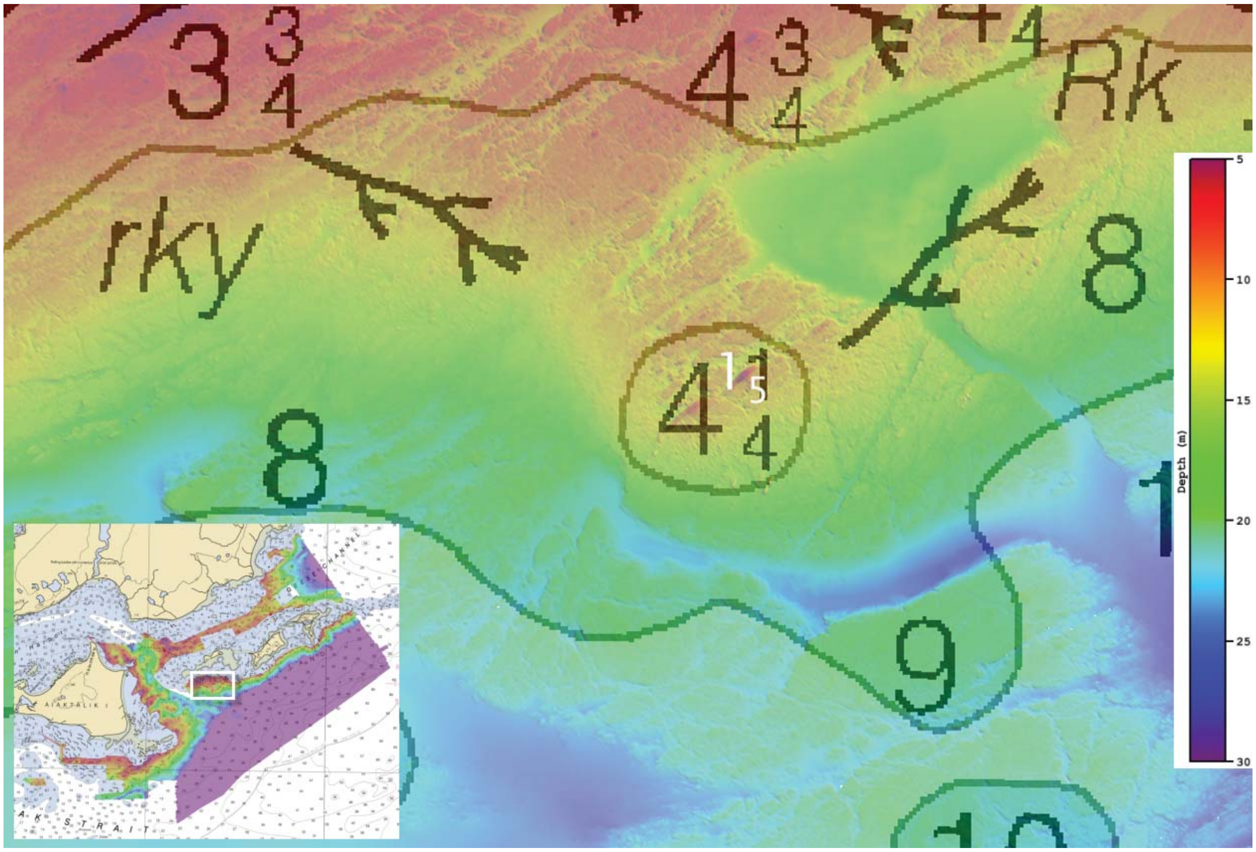


Figure 1.1.1

APPROVAL PAGE

H12896

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

- H12896_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12896_GeoImage.pdf

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

Digitally signed by HOLMBERG.PETER.SCOTT.1365886101
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOLMBERG.PETER.SCOTT.1365886101
Date: 2017.05.03 13:32:21 -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.

Digitally signed by BROWN.KURT.E.1156712600
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=BROWN.KURT.E.1156712600
Date: 2017.05.03 08:45:48 -07'00'

Approved:____

Kurt Brown
Physical Scientist, Pacific Hydrographic Branch