H12533

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12533

LOCALITY

State(s):	Alaska
General Locality:	Chatham Strait
Sub-locality:	Red Bluff Bay and Vicinity

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	**H12533**

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:	**Red Bluff Bay and Vicinity**
Scale:	**10000**
Dates of Survey:	**05/22/2013 to 06/28/2013**
Instructions Dated:	**04/26/2013**
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. 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 Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

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Descriptive Report to Accompany Survey H12533

Project: OPR-O322-RA-13

Locality: Chatham Strait

Sublocality: Red Bluff Bay and Vicinity

Scale: 1:10000

May 2013 - June 2013

NOAA Ship *Rainier*

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

A. Area Surveyed

The area surveyed is referred to as Sheet 3: "Red Bluff Bay and Vicinity" within the Project Instructions. The area is at the western edge of Chatham Strait adjacent to Baranof Island, Alaska (Figure 1).

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
56° 56" 13.75' N 134° 44" 13.27' W	56° 47" 23.05' N 134° 38" 38.99' W

Table 1: Survey Limits

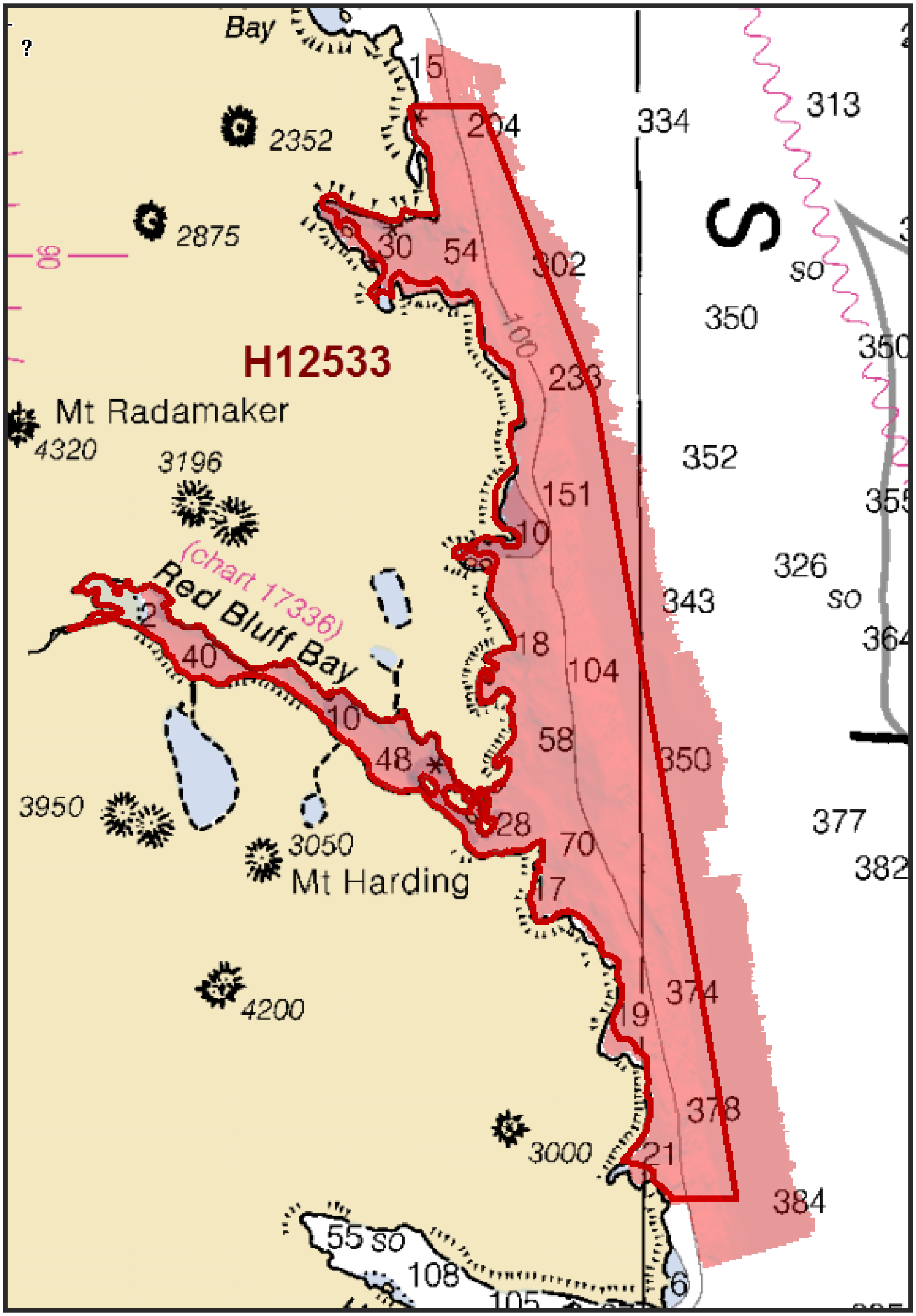


Figure 1: H12533 survey limits.

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 H12533 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 HSSD (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 99.4% of the nodes and 98.8% of the total area.

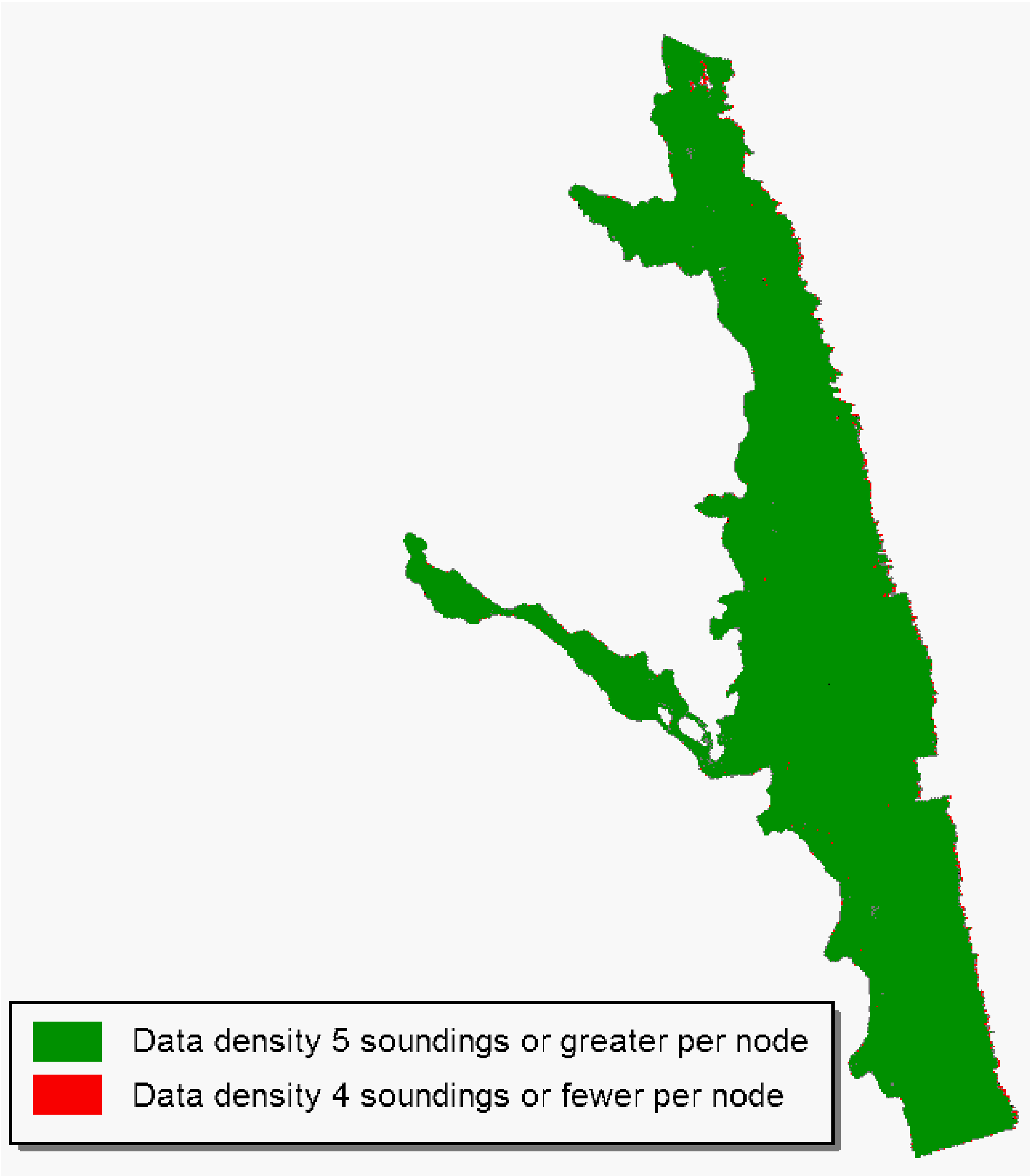


Figure 2: H12533 data density.

H12533 Density Statistics				
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	2,818,801	17,955	99.4%
2m	18 - 40m	902,729	5,117	99.4%
4m	36 - 80m	369,101	661	99.8%
8m	72 - 160m	96,491	76	99.9%
16m	144 - 320m	16,780	39	99.8%
32m	288 - 1000m	23,459	505	97.8%
	TOTAL:	4,227,361	24,353	**99.4%**
	TOTAL (by area):	46,828,453	580,967	**98.8%**

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

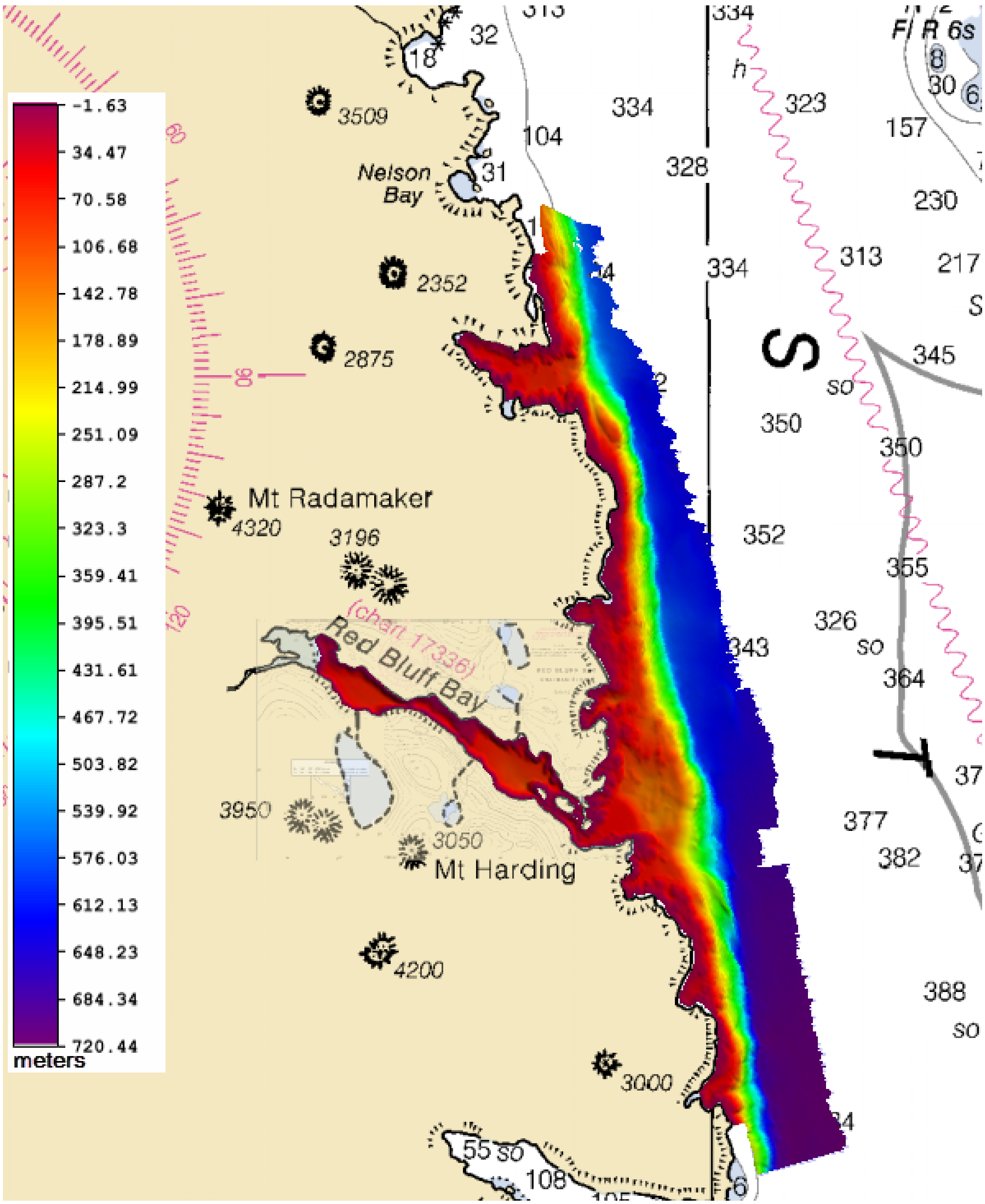


Figure 4: Acquired survey coverage overlaid on Chart 17320.

Complete 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.

Acoustic Shadowing and Downslope Masking: There were numerous gaps in coverage as a result of acoustic shadowing and downslope masking. Acoustic shadowing is an effect seen where data density on the 'dark side' of a feature, or between features, was too sparse to produce a surface at the appropriate resolution. Downslope masking is a lack of coverage due to poor geometry associated with rapid drops in the seafloor. All cases were examined to assure that least depths were obtained (Figure 7).

Kelp: Numerous shoreline and reef areas within the assigned survey limits were beyond the NALL due to kelp (Figure 8). Kelp areas were inspected in CARIS using Subset Editor and cleaned. The Hydrographer is confident that kelp areas are adequately represented in the Final Feature File, and that the data is adequate to supersede the chart.

There are numerous gaps in coverage where multibeam data did not meet the sheet limit nor the 4-meter curve. In all cases, these gaps were nearshore and dangerous to approach, and were therefore deemed to be inshore of the NALL.

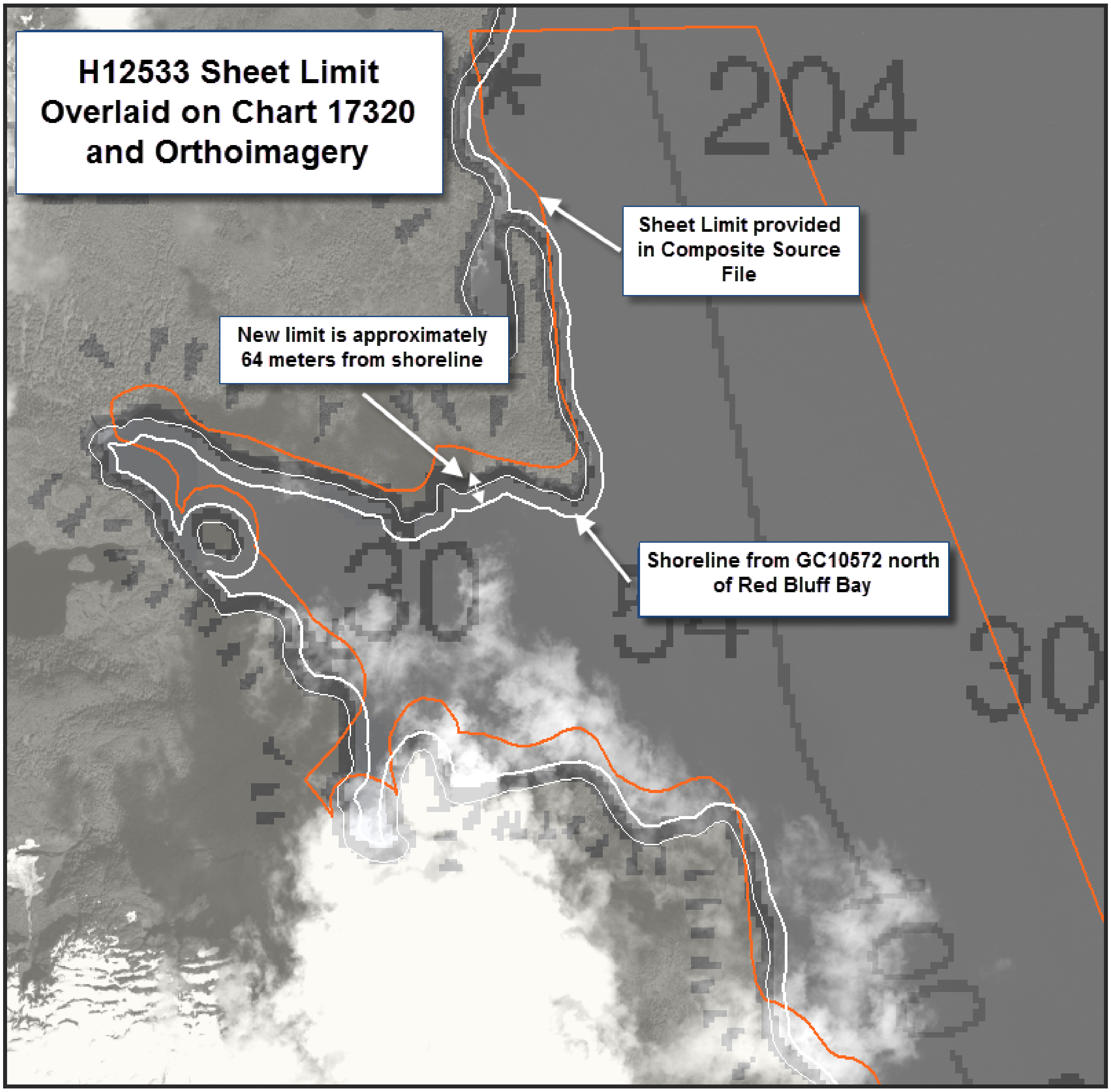


Figure 5: H12533 survey limit deviation.

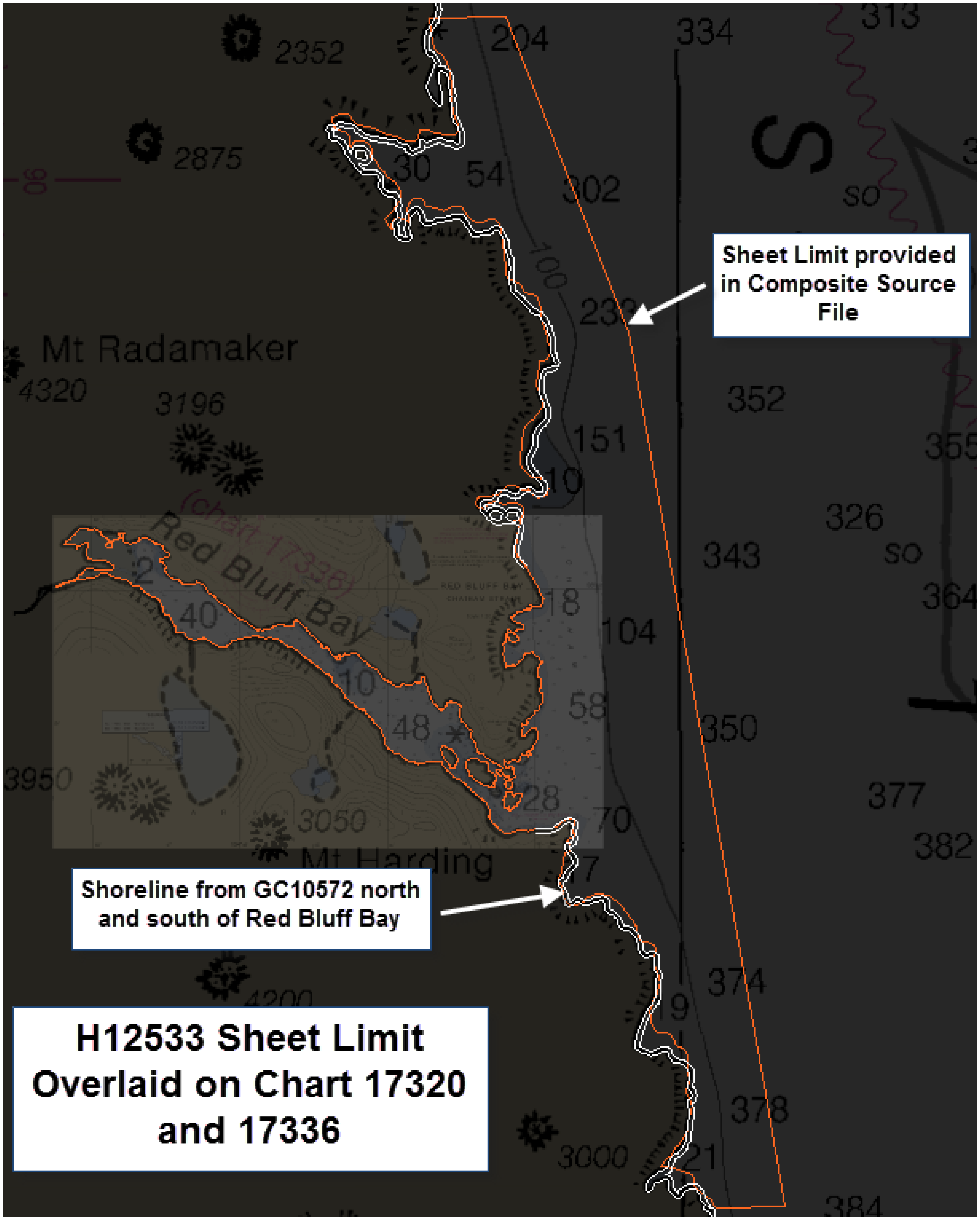


Figure 6: H12533 survey limit overview.

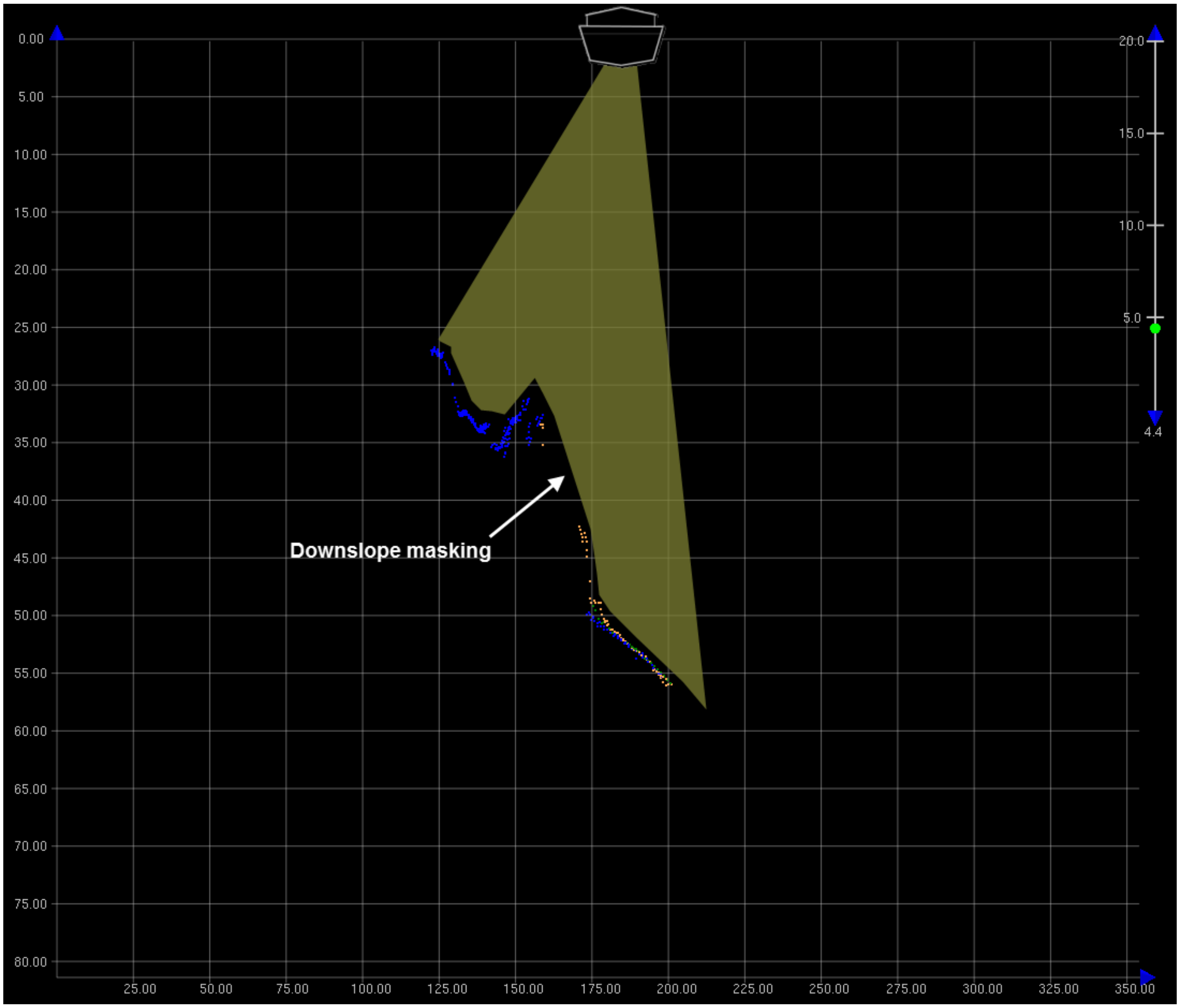


Figure 7: Example of downslope masking in survey H12533. Yellow swath indicates portion of seafloor ensonified by sonar; white arrow depicts the masked portion of the seafloor.

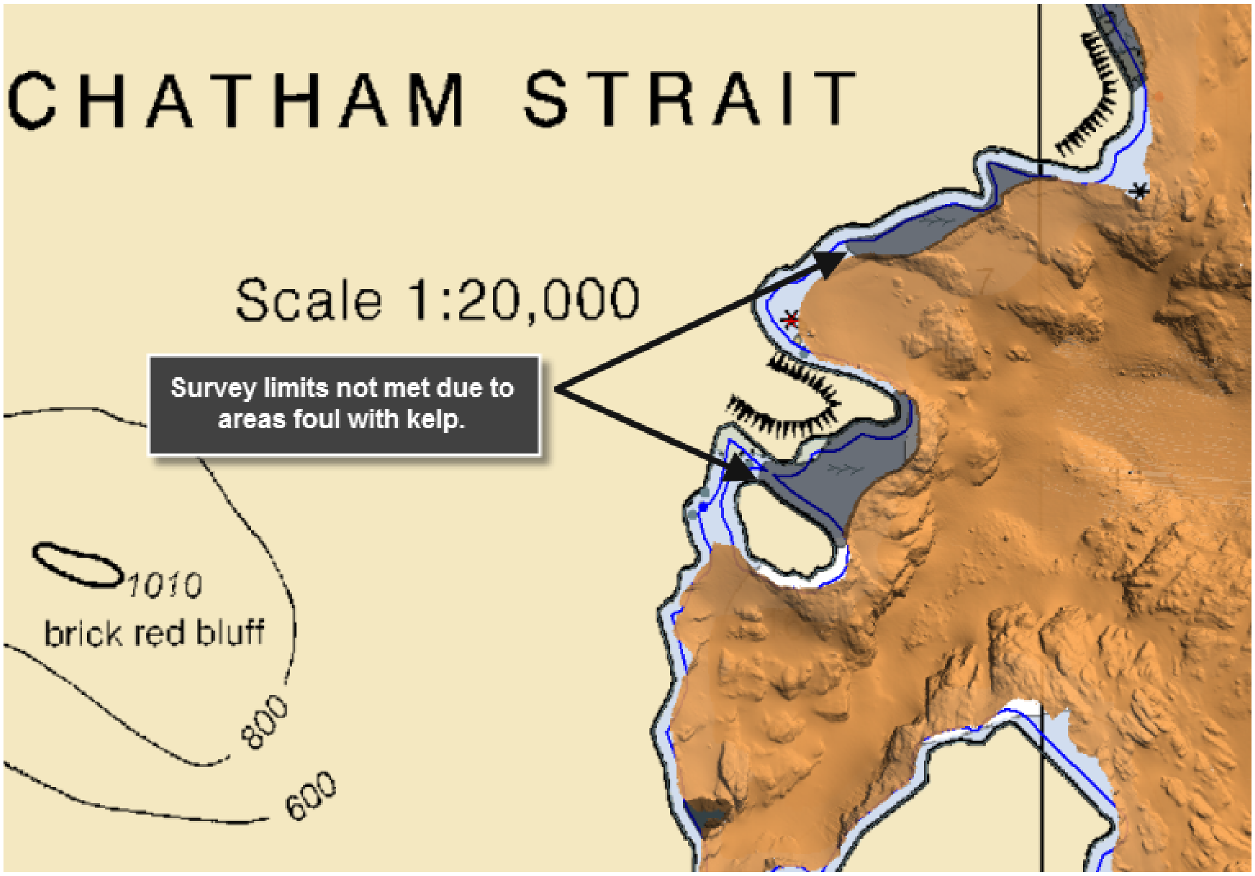


Figure 8: Areas foul with kelp.

At the time of office processing, the coastline on ENC US3AK4PM had been updated with the latest GC.

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	17.13	77.55	48.9	39.6	12.8	159.96
	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	1.41	0	1.69	0	3.13	6.25
	Lidar Crosslines	0	0	0	0	0	0
Number of Bottom Samples							5
Number AWOIS Items Investigated							1
Number Maritime Boundary Points Investigated							0
Number of DPs							23
Number of Items Items Investigated by Dive Ops							0
Total Number of SNM							17.25

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
06/19/2013	170
06/23/2013	174
06/27/2013	178
06/28/2013	179

Table 3: Dates of Hydrography

An outline of the survey area was created in Caris Base Editor 4.0 and the coverage was shown to be 12.98 SNM.

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***	***2801***	***2802***	***2803***	***2804***	***1906***
LOA	231 feet	28 feet	28 feet	28 feet	28 feet	19 feet
Draft	16.5 feet	3.5 feet	3.5 feet	3.5 feet	3.5 feet	1.7 feet

Table 4: Vessels Used

Data was acquired by RAINIER (S221), her four survey launches (2801, 2802, 2803 and 2804), and a skiff (1906). The ship and launches acquired multibeam echosounder (MBES) soundings, sound speed profiles, and bottom samples. The skiff was used for shoreline verification (Table 4).

B.1.2 Equipment

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

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

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines, acquired for this survey, totalled 3.9% of mainscheme acquisition.

Multibeam crosslines were acquired using the EM710 on RAINIER as well as the Reson 7125 on Launches 2802 and 2804. A 4-meter CUBE surface was created using strictly the mainscheme lines, while a second 4-meter CUBE surface was created using only crosslines, from which a CARIS Difference Surface was generated at a 4-meter resolution (Figure 9). Statistics were then derived from the CARIS Difference Surface and are shown in Figure 10. The average difference between the depths derived from mainscheme and crosslines was 0.09 meters (crosslines being shoaler) with a standard deviation of 5.78 meters. The largest differences were seen in areas of high relief and along steep sloping areas.

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 11). In total, 95.4% of the depth differences between H12533 mainscheme and crossline data are within allowable IHO accuracies (Figure 12). Locations that did not meet accuracy standards were areas of high relief and along steep slopes (Figure 13).

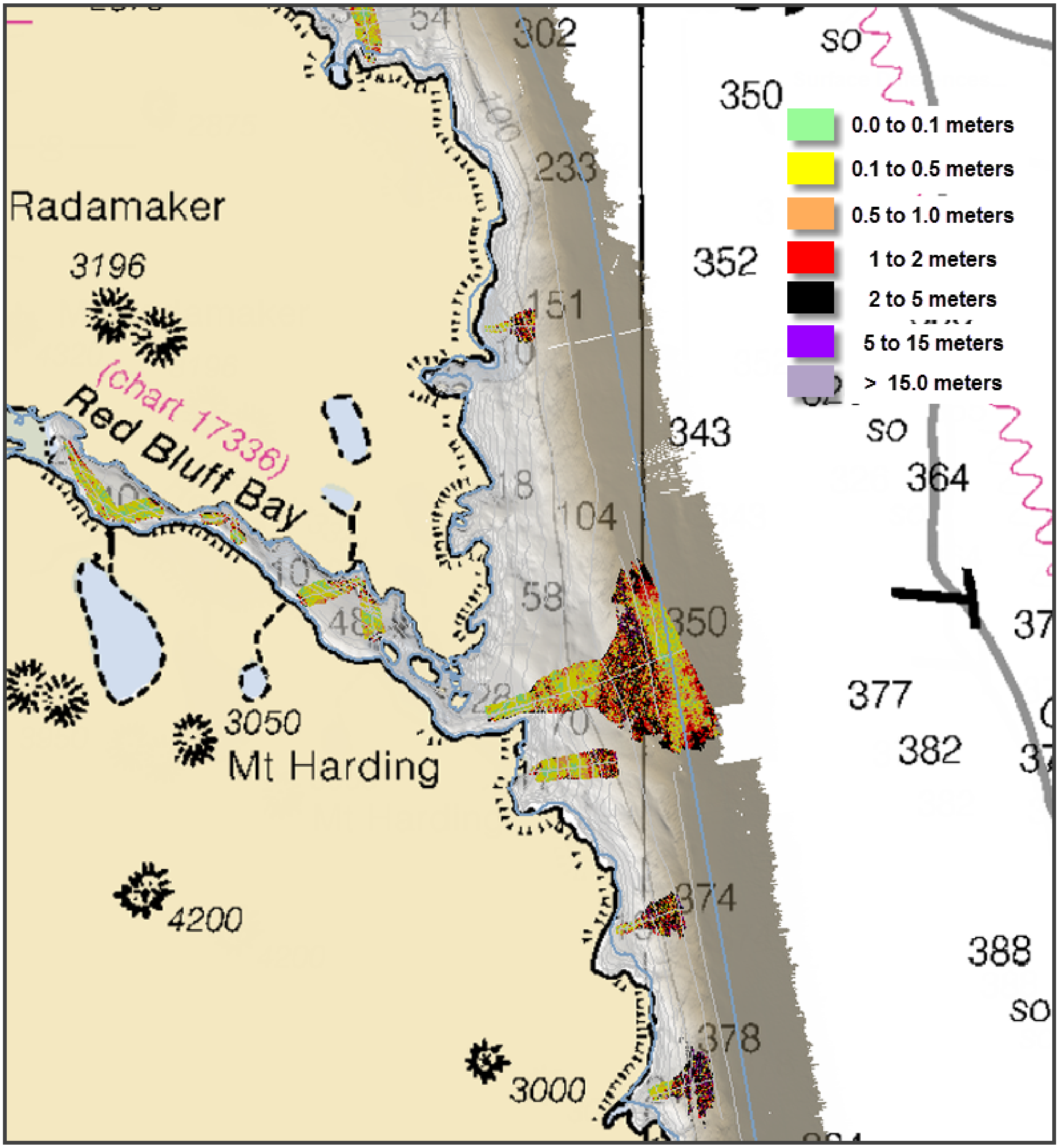


Figure 9: H12533 crosslines.

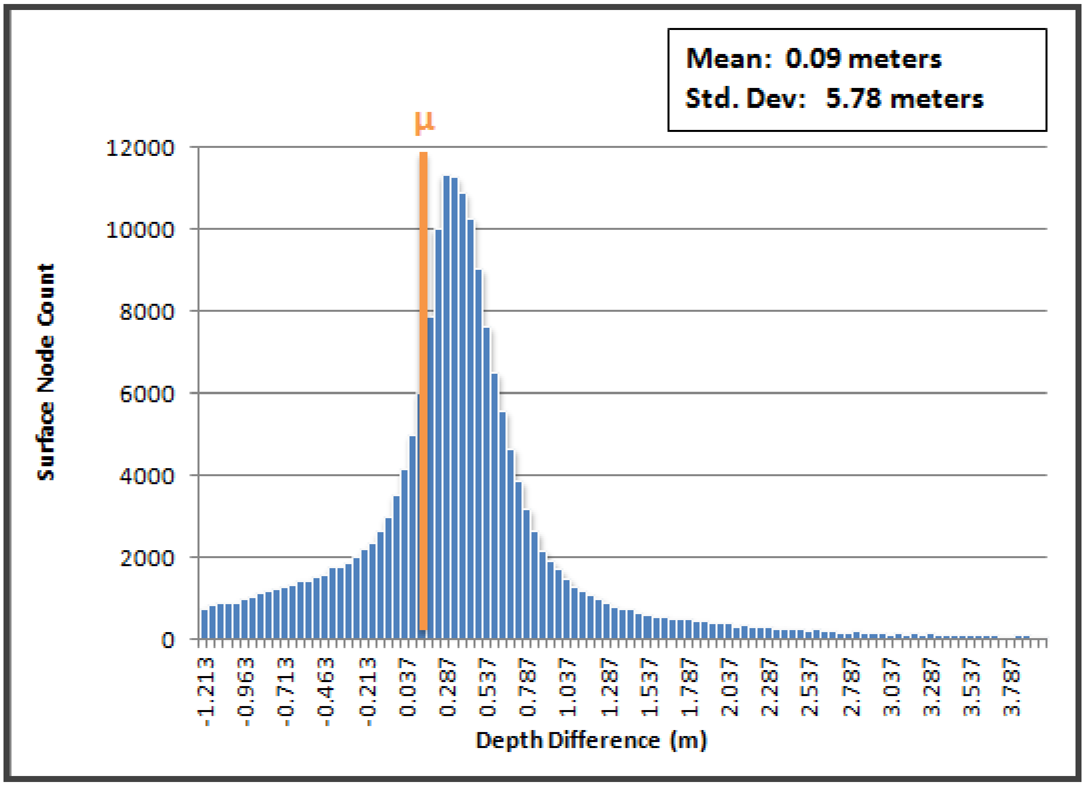


Figure 10: Crossline comparison with mainscheme.

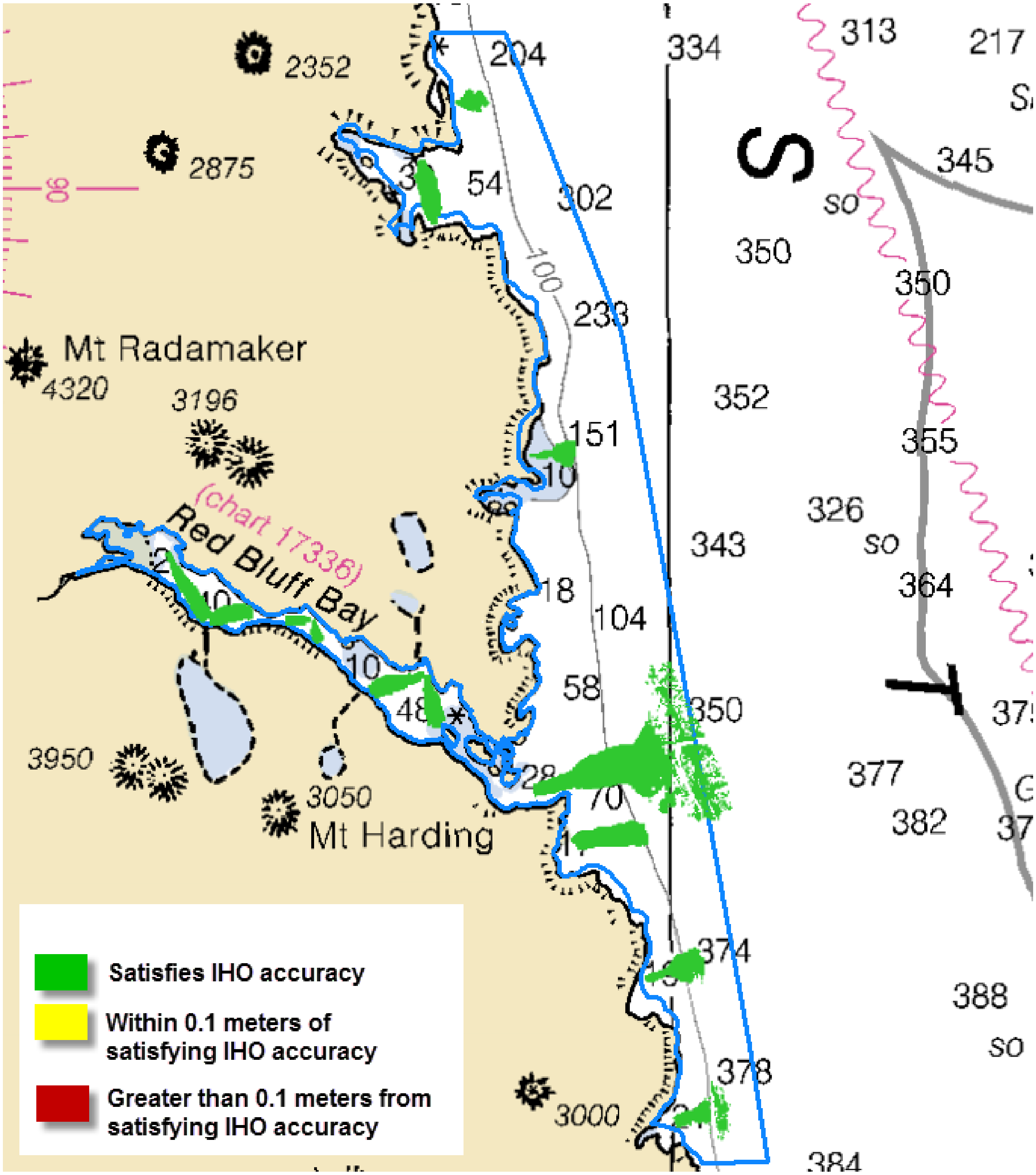


Figure 11: Depth differences between H12533 mainscheme and crossline data as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Less than 100m	Order 1	95,342	86,372	90.6%
Greater than 100m	Order 2	212,052	206,923	97.6%
	TOTAL:	307,394	293,295	95.4%

Figure 12: Crossline IHO compliance.

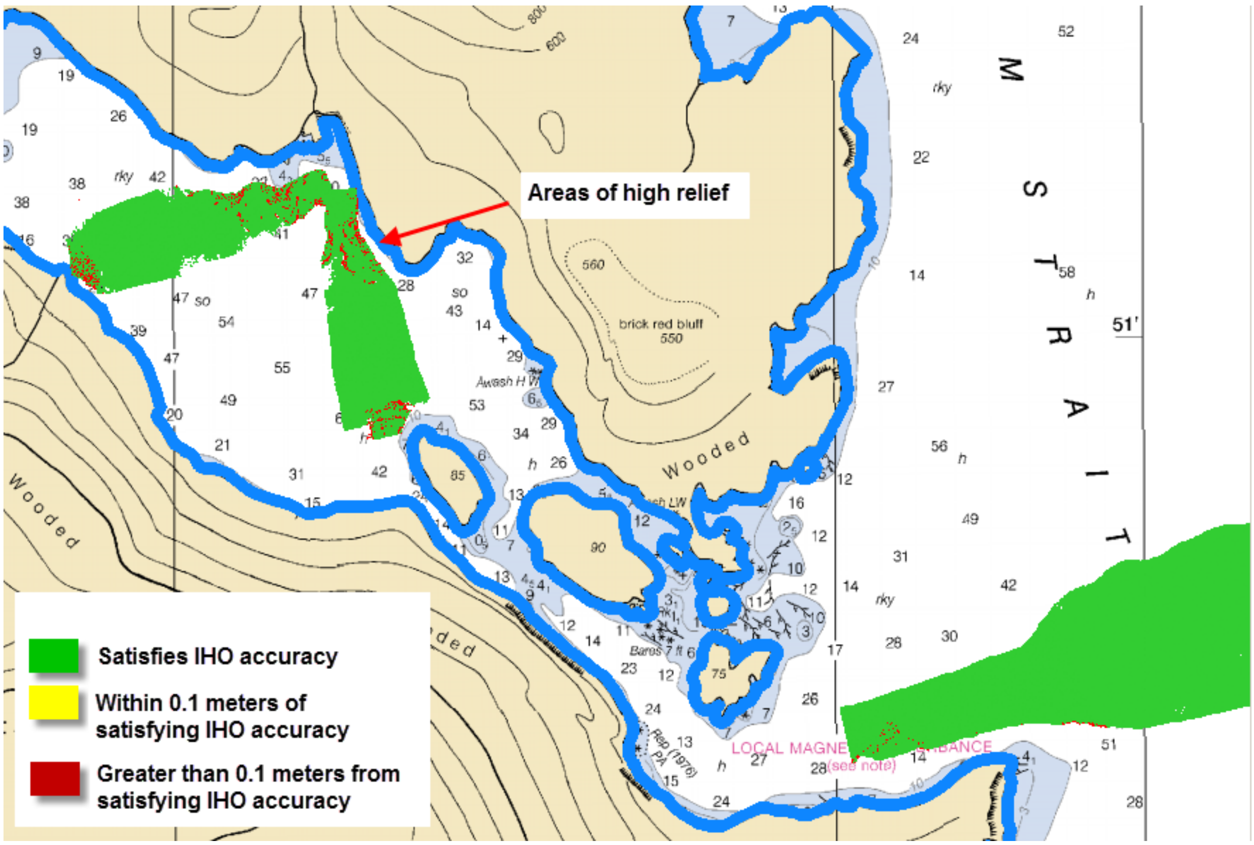


Figure 13: Crossline IHO compliance inset area of high relief.

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. Larger depth differences between survey lines are expected in deep areas and areas with steep topography. The data is adequate for charting.

B.2.2 Uncertainty

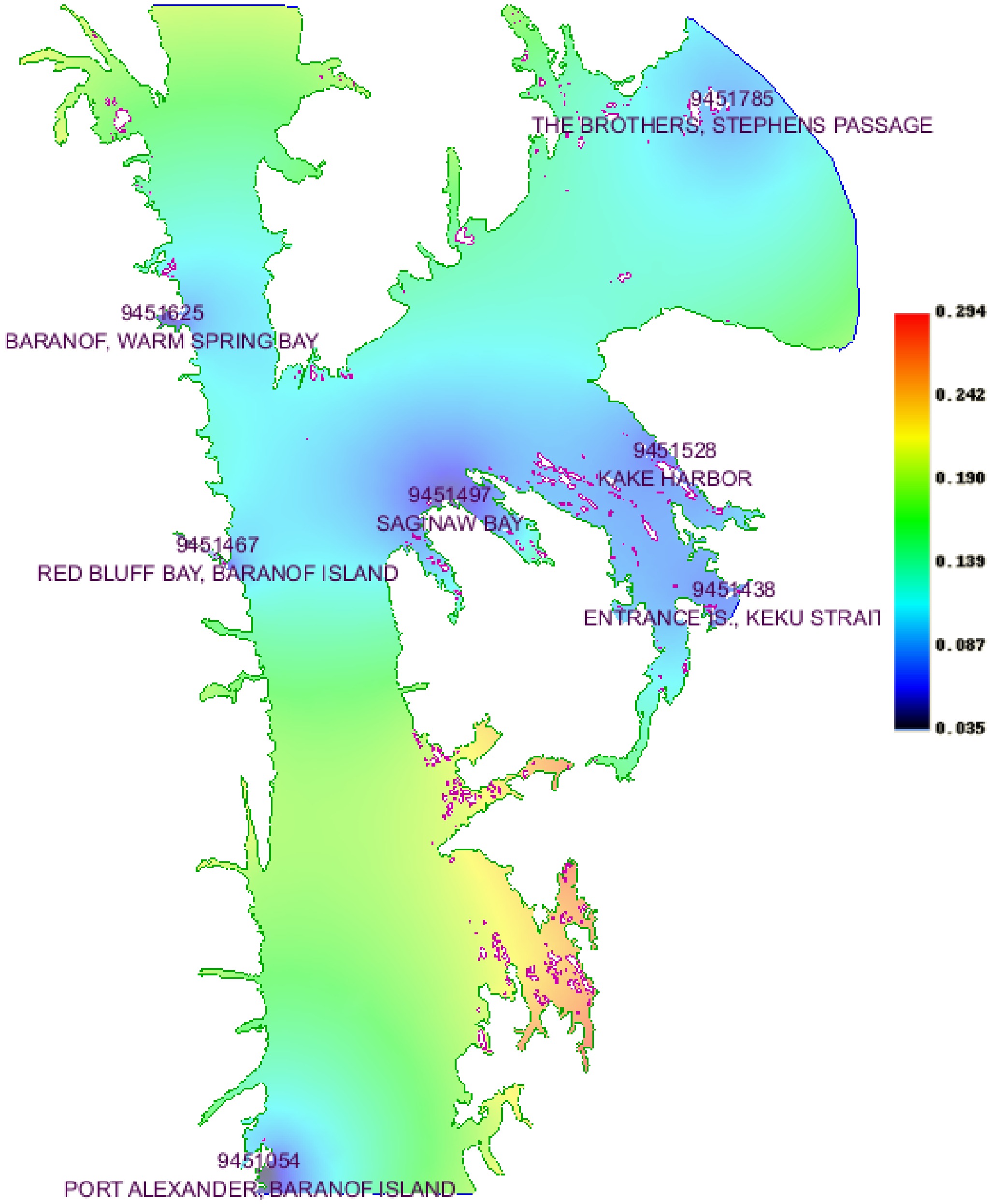
Hull ID	Measured - CTD	Measured - MVP	Surface
2801	3 meters/second		.15 meters/second
2802	3 meters/second		.15 meters/second
2803	3 meters/second		.15 meters/second
2804	3 meters/second	1 meters/second	.15 meters/second
S221		1 meters/second	.05 meters/second

Table 6: Survey Specific Sound Speed TPU Values

Total propagated uncertainty values for survey H12533 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 14). 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 H12533. 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 include 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 15). 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 16). Overall 100.0% by node and 100.0% by area of survey H12533 met the accuracy requirements stated in the HSSD.



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

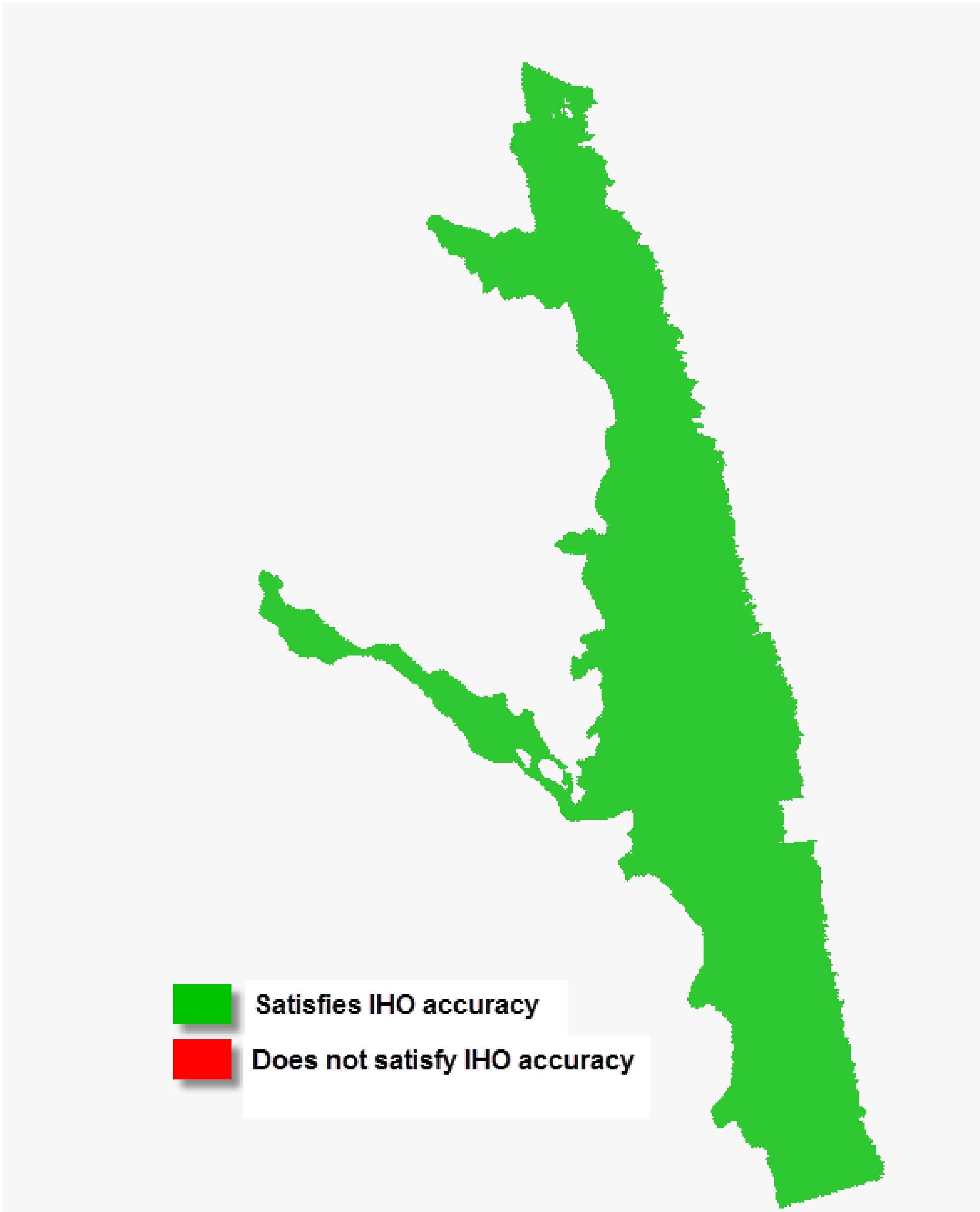


Figure 15: H12533 met IHO accuracy standards for 100.0% of the survey area.

H12533 IHO Table					
Resolution	Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
1m	0 - 20m	Order 1	2,818,801	2,818,800	100.0%
2m	18 - 40m	Order 1	902,729	902,729	100.0%
4m	36 - 80m	Order 1	369,101	369,101	100.0%
8m	72 - 100m	Order 1	36,235	36,235	100.0%
8m	100 - 160m	Order 2	50,112	50,112	100.0%
16m	144 - 320m	Order 2	16,780	16,780	100.0%
32m	288 - 1000m	Order 2	23,459	23,458	100.0%
		TOTAL:	4,217,217	4,217,215	**100.0%**
		TOTAL (by area):	46,179,237	46,178,212	**100.0%**

Figure 16: 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 the number of different resolution nodes into a common unit of area.

B.2.3 Junctions

Three junction comparisons were completed for H12533 (Figure 17). Junctioning survey H11708 was a Fugro Pelagos, Inc. survey from 2007 and two surveys (H12532 and H12537) were acquired concurrently with this survey. Depth comparisons were performed using difference surfaces and sounding comparison in CARIS Subset Editor. Histograms of the difference surfaces are included, showing mean and standard deviation.

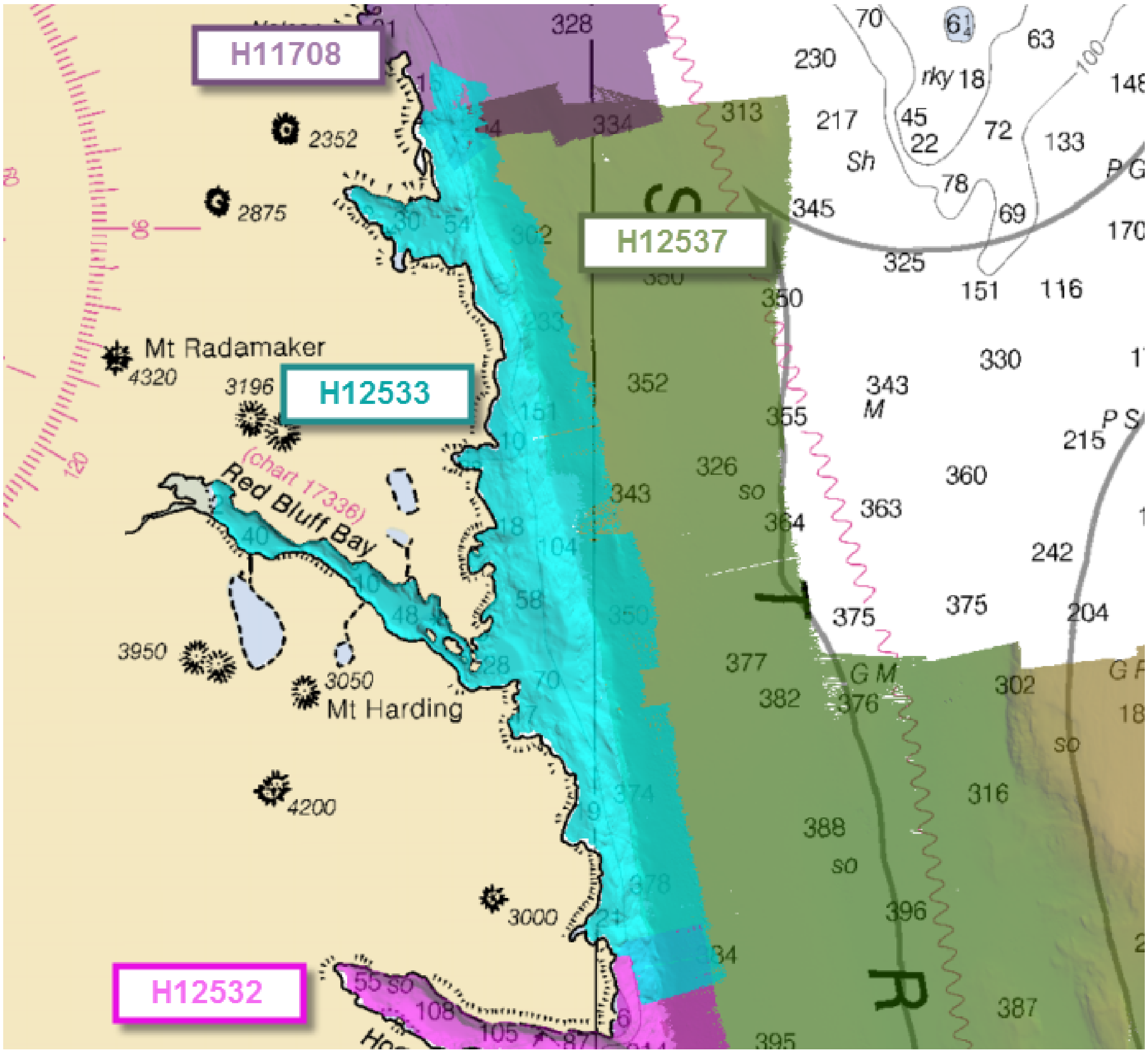


Figure 17: Overview of junctions with H12533.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H11708	1:20000	2007	23 Fugro Pelagos, Inc.	N
H12537	1:40000	2013	NOAA Ship RAINIER	E
H12532	1:10000	2013	NOAA Ship RAINIER	S

H11708

Overlap with survey H11708 was an approximately 1,100 by 800 meters area along the northern boundary of H12533 (Figure 18). Depths in the junction area range from approximately 200 to 580 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H11708 to be an average of 5.65 meters shoaler than H12533, with a standard deviation of 6.65 meters (Figure 19).

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 20). In total, 51.5% of the depth differences between H12533 and junctioning survey H11708 are within allowable IHO accuracies (Figure 21). Nearly the entire junction area is directly along the steep and deep slopes of Chatham Strait, suggesting that the majority of inconsistencies are an artifact of the gridding algorithm. Sounding data from H11708 was not available for comparison in Subset Editor.

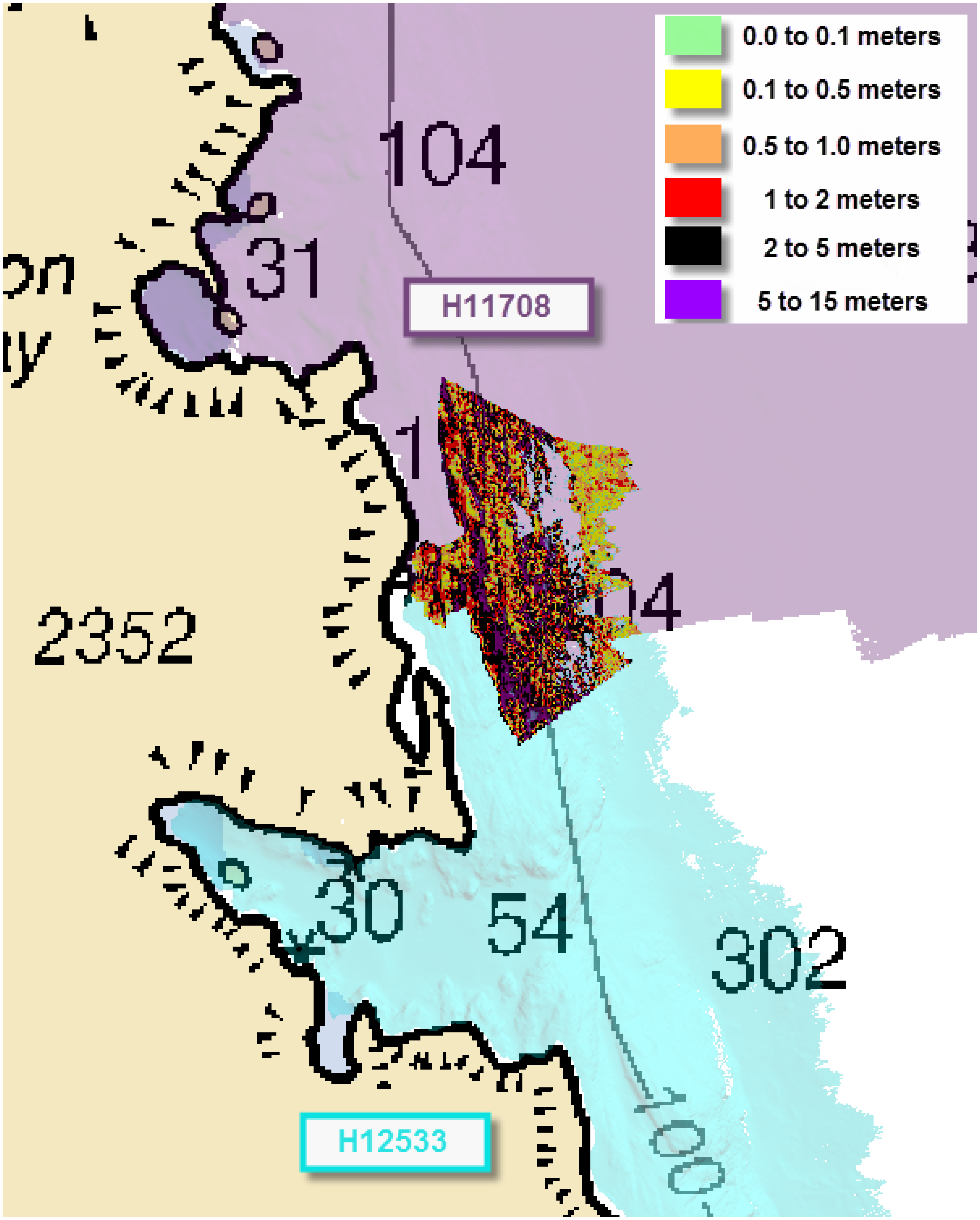


Figure 18: Junction between H12533 (blue) and H11708 (purple).

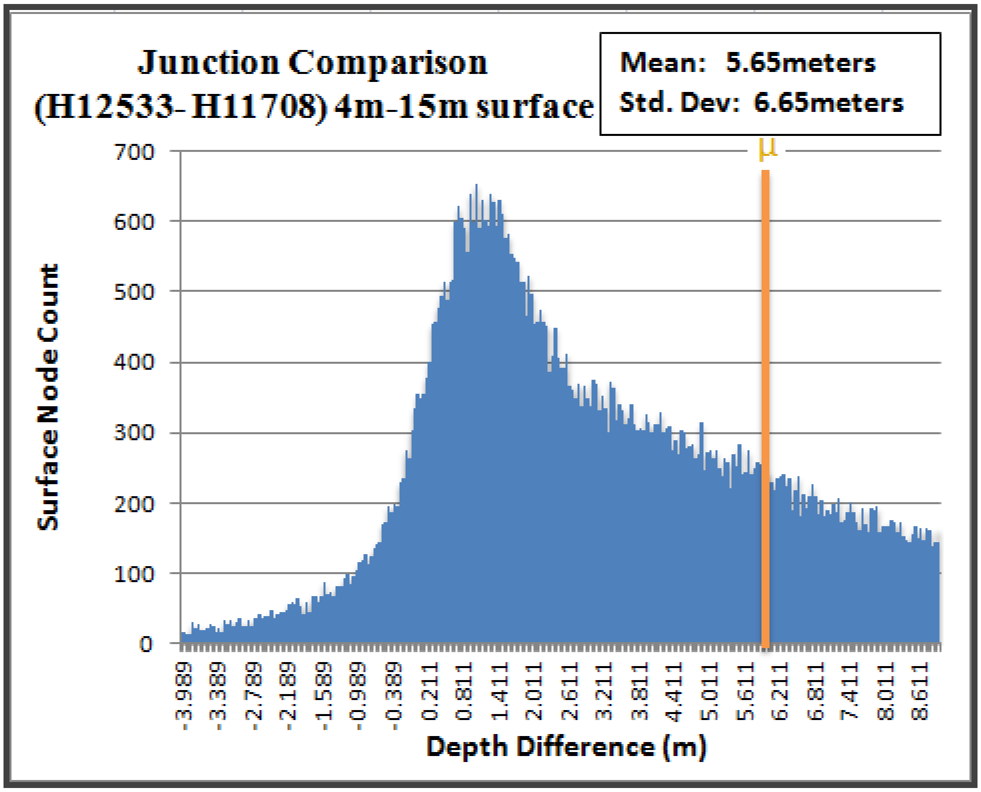


Figure 19: Difference surface statistics between H12532 and H11708 CUBE depth layer (8m grid size).

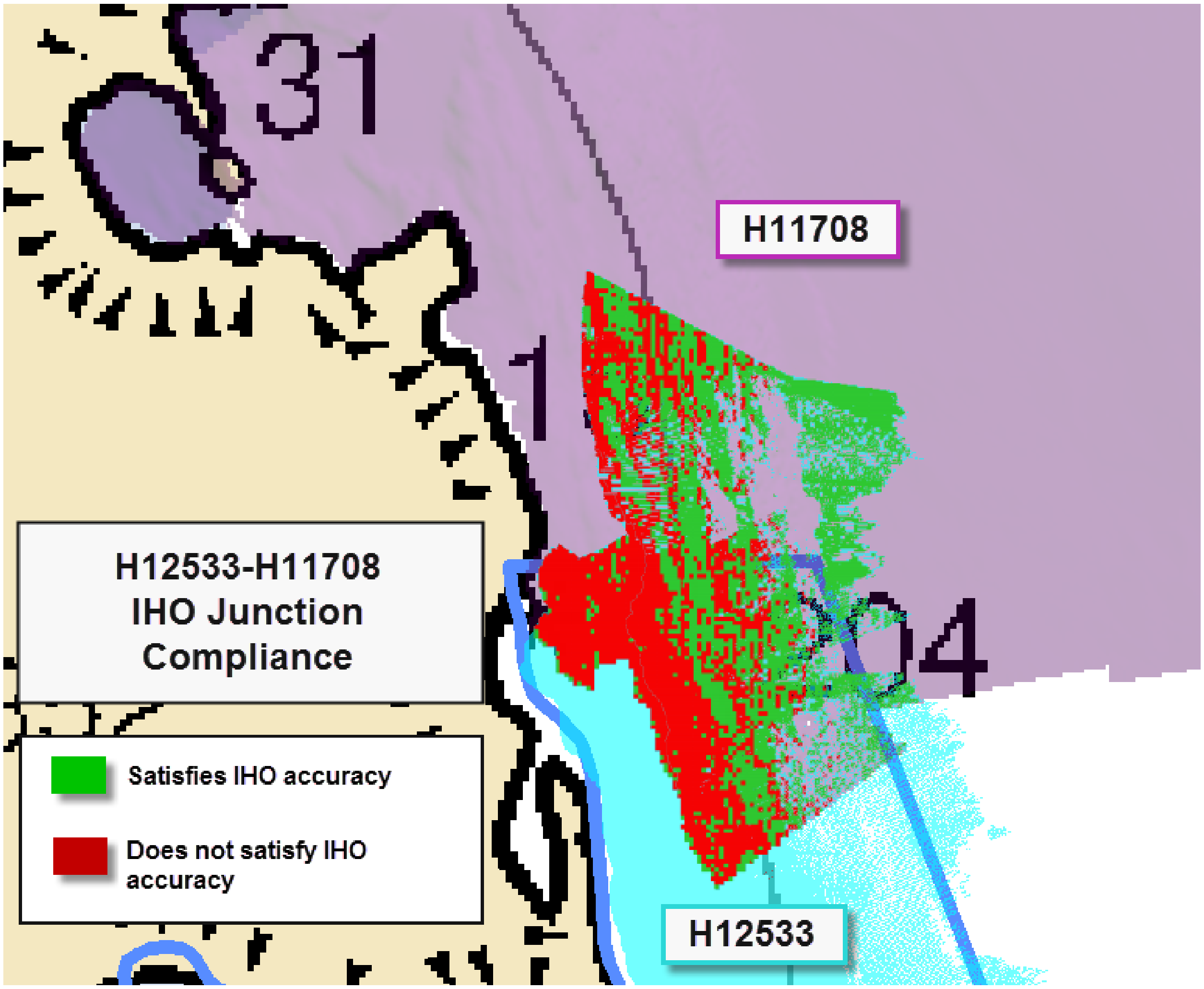


Figure 20: Depth difference between H12533 and junctioning survey H11708 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Less than 100m	Order 1	10,338	897	8.7%
Greater than 100m	Order 2	66,282	38,588	58.2%
	TOTAL:	76,620	39,485	51.5%

Figure 21: Summary table showing percentage of difference surface nodes between H12533 and junctioning survey H11708 that meet allowable IHO accuracy standards for the associated depths.

The minimum depth range of 200 meters for the junction is incorrect. Table 21 states that 8.7% of the survey was in depth less than 100 meters. Larger depth differences between surveys are expected in deep areas and areas with steep topography. The data is adequate for charting.

H12537

Overlap with survey H12537 was approximately 1,400 meters wide along the eastern boundary of H12533 (Figure 22). Depths in the junction area range from 290 to 715 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12533 to be an average of 0.41 meters shoaler than H12537 with a standard deviation of 3.13 meters (Figure 23). This is within allowable IHO Order 2 accuracies at these depths.

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 24). In total, 100.0% of the depth differences between H12533 and junctioning survey H12537 are within allowable IHO accuracies (Figure 25). Inspection of the data in Subset Editor shows agreement between the two surveys, suggesting the majority of the inconsistencies seen in the difference surface are artifacts of the gridding algorithm along the steep and deep slopes of Chatham Strait.

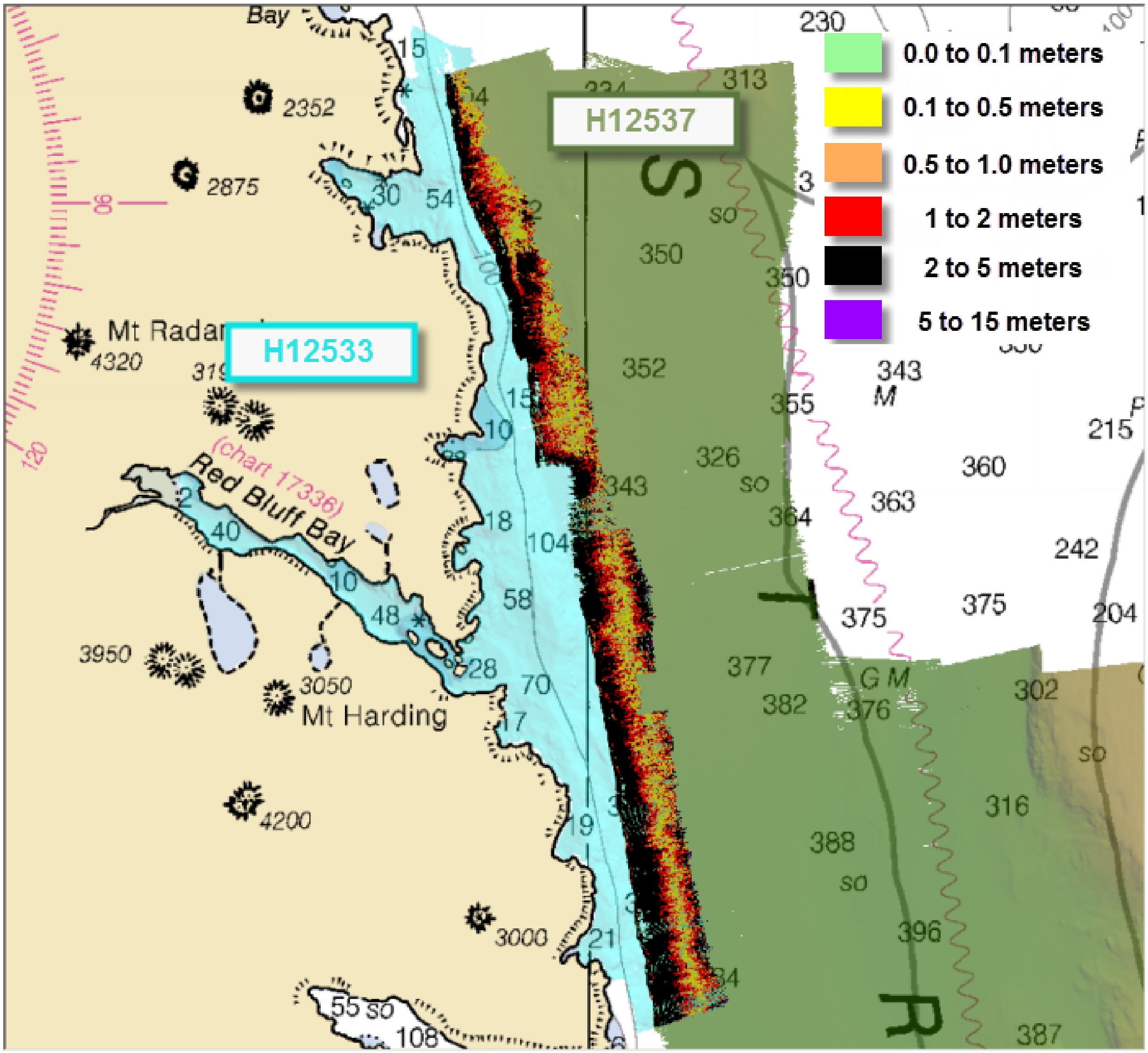


Figure 22: Difference surface between H12533 and junctioning survey H12537.

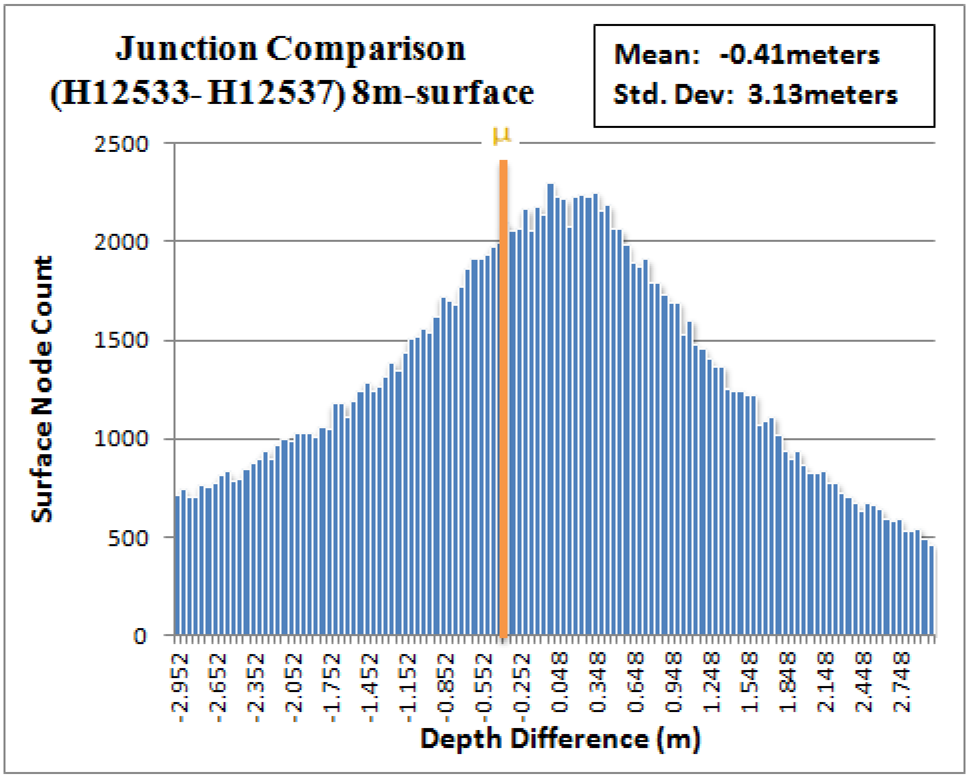


Figure 23: Difference surface statistics between H12533 and H12537 CUBE depth layers (8-meter grid size). H12533 is an average of 0.41meters shoaler.

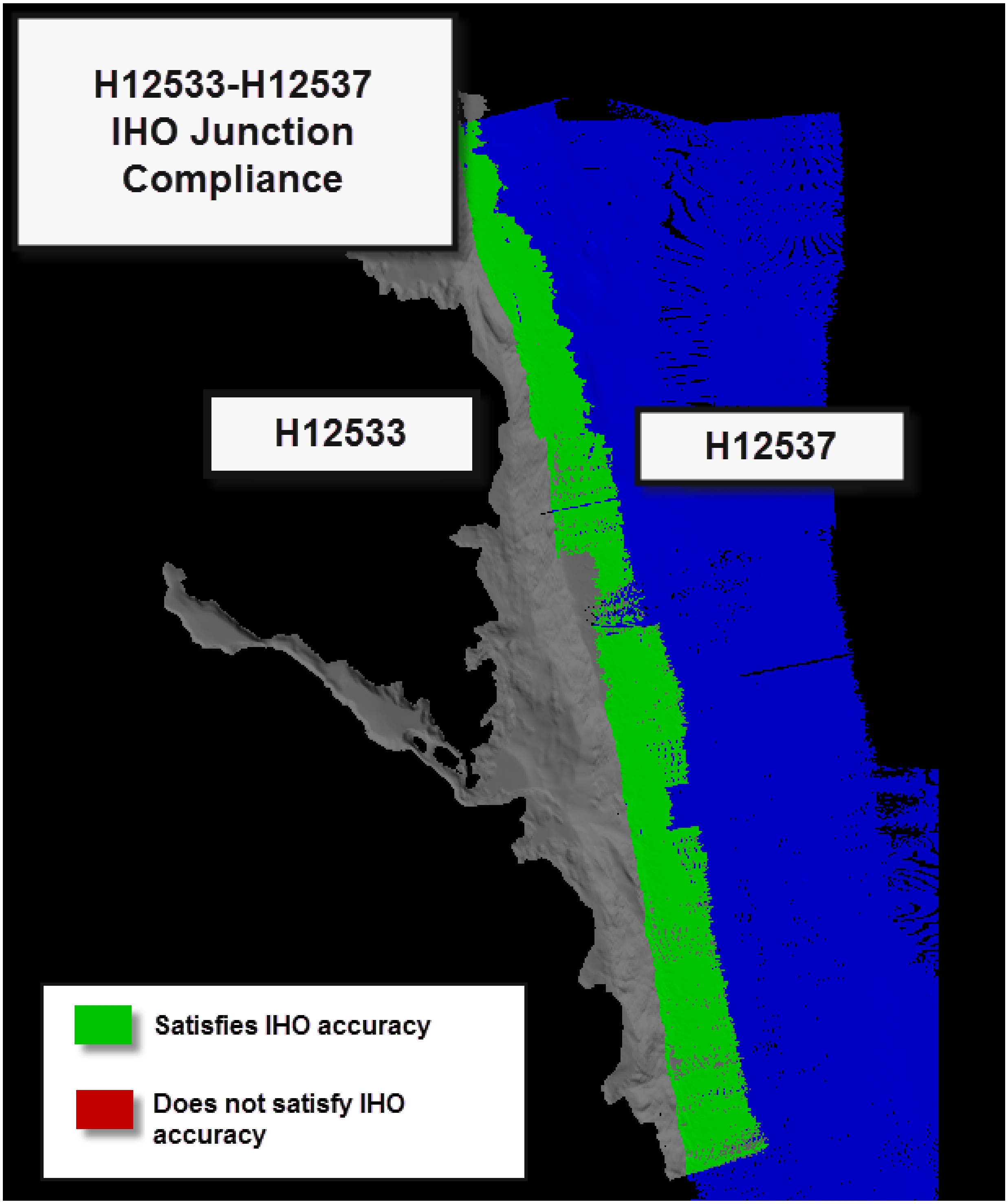


Figure 24: Depth difference between H12533 and junctioning survey H12537 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Greater than 100m	Order 2	200,063	200,063	100.0%

Figure 25: Summary table showing percentage of difference surface nodes between H12533 and junctioning survey H12537 that meet allowable IHO accuracy standards for the associated depths.

Larger depth differences between surveys are expected in deep areas and areas with steep topography. The data is adequate for charting.

H12532

Overlap with survey H12532 was approximately 1,250 meters wide along the southern boundary of H12533 (Figure 26). 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 3.60 meters (Figure 27).

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 28). Given the steepness of the slope in the area, there were very few nodes in depths less than 100 meters 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 29). Inspection of the data in Subset Editor shows agreement between the two surveys, suggesting the majority of the inconsistencies are an artifact of the gridding algorithm along the steep and deep slopes of Chatham Strait.

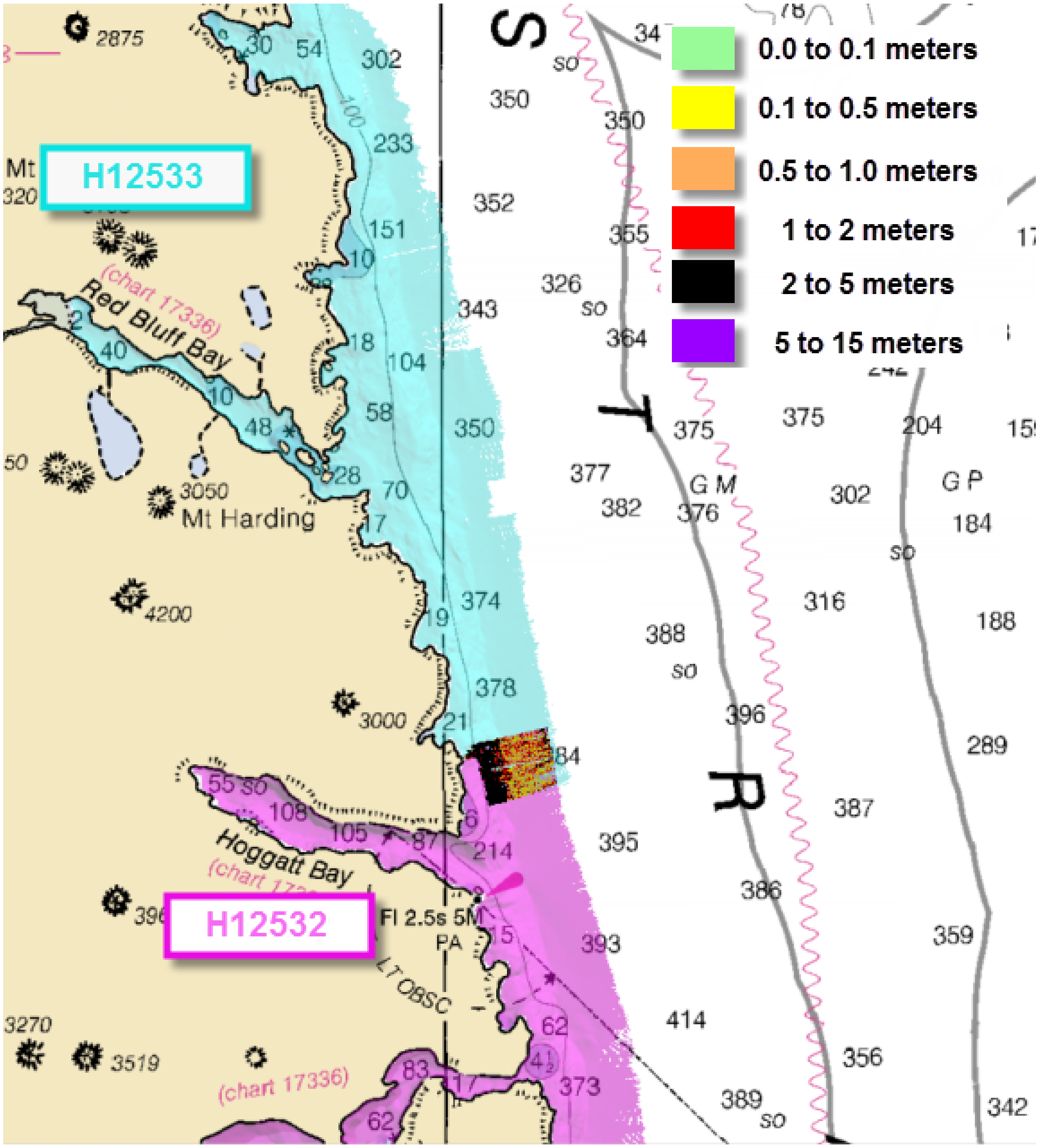


Figure 26: Difference surface between H12533 and junctioning survey H12532.

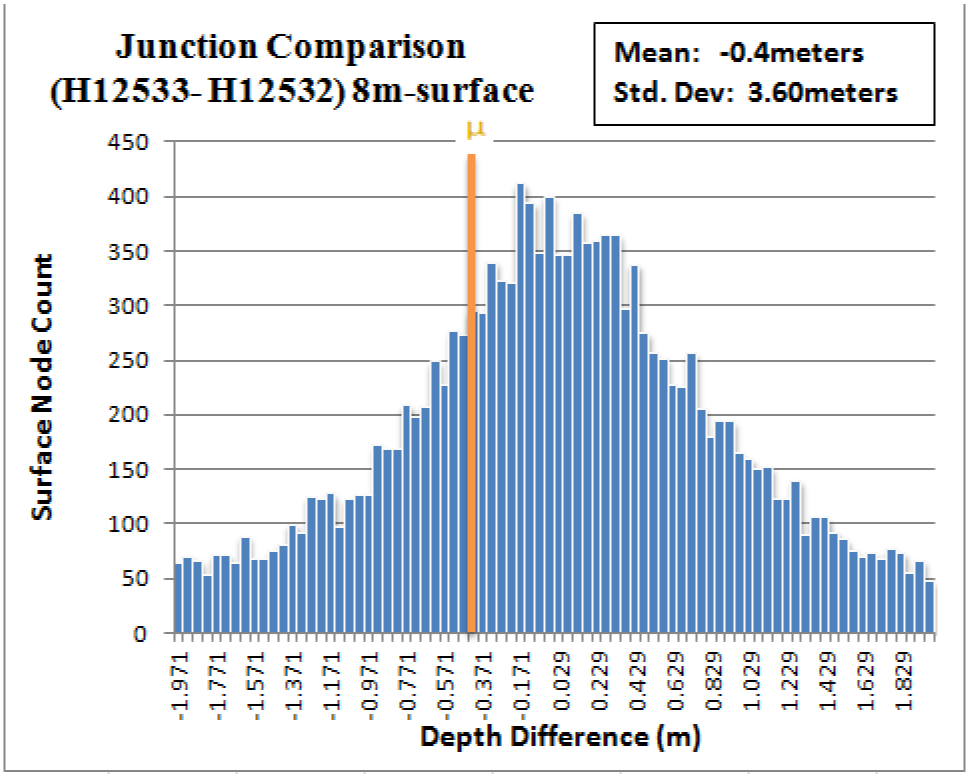


Figure 27: Difference surface statistics between H12533 and H12532 CUBE depth layers (8-meter grid size). H12533 is an average of 0.4 meters deeper.

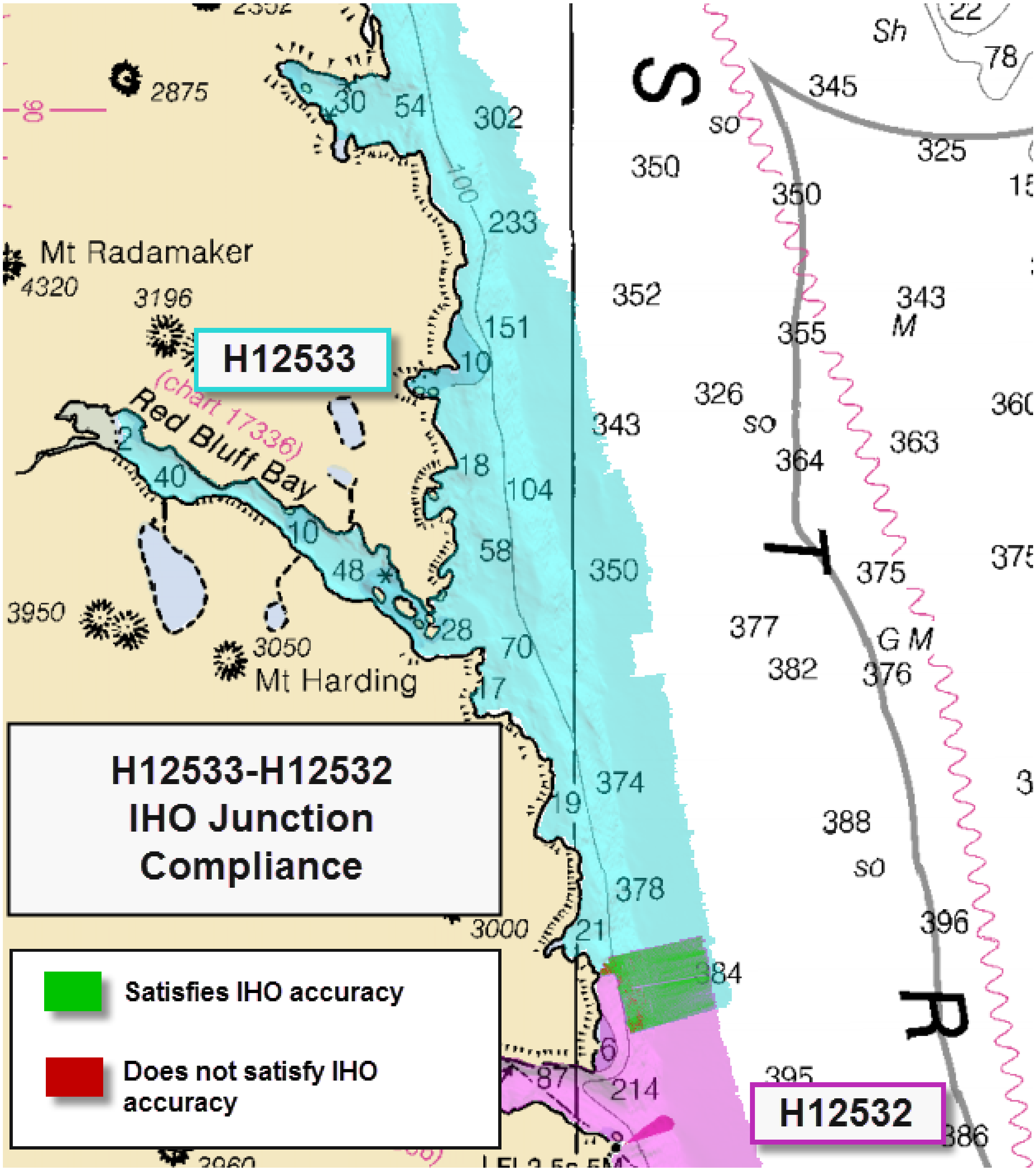


Figure 28: Depth difference between H12533 and junctioning survey H12532 as compared to allowable IHO accuracy standards for the associated depths.

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 H12533 and junctioning survey H12532 that meet allowable IHO accuracy standards for the associated depths.

Larger depth differences between surveys are expected in deep areas and areas with steep topography. The data is adequate for charting.

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 Artifacts

Despite the attempts of the survey crews to spatially and temporally collect sound speed profiles, sound speed artifacts were seen within the data in the form of 'smiles' or 'frowns', particularly in areas of fresh water inflow near rivers and streams in Red Bluff Bay (Figure 30). Where possible, these 'smiles' or 'frowns' 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 HSSD.

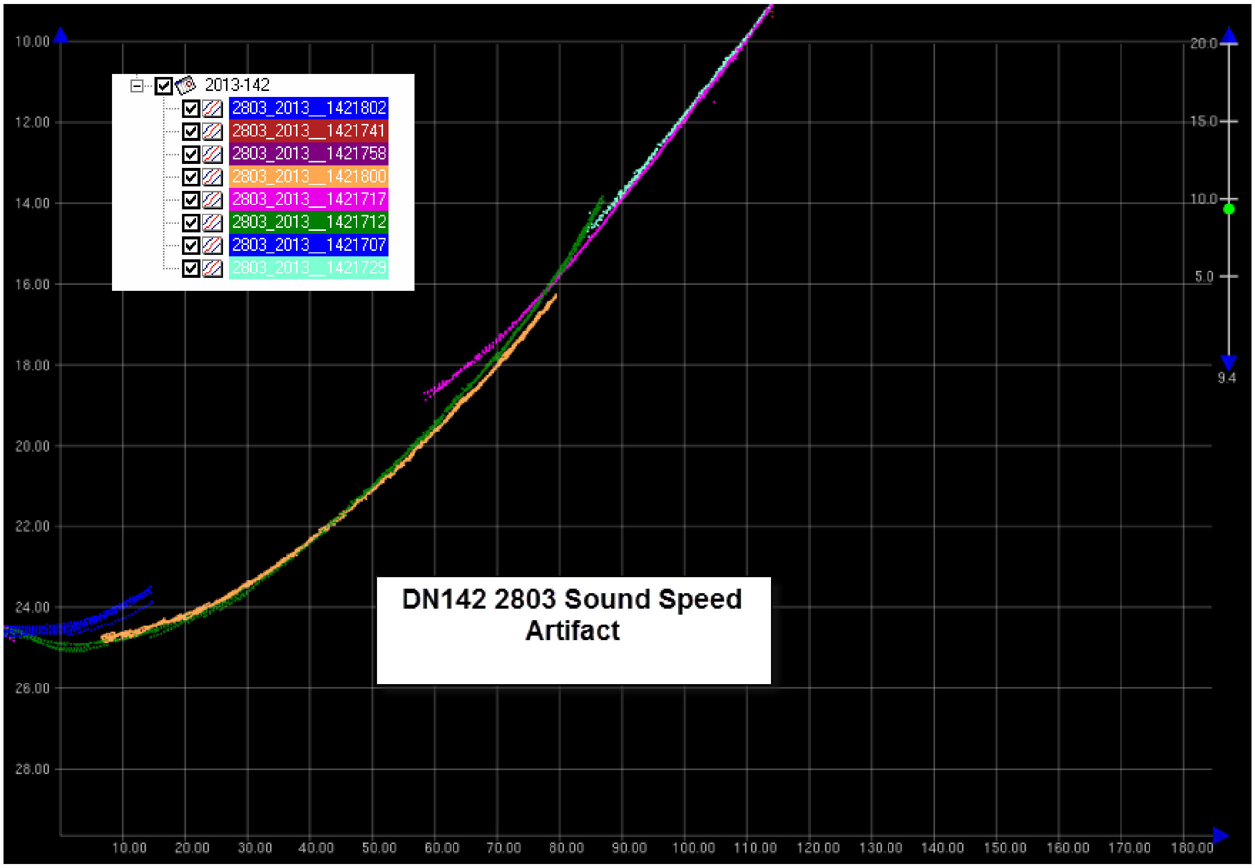


Figure 30: Sound speed artifact.

After rejecting data to mitigate the effects of the sound speed artifacts, the data is adequate for charting.

ERS to MLLW Comparison

Using the GPS height determined from the SBET file, data from H12533 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. 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.

Initial review of the difference surface revealed an east to west gradient across the survey (Figure 31). Upon investigation, it was found that the EGM2008-WGS84 geoid-ellipsoid separation model published by the National Geospatial-Intelligence Agency (NGA) showed a similar trend across the survey; these surfaces have a similar slope and magnitude and agree well, considering the 2.5' resolution of the NGA surface and the expected differences between the geoid and MLLW (Figure 32).

Additional review revealed offsets between adjacent lines at the head of Red Bluff Bay (Launch 2803 DN142); upon inspection in Subset Editor, these offsets were approximately 0.5 meters when referenced to MLLW (without SBETs) and increased to as much as 1.5 meters when referenced to the ellipse (Figures 33 and 34). Upon review of the SBET data in POSPac, there was an obvious altitude shift during the time of acquisition at the head of the bay (Figure 35). Given this suspect data, those lines were not used in the ERS to MLLW Difference Surface; however, comparison of data with and without SBETs at MLLW showed improved agreement with SBETs applied, and thus they were retained for these lines for the benefit of improved horizontal positioning (Figure 36).

It should also be noted that four lines of data acquired by S221 (DN143) were not used for the ERS surface; these lines were acquired prior to updating the HVF with a new reference frame (Section B.3.2 Calibrations). The original HVF (S221_Simrad-EM710) could not be reliably referenced to the ellipse and was thus left out of the difference surface.

The Hydrographer recommends that all data supersede the chart.

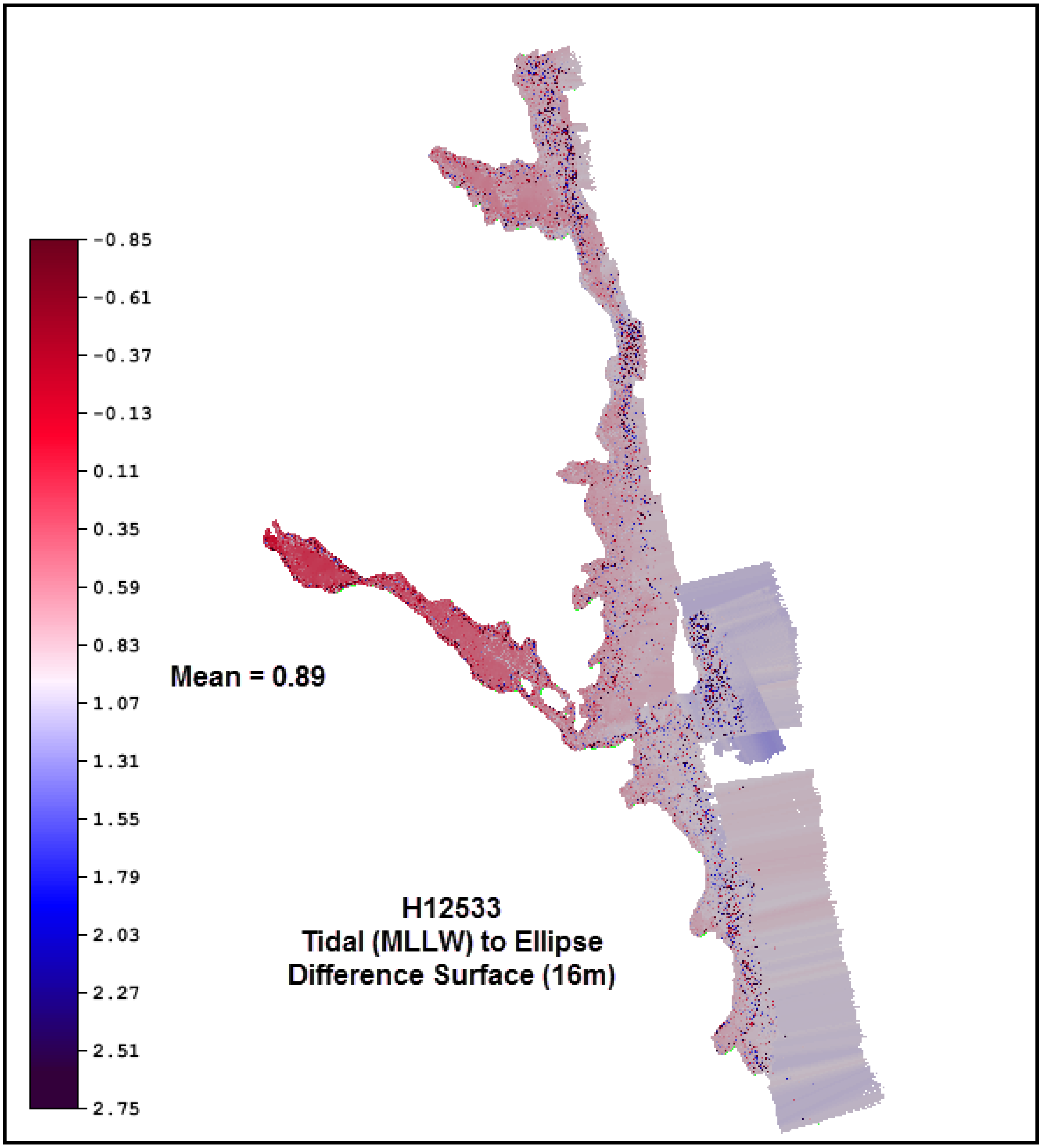


Figure 31: Difference surface between tidally-referenced and ellipsoidally-referenced surface. Red and blue show divergence from the mean. Several lines were not used in this difference surface (discussed in preceding paragraph).

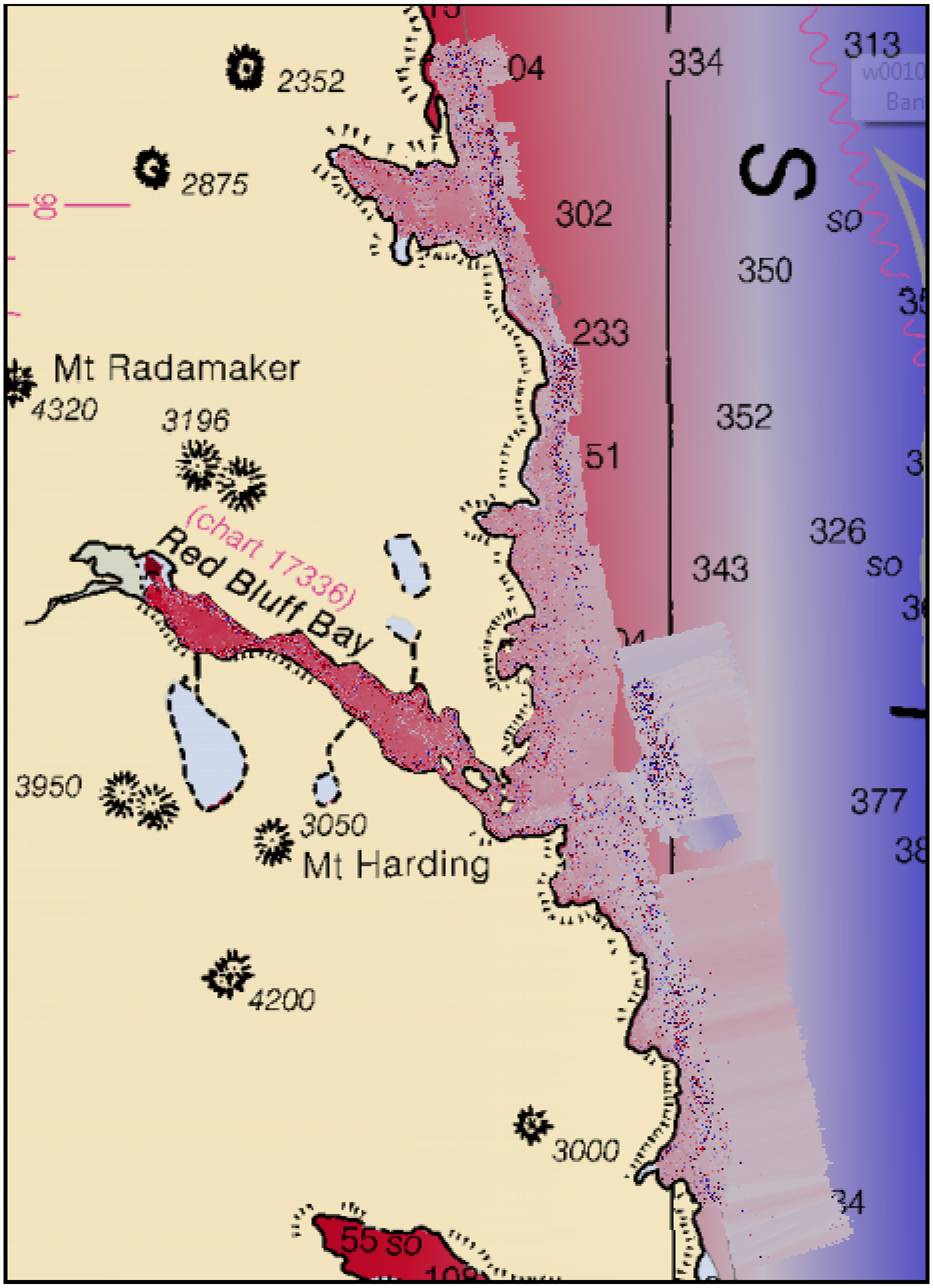


Figure 32: MLLW-ERS difference surface displayed over EGM2008-WGS84 geoid-ellipsoid separation model (Chart 17320).

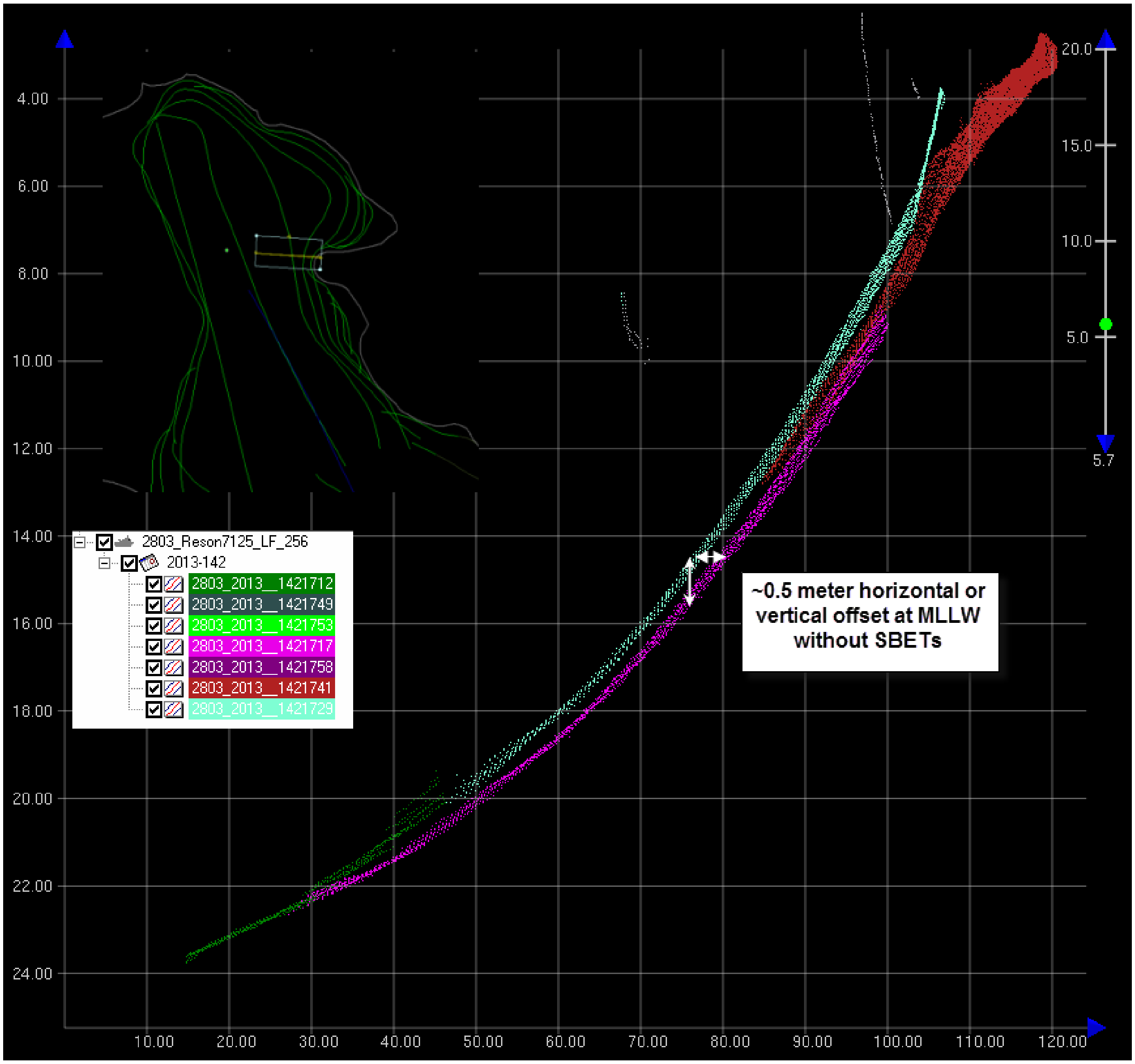


Figure 33: Offset seen between adjacent lines at MLLW without SBETs (Red Bluff Bay).

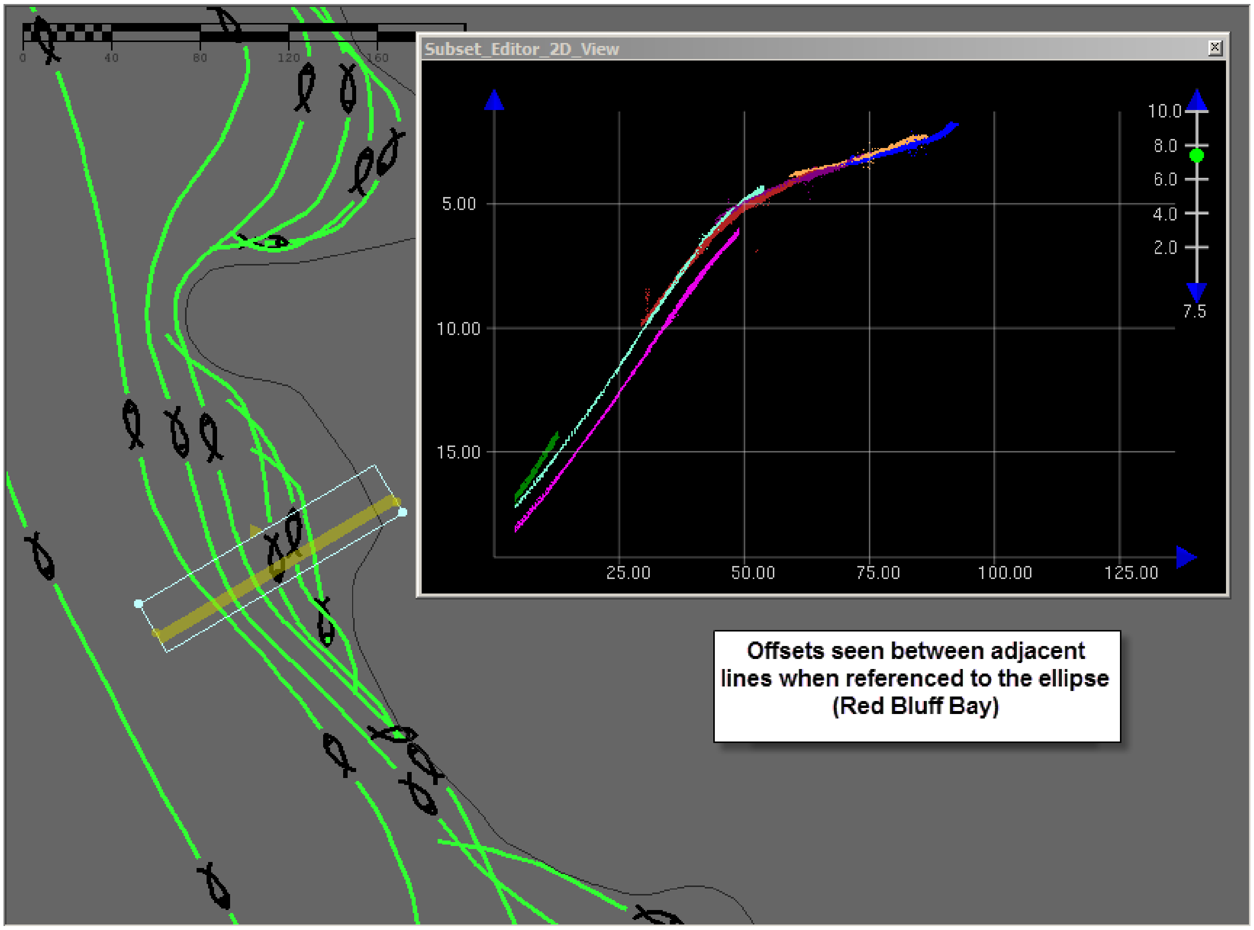


Figure 34: Offset between adjacent lines when referenced to the ellipse (Red Bluff Bay).

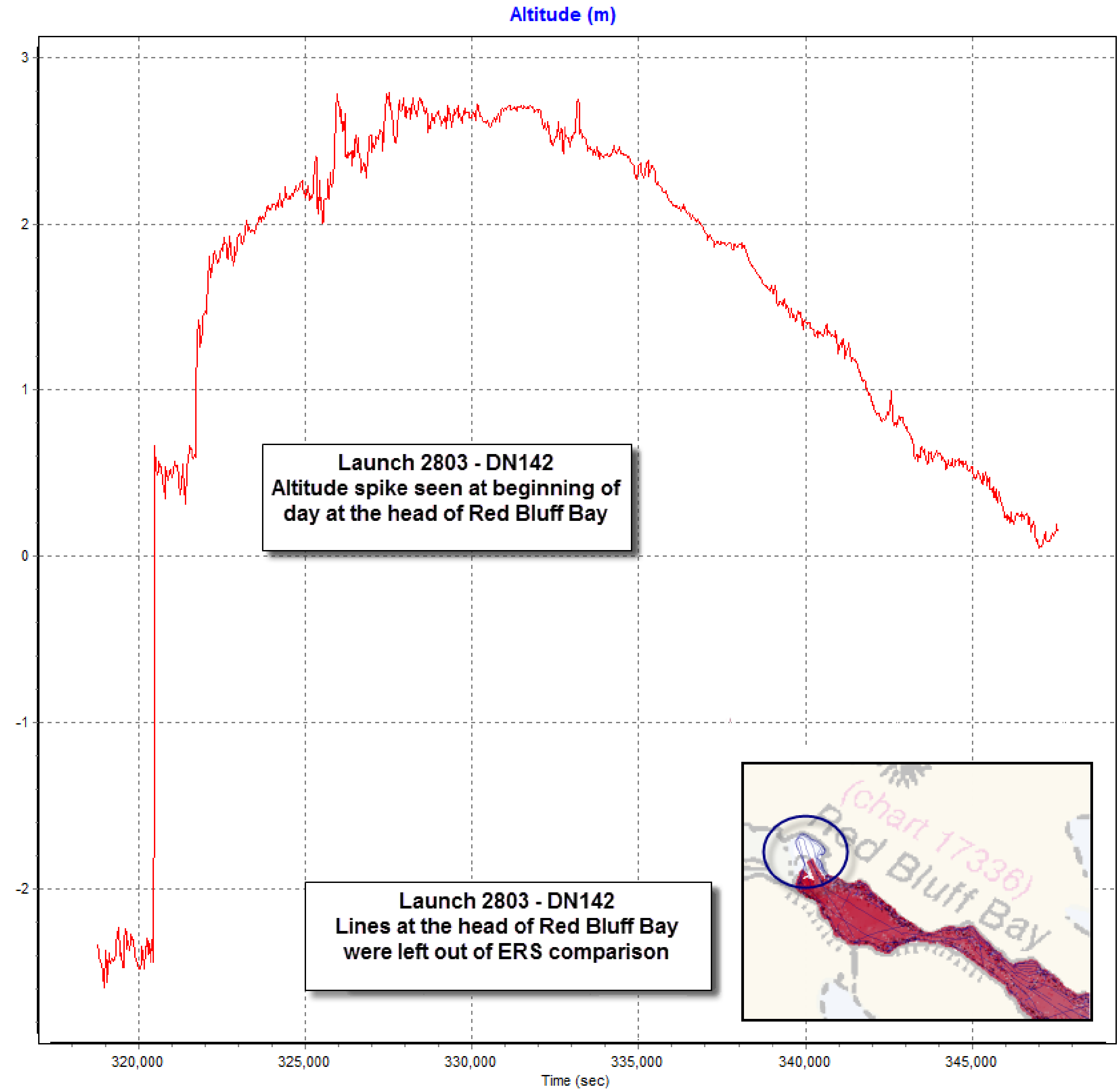


Figure 35: Altitude spike seen at the beginning of the day for Launch 2803 DN142. Lines acquired during that time were not used in the difference surface.

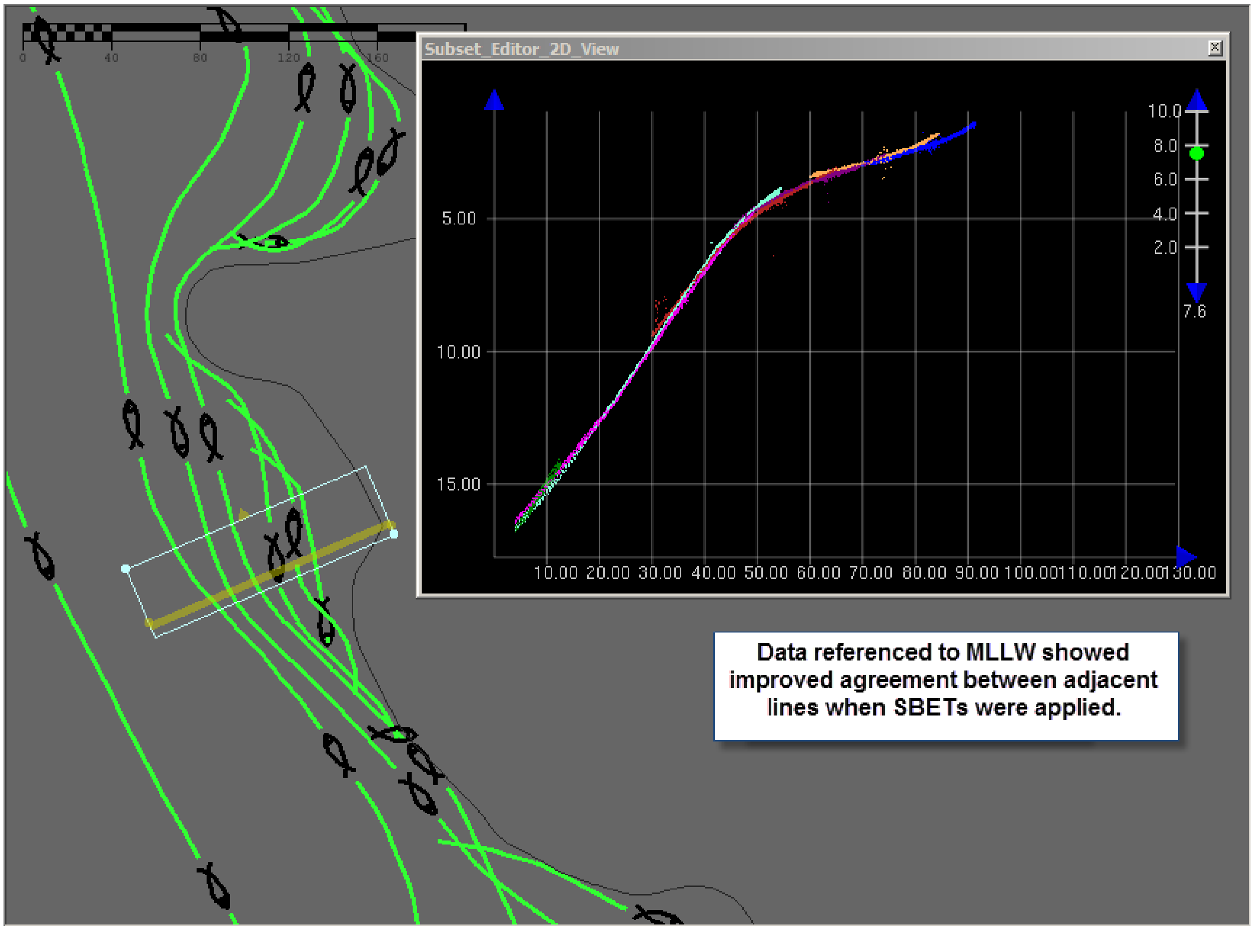


Figure 36: Data referenced to MLLW showed improved agreement between adjacent lines when SBETs were applied.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: For data collected by launches, sound speed profiles were acquired using the SBE 19plus and SBE19 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 by 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 by 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 37).

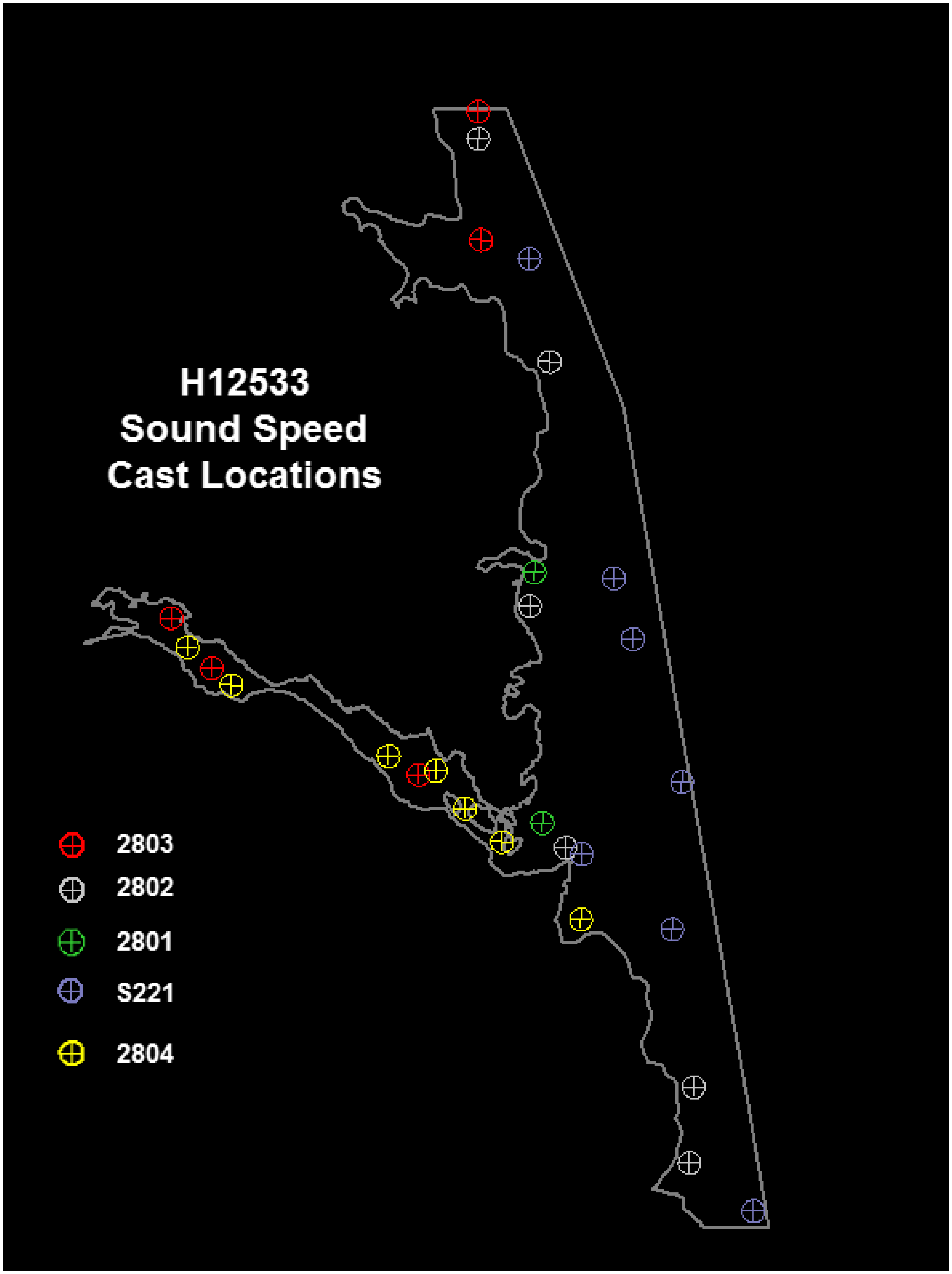


Figure 37: H12533 sound speed locations.

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

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

B.3.2 Calibrations

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

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

Table 8: Calibrations not discussed in the DAPR.

In cooperation with the 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. All lines except for five lines acquired on DN143 were acquired using this new configuration. This configuration is further described in the DAPR.

The data logged using the updated configuration is adequate for charting.

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: NOAA Extended Attribute Files Version 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.

The EM710 data processed using the custom CARIS license file is adequate for charting.

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
H12533_1m	CUBE	1 meters	-2.0 meters - 725 meters	NOAA_1m	Complete MBES
H12533_2m	CUBE	2 meters	-2.0 meters - 725 meters	NOAA_2m	Complete MBES
H12533_4m	CUBE	4 meters	-2.0 meters - 725 meters	NOAA_4m	Complete MBES
H12533_8m	CUBE	8 meters	-2.0 meters - 725 meters	NOAA_8m	Complete MBES
H12533_16m	CUBE	16 meters	-2.0 meters - 725 meters	NOAA_16m	Complete MBES
H12533_32m	CUBE	32 meters	-2.0 meters - 725 meters	NOAA_32m	Complete MBES
H12533_1m_-2to40m_Final	CUBE	1 meters	-2.0 meters - 40 meters	NOAA_1m	Complete MBES
H12533_2m_18to80m_Final	CUBE	2 meters	18 meters - 80 meters	NOAA_2m	Complete MBES
H12533_4m_36to160m_Final	CUBE	4 meters	36 meters - 160 meters	NOAA_4m	Complete MBES
H12533_8m_72to320m_Final	CUBE	8 meters	72 meters - 320 meters	NOAA_8m	Complete MBES
H12533_16m_144to500m_Final	CUBE	16 meters	144 meters - 500 meters	NOAA_16m	Complete MBES
H12533_32m_288to1000m_Final	CUBE	32 meters	288 meters -	NOAA_32m	Complete MBES

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
			1000 meters		
H12533_32m_Combined	CUBE	32 meters	-2.0 meters - 720 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 H12533 (Figure 38), finalized surfaces were extended beyond the depth thresholds specified in the HSSD. 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.

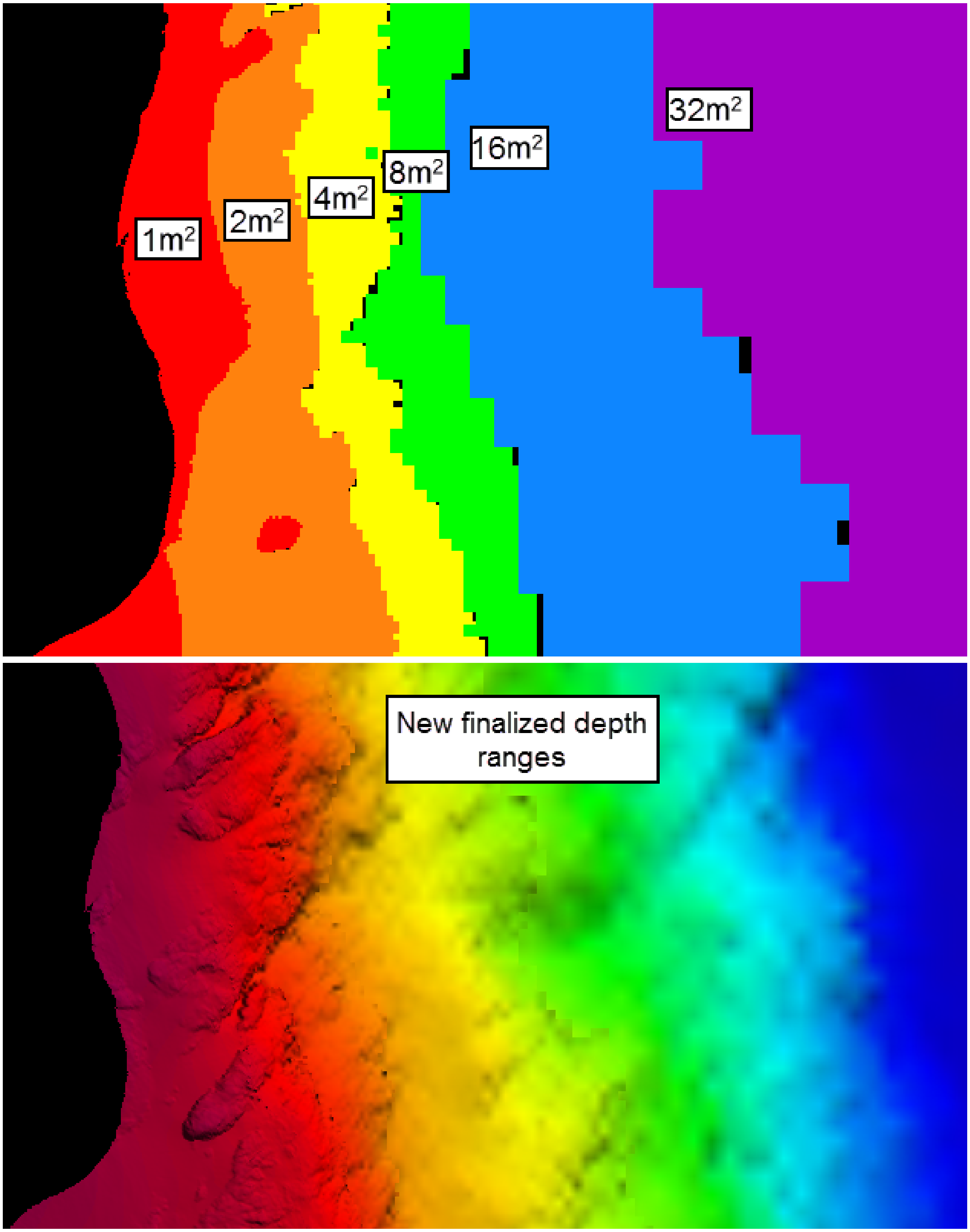


Figure 38: (Top) Finalized surfaces created using depth thresholds specified in the HSSD; notice the gaps between depth resolutions. (Bottom) The same region gridded using the new finalized depth ranges.

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.

See attached tide note dated August 27, 2013.

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 for the entire survey.

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.

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

A comparison was made between survey H12533 and Chart 17320 using CARIS CUBE surfaces and a sounding and contour layer. The Hydrographer recommends that a sounding set derived from survey H12533 supersede charted depths.

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	08/06/2013	08/17/2013
17336	1:20000	10	01/2013	08/06/2013	08/17/2013

Table 14: Largest Scale Raster Charts

<u>17320</u>

A comparison was performed between survey H12533 and Chart 17320 (1:217828) using CARIS sounding and contour layers derived from the 32-meter combined surface. The contours and soundings have been overlaid on the chart, and representative areas are shown in Figure 39. The Hydrographer recommends that all H12533 data supersede depths on Chart 17320. For further discussion of the surveyed depths to charted sounding comparison, refer to Section D.1.2 - Electronic Navigation Charts.

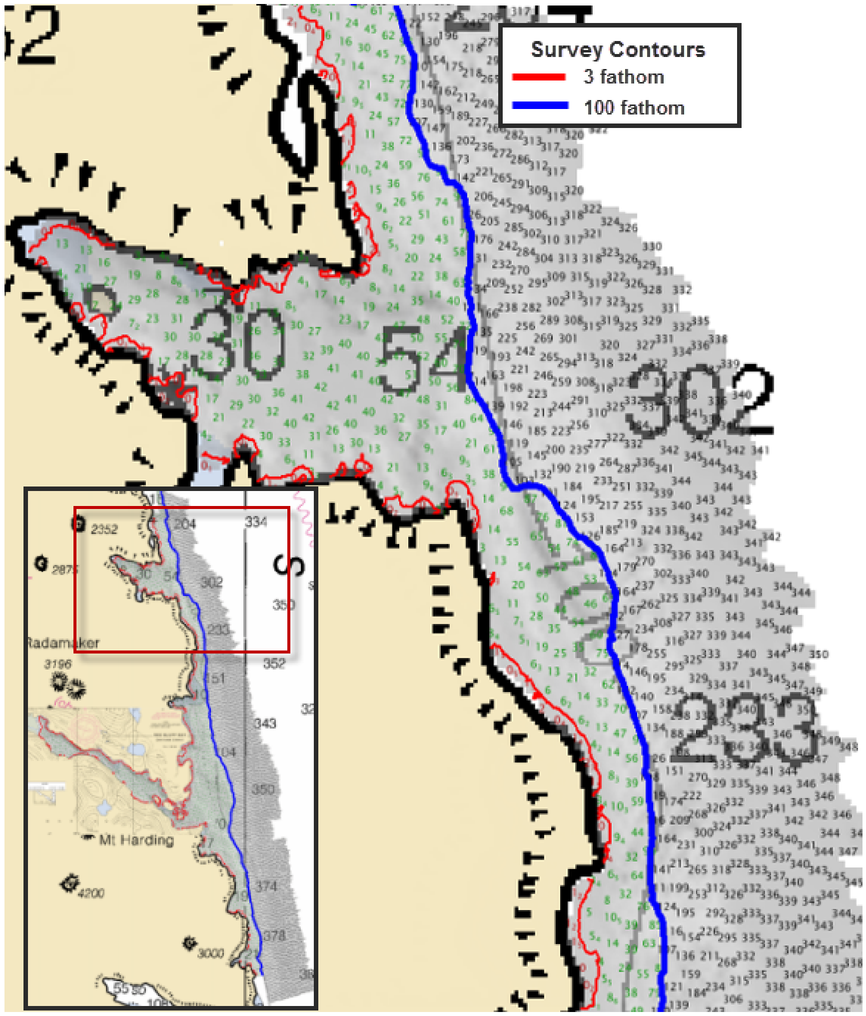


Figure 39: Overview of northern portion of H12533, showing comparison of contours derived from survey H12533 and those depicted on Chart 17320.

17336

A comparison was performed between survey H12533 and Chart 17336_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 representative areas are shown in Figures 40 and 41. The Hydrographer recommends that all H12533 data supersede depths on Chart 17336. For a further discussion of the surveyed depths to charted sounding comparison, refer to Section D.1.2 - Electronic Navigation Charts.

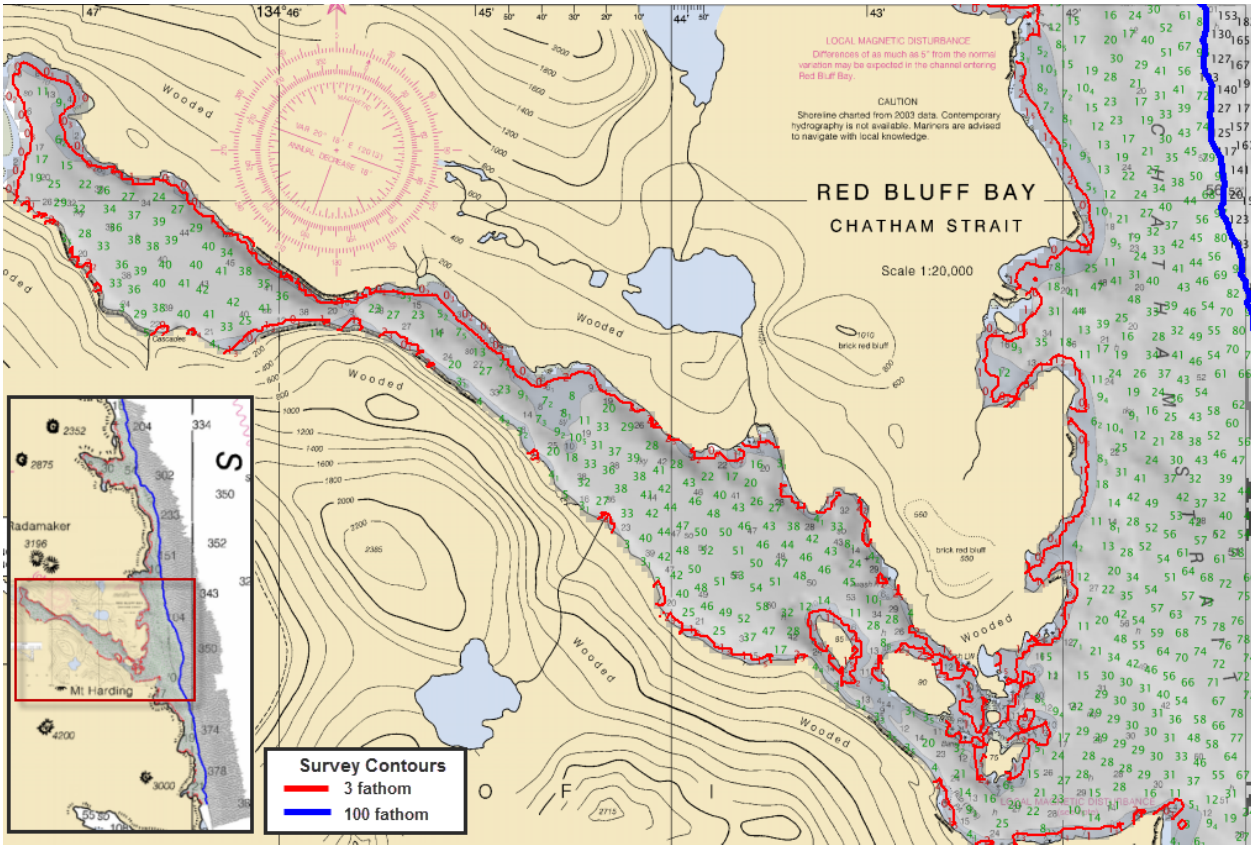


Figure 40: Close-up of Red Bluff Bay, showing comparison of contours derived from survey H12533 and those depicted on Chart 17336_1.

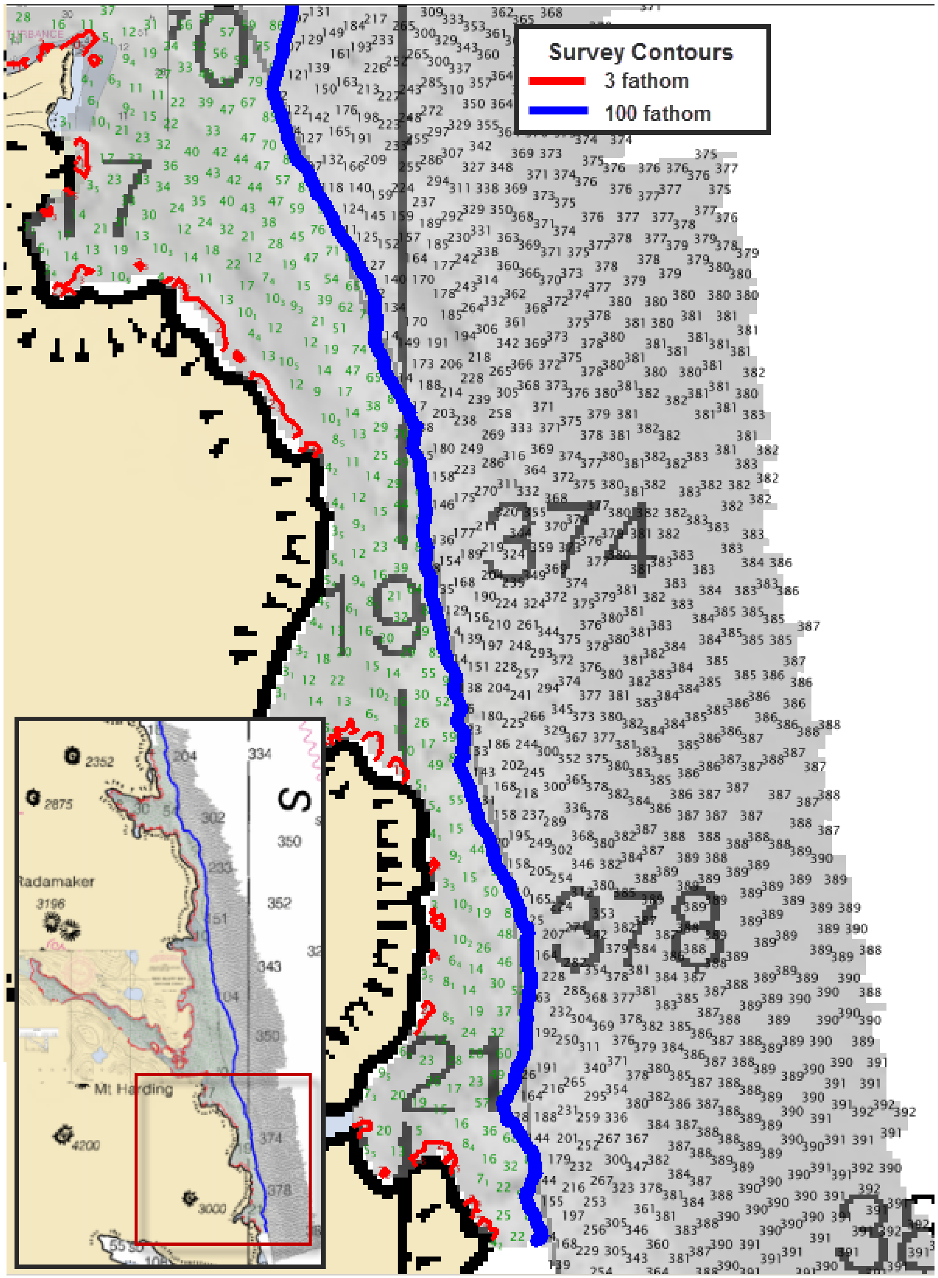


Figure 41: Overview of southern portion of H12533, showing comparison of contours derived from survey H12533 and those depicted on Charts 17336_1 and 17320.

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?
US3AK4PM	1:217828	9	03/21/2011	09/20/2012	NO

Table 15: Largest Scale ENCs

US3AK4PM

ENC US3AK4PM coincides with raster Chart 17320. To compare soundings, a TIN surface was created from the ENC depth features (soundings and contours). A 4-meter surface from H12533 was then differenced from the ENC TIN (Figure 42). Negative (blue) values show where survey H12533 is shoaler than the TIN and positive (gray) values show where survey H12533 is deeper than the TIN. Surveyed depths and charted soundings agree well in some areas of the survey and not in others; otherwise, there is a tendency for the chart to express a shoal biasing in the soundings (sometimes by over 10 fathoms). There are discrepancies between the two sources which may be an artifact of the interpolation process used to create the TIN, as well as cartographic reasons for the placement of soundings on the chart.

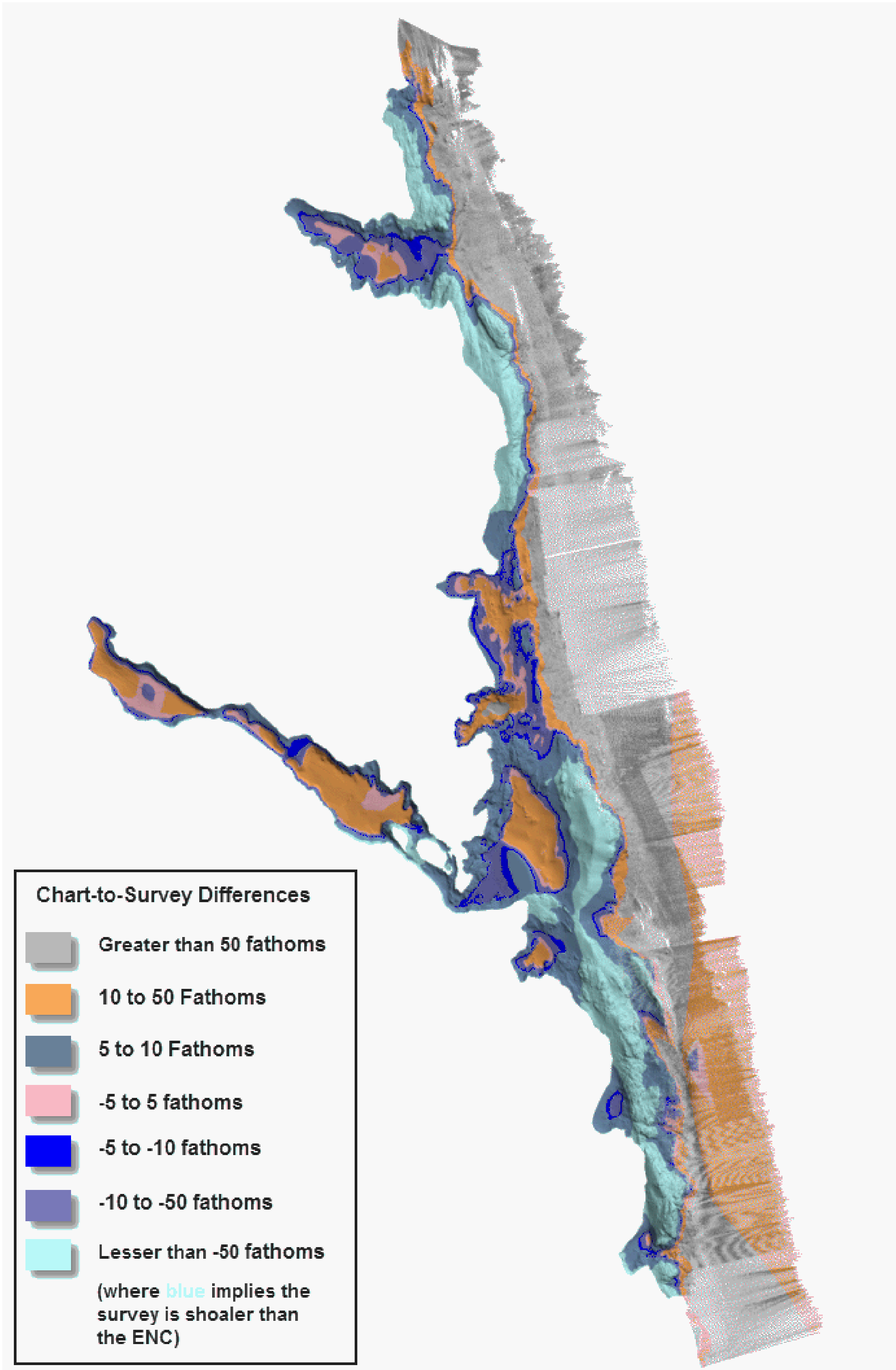


Figure 42: Difference surface between depth estimates from survey H12533 and an interpolated surface created from the soundings and contours of ENC US3AK4PM.

ENC US5AK2YM (Scale 1:20,000, Edition 1, Update Application Date 04/16/2013, Issue Date 04/16/2013) also covers a portion of the survey area. This ENC corresponds to Chart 17336 and has no deviations. Therefore, the chart comparison described for Charts 17336 also applies to this ENC.

D.1.3 AWOIS Items

One AWOIS item was located within the sheet limits of H12533. The assigned AWOIS (database key ID 54104) was not found within the assigned 100 meter search radius, as there were no points within said radius that were dry at MLLW. However, one obstruction area located within the radius was inshore of the NALL and could not be searched.

See attached AWOIS Report.

D.1.4 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.5 Charted Features

No charted features exist for this survey.

D.1.6 Uncharted Features

No uncharted features exist for this survey.

The following orthometric imagery was used:

File Name	Source	Source Image Date
07Jun10WV01_P001	Digital Globe Inc.	08/05/2013
07JUN10WV01	Digital Globe Inc.	08/05/2013

Table 16: Orthometric Imagery

D.1.7 Dangers to Navigation

No Danger to Navigation Reports were submitted for this survey.

D.1.8 Shoal and Hazardous Features

Shoals or potentially hazardous features exist for this survey, but were not investigated.

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

Six bottom sample locations were identified in the Project Reference File. Five bottom sample locations were selected based on available time and distribution throughout the survey area (Figure 43). These five samples were acquired and are detailed in the Final Feature File accompanying this submission.

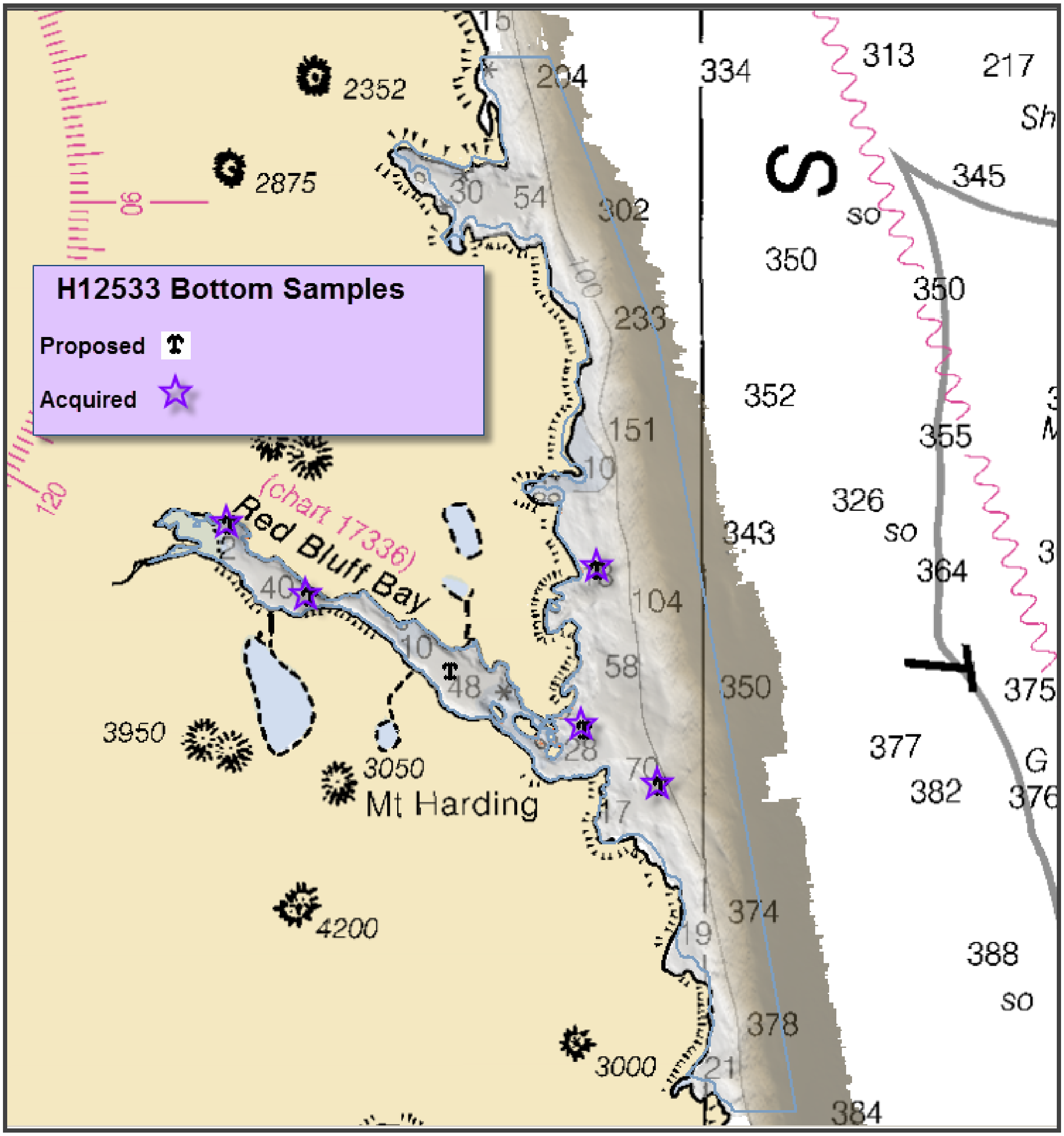


Figure 43: Bottom samples in H12533.

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 HSSD and FPM. There were 76 assigned features for the survey. All features were addressed as required with S-57 attribution and recorded in the H12533 Final Feature 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 Feature 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.

D.2.2 Prior Surveys

No prior survey comparisons exist for this survey.

D.2.3 Aids to Navigation

No Aids to navigation (ATONs) exist for this survey.

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	11/01/2013	
Meghan E. McGovern, LT/NOAA	Field Operations Officer, NOAA Ship RAINIER	11/01/2013	Date: 2013.11.01 11:03:28 -07'00'
James B. Jacobson	Chief Survey Technician, NOAA Ship RAINIER	11/01/2013	James Jacobson I have reviewed this document 2013.11.01 09:39:32 -08'00'
Brandy E. Geiger	Survey Technician, NOAA Ship RAINIER	11/01/2013	Brandy Geiger 2013.11.01 10:56:19 -07'00'

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: H12533

LOCALITY: Red Bluff Bay and Vicinity, Chatham Strait, AK
TIME PERIOD: May 22 - June 29, 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, H12533, during the time period between May 22 and June 29, 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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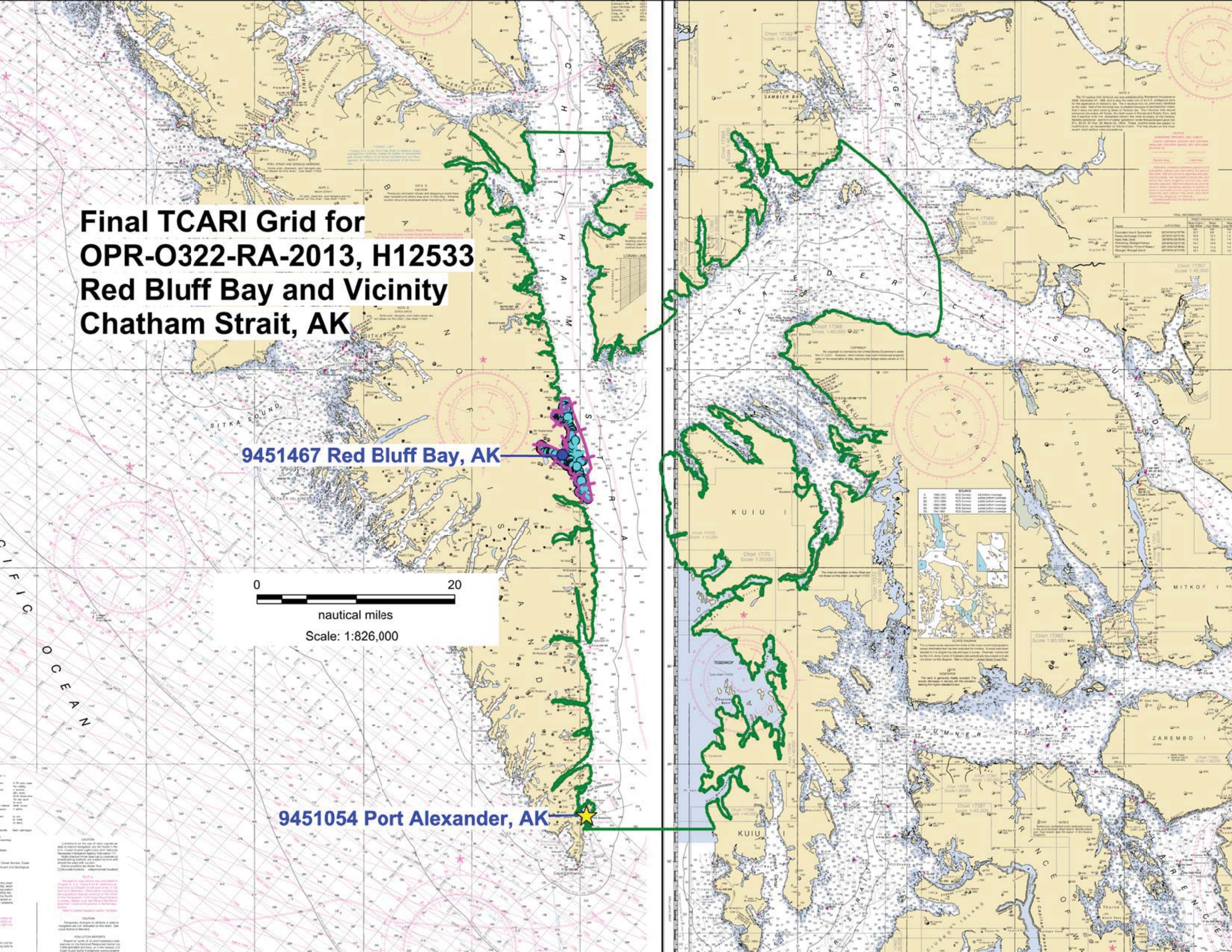
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.1365860250
Date: 2013.08.30 13:38:51 -04'00'

CHIEF, PRODUCTS AND SERVICES BRANCH


Final TCARI Grid for
OPR-O322-RA-2013, H12533
Red Bluff Bay and Vicinity
Chatham Strait, AK
9451467 Red Bluff Bay, AK
9451054 Port Alexander, AK
0
20
nautical miles
Scale: 1:826,000

H12533 AWOIS Report

Registry Number: H12533
State: Alaska
Locality: Chatham Strait
Sub-locality: Red Bluff Bay and Vicinity
Project Number: OPR-O322-RA-13
Survey Date: 05/22/2013 - 06/28/2013

Charts Affected

Number	Edition	Date	Scale (RNC)	RNC Correction(s)*
17336	9th	03/01/2007	1:20,000 (17336_1)	[L]NTM: ?
17320	18th	03/01/2008	1:217,828 (17320_1)	[L]NTM: ?
16016	21st	10/01/2007	1:969,756 (16016_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.	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	Obstruction	[None]	56° 50' 22.1" N	134° 42' 38.2" W	---

Generated by Pydro v14.6(r4694) on Thu Jun 19 18:20:20 2014 [UTC]

1 - New Features

1.1) US 0000057939 00001 / H12533_awois.000

Survey Summary

Survey Position:	56° 50' 22.1" N, 134° 42' 38.2" W
Least Depth:	[None]
TPU (±1.96σ):	**THU (TPEh)** [None] ; **TVU (TPEv)** [None]
Timestamp:	2013-179.00:00:00.000 (06/28/2013)
Dataset:	H12533_awois.000
FOID:	US 0000057939 00001(02260000E2530001)
Charts Affected:	17336_1, 17320_1, 16016_1, 531_1, 500_1, 530_1, 50_1

Remarks:

OBSTRN/remrks: new limit of obstruction (AWOIS 54104 - OBSTRUCTION)

Feature Correlation

Source	Feature	Range	Azimuth	Status
H12533_awois.000	US 0000057939 00001	0.00	000.0	Primary

Hydrographer Recommendations

Hydrographer reccomends moving the ledge to limits of multibeam coverage

S-57 Data

Geo object 1:	Obstruction (OBSTRN)
Attributes:	CATOBS - 6:foul area
	QUASOU - 2:depth unknown
	SORDAT - 20130628
	SORIND - US,US,graph,H12533
	TECSOU - 12:found by levelling

Feature Images

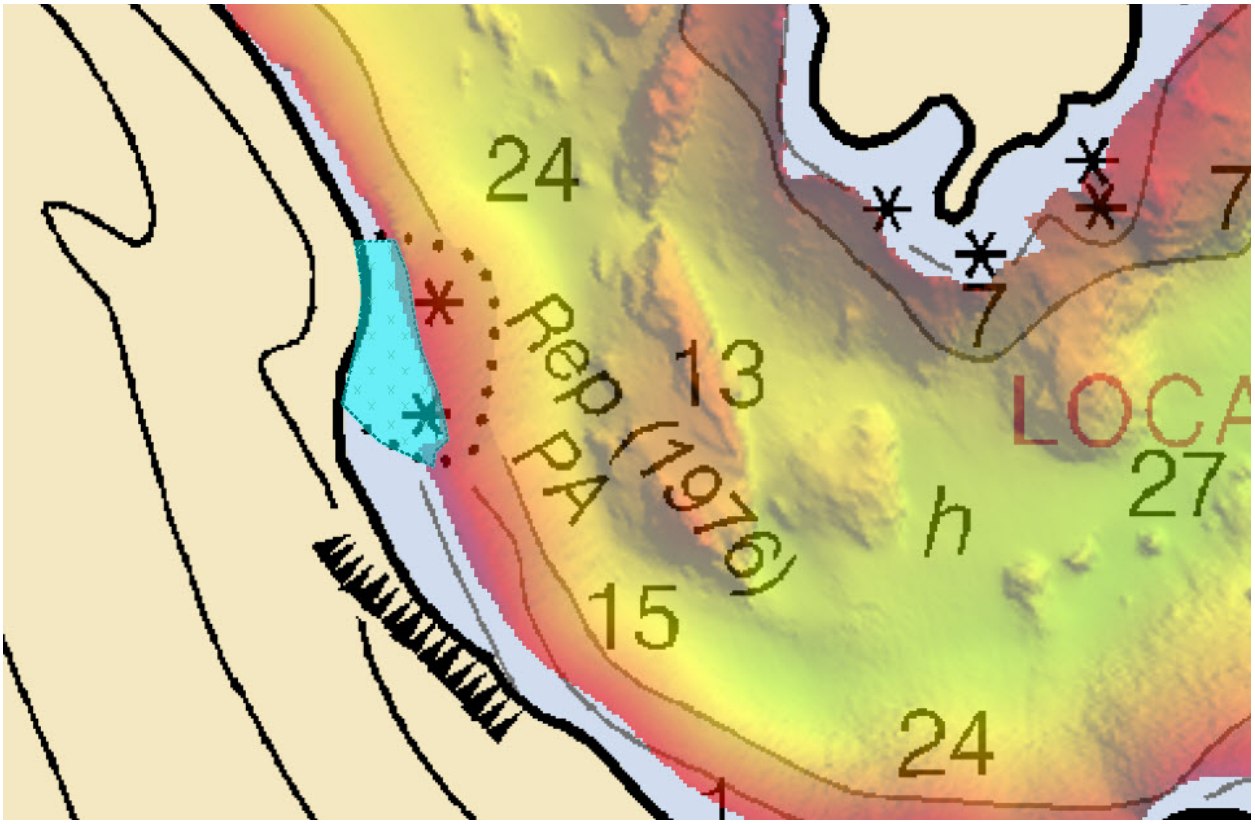


Figure 1.1.1

Office Notes

Concur with clarification. Chart foul area with updated extents and attribution. Chart inshore rock at 56-50-19.2156N,134-42-36.1764W with updated attribution. Remove offshore rock at 56-50-21.0444N, 134-42-35.7732W.

APPROVAL PAGE

H12533

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

- H12533_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12533_GeoImage.pdf

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

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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=BROWN.KURT.E.1156712600
Date: 2014.09.24 11:30:03 -07'00'

Approved:____

Kurt Brown for 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 EVANS.BENJAMIN.K.1237217094
Reason: I am approving this document
Date: 2014.09.30 14:51:14 -07'00'

Approved:____

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