H12532

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12532

LOCALITY

State(s):	Alaska
General Locality:	Chatham Strait
Sub-locality:	Hoggatt Bay to Patterson Pt

2013

CHIEF OF PARTY
Richard T. Brennan, CDR/NOAA

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Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H12532**

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:	**Chatham Strait**
Sub-Locality:	**Hoggatt Bay to Patterson Pt**
Scale:	**10000**
Dates of Survey:	**05/23/2013 to 06/28/2013**
Instructions Dated:	**04/18/2013**
Project Number:	**OPR-O322-RA-13**
Field Unit:	**NOAA Ship *Rainier***
Chief of Party:	**Richard T. Brennan, CDR/NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	
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. Notes in red were generated during office processing. The processing branch concurs with all information and recommendations in the DR unless otherwise noted. Page numbering may be interrupted or non-sequential. All pertinent records for this survey, including the Descriptive Report, are archived at the National Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

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Descriptive Report to Accompany Survey H12532

Project: OPR-O322-RA-13

Locality: Chatham Strait

Sublocality: Hoggatt Bay to Patterson Pt

Scale: 1:10000

May 2013 - June 2013

NOAA Ship *Rainier*

Chief of Party: Richard T. Brennan, CDR/NOAA

A. Area Surveyed

The project area is referred to as Sheet 2: "Hoggatt Bay to Patterson Pt." within the Project Instructions (Figure 1). The project area spans from north of Hoggatt Bay to north of Patterson Pt.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
56° 47" 18.18' N 134° 45" 6.63' W	56° 33" 32.47' N 134° 36" 36.6' W

Table 1: Survey Limits

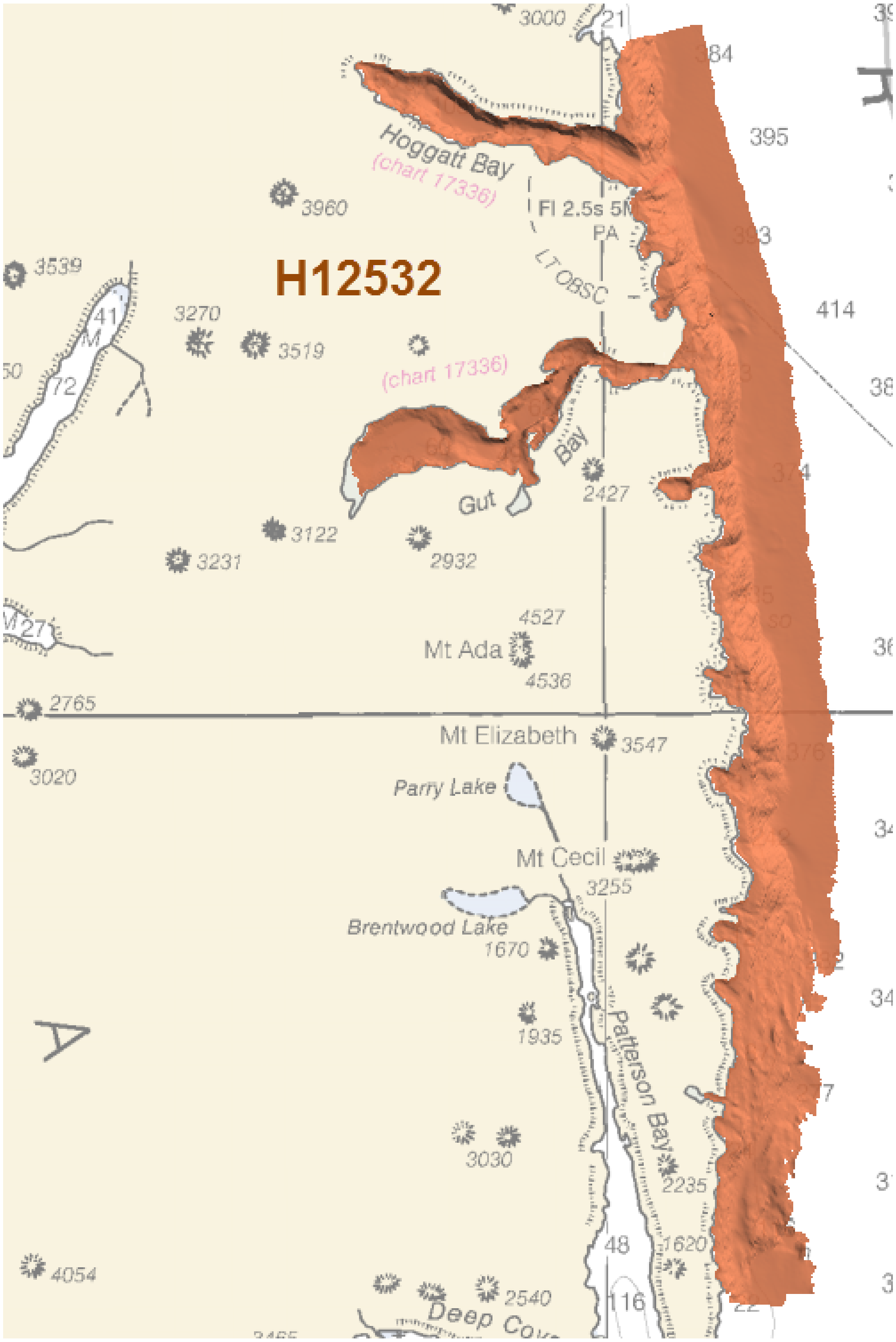


Figure 1: H12532 survey limits

Survey Limits were acquired in accordance with the requirements in the Project Instructions and the HSSD.

A.2 Survey Purpose

The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products. Other vessels such as cruise liners, ferries, USCG cutters, US Navy vessels, tugs and barges use the waterway on a regular basis as do larger ships when avoiding storms in the Gulf of Alaska.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired on survey H12532 met complete multibeam echosounder (MBES) coverage requirements, including the 5 soundings per node data density requirements outlined in section 5.2.2.2 of the HSSDM (Figure 2). In order to extract some descriptive statistics of the data density achievements, the density layer of each finalized surface was queried within CARIS and then examined in Excel (Figure 3). Overall, the required data density was achieved in 98.7% of the nodes and 98.7% of the total area.

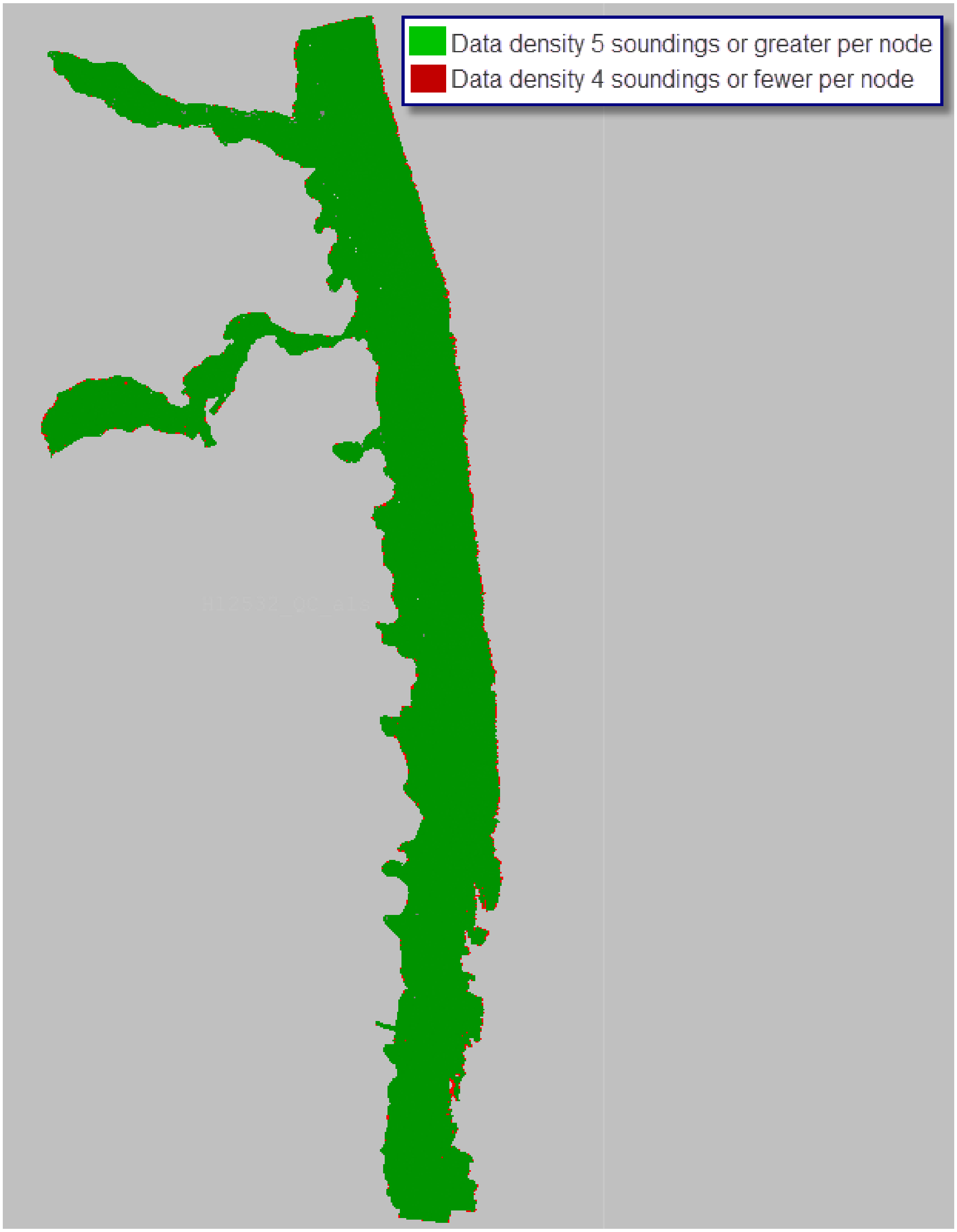


Figure 2: H12532 data density.

Resolution	Depth range	Number of nodes	Fewer than five soundings per node	Percent of nodes with greater than five soundings per node
1m	0 - 20m	2,849,269	50,393	98.2%
2m	18 - 40m	1,132,396	6,487	99.4%
4m	36 - 80m	386,439	863	99.8%
8m	72 - 160m	131,914	40	100.0%
16m	144 - 320m	39,969	234	99.4%
32m	288 - 1000m	33,294	662	98.0%
	TOTAL:	4,573,281	58,679	**98.7%**
	TOTAL (by area):	66,329,493	830,501	**98.7%**

Figure 3: Summary table showing the percentage of nodes satisfying the 5 sounding density requirements, sub-divided by the appropriate depth ranges. Note: The final row has a unit of square meters, and sums the number of different resolution nodes into a common unit of area.

A.4 Survey Coverage

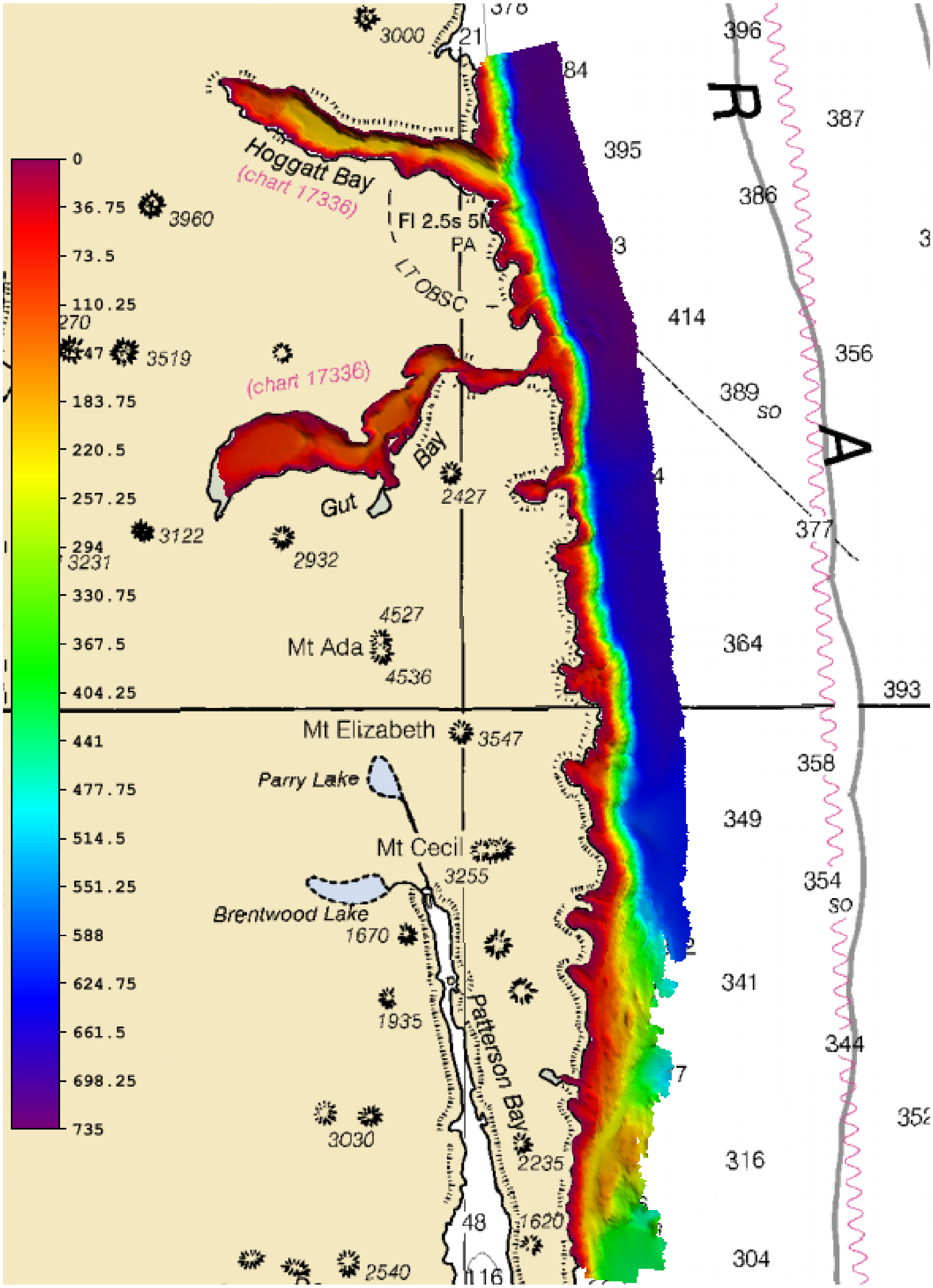


Figure 4: Acquired survey coverage overlaid on Chart 17320 (scale shows depths in meters).

Complete multibeam (MBES) coverage was achieved within the limits of hydrography as defined in the Project Instructions with the following exceptions:

There were numerous areas where the sheet limits provided with the project deviated significantly from the true coastline as well as from the acquired bathymetry (Figures 5 and 6). It was determined that the survey limits and features assigned for investigation were sourced from ENC US3AK4PM (1:217,828), which had sections of outdated shoreline and features. The larger scale ENCs as well as all raster charts of the area appear to be correct.

Also, there are numerous areas where the sheet limits were not met due to areas foul with kelp (Figure 7). These areas are delineated in the Final Features File.

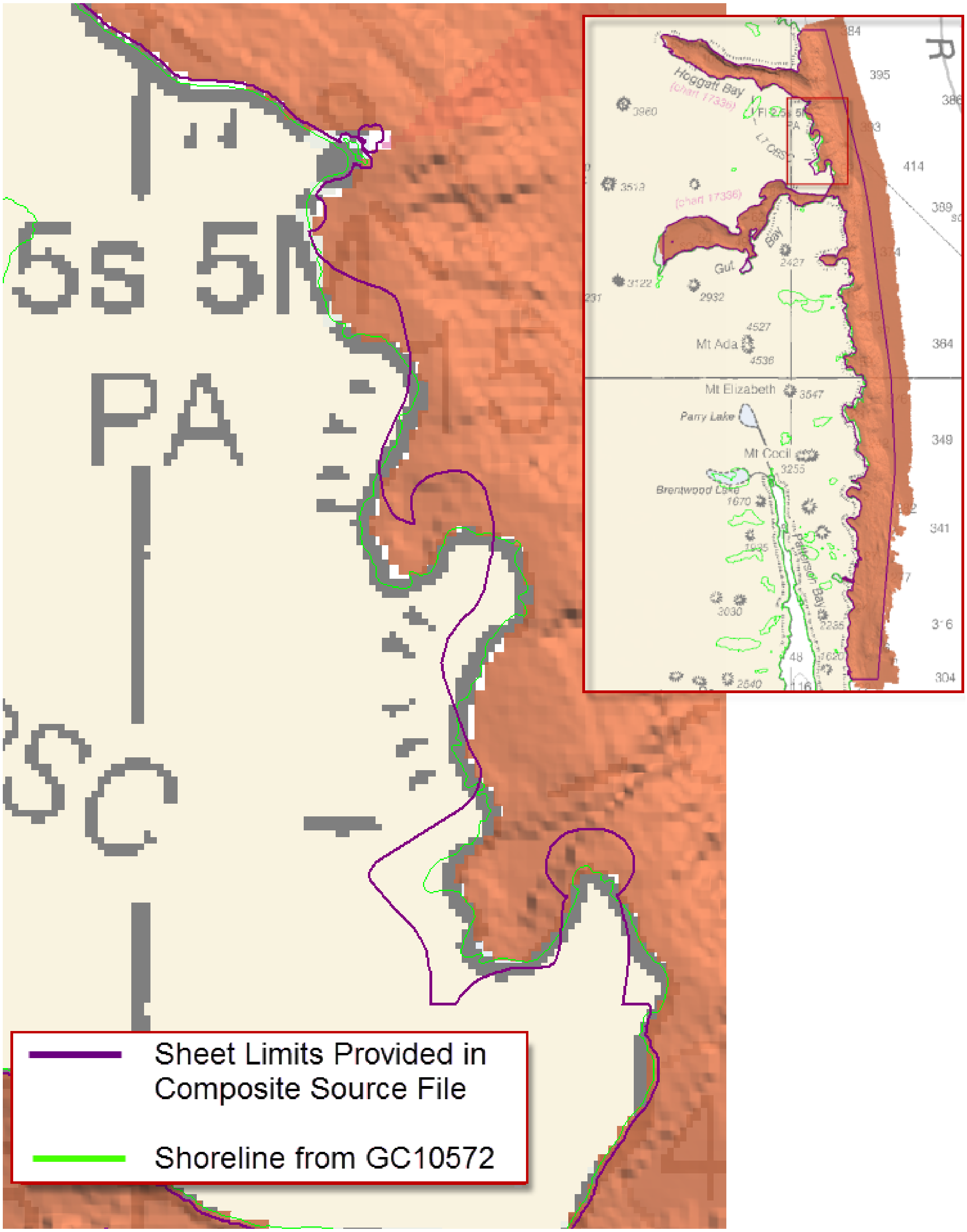


Figure 5: Offset of assigned sheet limits between Hoggatt Bay and Gut Bay for H12532.

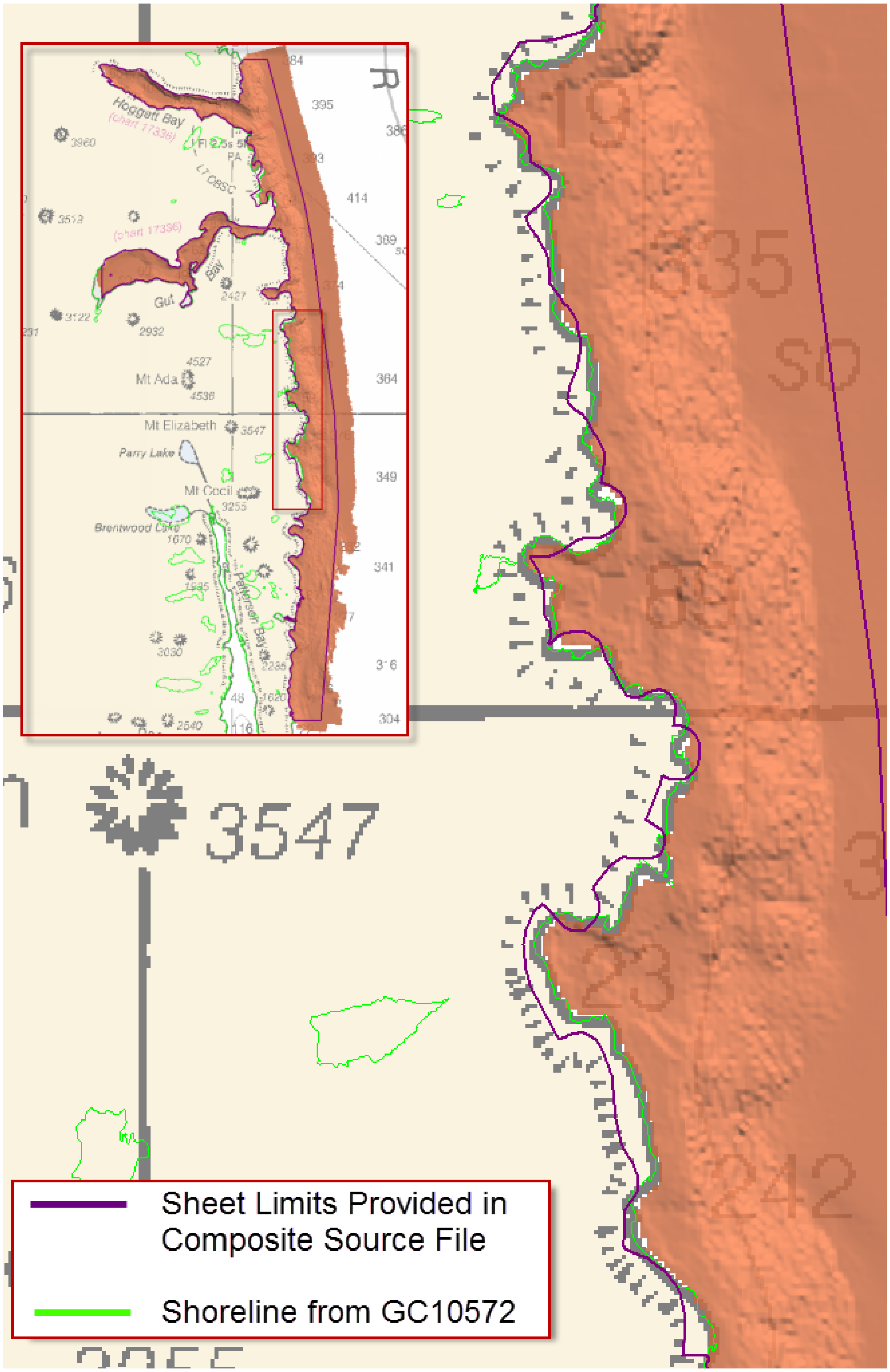


Figure 6: Offset of assigned sheet limits south of Gut Bay for H12532.

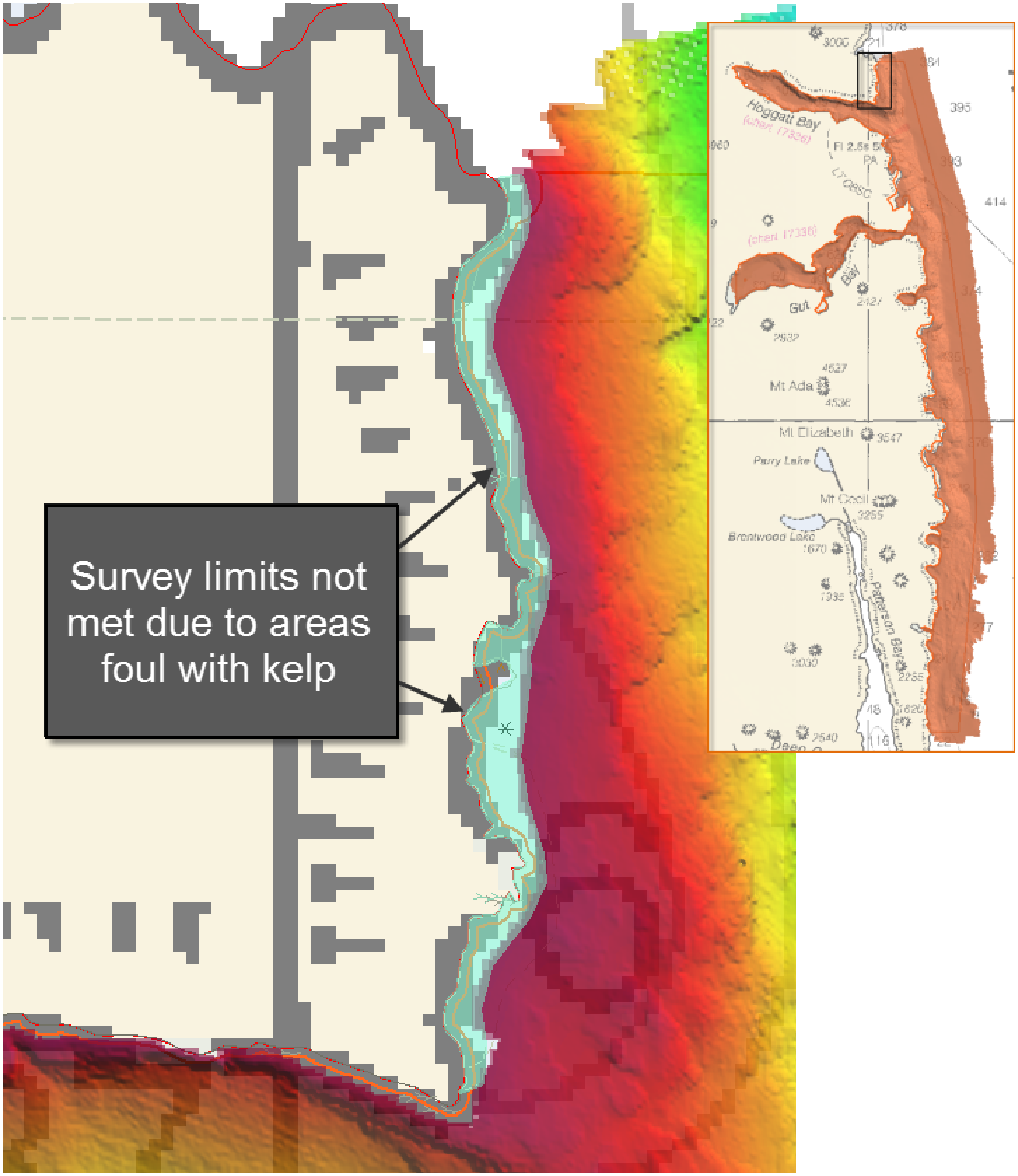


Figure 7: Example of areas where assigned sheet limits were not met due to kelp.

A.5 Survey Statistics

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

	Vessel	*S221*	*2801*	*2802*	*2803*	*2804*	*Total*
LNM	**SBES Mainscheme**	0	0	0	0	0	0
	MBES Mainscheme	28.00	43.09	32.37	28.84	58.30	190.60
	Lidar Mainscheme	0	0	0	0	0	0
	SSS Mainscheme	0	0	0	0	0	0
	SBES/MBES Combo Mainscheme	0	0	0	0	0	0
	SBES/SSS Combo Mainscheme	0	0	0	0	0	0
	MBES/SSS Combo Mainscheme	0	0	0	0	0	0
	SBES/MBES Combo Crosslines	0	5.69	0	0	1.62	7.32
	Lidar Crosslines	0	0	0	0	0	0
Number of Bottom Samples							5
Number AWOIS Items Investigated							0
Number Maritime Boundary Points Investigated							0
Number of DPs							0
Number of Items Items Investigated by Dive Ops							0
Total Number of SNM							18.69

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Julian Day Number
05/22/2013	142
05/23/2013	143
05/27/2013	147
05/28/2013	148
06/19/2013	170
06/22/2013	173
06/23/2013	174
06/27/2013	178
06/28/2013	179

Table 3: Dates of Hydrography

Fourteen detached positions (DPs) were taken on rocks during the survey.

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the 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	*S221 (Rainier)*	*1906 (RA-7)*	*2801 (RA-4)*	*2802 (RA-5)*	*2803 (RA-3)*	*2804 (RA-6)*
LOA	231 feet	19 feet	28 feet	28 feet	28 feet	28 feet
Draft	16.5 feet	1.7 feet	3.5 feet	3.5 feet	3.5 feet	3.5 feet

Table 4: Vessels Used

All data for survey H12532 was acquired by NOAA Ship RAINIER, her survey launches (2801, 2802, 2803, and 2804), and a skiff (1906). The survey launches and ship acquired MBES depth soundings, sound speed profiles, bottom samples, and conducted shoreline verification. Skiff 1906 was used for shoreline verification.

B.1.2 Equipment

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

Manufacturer	Model	Type
Reson	7125	MBES
Reson	8125	MBES
Kongsberg	EM710	MBES
ODIM Brooke Ocean (Rolls-Royce group)	MVP30	Conductivity, Temperature, and Depth Sensor
ODIM Brooke Ocean (Rolls-Royce group)	MVP200	Conductivity, Temperature, and Depth Sensor
Applanix	POS-MV V4	Vessel Attitude and Positioning System
Seabird	SBE 19 Plus	Conductivity, Temperature, and Depth Sensor
Seabird	SBE 19	Conductivity, Temperature, and Depth Sensor
Reson	SVP 71	Sound Speed System
Reson	SVP 70	Sound Speed System

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines, acquired for this survey, totalled 3.8% of mainscheme acquisition.

Multibeam crosslines were acquired using the Reson 7125 on vessels 2801 (RA-4) and 2804 (RA-6). The crosslines covered 7.32 nautical miles, which comprised 3.8% of mainscheme hydrography. A 4-meter CUBE surface was created using the mainscheme lines, while a second 4-meter CUBE surface was created using only crosslines, from which a difference surface was generated at a 4-meter resolution (Figure 8).

Statistics were then derived from the CARIS Difference Surface and are shown in Figure 9. The average difference between the depths derived from the mainscheme and crosslines was 0.33 meters (crosslines being shoaler) with a standard deviation of 3.15 meters.

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 10). In total, 95.6% of the depth differences between H12532 mainscheme and crossline data are within allowable IHO accuracies (Figure 11).

In addition to performing a crossline comparison using surface differencing, the CARIS QC Report was used to compare the crossline soundings to the depth estimates of the 4-meter resolution surface. The depth differences are calculated for each crossline ping and then compared to the allowable IHO uncertainties (Figure 12). The output QC Report classifies the percentage of pings meeting IHO orders by beam angle. The table was copied and examined in Excel (Figure 11). On average, 95.6% of all soundings for any given depth and beam angle meet IHO Order 1 and 2 accuracies for those respective depths.

Figure 8: H12532 crosslines.

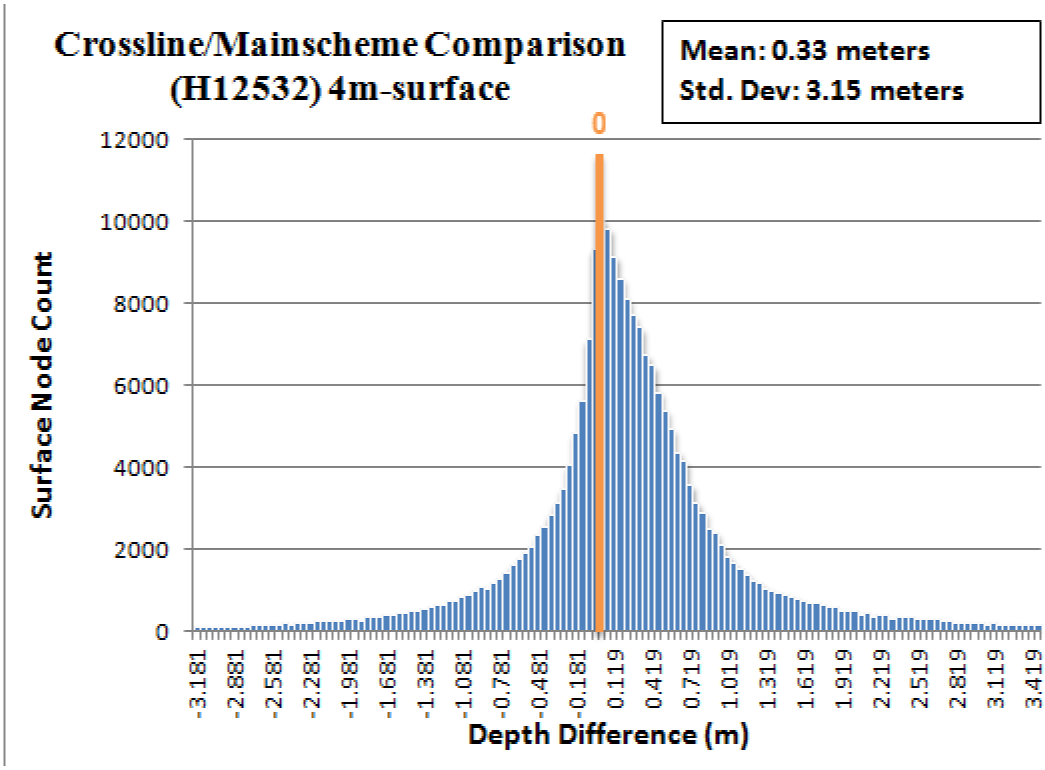


Figure 9: Crossline comparison with mainscheme lines.

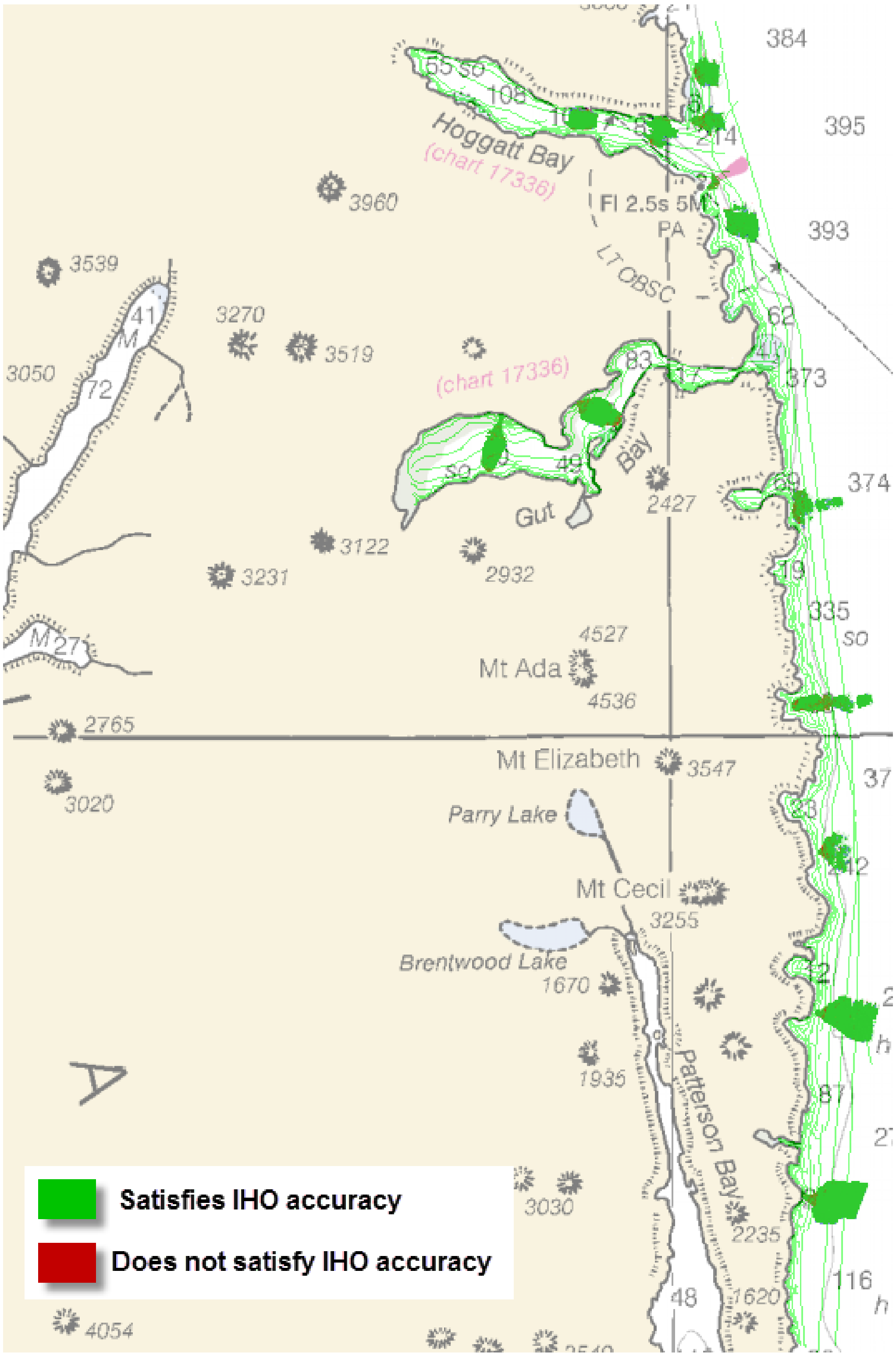


Figure 10: Depth differences between H12532 mainscheme and crossline data as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Less than 100m	Order 1	10,947	9,455	86.4%
Greater than 100m	Order 2	46,246	45,224	97.8%
	TOTAL:	57,193	54,679	95.6%

Figure 11: Summary table showing percentage of difference surface nodes between H12532 mainscheme and crossline data that meet allowable IHO accuracy standards for the respective depths.

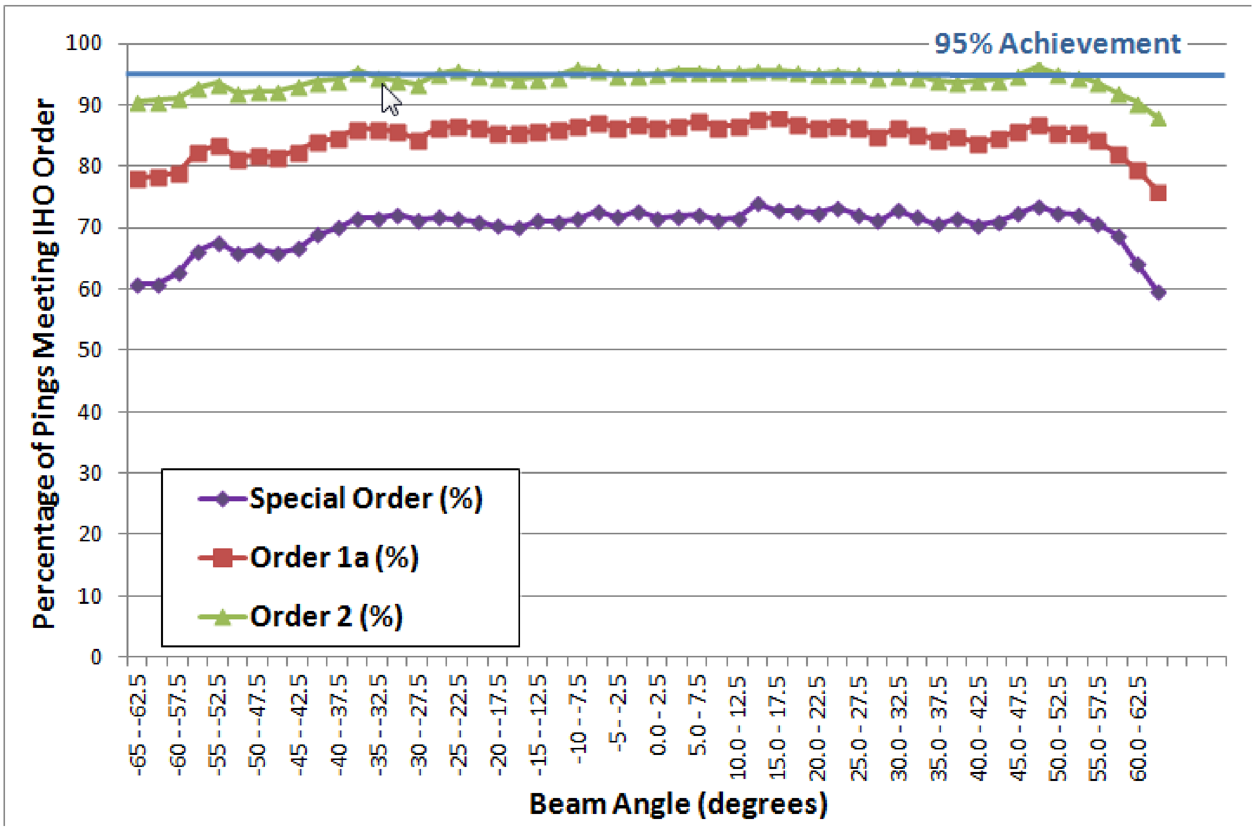


Figure 12: CARIS QC Report comparing crossline soundings to depth estimates.

Crosslines comprised 3.8% instead of the required 4% of the main scheme mileage. The percentage attained is sufficient for comparison and quality check purposes.

B.2.2 Uncertainty

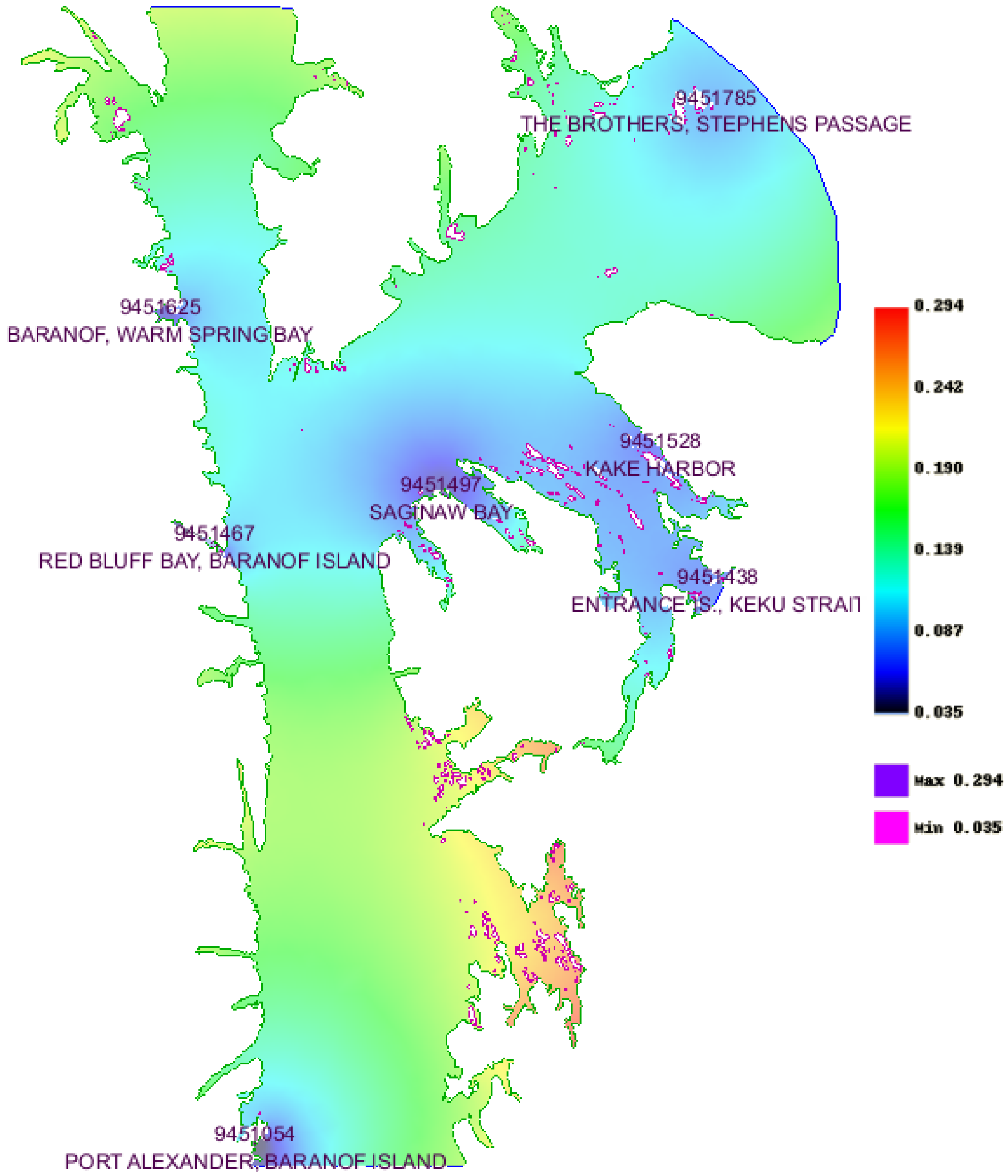
Hull ID	Measured - CTD	Measured - MVP	Surface
S221	3 meters/second	1 meters/second	0.05 meters/second
2801	3 meters/second	1 meters/second	0.15 meters/second
2802	3 meters/second	1 meters/second	0.15 meters/second
2803	3 meters/second	1 meters/second	0.15 meters/second
2804	3 meters/second	1 meters/second	0.15 meters/second

Table 6: Survey Specific Sound Speed TPU Values

Total Propagated Uncertainty values for survey H12532 were derived from a combination of fixed values for equipment and vessel characteristics, as well as field assigned values for sound speed uncertainties. Tidal uncertainties were provided by NOAA's Center for Operational Oceanographic Products and Services (CO-OPS), and were applied to depth soundings using a Tidal Constituent and Residual Interpolation (TCARI) grid. TCARI automatically calculates the uncertainty associated with water level interpolation, which is then written into the CARIS HDCS (Figure 13). For this reason, no tidal uncertainty values were entered into the Tide Value section of the CARIS Compute TPU function.

In addition to the usual a priori estimates of uncertainty, some real-time and post-processed uncertainty sources were also incorporated into the depth estimates of survey H12532. Real-time uncertainties from both the EM710 and Reson 7125 were recorded and applied in post-processing. Applanix TrueHeave files are recorded on all survey vessels, which includes an estimate of the heave uncertainty, and are applied during post-processing. Finally, the post-processed uncertainties associated with vessel roll, pitch, gyro and navigation are applied in CARIS HIPS via an SBET RMS file generated in POSPac.

Uncertainty values of submitted finalized grids were calculated in CARIS using the "Greater of the Two" of uncertainty and standard deviation (scaled to 95%). To visualize the locations in which accuracy requirements were met, for each finalized surface a custom "predicted IHO compliance" layer was created, based on the difference between calculated uncertainty of the nodes and the allowable IHO uncertainty (Figure 14). To quantify the extent to which accuracy requirements were met, the preceding "predicted IHO compliance" layers were queried within CARIS and then examined in Excel (Figure 15). Overall 100.0% by node and 100.0% by area of survey H12532 met the accuracy requirements stated in the HSSDM.



Gauge Number	Latitude	Longitude	HCs	Residuals	Datum	Gauge Radius	Station Name
9451054	56.24673692	-134.64790043	✓	✓	✓	1500	PORT ALEXANDER, BARANOF ISLAND
9451438	56.81170000	-133.78700000	✓	☐	✓	1500	ENTRANCE IS., KEKU STRAIT
9451528	56.94830600	-133.89472200	✓	☐	✓	1500	KAKE HARBOR
9451625	57.08335600	-134.82500000	✓	☐	✓	1500	BARANOF, WARM SPRING BAY
9451785	57.29657854	-133.79039095	✓	☐	✓	1500	THE BROTHERS, STEPHENS PASSAGE
9451497	56.90367600	-134.30243267	✓	☐	✓	1500	SAGINAW BAY
9451467	56.85490000	-134.72466700	✓	✓	✓	1500	RED BLUFF BAY, BARANOF ISLAND

Figure 13: Final TCARI grid for OPR-O322-RA-13.

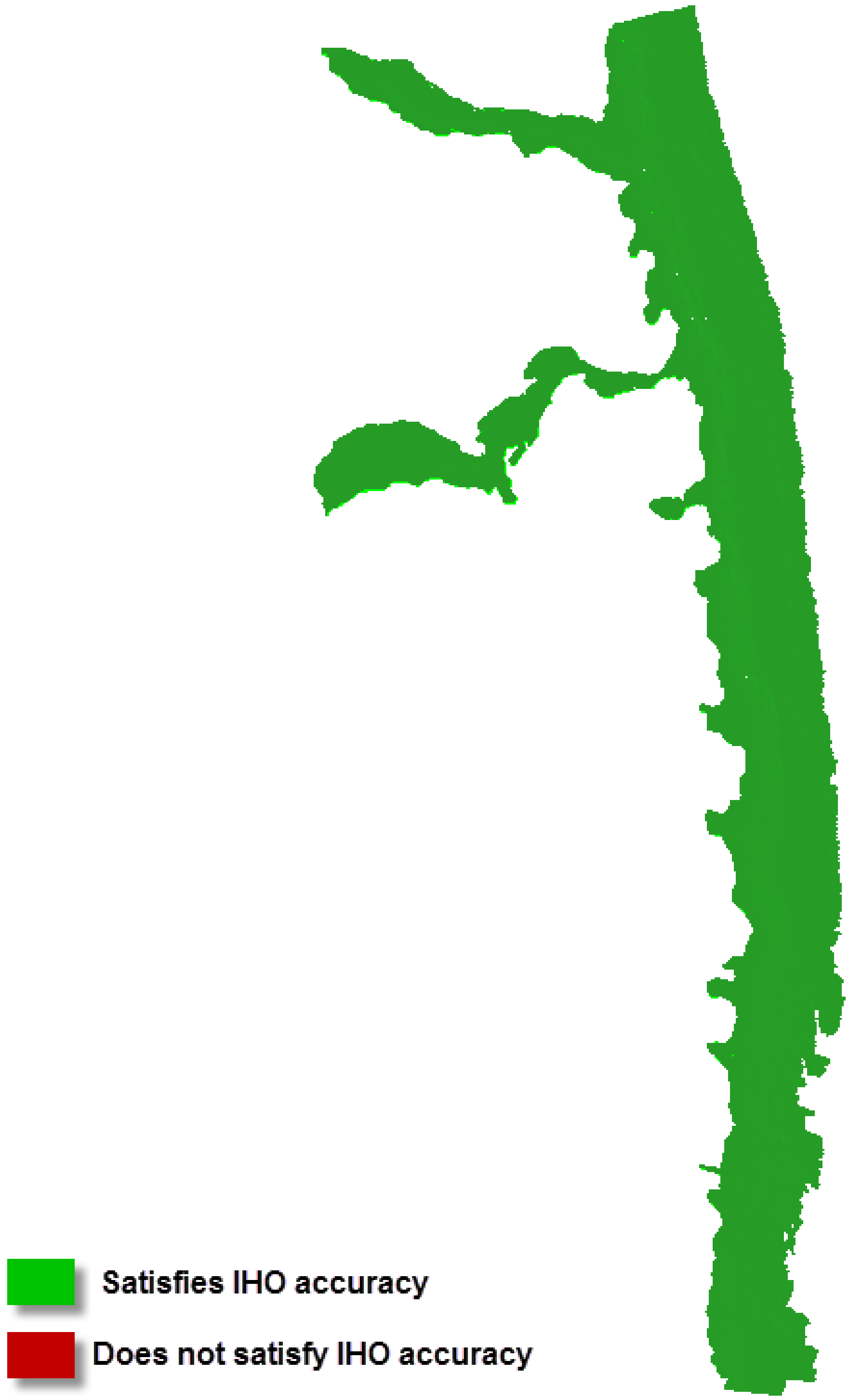


Figure 14: H12532 met IHO accuracy standards for100.0% of the survey area.

Resolution	Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
1m	0 - 40m	Order 1	6,900,749	6,900,742	100.0%
2m	18 - 80m	Order 1	2,507,286	2,507,276	100.0%
4m	36 - 160m	Order 1	848,342	848,330	100.0%
8m	72 - 320m	Order 1	277,399	277,398	100.0%
8m	100 - 320m	Order 2	277,399	277,398	100.0%
16m	144 - 1000m	Order 2	165,879	165,878	100.0%
32m	288 - 1000m	Order 2	33,294	33,294	100.0%
		TOTAL:	11,010,348	11,010,316	**100.0%**
		TOTAL (by area):	142,568,517	142,567,894	**100.0%**

Figure 15: Summary table showing the percentage of nodes satisfying the indicated IHO accuracy level, sub-divided by the appropriate depth ranges. Note: The final row has a unit of square meters, and sums of different resolution nodes into a common unit of area.

B.2.3 Junctions

Five junction comparisons were completed for H12532 (Figure 16). Three of these surveys (H12533, H12534, H12537) were acquired concurrently with this survey and two surveys (H12373, H12370) were completed in 2011 by NOAA Ship FAIRWEATHER. Depth comparisons were performed using the CARIS Difference Surface and CARIS Subset Editor.

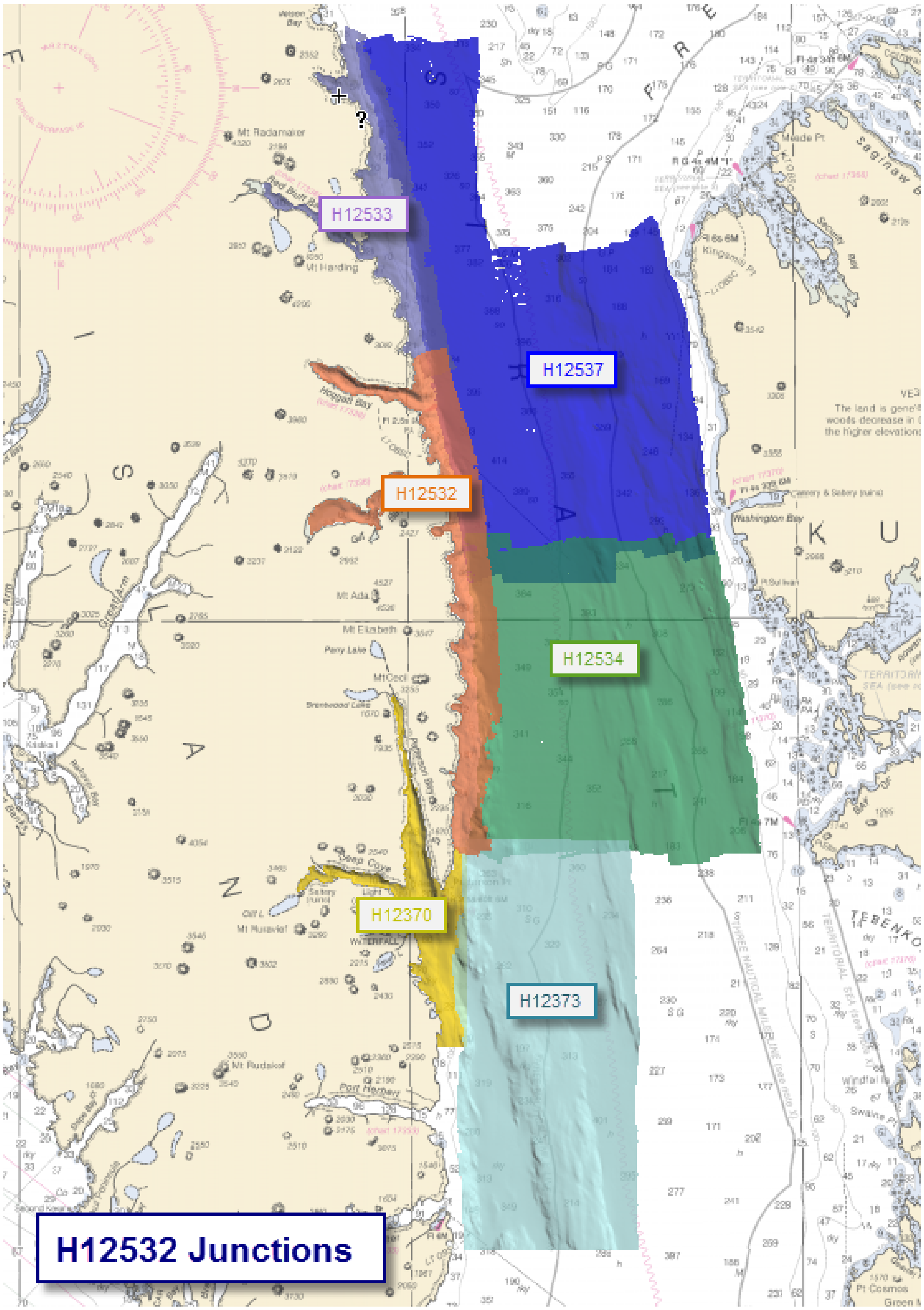


Figure 16: H12532 junction overview.

H12537

Overlap with survey H12537 was mostly 1,400 meters wide along the northeastern boundary of H12532 (Figure 17). Depths in the junction area range from approximately 495 to 725 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12532 to be an average of 0.27 meters shoaler than H12537, with a standard deviation of 2.92 meters (Figure 18).

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 19). In total, 99.5% of the depth differences between H12532 and junctioning survey H12537 are within allowable IHO accuracies (Figure 20). Inspection of the data in CARIS Subset Editor (Figure 21), shows agreement between the two surveys, suggesting the majority of the inconsistencies seen in the difference surface are just artifacts of the gridding algorithm along the steep and deep slopes of Chatham Strait.

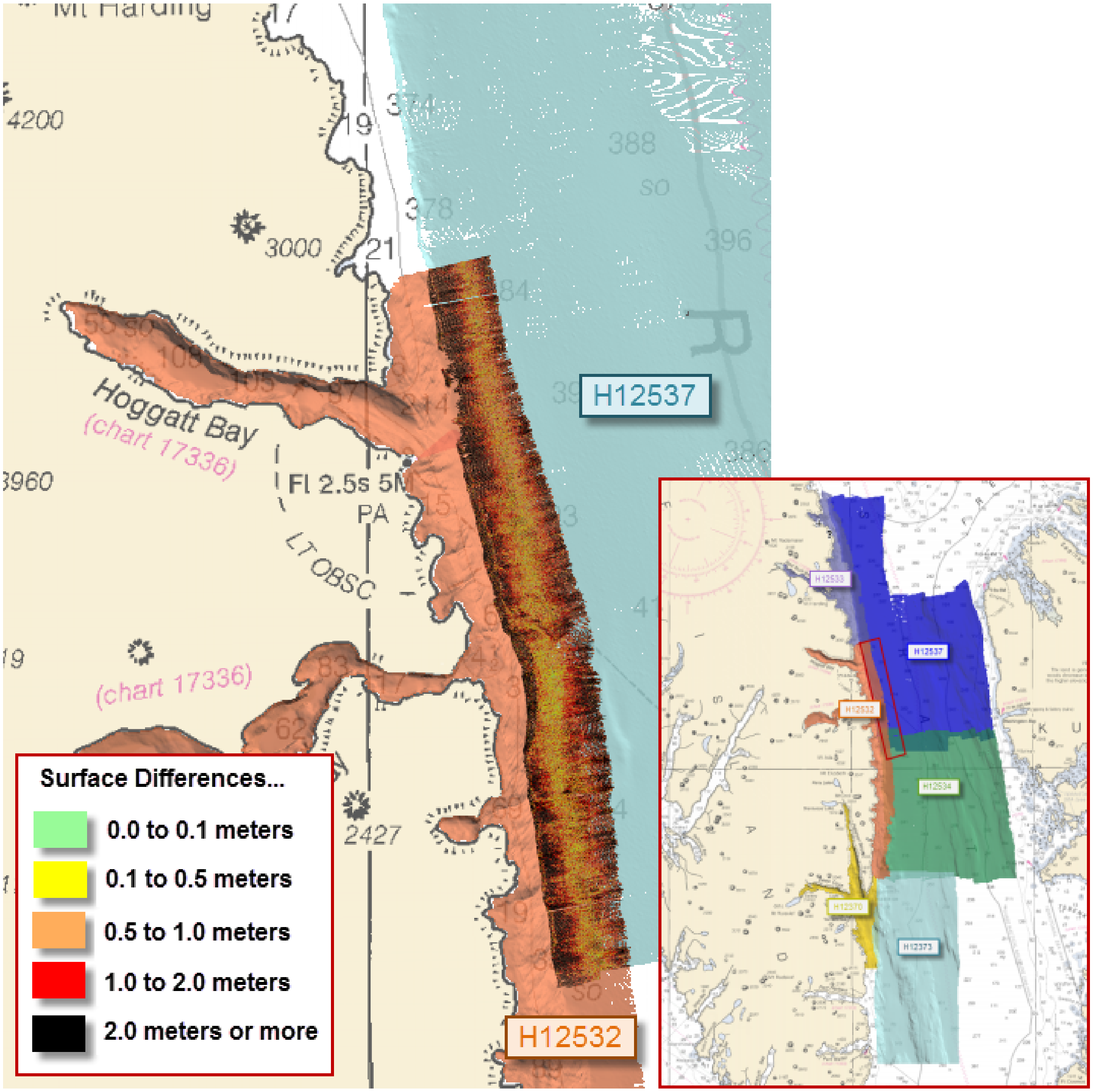


Figure 17: Junction between H12532 (orange) and H12537 (blue).

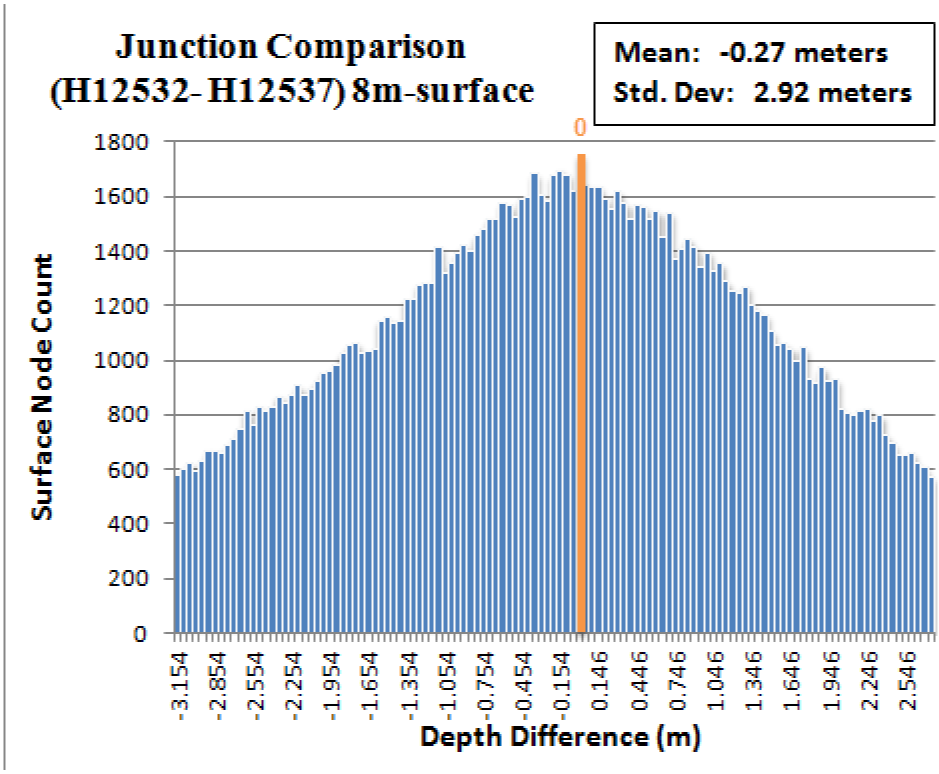


Figure 18: Difference surface statistics between H12532 and H12537 CUBE depth layer (8m grid size). H12532 is an average of 0.27m shoaler.

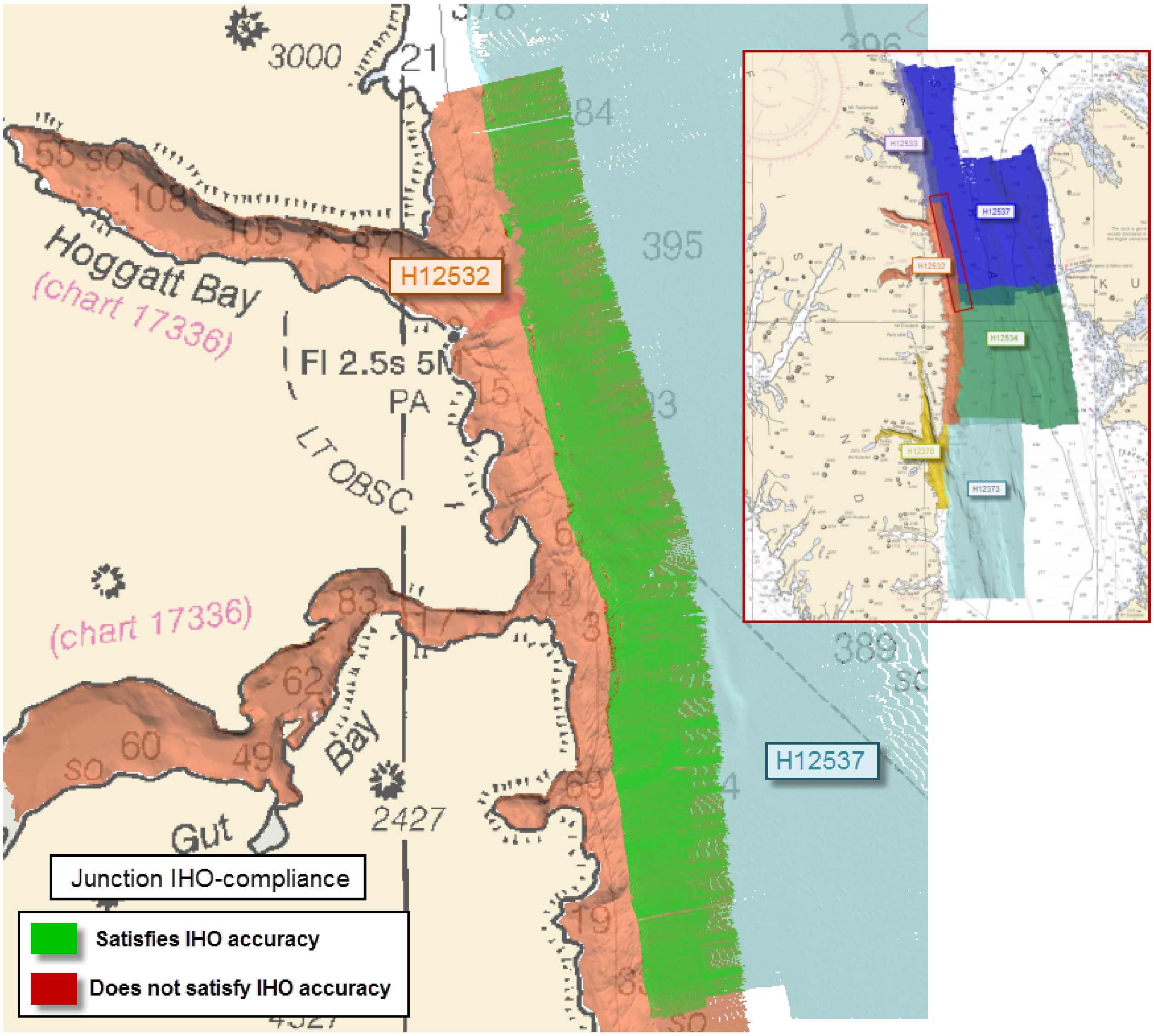


Figure 19: Depth difference between H12532 and junctioning survey H12537 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Greater than 100m	Order 2	172,353	171,555	99.5%

Figure 20: Summary table showing percentage of difference surface nodes between H12532 and junctioning survey H12537 that meet allowable IHO accuracy standards for the associated depths.

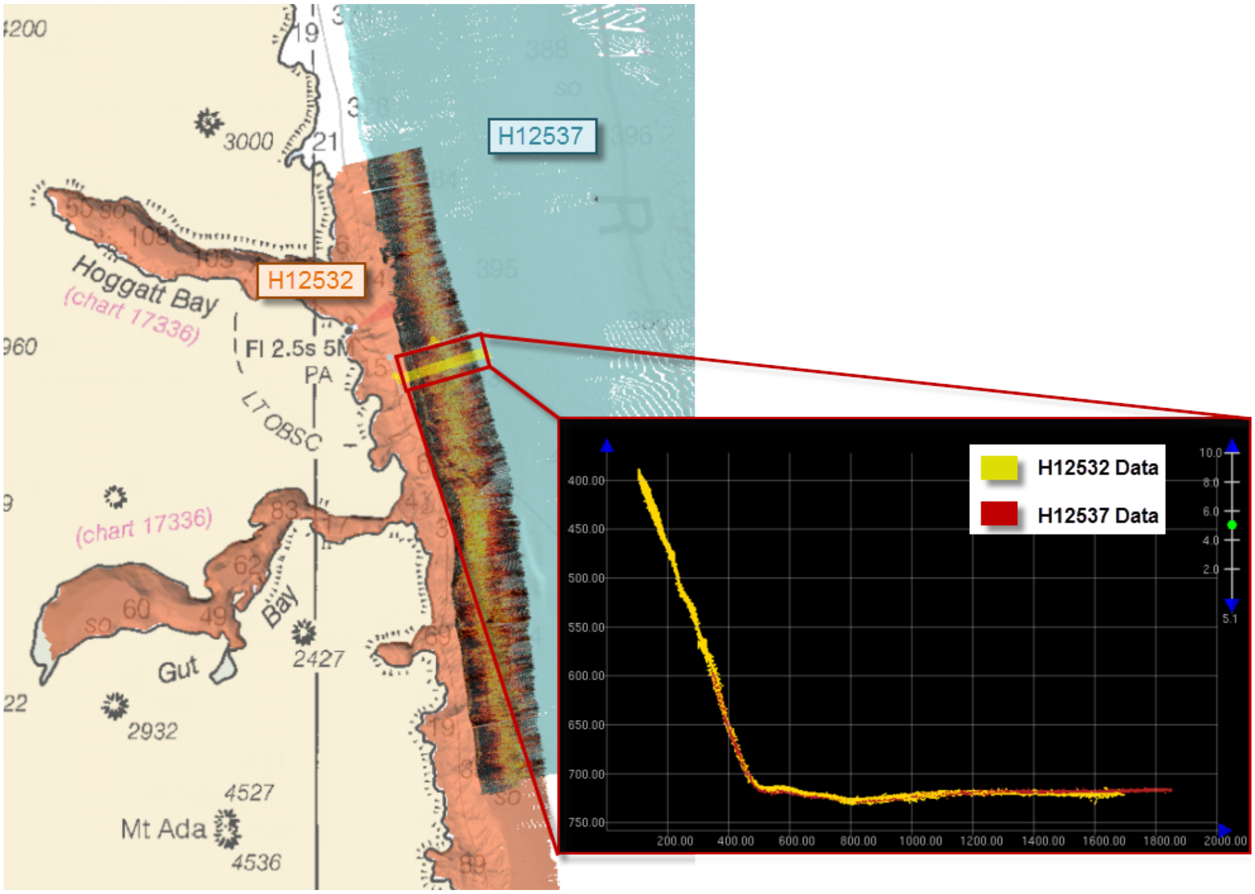


Figure 21: Subset view of sounding data between H12532 (yellow) and junctioning survey H12537 (red).

<u>H12534</u>

Overlap with survey H12534 was mostly 1,300 meters wide along the southeastern boundary of H12532 (Figure 22). Depths in the junction area range from approximately 185 to 685 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12534 to be an average of 0.24 meters shoaler than H12532, with a standard deviation of 2.71 meters (Figure 23).

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 24). In total, 99.2% of the depth differences between H12532 and junctioning survey H12534 are within allowable IHO accuracies (Figure 25). Inspection of the data in CARIS Subset Editor (Figure 26), shows agreement between the two surveys, suggesting the majority of the inconsistencies seen in the difference surface are just artifacts of the gridding algorithm along the steep and deep slopes of Chatham Strait.

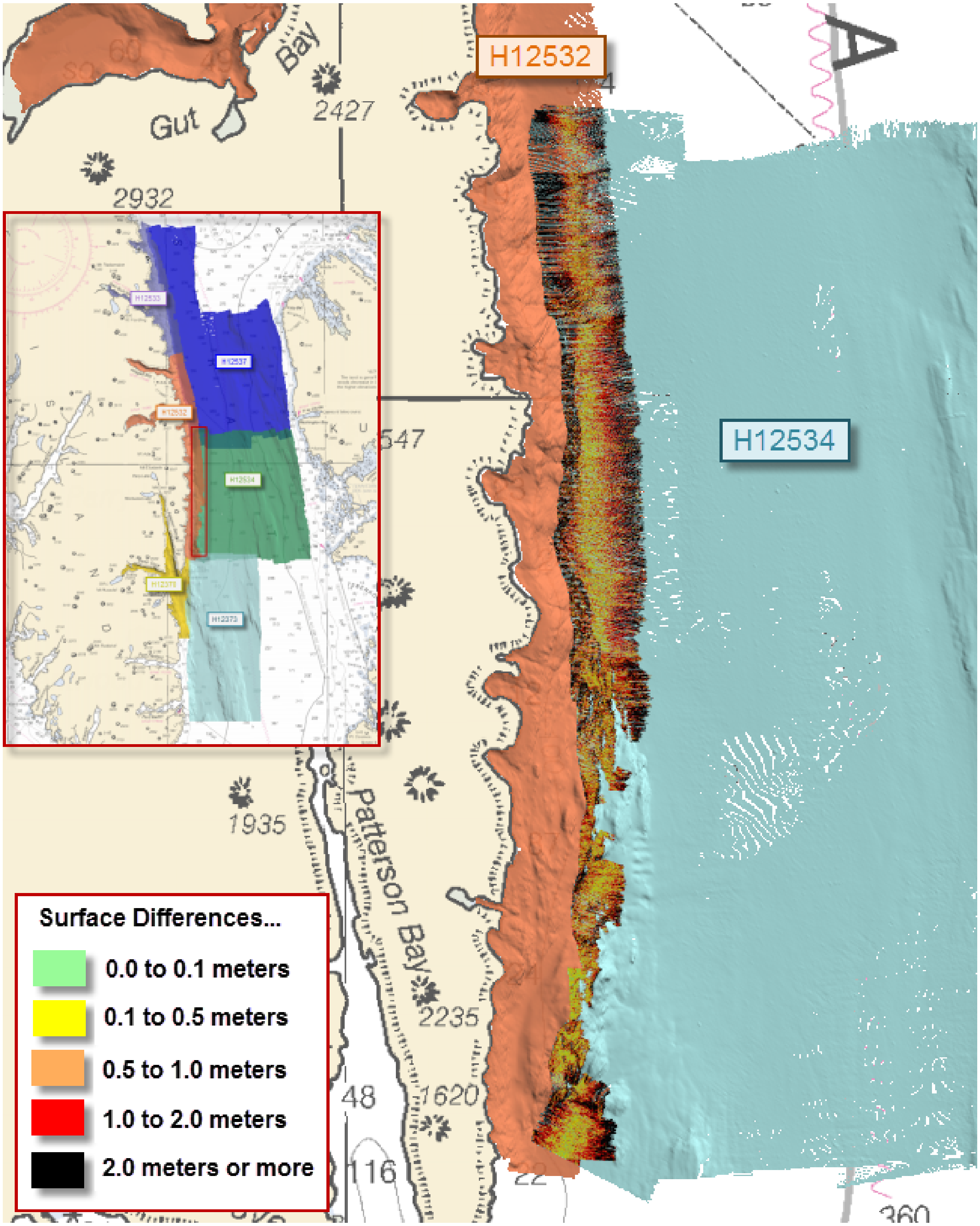


Figure 22: Junction between H12532 (orange) and H12534 (blue).

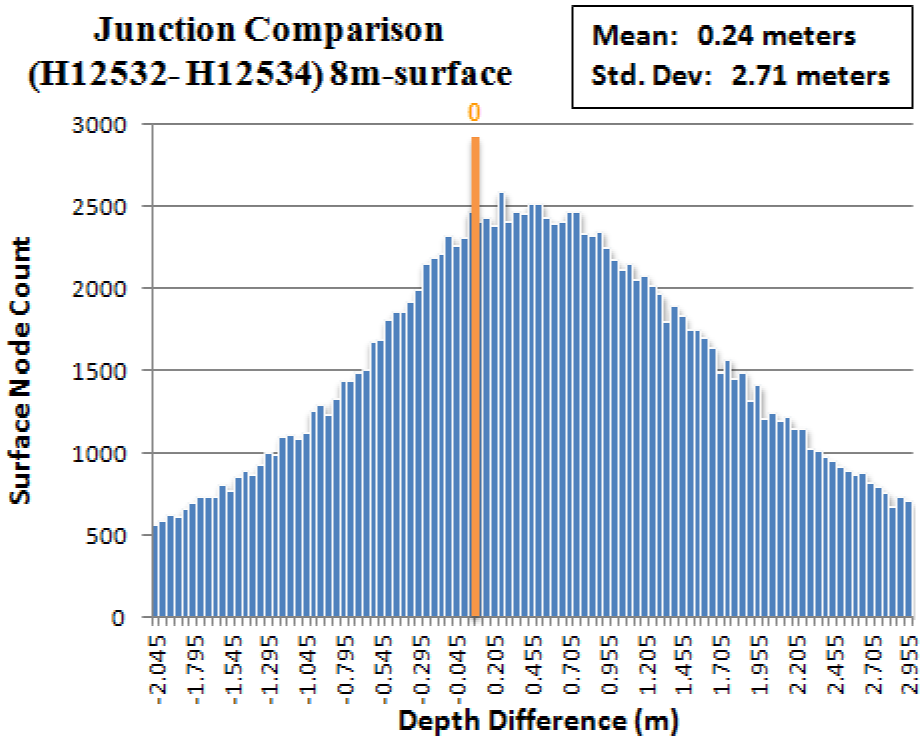


Figure 23: Difference surface statistics between H12532 and H12534 CUBE depth layer (8m grid size). H12534 is an average of 0.24m shoaler.

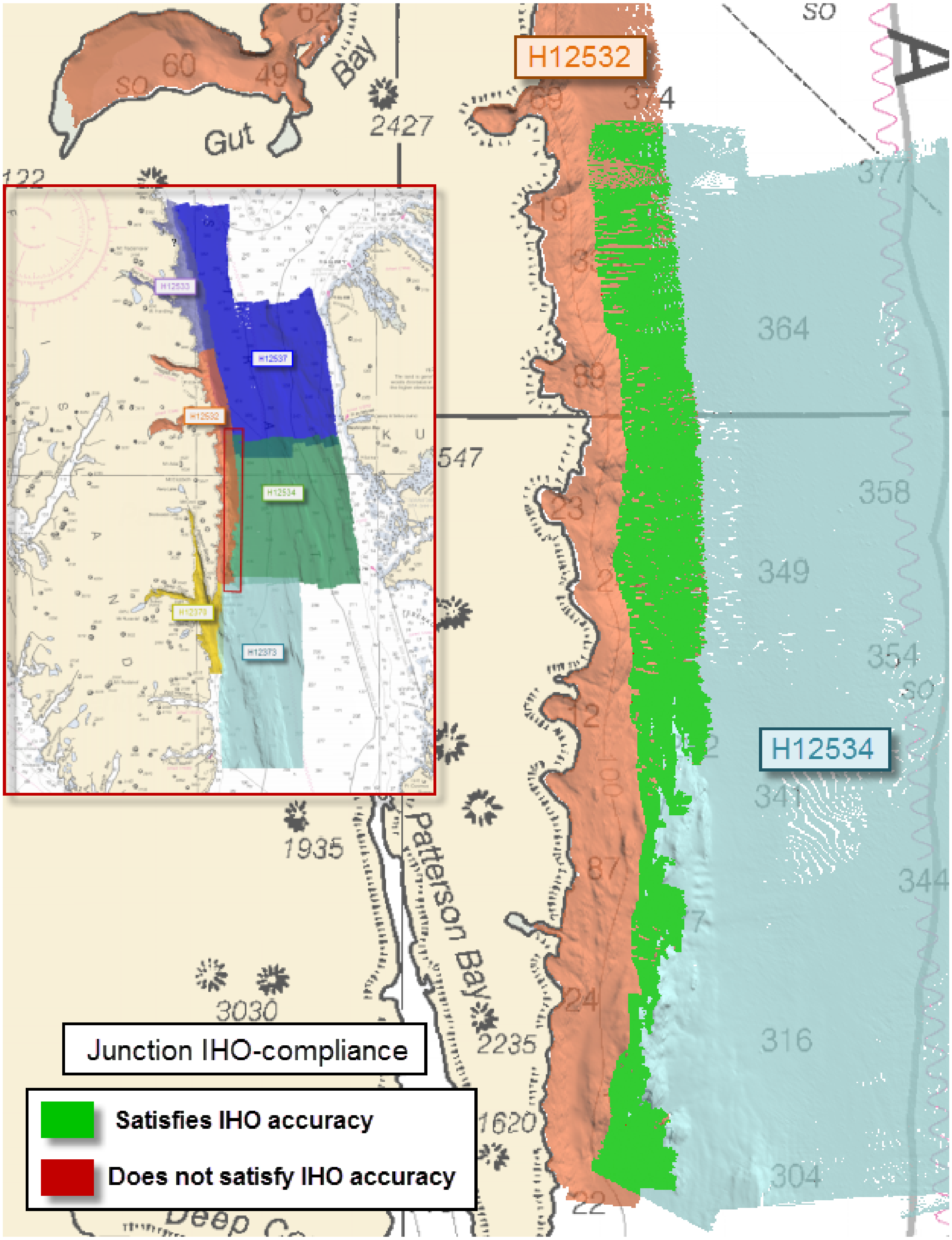


Figure 24: Depth difference between H12532 and junctioning survey H12534 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Greater than 100m	Order 2	198,514	196,953	99.2%

Figure 25: Summary table showing percentage of difference surface nodes between H12532 and junctioning survey H12534 that meet allowable IHO accuracy standards for the associated depths.

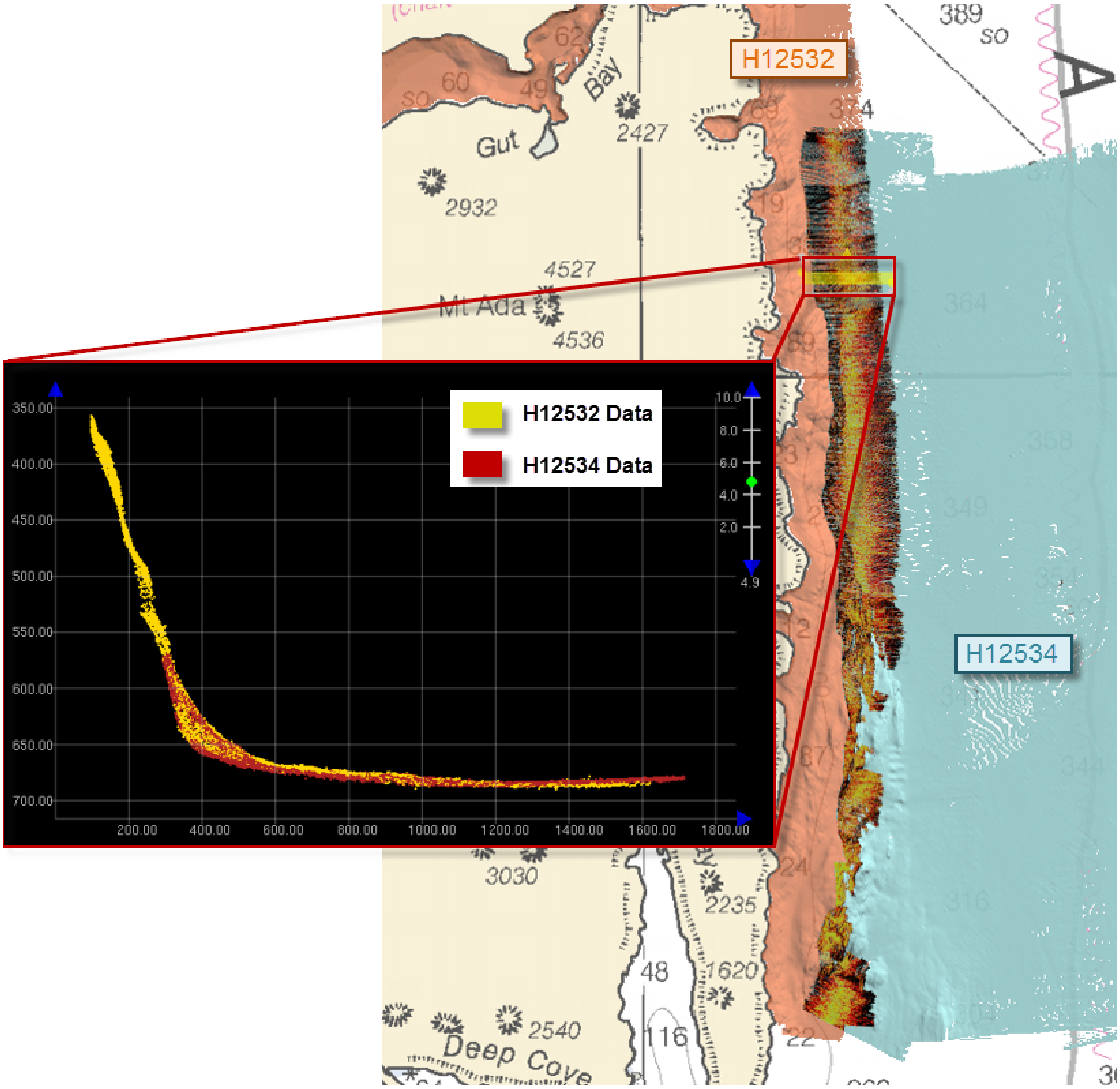


Figure 26: Subset view of sounding data between H12532 (yellow) and junctioning survey H12534 (red).

<u>H12533</u>

Overlap with survey H12533 was mostly 1,250 meters wide along the northern boundary of H12532 (Figure 27). Depths in the junction area range from approximately 8 to 715 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12532 to be an average of 0.40 meters shoaler than H12533, with a standard deviation of 3.63 meters (Figure 28).

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 29). Given the steepness of the slope in the area there were only 213 nodes in depths less than 100m and thus a very low percentage of nodes satisfying IHO Order 1 accuracies. In total, 96.4% of the depth differences between H12532 and junctioning survey H12533 are within allowable IHO accuracies (Figure 30). Inspection of the data in CARIS Subset Editor (Figure 31), shows agreement between the two surveys, suggesting the majority of the inconsistencies seen in the difference surface are just artifacts of the gridding algorithm along the steep and deep slopes of Chatham Strait.

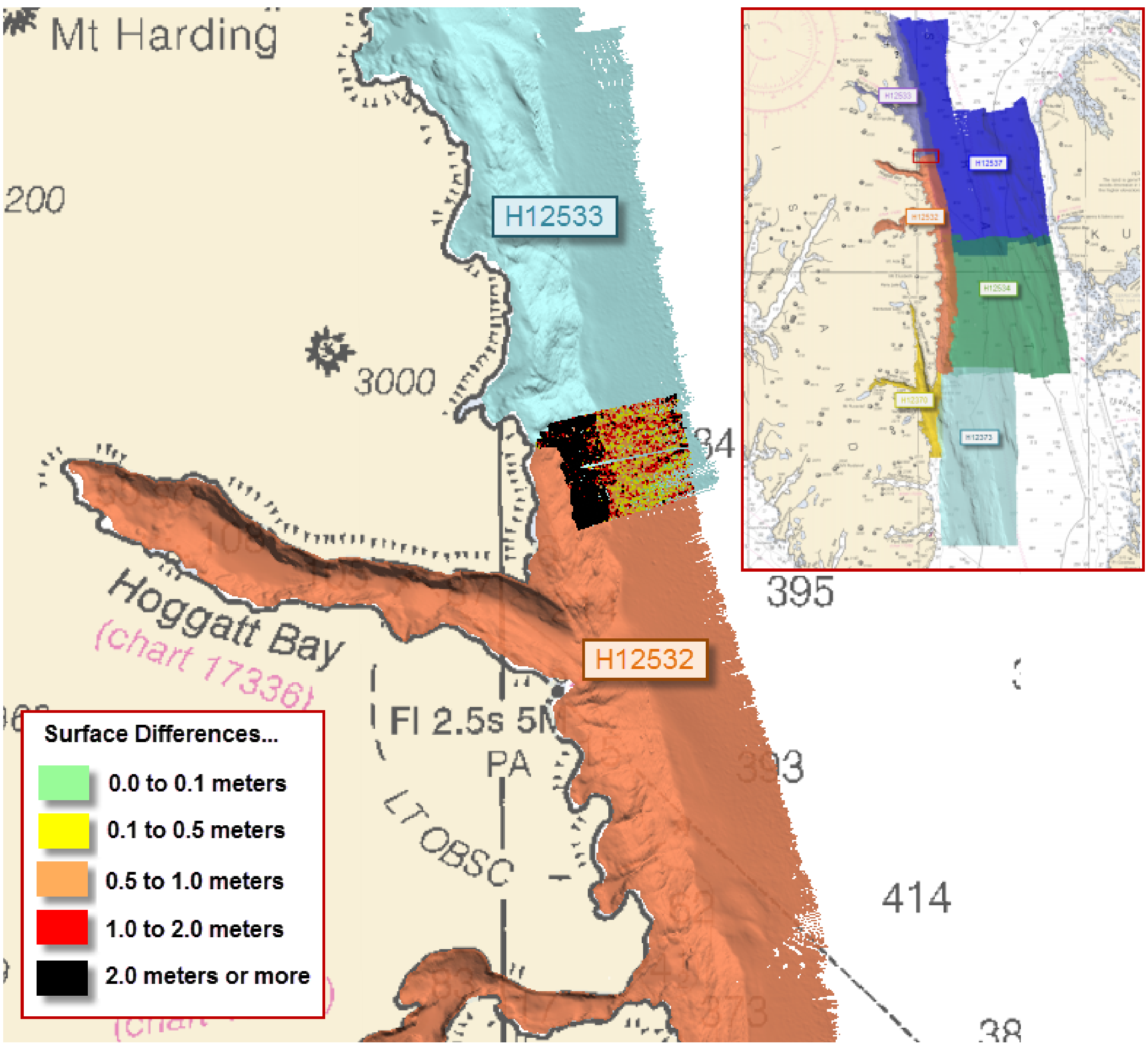


Figure 27: Junction between H12532 (orange) and H12533 (blue).

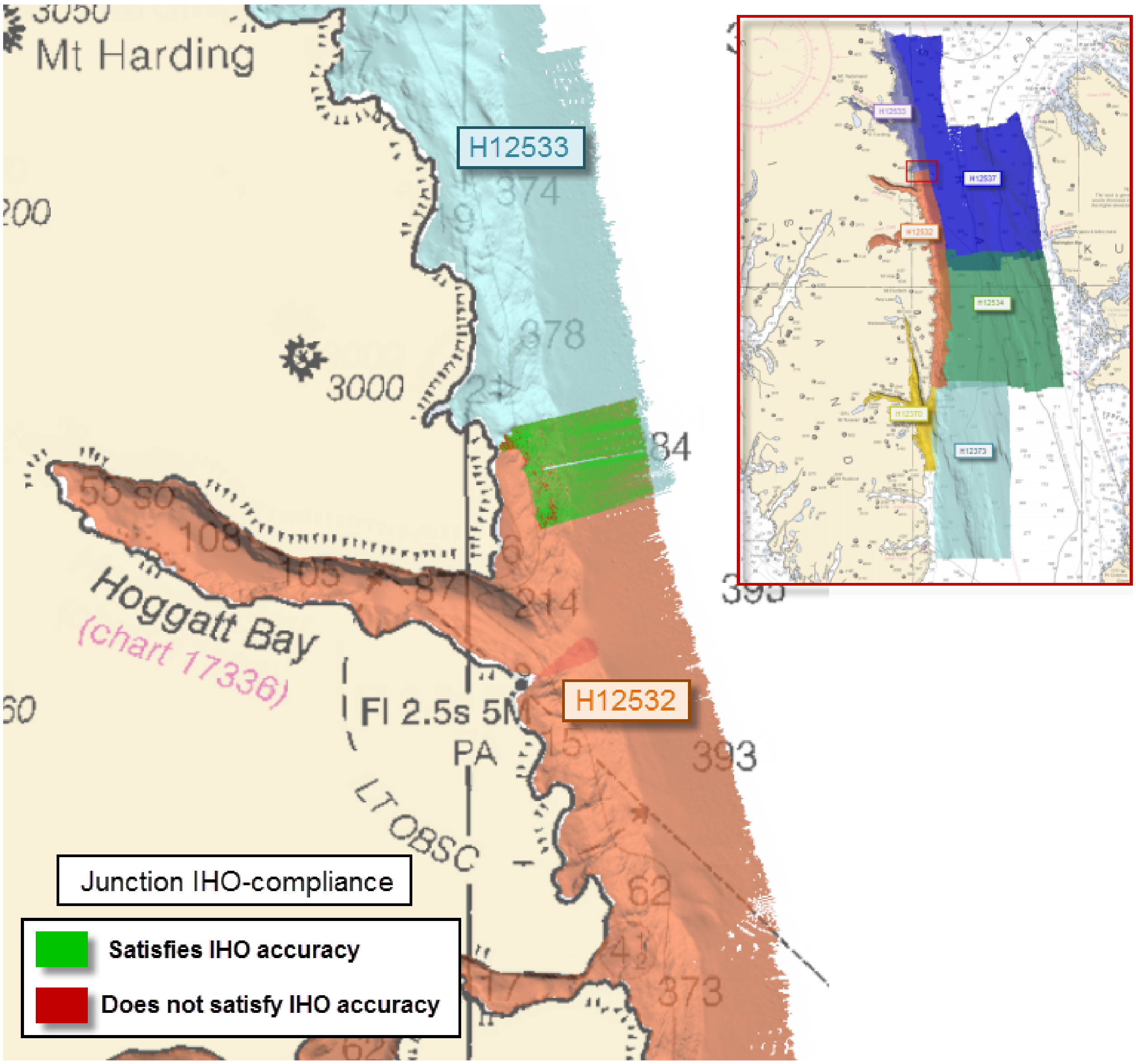


Figure 28: Depth difference between H12532 and junctioning survey H12533 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Less than 100m	Order 1	213	102	47.9%
Greater than 100m	Order 2	19,604	19,001	96.9%
	TOTAL:	19,817	19,103	96.4%

Figure 29: Summary table showing percentage of difference surface nodes between H12532 and junctioning survey H12533 that meet allowable IHO accuracy standards for the associated depths.

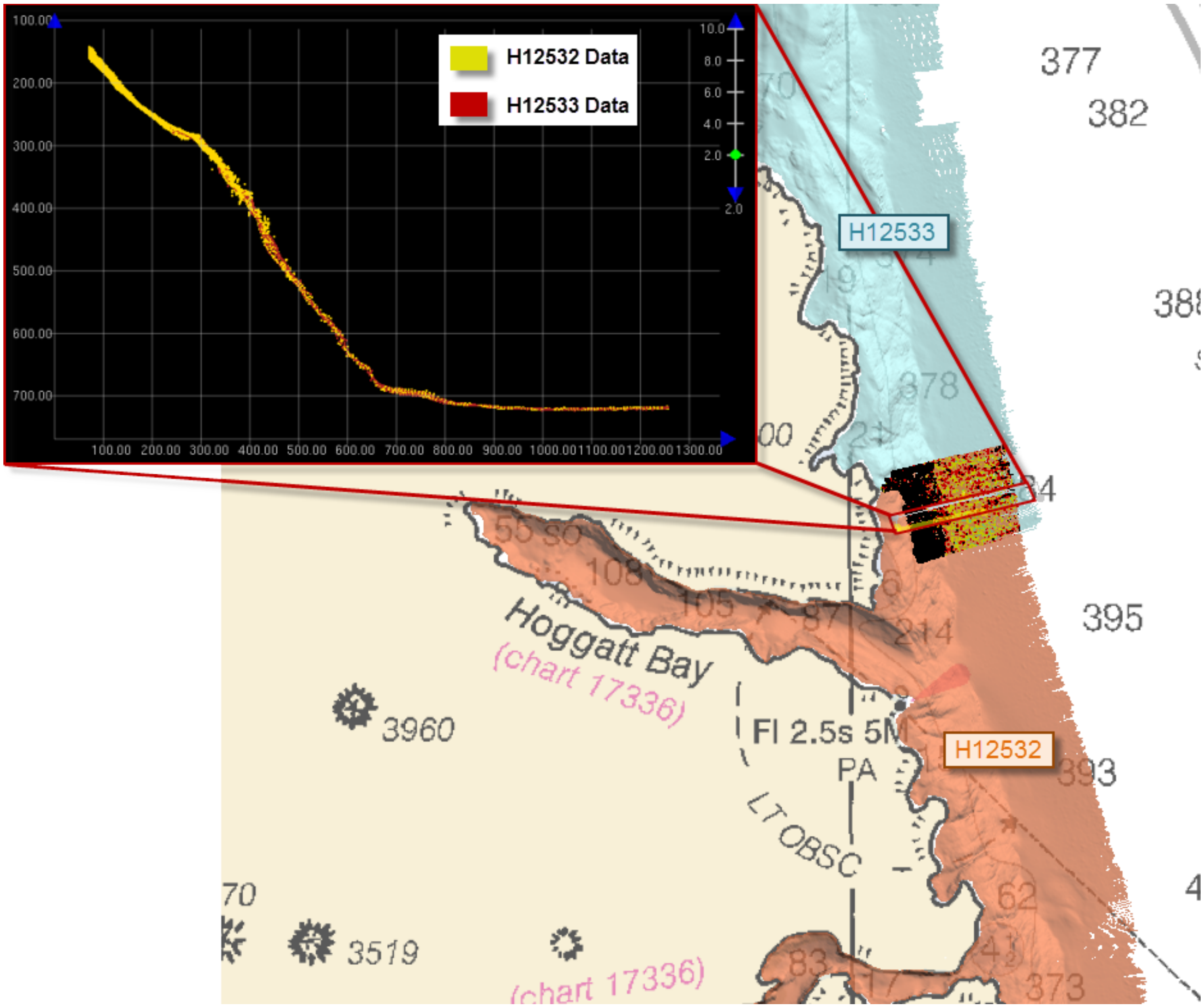


Figure 30: Subset view of sounding data between H12532 (yellow) and junctioning survey H12533 (red).

<u>H12370</u>

Overlap with survey H12370 was mostly 575 meters wide along the southwestern boundary of H12532 (Figure 32). Depths in the junction area range from approximately 11 to 399 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12370 to be an average of 2.26 meters shoaler than H12532, with a standard deviation of 6.39 meters (Figure 33).

The junction between these two surveys is along the steep slopes of Chatham Strait, which may be causing a gridding artifact when differencing the two surfaces. For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 34). In total, 53.9% of the depth differences between H12532 and junctioning survey H12370 are within allowable IHO accuracies (Figure 35). This junction was not examined in CARIS Subset Editor because the sounding data was not available at the time of the comparison.

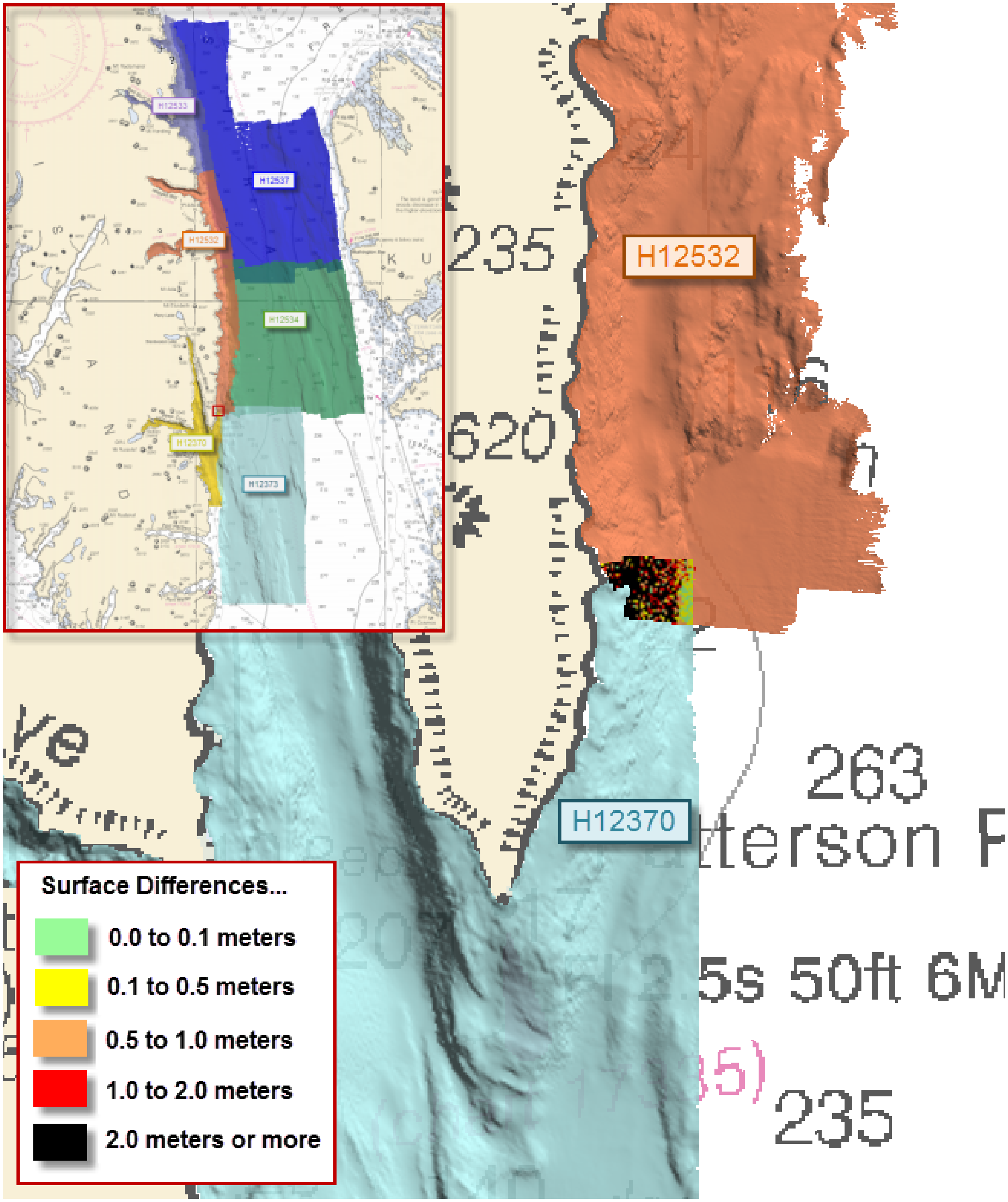


Figure 31: Junction between H12532 (orange) and H12370 (blue).

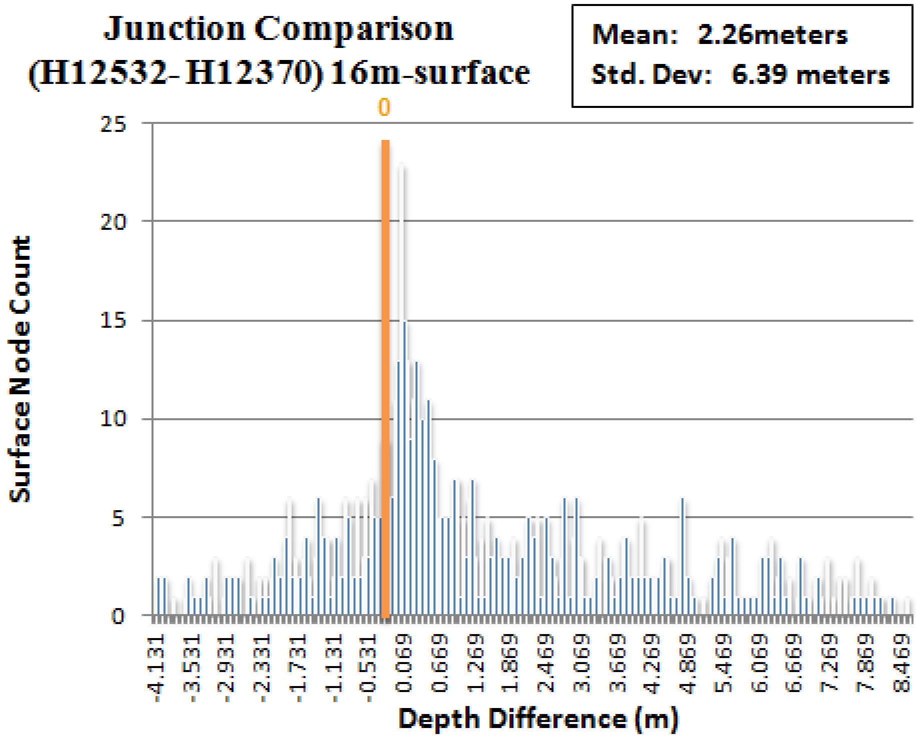


Figure 32: Difference surface statistics between H12532 and H12370 CUBE depth layer (16m grid size). H12370 is an average of 2.26m shoaler.

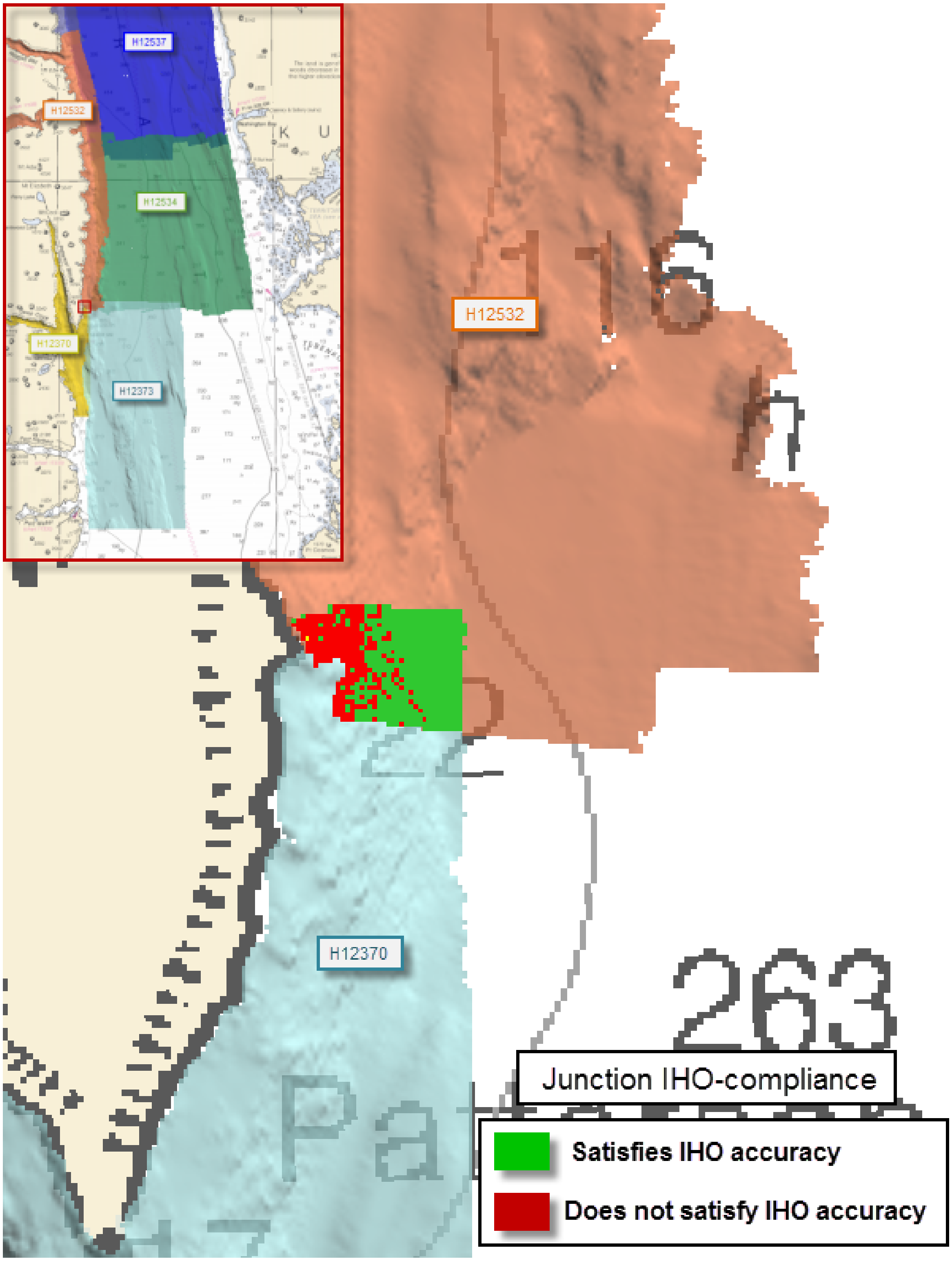


Figure 33: Depth difference between H12532 and junctioning survey H12370 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Less than 100m	Order 1	826	484	58.6%
Greater than 100m	Order 2	88	9	10.2%
	TOTAL:	914	493	**53.9%**

Figure 34: Summary table showing percentage of difference surface nodes between H12532 and junctioning survey H12370 that meet allowable IHO accuracy standards for the associated depths.

H12373

Overlap with survey H12373 was mostly 1,500 meters wide along the southeastern boundary of H12532 (Figure 36). Depths in the junction area range from approximately 195 to 440 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12532 to be an average of 0.36 meters shoaler than H12373, with a standard deviation of 4.11 meters (Figure 37).

The junction between these two surveys is along the steep slopes of Chatham Strait, which may be causing a gridding artifact when differencing the two surfaces. For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 38). In total, 94.1% of the depth differences between H12532 and junctioning survey H12373 are within allowable IHO accuracies (Figure 39). This junction was not examined in CARIS Subset Editor because the sounding data was not available at the time of the comparison.

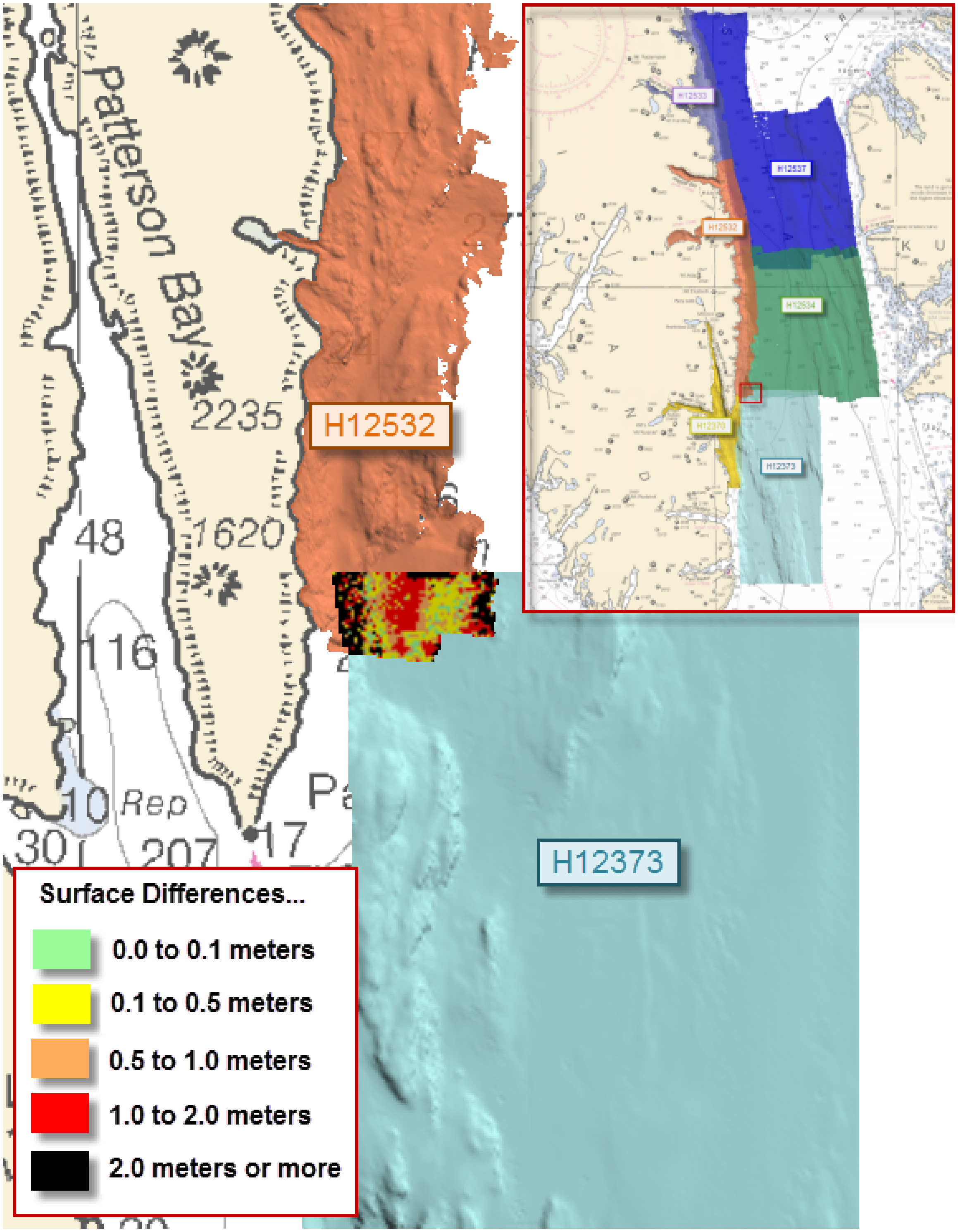


Figure 35: Junction between H12532 (orange) and H12373 (blue).

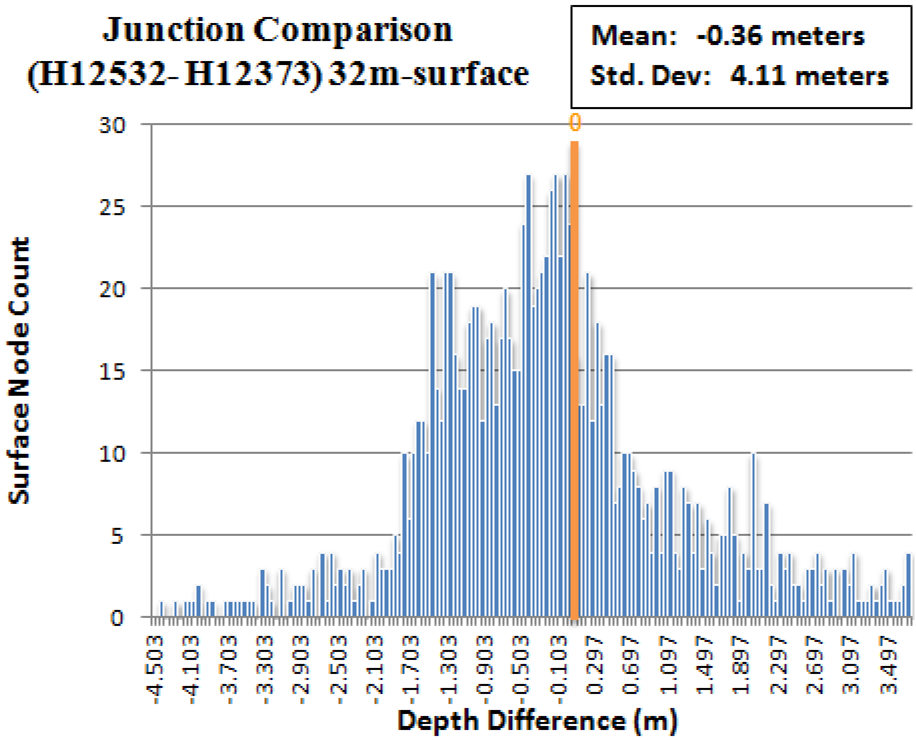


Figure 36: Difference surface statistics between H12532 and H12373 CUBE depth layer (32m grid size). H12532 is an average of 0.36m shoaler.

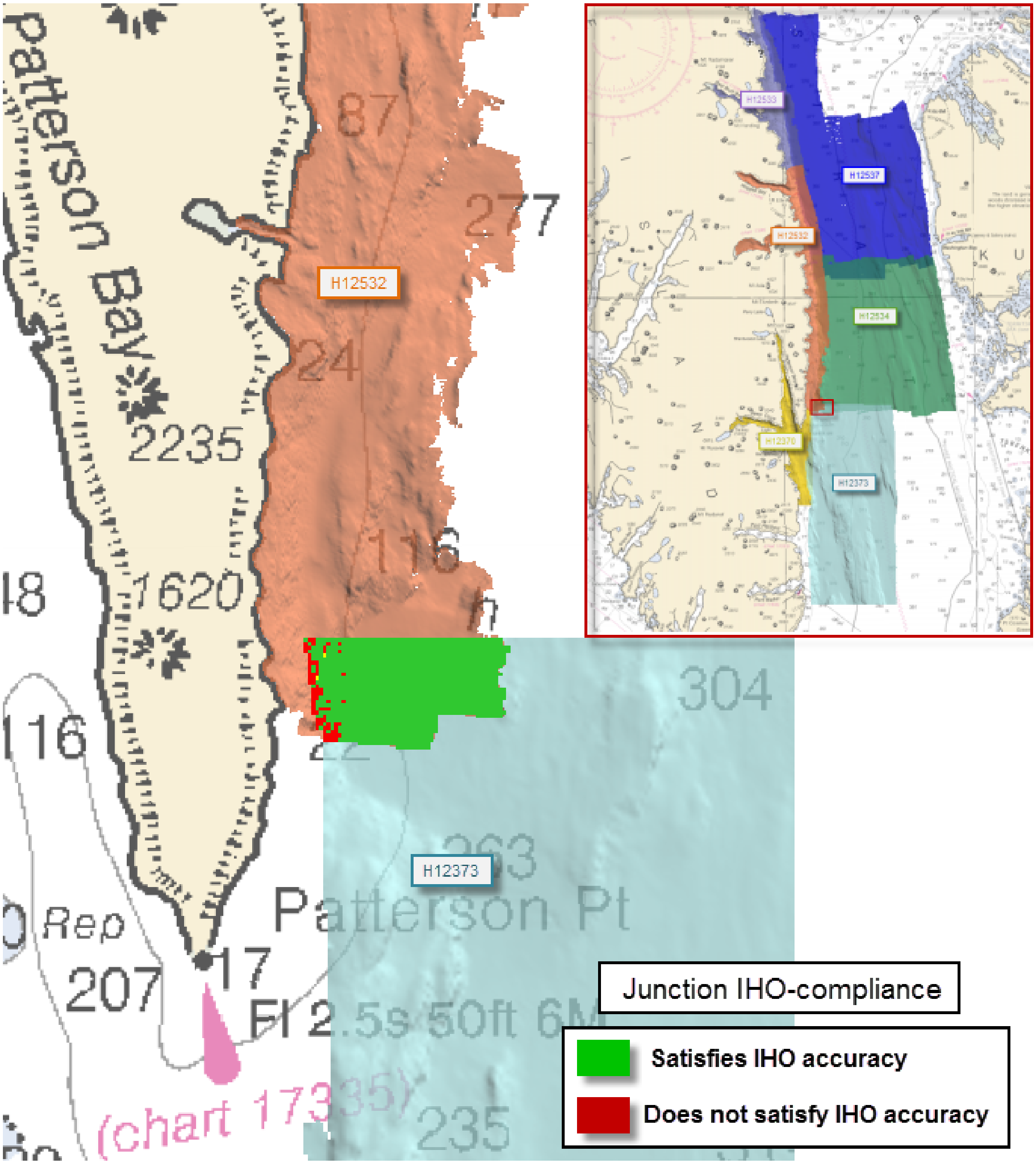


Figure 37: Depth difference between H12532 and junctioning survey H12373 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Greater than 100m	Order 2	1,274	1,199	94.1%

Figure 38: Summary table showing percentage of difference surface nodes between H12532 and junctioning survey H12373 that meet allowable IHO accuracy standards for the associated depths.

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

<u>Sound Speed Artifacts</u>

Despite the attempts of the survey crews to spatially and temporally collect sound speed profiles, artifacts were seen within the data in the form of 'smiles' or 'frowns', particularly in Gut Bay and Hoggatt Bay (Figure 40). In these areas, the outer beams were flagged as rejected to assist the gridding algorithm to better represent the true seafloor, as well as bring it within the accuracy specifications defined in the HSSDM (Figure 41). Additionally there is one line (2802013_1481915) in Gut Bay that has a sound speed artifact which deviates by over 0.5 meters from the suspected true seafloor. This artifact exceeds the maximum allowable error as described in HSSD 5.2.3.5 “Error Budget Analysis for Depths”. Given that there is no additional data in this area, the soundings were not rejected and the Hydrographer recommends that this data supersede the chart.

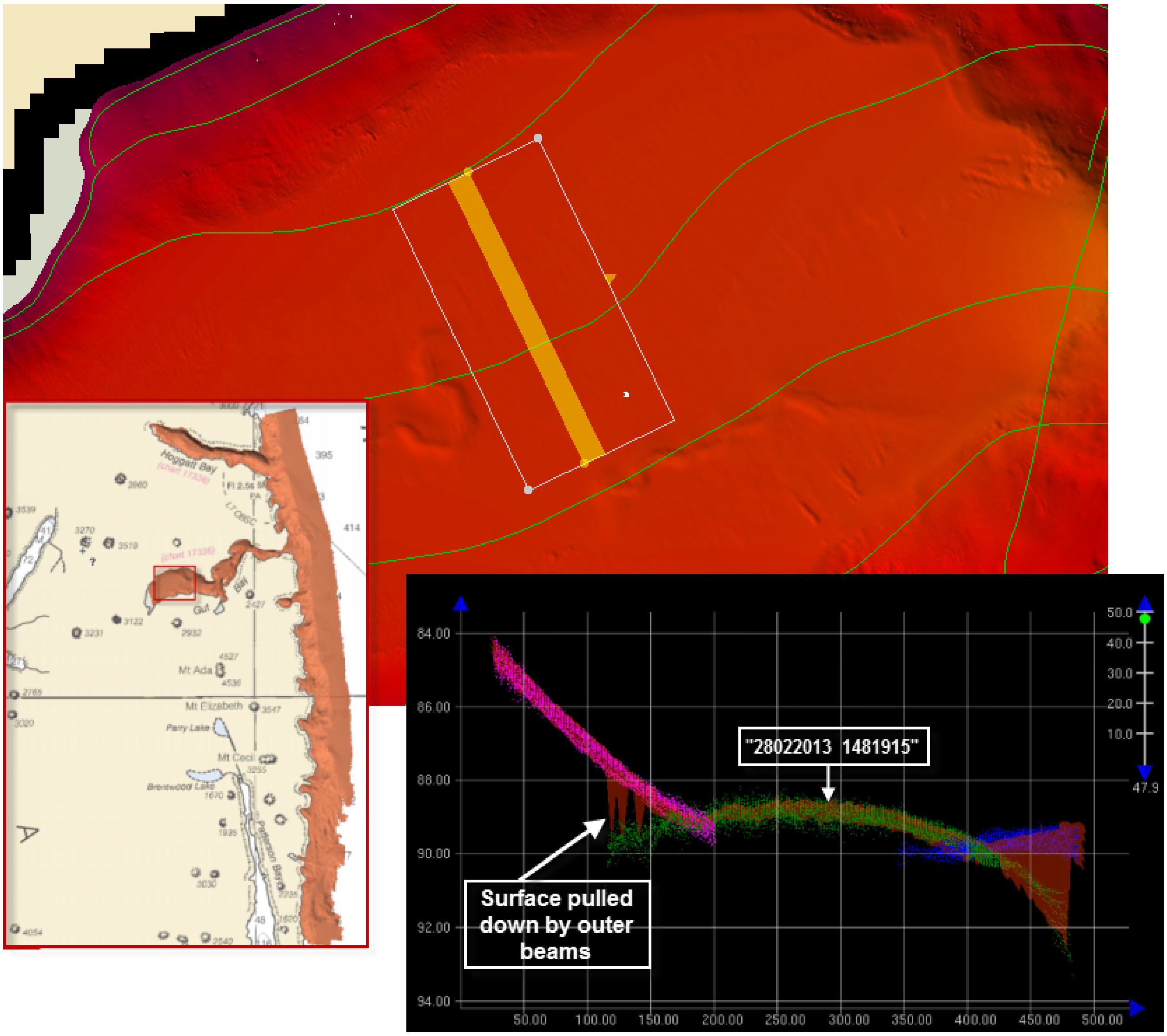


Figure 39: Example of sound speed artifact seen within H12532 prior to cleaning.

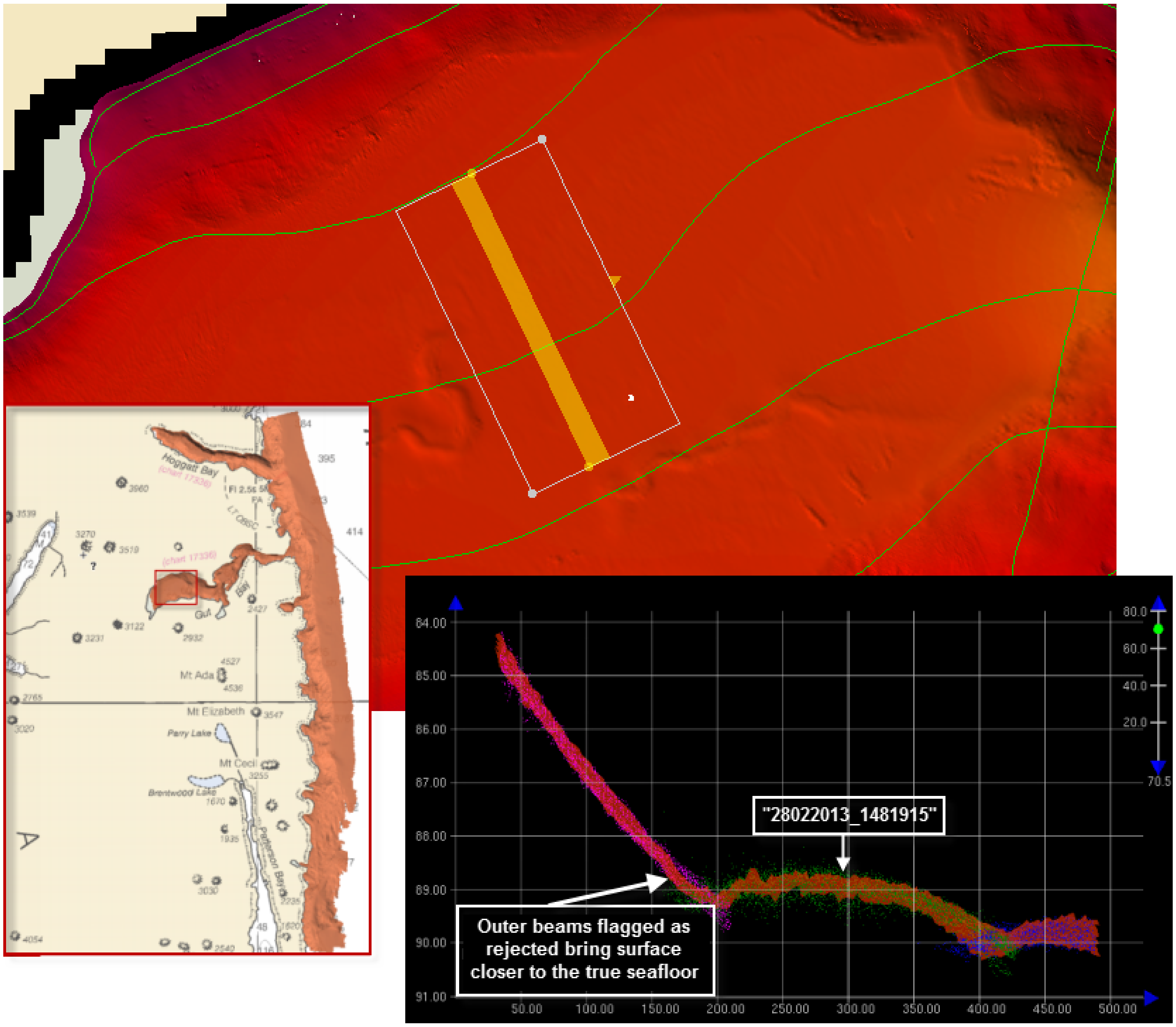


Figure 40: Example of sound speed artifact seen within H12532 after cleaning.

For clarification, outer beam data from line 1481915 were rejected by the field unit to mitigate sound speed errors. The largest sound speed errors are in depths greater than 80 meters. The data is within IHO Order tolerance for depth and is adequate for charting.

Ellipsoid-to-Tidal Surface Comparison

Using the GPS height determined from the SBET file, data from H12532 was referenced to the ITRF00 ellipsoid and gridded. By differencing this ellipsoidally-referenced surface (ERS) from the traditional tidally-referenced surface, one should only see the ellipsoidal slope across the length of the survey. Any deviations from this slope would therefore be the result of an error intrinsic to either the ERS or tidal processing work flow. For example, misprojected SBETs, current-induced dynamic draft, incorrect waterline measurements, corrupt True Heave files, or poorly-modeled water levels are all examples of artifacts that can be identified through the difference of the ERS and tidally-referenced surfaces.

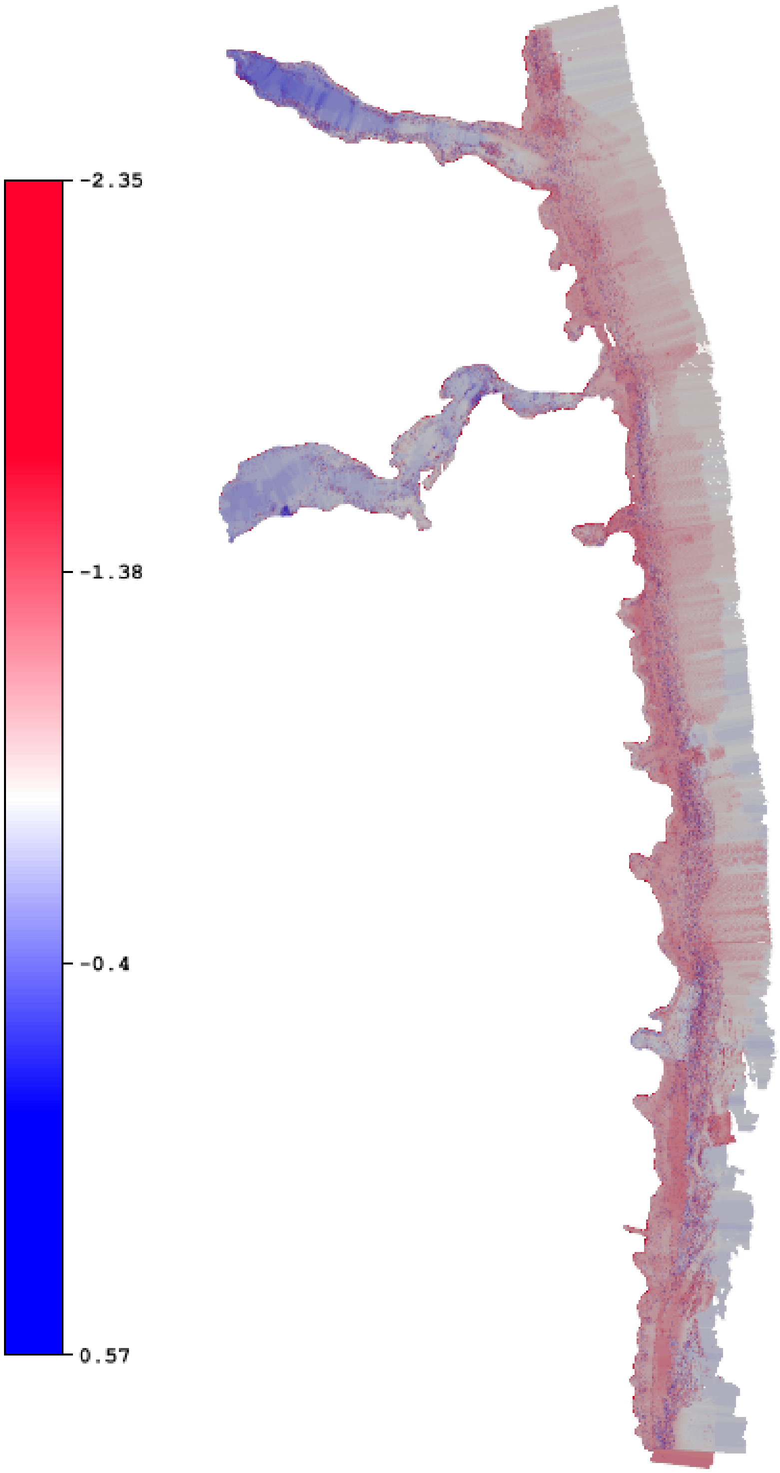


Figure 41: Difference surface between the ellipsoidally-referenced and tidally-referenced surfaces.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: For data collected by launches, sound speed profiles were acquired using the SBE 19 and SBE 19plus CTDs at discrete locations within the survey area at least once every four hours, when large changes in surface sound speed were apparent, and when moving to a new area. For data collected on S221 (RAINIER), sound speed profiles were acquired using the Rolls Royce MVP200 approximately every 15 minutes or when recommended by "CastTime", a cast frequency program developed at the University of New Hampshire. All casts were concatenated into a master file for each vessel and applied to lines using the "Nearest in distance within time (4 hours)" selection method (Figure 43).

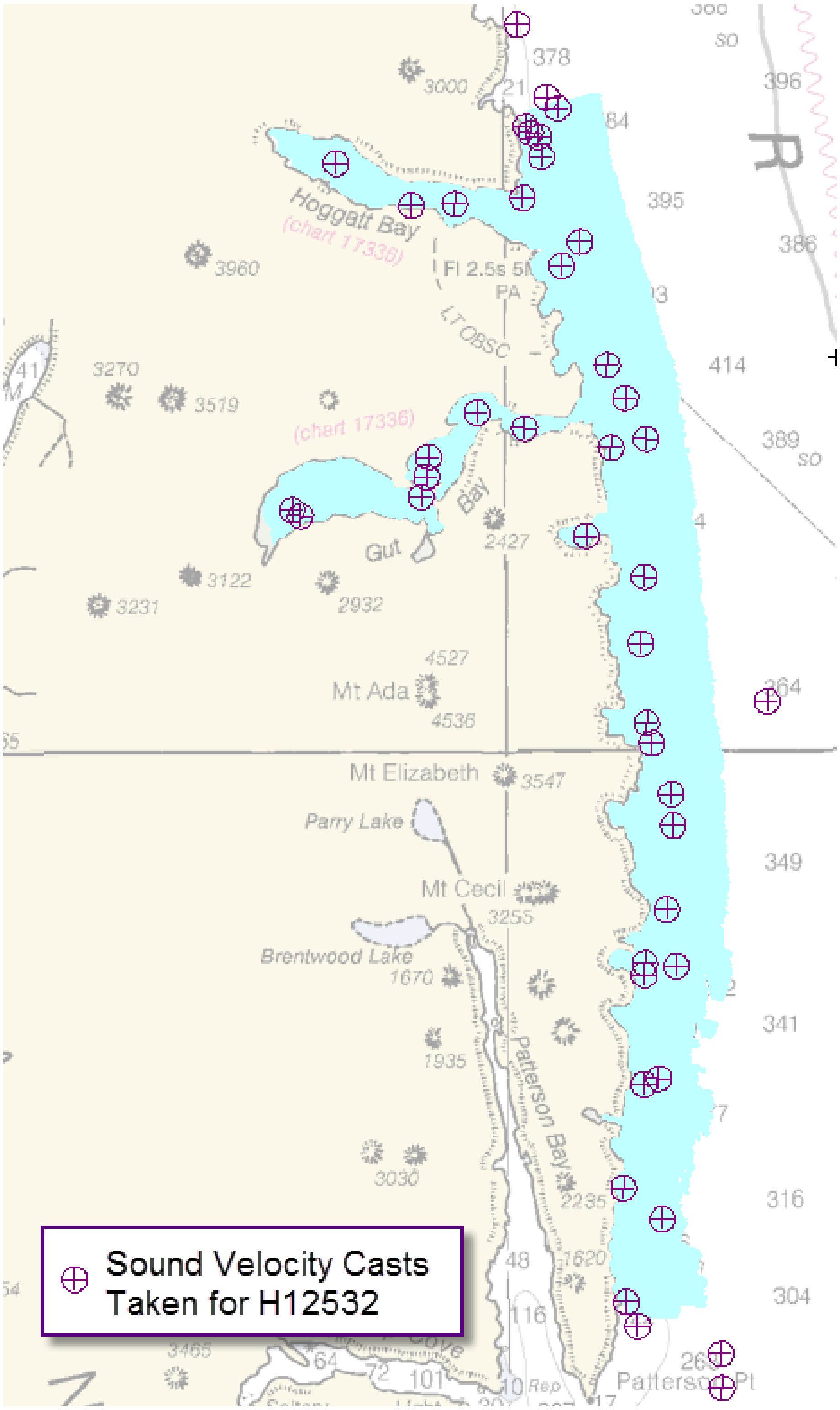


Figure 42: Distribution of sound speed profiles acquired for survey H12532.

B.2.8 Coverage Equipment and Methods

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

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

SBETs and RMS error data could not be applied to Launch 2803 (RA-3) on DN147 because the file was corrupted and would not process when imported to POSPac MMS 6.1. SBETs would not apply to vessel 2802 line "142_000_2356" due to logging close to UTC midnight. SBETs and RMS error data could also not be applied to Launch 2801 (RA-4) line "2804_2013RA1732302" because it corrupted the navigation of the line. The affected data was examined in CARIS Subset Editor and found to be in agreement with surrounding data.

B.3.2 Calibrations

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

Calibration Type	Date	Reason
S221 Patch Test	2013-05-25	Update of system configuration.

Table 8: Calibrations not discussed in the DAPR.

In cooperation with University of New Hampshire and The Center for Coastal and Ocean Mapping, a new vessel file was created for S221 to resolve a recurring artifact seen in data collected by the Kongsberg EM710 on the RAINIER. On 25 May (DN146), the ship's system integration was reconfigured, moving the reference point for both the IMU and the sonar to the center of the sonar's transmit array. This implies that both real-time and logged data is in the ship's reference frame, with the EM710 transmitter as the origin.

Necessarily, this new vessel file (S221_Simrad-EM710_TxRef.hvf) contains new patch test values as well as the change to the vessel's reference frame. Three lines (0000_20130619_191946_Rainier, 0001_20130619_194912_Rainier, and 0002_20130619_201314_Rainier) were acquired using this new configuration. This configuration is further described in the DAPR.

B.4 Backscatter

Backscatter data was acquired, but not formally processed by RAINIER personnel. However, periodic spot checks were performed to ensure backscatter quality. Backscatter was logged as 7k or .ALL files and submitted to NGDC, but is not included with the data submitted to the Branch.

B.5 Data Processing

B.5.1 Software Updates

There were no software configuration changes after the DAPR was submitted.

The following Feature Object Catalog was used: 5_3_2

All data was processed using CARIS HIPS and SIPS 8.0.4. It should be noted that all Kongsberg EM710 data was intentionally processed without the Simrad Sound Velocity Correction (SVC) module. This was done in order to avoid a known error in the SVC module associated with reverse-mounted transducers. To accomplish this, a custom CARIS license file was used, which excluded the licensing for the Simrad SVC. For further details, refer to the DAPR.

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
H12532_1m	CUBE	1 meters	-3 meters - 730 meters	NOAA_1m	Complete MBES
H12532_2m	CUBE	2 meters	-3 meters - 730 meters	NOAA_2m	Complete MBES
H12532_4m	CUBE	4 meters	-3 meters - 730 meters	NOAA_4m	Complete MBES
H12532_8m	CUBE	8 meters	-3 meters - 730 meters	NOAA_8m	Complete MBES
H12532_16m	CUBE	16 meters	-3 meters - 730 meters	NOAA_16m	Complete MBES
H12532_32m	CUBE	32 meters	-3 meters - 730 meters	NOAA_32m	Complete MBES
H12532_1m_Final_-30to40	CUBE	1 meters	-3 meters - 40 meters	NOAA_1m	Complete MBES
H12532_2m_Final_18to80	CUBE	2 meters	18 meters - 80 meters	NOAA_2m	Complete MBES
H12532_4m_Final_36to160	CUBE	4 meters	36 meters - 160 meters	NOAA_4m	Complete MBES
H12532_8m_Final_72to320	CUBE	8 meters	72 meters -	NOAA_8m	Complete MBES

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
			320 meters		
H12532_16m_Final_144to1000	CUBE	16 meters	144 meters - 1000 meters	NOAA_16m	Complete MBES
H12532_32m_Final_288to1000	CUBE	32 meters	288 meters - 1000 meters	NOAA_32m	Complete MBES
H12532_Combined	CUBE	32 meters	-3 meters - 730 meters	NOAA_32m	Complete MBES

Table 9: Submitted Surfaces

In order to prevent apparent coverage gaps resulting from the gridding algorithm in the "steep and deep" bathymetry found in H12532 (Figure 44), finalized surfaces were extended beyond the depth thresholds specified in the HSSDM. For example, rather than gridding the data at a 2-meter resolution between 18 and 40 meter depths; the depth range was extended to between 18 and 80 meter depths. All other finalization depth ranges are stated in Table 9.

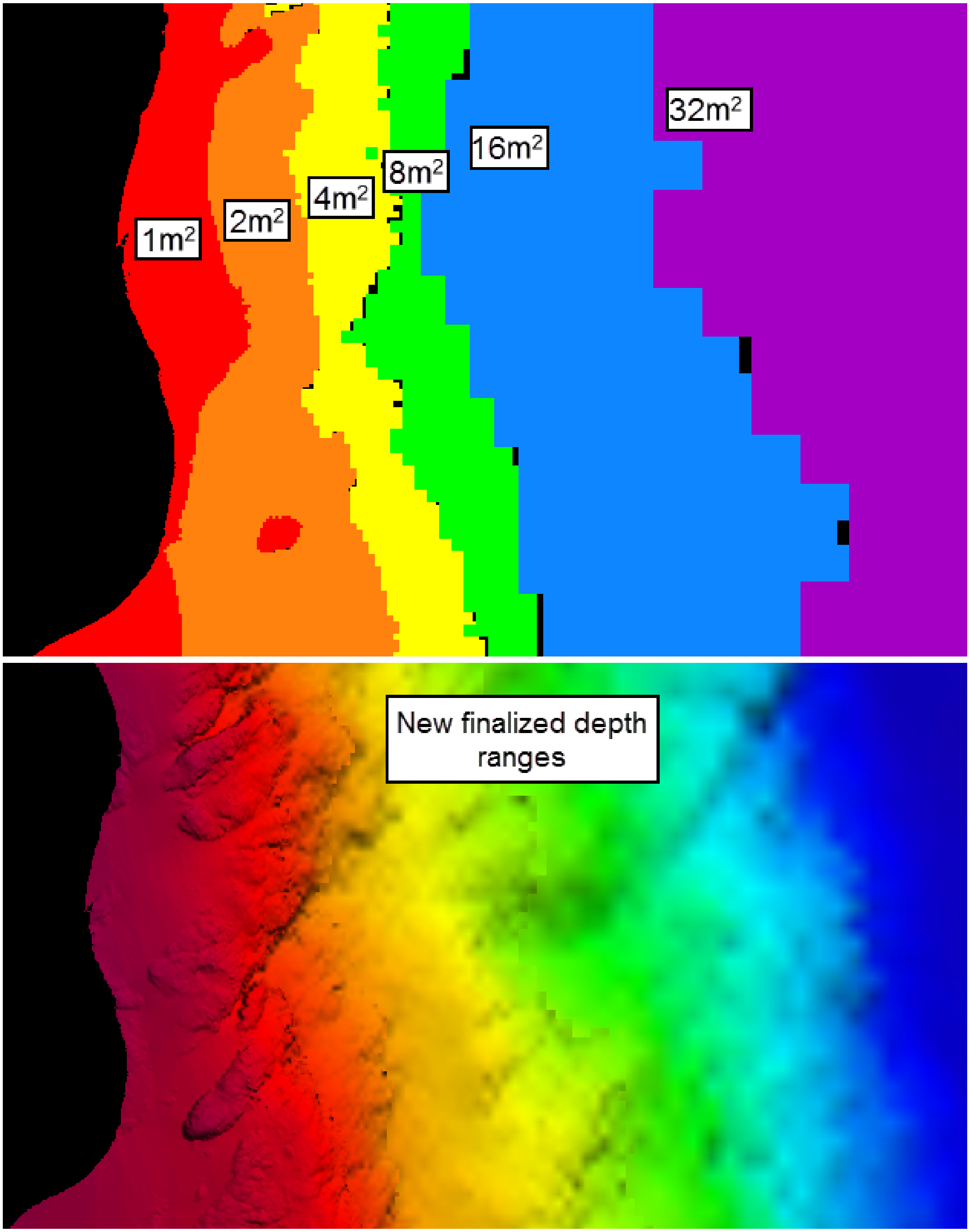


Figure 43: (Top) Finalized surfaces created using depth thresholds specified in the HSSDM; notice the gaps between depth resolutions. (Bottom) The same region gridded using the new finalized depth ranges.

C. Vertical and Horizontal Control

Additional information discussing the vertical or 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.

Standard Vertical Control Methods Used:

TCARI

File Name	Status
9451467.tid	Final Approved
9451054.tid	Final Approved

Table 10: Water Level Files (.tid)

File Name	Status
O322RA2013_Final.tc	Final

Table 11: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 06/29/2013. The final tide note was received on 08/30/2013.

The Tide Note is attached.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD83).

The projection used for this project is UTM - 08 North.

The following PPK methods were used for horizontal control:

Single Base

In conjunction with this project, a GNSS base station was established by RAINIER personnel on a small island at the head of Red Bluff Bay. Vessel kinematic data was post-processed using Applanix POSPac processing software, POSGNSS processing software and Single Base processing methods described in the DAPR. Single Base processing was used from DN142 to DN179 while the site was installed.

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
Red Bluff Bay	N/A

Table 12: User Installed Base Stations

DGPS was used for primary positioning during acquisition. Following PPK processing, DGPS position data was replaced with improved SBET navigation data. For Launch 2803 DN147, DGPS was used for final positioning. DGPS was also used for Launch 2801 line "2801_2013RA1731831" (see Section B.3.1 - Corrections to Echo Soundings). Data using DGPS positioning was in agreement with surrounding data.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Annette Island, AK (323 kHz)
Level Island, AK (295 kHz)
Biorka Island, AK (305 kHz)

Table 13: USCG DGPS Stations

D. Results and Recommendations

D.1 Chart Comparison

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
17320	1:217828	18	03/2008	03/04/2008	03/01/2008
17336	1:20000	9	03/2007	02/13/2008	03/03/2007
17335	1:20000	8	11/2011	10/25/2011	11/12/2011

Table 14: Largest Scale Raster Charts

17320

Raster Chart 17320 (1:217828) coincides with ENC US3AK4PM. A comparison of soundings between the two charts was performed and it was determined that the provided ENC was in agreement with Chart 17320. For a further discussion of the surveyed depths to charted sounding comparison, refer to Section D.1.2 - Electronic Navigation Charts.

17336

A comparison was performed between survey H12532 and Chart 17336_3 (1:20000) and 17336_4 (1:20000) using CARIS sounding and contour layers derived from the 32-meter combined surface. The contours and soundings have been overlaid on the charts, and representative areas are shown in Figures 45 and 46. The Hydrographer recommends updating the 100-fathom contour to better reflect the depths seen throughout this survey. For a further discussion of the surveyed depths to charted sounding comparison, refer to Section D.1.2 - Electronic Navigation Charts.

It is recommended that H12532 data supersede all charted depths on Chart 17336.

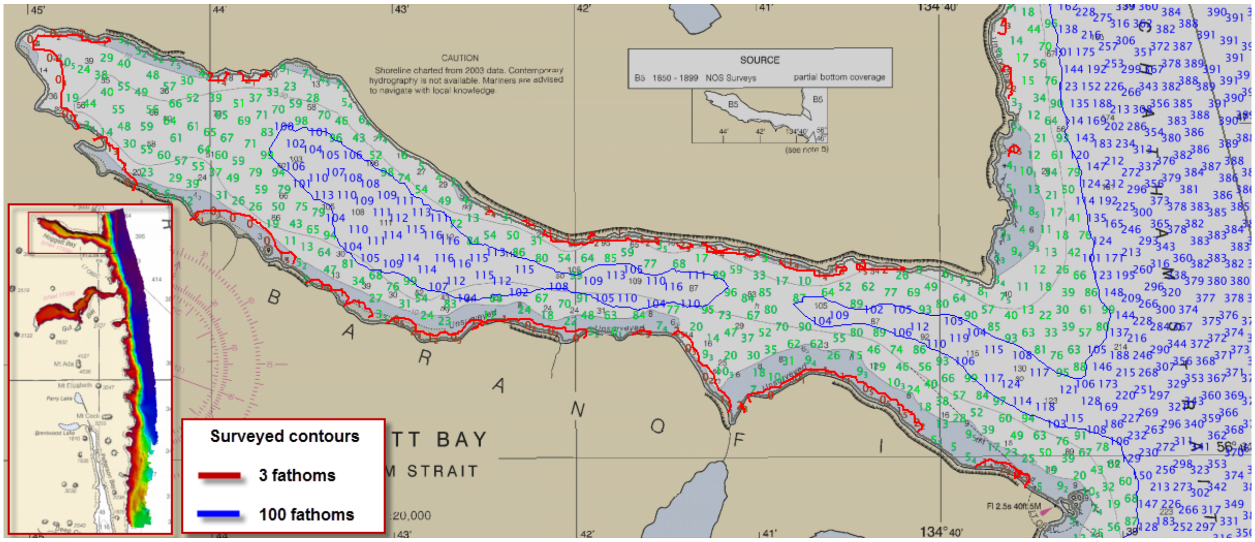


Figure 44: Close-up of Gut Bay, showing comparison of contours derived from survey H12532 and those depicted in Chart 17336_3.

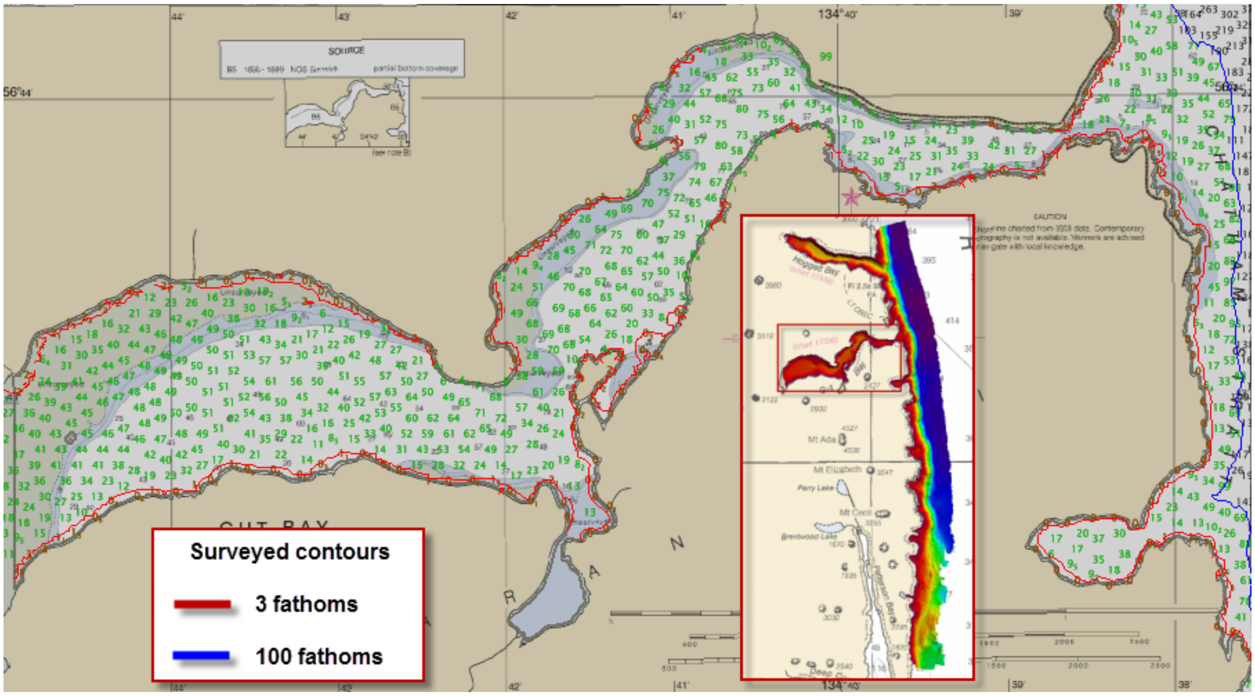


Figure 45: Close-up of Hoggatt Bay, showing comparison of contours derived from survey H12532 and those depicted in Chart 17336_4.

<u>17335</u>

A comparison was performed between survey H12532 and Chart 17335_1 (1:20000) using CARIS sounding and contour layers derived from the 32-meter combined surface. The contours and soundings have been overlaid on the chart, and a representative area is shown in Figure 47. The Hydrographer recommends updating the 100-fathom contour to better reflect the depths seen throughout this survey. For a further discussion of the surveyed depths to charted sounding comparison, refer to Section D.1.2 - Electronic Navigation Charts.

It is recommended that H12532 data supersede all charted depths on Chart 17335.

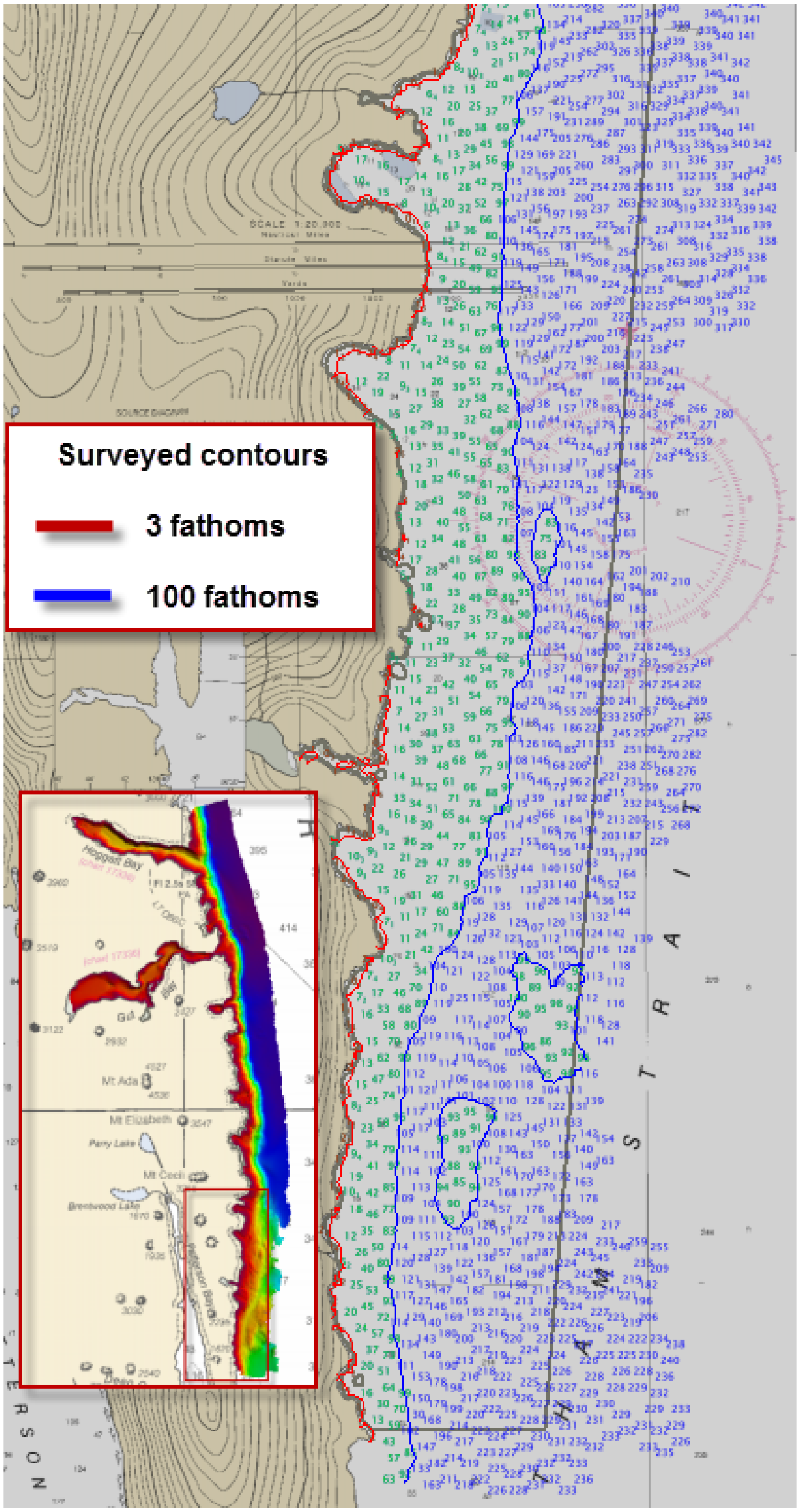


Figure 46: Close-up of the south end of H12532, showing comparison of contours derived from survey H1232 and those depicted in Chart 17336_4.

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?
US5AK2YM	1:20000	1	04/16/2013	04/16/2013	NO
US3AK4PM	1:217828	9	03/21/2011	09/20/2012	NO

Table 15: Largest Scale ENCs

US5AK2YM

ENC US5AK2YM coincides with raster Charts 17335 and 17336, which cover Hoggatt Bay and Gut Bay. To compare soundings, sounding sets from ENC US5AK2YM (the larger scale chart) and US3AK4PM (the smaller scale chart) were combined, from which a point surface was generated. This point surface was then differenced from the 8-meter CUBE surface of H12532 (Figures 48 and 49). In the Figures below, differences in blue show comparisons where survey H12532 is deeper than the charted soundings, while differences in red (underlined) show comparisons where survey H12532 is shoaler than the charted soundings.

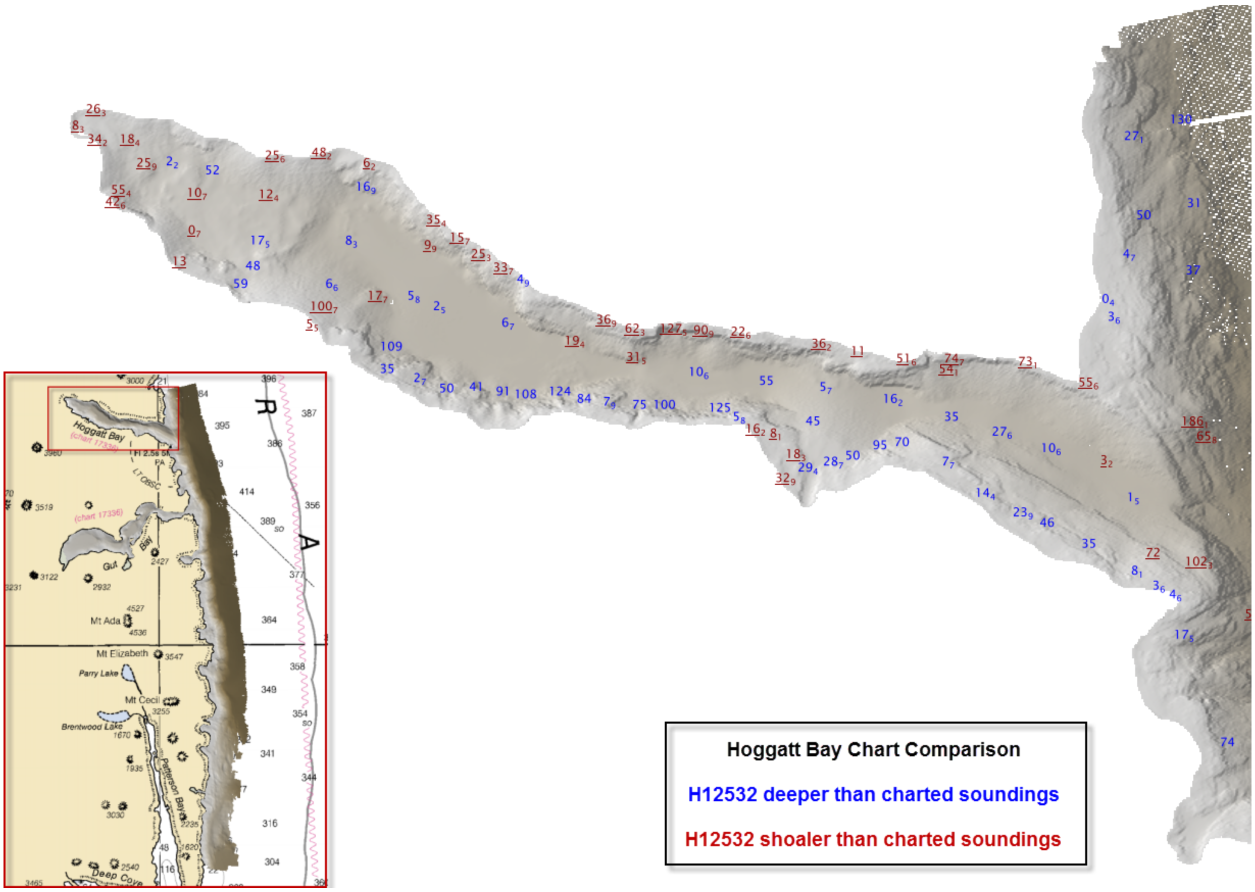


Figure 47: H12532 differenced with soundings from ENCs US5AK2YM and US3AK4PM for Hoggatt Bay in fathoms. Red soundings reflect H12532 depths shoaler than chart and blue soundings reflect H12532 depths deeper than chart.

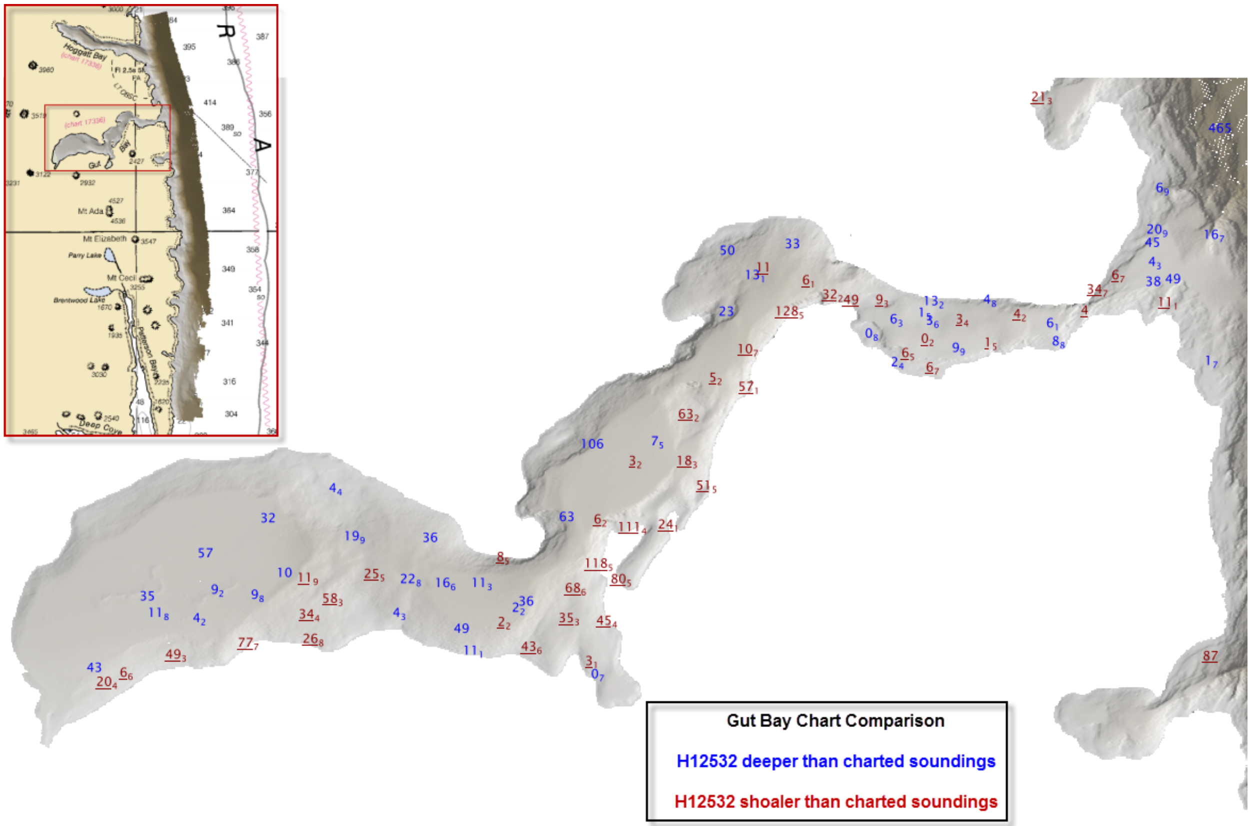


Figure 48: H12532 differenced with soundings from ENCs US5AK2YM and US3AK4PM for Gut Bay in fathoms. Red soundings reflect H12532 depths shoaler than chart and blue soundings reflect H12532 depths deeper than chart.

US3AK4PM

ENC US3AK4PM coincides with raster Chart 17320. This ENC is the smaller scale chart of the area. Soundings from this ENC were combined with ENC US5AK2YM (the larger scale chart) and differenced from the 8-meter CUBE surface of H12532. Refer to the previous comparison of ENC US5AK2YM.

ENC US5AK2XM (Scale 1:20,000, Edition 1, Update 0, Issue Date 06/14/2013), coinciding with raster 17335, covers the southern portion of the survey area. The comparison to raster 17335 above also applies to this ENC.

D.1.3 AWOIS Items

No AWOIS items were assigned for this survey.

D.1.4 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.5 Charted Features

Charted features exist for this survey, but were not investigated.

D.1.6 Uncharted Features

No uncharted features exist for this survey.

D.1.7 Dangers to Navigation

No Danger to Navigation Reports were submitted for this survey.

D.1.8 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.9 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.1.10 Bottom Samples

Twelve bottom sample locations were identified in the Project Reference File. Six assigned bottom samples were not acquired due to equipment limitations. Six bottom sample locations were selected based on feasibility and distribution throughout the survey area (Figure 50). Of the six feasible sites, one was attempted three times without yielding a valid sample and therefore considered to be a failed attempt. Acquired bottom samples are addressed, as required, with S-57 attribution and recorded in the Final Features File accompanying this submission.

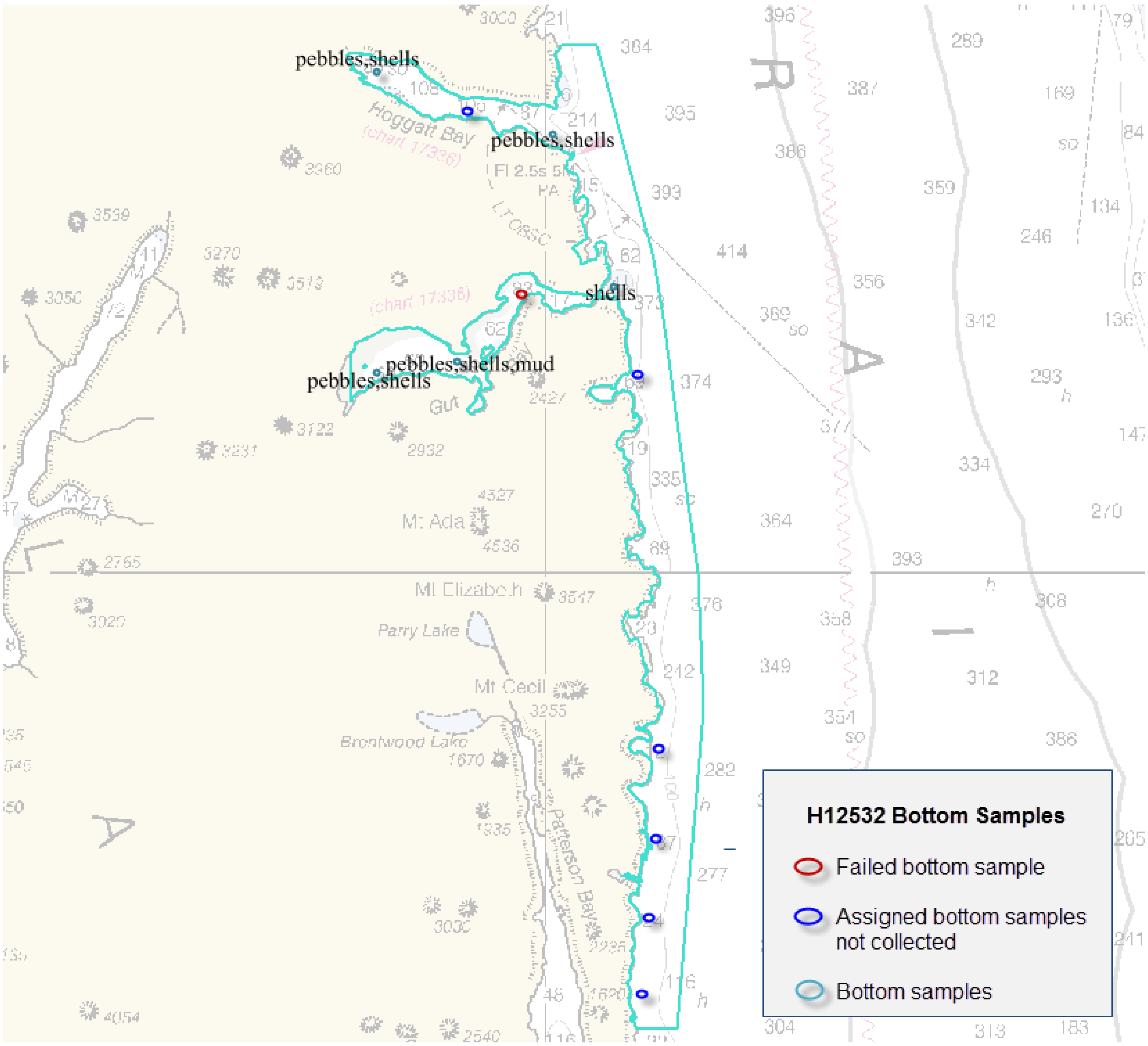


Figure 49: Bottom samples in H12532.

D.2 Additional Results

D.2.1 Shoreline

Shoreline verification was conducted near predicted low water in accordance with the applicable sections of the NOAA HSSDM and FPM. There were 19 assigned features for the survey. All features were addressed as required with S-57 attribution and recorded in the H12532 Final Features File to best represent the features at chart scale.

There were numerous areas where the provided shoreline from the Composite Source File (CSF) deviated significantly from the true coastline as well as from the acquired bathymetry. It was determined that the CSF was sourced from ENC US3AK4PM (1:217,828), which had sections of outdated shoreline and features.

The Hydrographer downloaded the more accurate geographic cell shoreline data, which matched the hydrography in the area as well as all raster charts of the area.

This shoreline from GC10572 is included in the Final Features File as an 'Update' feature. The incorrect shoreline is marked as 'Delete'. The Hydrographer recommends that the ENC be updated with the correct GC shoreline.

The GC shoreline recommended to be updated falls on the small scale ENC US3AK4PM and is digitized from the raster. The Marine Chart Division is responsible for updating the charted shoreline, as appropriate to scale, with latest available source, including changes recommended in the chart update product.

D.2.2 Prior Surveys

No prior survey comparisons exist for this survey.

D.2.3 Aids to Navigation

Aids to navigation (ATONs) exist for this survey, but were not investigated.

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 Recommendations

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

D.2.11 New Inset Recommendations

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 and Specifications Deliverables 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.

Approver Name	Approver Title	Approval Date	Signature
Richard T. Brennan, CDR/NOAA	Commanding Officer, NOAA Ship RAINIER	08/31/2013	Richard T. Brennan 2013.09.24 19:45:33 -08'00'
Meghan E. McGovern, LT/NOAA	Field Operations Officer, NOAA Ship RAINIER	08/31/2013	Date: 2013.09.15 10:51:04 -09'00'
James B. Jacobson	Chief Survey Technician, NOAA Ship RAINIER	08/31/2013	James Jacobson I have reviewed this document 2013.09.15 12:09:12 -08'00'
Allix L. Slagle	Assistant Survey Technician, NOAA Ship RAINIER	08/31/2013	Date: 2013.09.15 10:51:48 -09'00'

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
TPU	Total Porpagated 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 : August 27, 2013

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-O322-RA-2013
HYDROGRAPHIC SHEET: H12532

LOCALITY: Hoggatt Bay to Patterson Pt., Chatham Strait, AK
TIME PERIOD: May 22 - June 28, 2013

TIDE STATION USED: 9451054 Port Alexander,AK
Lat.56° 14.8’ N Long. 134° 38.8' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.070 meters

TIDE STATION USED: 9451467 Red Bluff Bay, AK
Lat. 56° 51.4' N Long. 134° 43.5' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.631 meters

REMARKS: RECOMMENDED GRID

Please use the TCARI grid "O322RA2013_Final.tc" as the final grid for project OPR-O322-RA-2013, H12532, during the time period between May 22 and June 28, 2013.

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: Due to inaccurate shoreline, survey tracklines fall outside of the TCARI grid boundaries in some areas. TCARI will extrapolate the tide corrector to cover these soundings.

HOVIS.GERALD.THOMAS.1365860250

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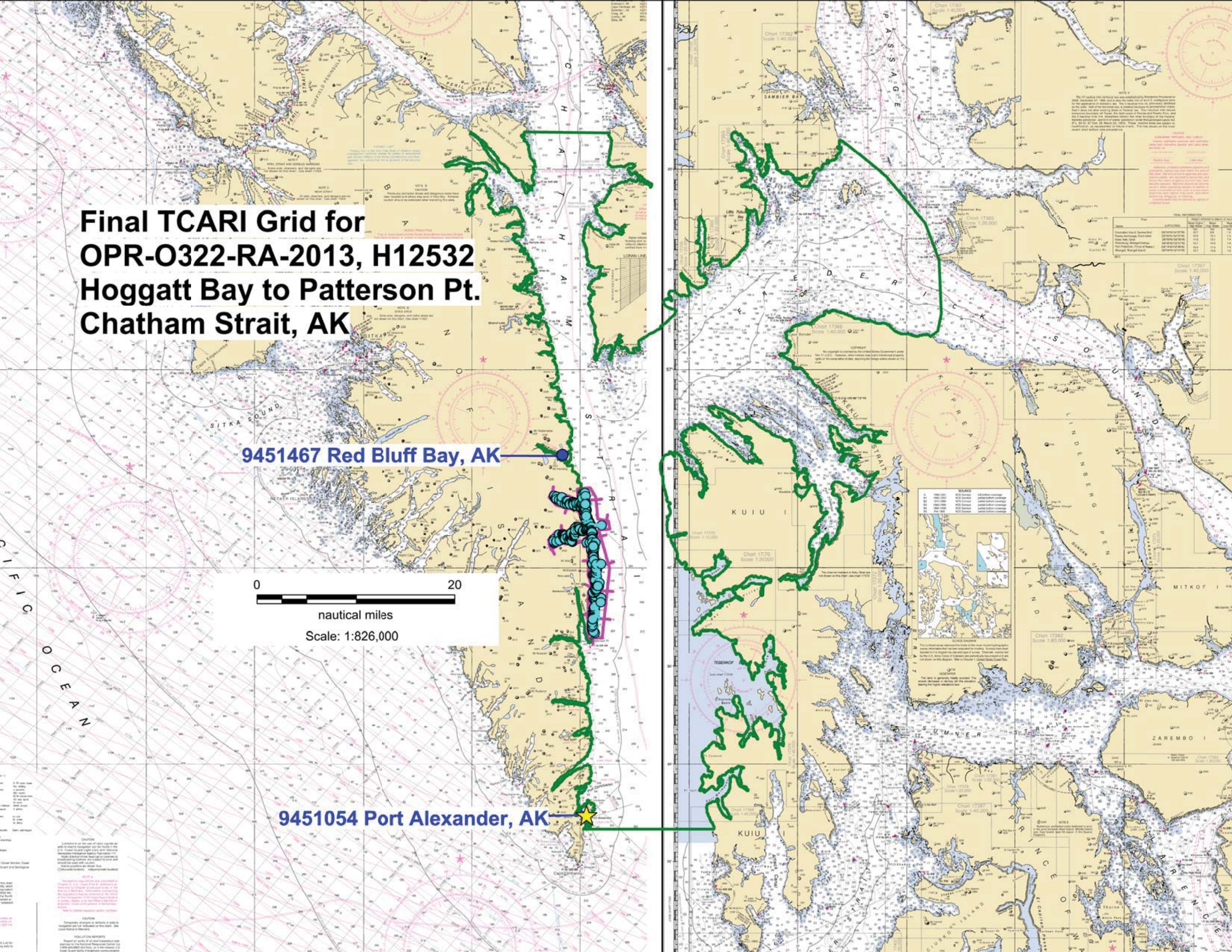
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.1365860250
Date: 2013.08.30 13:38:04 -04'00'

CHIEF, PRODUCTS AND SERVICES BRANCH



Final TCARI Grid for
OPR-O322-RA-2013, H12532
Hoggatt Bay to Patterson Pt.
Chatham Strait, AK
9451467 Red Bluff Bay, AK
9451054 Port Alexander, AK
0
20
nautical miles
Scale: 1:826,000

APPROVAL

PAGE H12532

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 NGDC for archive
- H12532_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12532_GeoImage.pdf

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

Digitally signed by EVANS.BENJAMIN.K.1237217094
Reason: I have reviewed this document
Date: 2014.09.30 14:48:17 -07'00'

Approved:______________________________

Pete 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 EVANS.BENJAMIN.K.1237217094
Reason: I am approving this document
Date: 2014.09.30 14:48:41 -07'00'

Approved:______________________________

LCDR Benjamin K. Evans, NOAA
Chief, Pacific Hydrographic Branch