H13292

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

DESCRIPTIVE REPORT

Type of Survey:	Basic Hydrographic Survey
Registry Number:	H13292

LOCALITY

State(s):	Washington
General Locality:	Bellingham, WA
Sub-locality:	Approach to Bellingham

2019

CHIEF OF PARTY
Michelle M. Levano, LTJG/NOAA

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13292**

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):	**Washington**
General Locality:	**Bellingham, WA**
Sub-Locality:	**Approach to Bellingham**
Scale:	**10000**
Dates of Survey:	**06/24/2019 to 08/01/2019**
Instructions Dated:	**06/19/2019**
Project Number:	**S-N905-NRT3-19**
Field Unit:	**NOAA Navigation Response Team - Seattle**
Chief of Party:	**Michelle M. Levano, LTJG/NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

Any revisions to the Descriptive Report (DR) applied during office processing are shown in red italic text. The DR is maintained as a field unit product, therefore all information and recommendations within this report are considered preliminary unless otherwise noted. The final disposition of survey data is represented in the NOAA nautical chart products. All pertinent records for this survey are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via https://www.ncei.noaa.gov/. Products created during office processing were generated in NAD83 UTM 10N, MLLW. All references to other horizontal or vertical datums in this report are applicable to the processed hydrographic data provided by the field unit.

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Descriptive Report to Accompany Survey H13292

Project: S-N905-NRT3-19

Locality: Bellingham, WA

Sublocality: Approach to Bellingham

Scale: 1:10000

June 2019 - August 2019

NOAA Navigation Response Team - Seattle

Chief of Party: Michelle M. Levano, LTJG/NOAA

A. Area Surveyed

This hydrographic survey was acquired in accordance with the requirements defined in the Project Instruction S-N905-NRT3-19. H13292 survey area includes Bellingham Bay along with a general anchorage and an explosives anchorage which are both large ship anchorages (Figure 1).

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
48° 45' 36.14" N 122° 34' 45.97" W	48° 42' 11.93" N 122° 29' 5.92" W

Table 1: Survey Limits

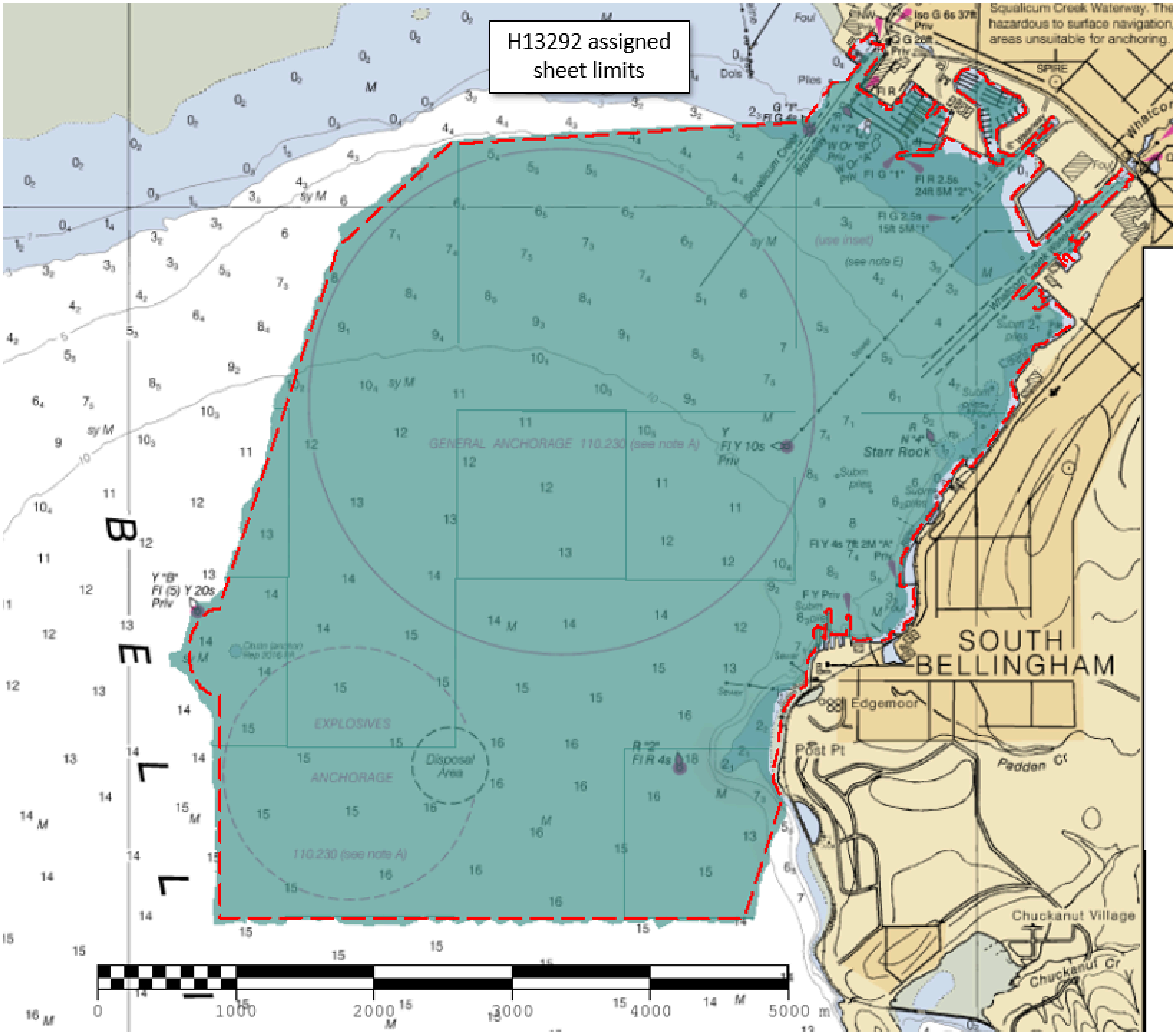


Figure 1: H13292 assigned sheet limits (in red) and survey coverage overlaid onto NOAA chart 18424_1.

Data was acquired to the survey limits in accordance with the requirements in the Project Instructions S-N905-NRT3-19 and the National Ocean Service (NOS) 2019 Hydrographic Surveys Specifications and Deliverables (HSSD).

A.2 Survey Purpose

The United States Coast Guard (USCG) and Puget Sound Pilots have requested a hydrographic survey for updated bathmetry to the Approach to Bellingham. This area is highly changeable and there is concern of the areas outside of the channel. Also there is concerns of under keel clearance in the anchorage areas. Survey data from this project is intended to supersede all prior survey data in the common area.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired in H13292 meet multibeam echo sounder (MBES) coverage requirements for object detection, as required by the 2019 HSSD. This includes crosslines (see Section B.2.1), NOAA allowable uncertainty (see Section B.2.10), and density requirements (see Section B.2.11).

The surface was analyzed using the HydrOffice QC Tools Grid QA feature (Figure 2). Density requirements for H13292 were achieved with at least 99.5% of surface nodes containing five or more soundings as required by HSSD Section 5.2.2.3. The H13292 survey area shows that the depths less then 30 meters has a largest number of grid nodes (Figure 3).

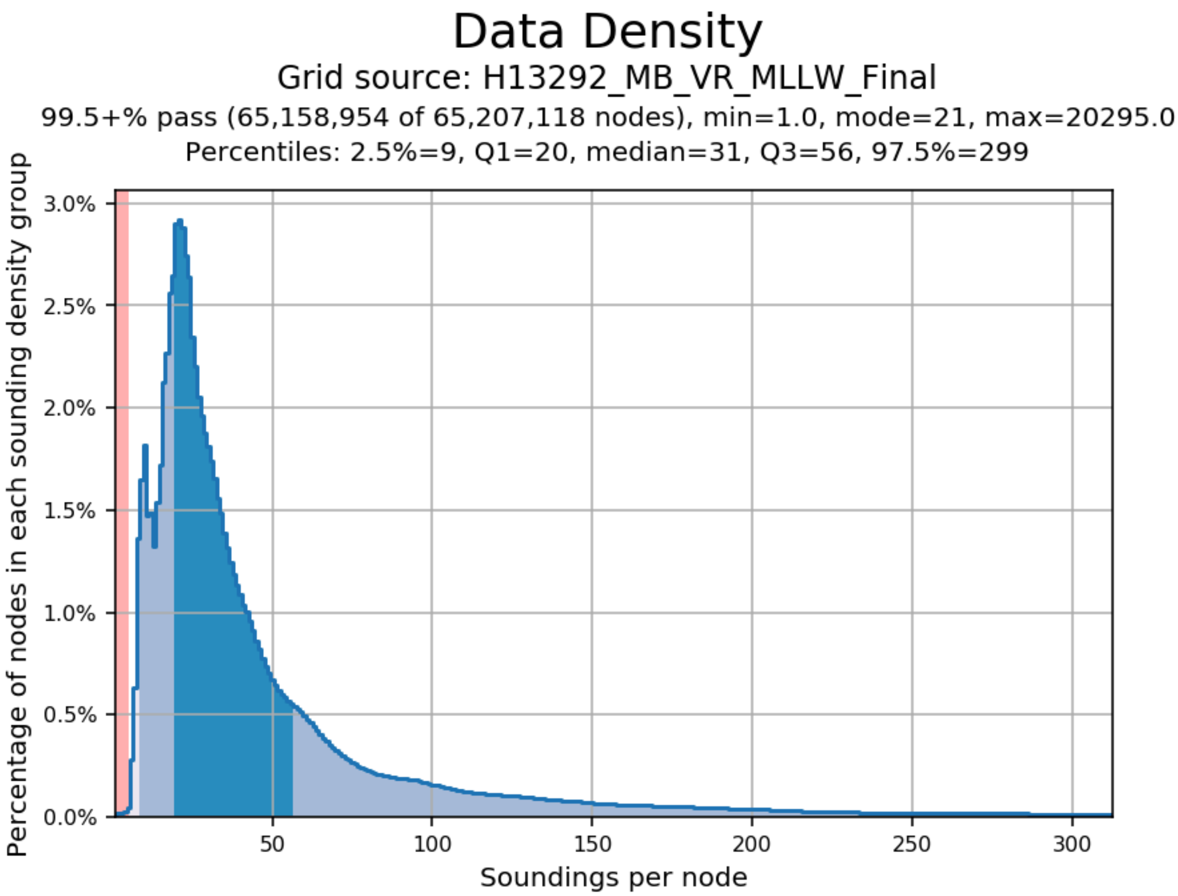


Figure 2: Pydro derived histogram plot showing HSSD object detection compliance of H13292 MBES within the finalized CUBE surface.

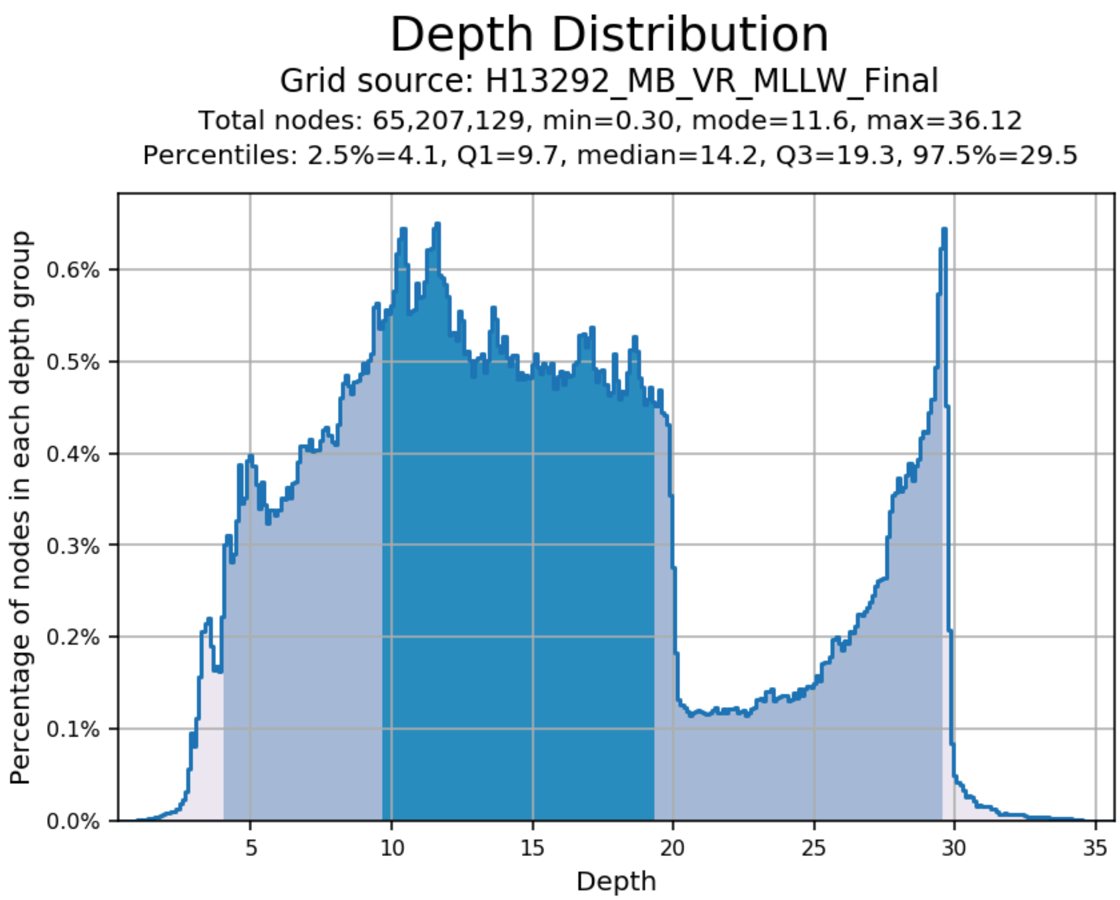


Figure 3: Pydro QC tools derived plot showing the percentage of nodes per the depth distribution for H13292 MBES within the finalized CUBE surface.

A.4 Survey Coverage

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

Water Depth	Coverage Required
All waters within survey area	Object Detection Coverage (Refer to HSSD Section 5.2.2.2)

Table 2: Survey Coverage

The entirety of H13292 was acquired with Object Detection Coverage, meeting the requirements listed above and in the HSSD (Figure 3)

H13292 data were reviewed in CARIS HIPS and SIPS for holidays in accordance with Section 5.2.2.3 of the HSSD. 22 holidays were identified via HydrOffice QC Tools Holiday Finder tool. This tool automatically scans the surface for holidays as defined in the HSSD and was run in conjunction with a visual inspection of the surface by the hydrographer. 11 of the holidays are on the edge of the surface or along pier faces. For the remaining holidays, none of them are near any charted or surveyed Dangers to Navigation (DToNs), and the hydrographer recommends that this survey be processed and compiled to object detection standards.

In all areas where the 3.5 meter depth contour or the sheet limits were not met, the Navigable Area Limit Line (NALL) was defined as the inshore limit of bathymetry due to the risks of maneuvering the survey vessel in close proximity to the shoreline and obstructions (Figures 4,5) Hydrographer oversight also lead to two small gaps in the survey coverage (Figures 6-8).

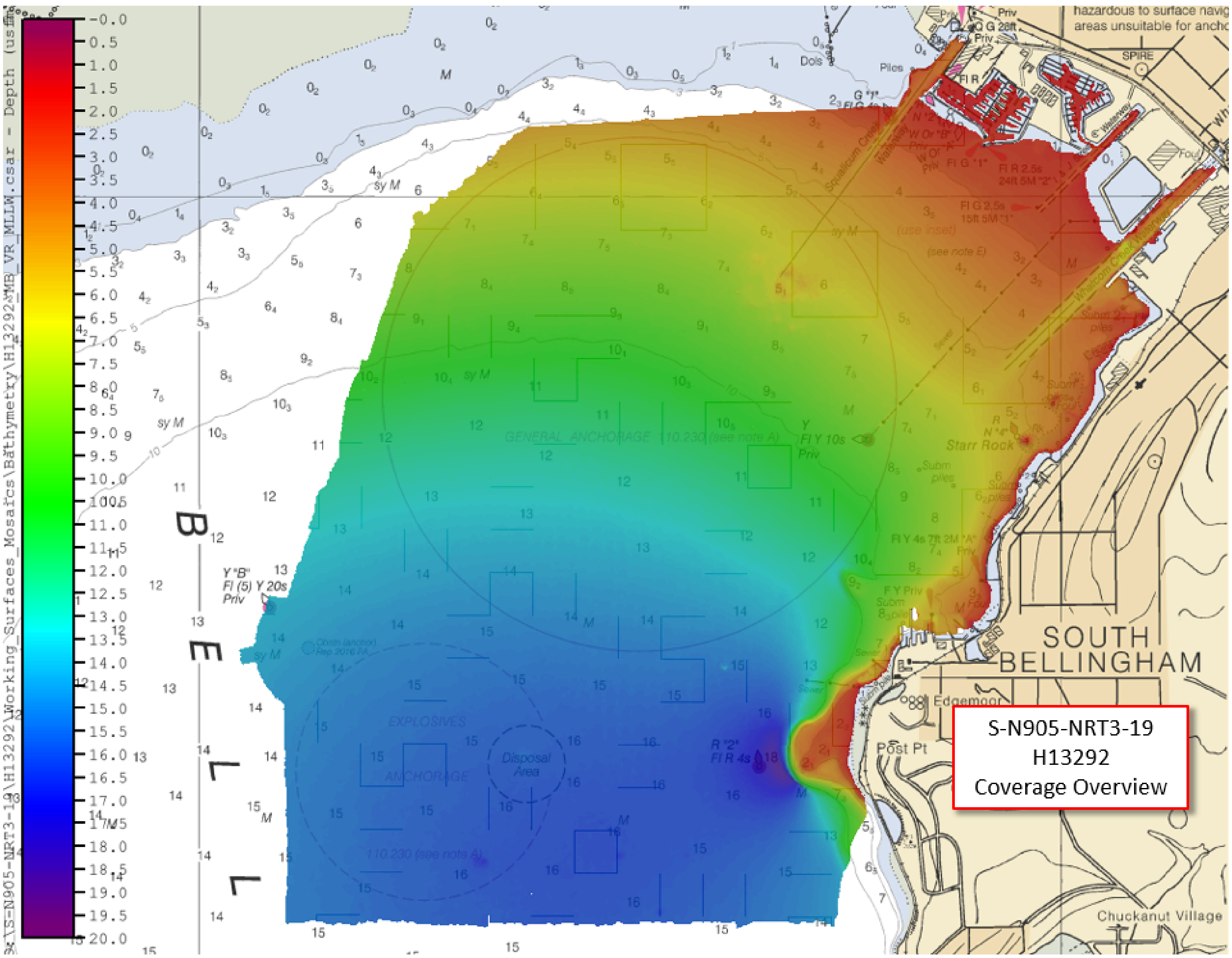


Figure 4: H13292 survey coverage overlaid onto chart 18424_1.

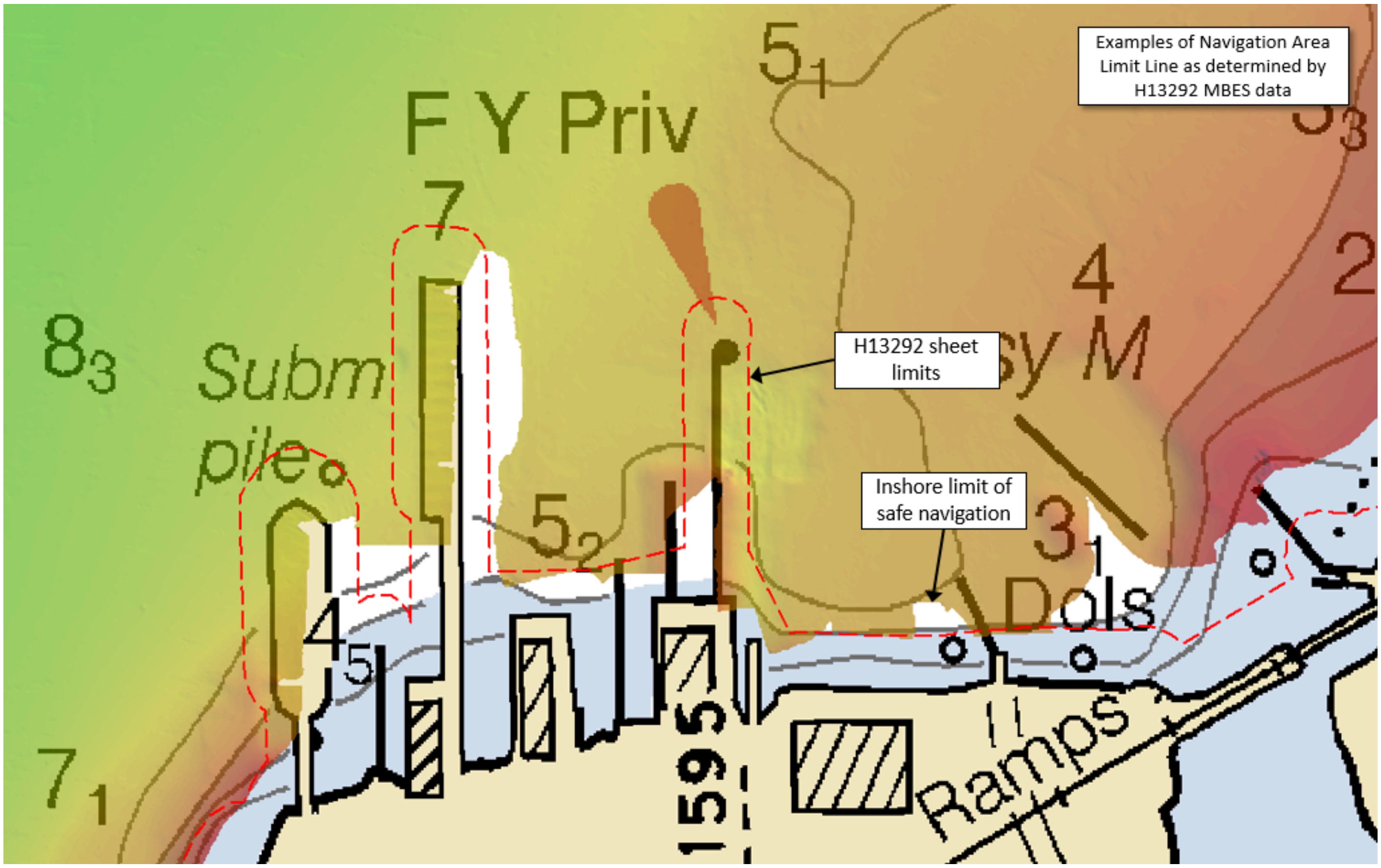


Figure 5: Examples of NALL determination due to piers and boat moorages.

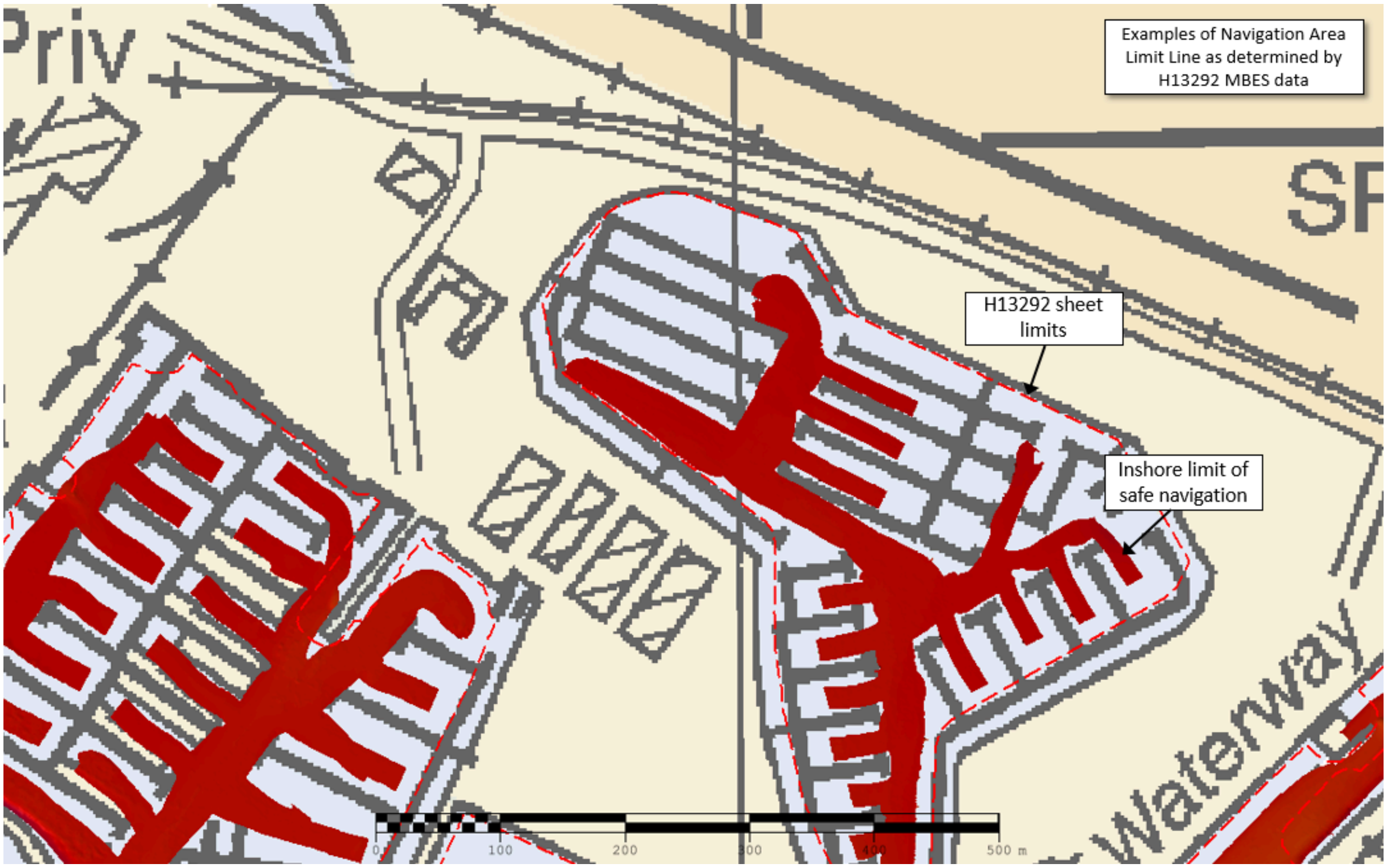


Figure 6: Examples of NALL determination due to boat slips.

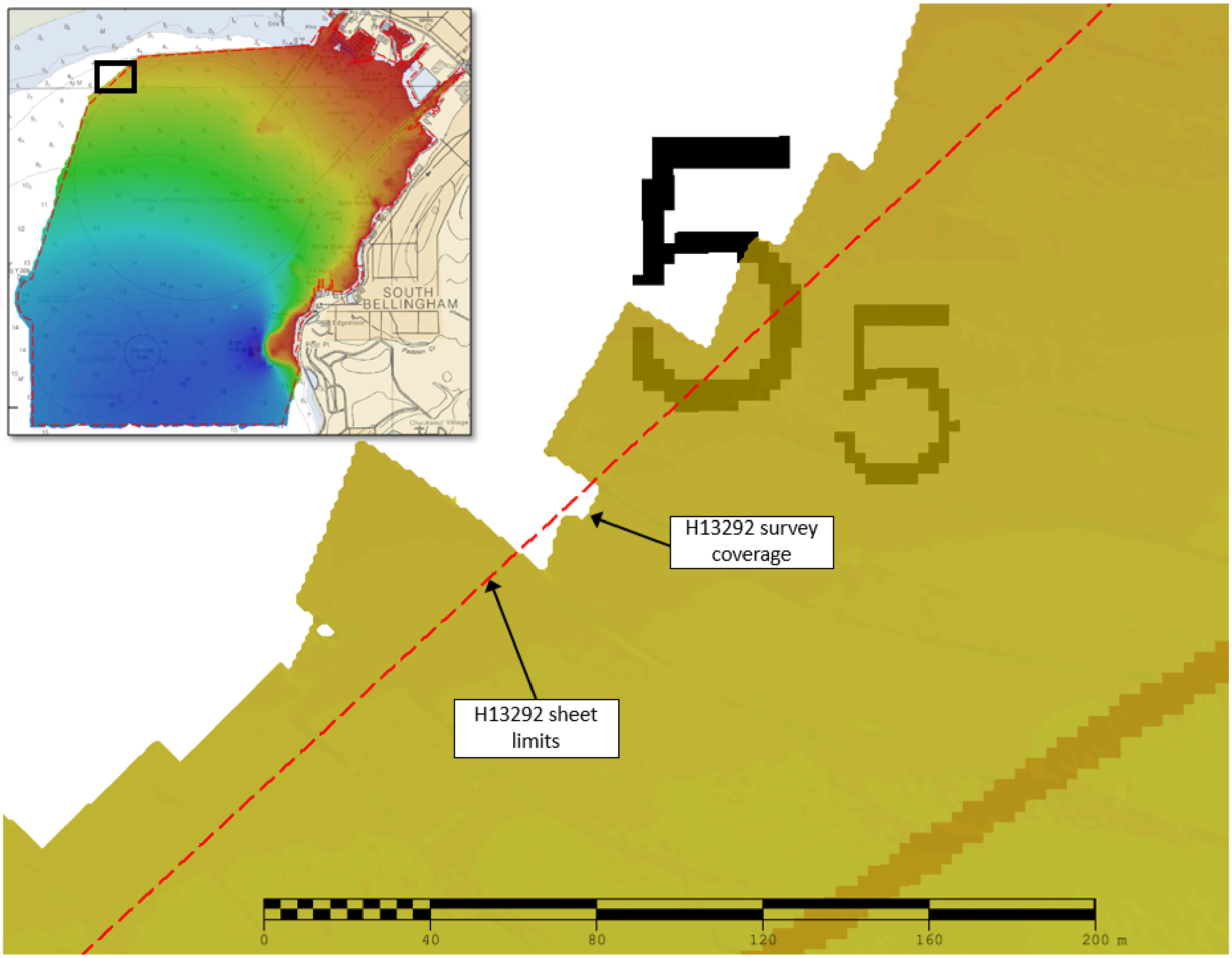


Figure 7: Example of small gap in coverage near survey limits.

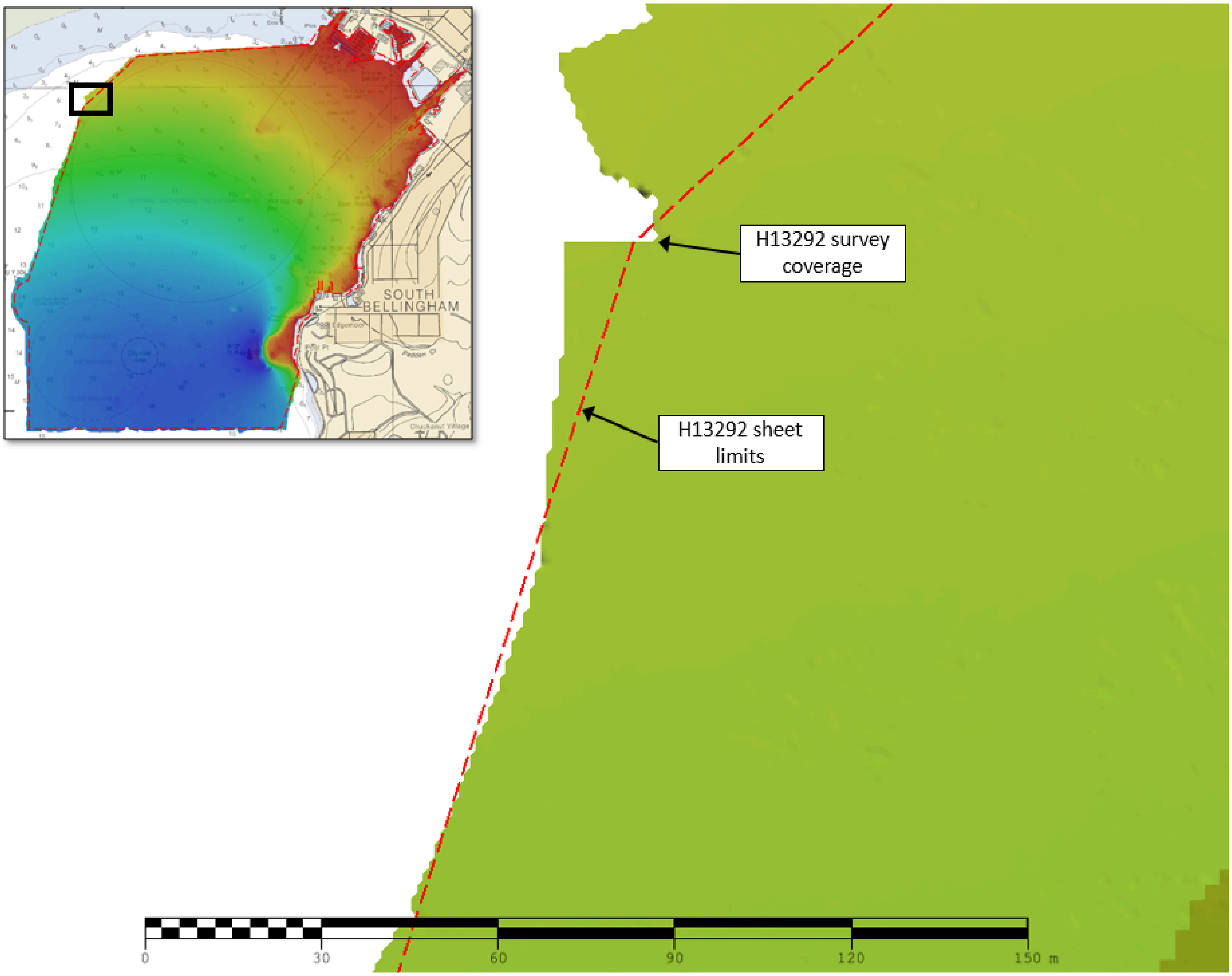


Figure 8: Example of small gap in coverage near survey limits.

A.6 Survey Statistics

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

	HULL ID	*S3006*	*Total*
LNM	**SBES Mainscheme**	0	0
	MBES Mainscheme	413.13	413.13
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/SSS Mainscheme	0	0
	MBES/SSS Mainscheme	0	0
	SBES/MBES Crosslines	26.39	26.39
	Lidar Crosslines	0	0
Number of Bottom Samples			4
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			7.84

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
06/24/2019	175
06/25/2019	176

Survey Dates	Day of the Year
06/26/2019	177
06/27/2019	178
06/28/2019	179
06/29/2019	180
06/30/2019	181
07/01/2019	182
07/02/2019	183
07/24/2019	205
07/25/2019	206
07/26/2019	207
07/27/2019	208
07/28/2019	209
07/29/2019	210
07/30/2019	211
07/31/2019	212
08/01/2019	213

Table 4: Dates of Hydrography

This survey data was collected from June 24, 2019 to July 3, 2019 and July 22, 2019 to August 2, 2019. NRT-Seattle would like to thank the following augmenters for assisting on this project: Maxwell Williamson, United States Navy Fleet Survey Team; Martha Herzog, Physical Scientist, NOAA Hydrographic Survey Division (HSD) Operations Branch; Jessica Murphy, Physical Scientist, Pacific Hydrographic Branch; Grant Froelich, Lead Physical Scientist, Pacific Hydrographic Branch.

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	***S3006***
LOA	34 feet
Draft	4 feet

Table 5: Vessels Used

Figure 9: NRT S3006

All data was collected by S3006 (Figure 9). The vessel acquired multibeam depth soundings, sound speed profiles, and bottom samples.

B.1.2 Equipment

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

Manufacturer	Model	Type
Kongsberg Maritime	EM 2040C	MBES
Applanix	POS MV 320 v5	Positioning and Attitude System
AML Oceanographic	MicroX SV	Sound Speed System
YSI	CastAway-CTD	Conductivity, Temperature, and Depth Sensor

Table 6: Major Systems Used

The equipment was installed on S3006. The vessel is equipped with POS MV v5 system for positioning and attitude, Kongsberg EM 2040C for MBES, AML Oceanographic MicroX SVS surface sound speed sensor, and YSI CastAway-CTD casts.

B.2 Quality Control

B.2.1 Crosslines

Crosslines were collected, processed and compared in accordance with Section 5.2.4.2 of the HSSD (Figure 10). A Variable Resolution (VR) surface was created of only mainscheme lines, and a second VR surface was created of only crosslines. A difference surface was generated in Pydro Explorers Compare Grids tool by subtracting the crossline only surface from the mainscheme surface (mainscheme- crosslines= difference surface). From the difference surface, the following statistics were derived. The mainshceme only, crossline only, and difference surface are included in the submission of this survey as Digital Data.

The coloring represents areas where the TVUmax error tolerance in exceeded; red, orange and yellow colors represent areas where mainscheme data is deeper than crossline data; the blue shades represent crossline data is deeper than mainscheme data (Figure 11). In total, 99.5% of the total number of nodes pass the TVUmax test between H13292 mainscheme and crossline data (Figure 12). For H13292 respective depths, the difference surface was compared to the allowable NOAA uncertainty standards (Figure 13,14). Statistics show the mean difference between the depths derived from mainscheme H13292 data and crossline data was 0.11 meters, with mainscheme data being deeper.

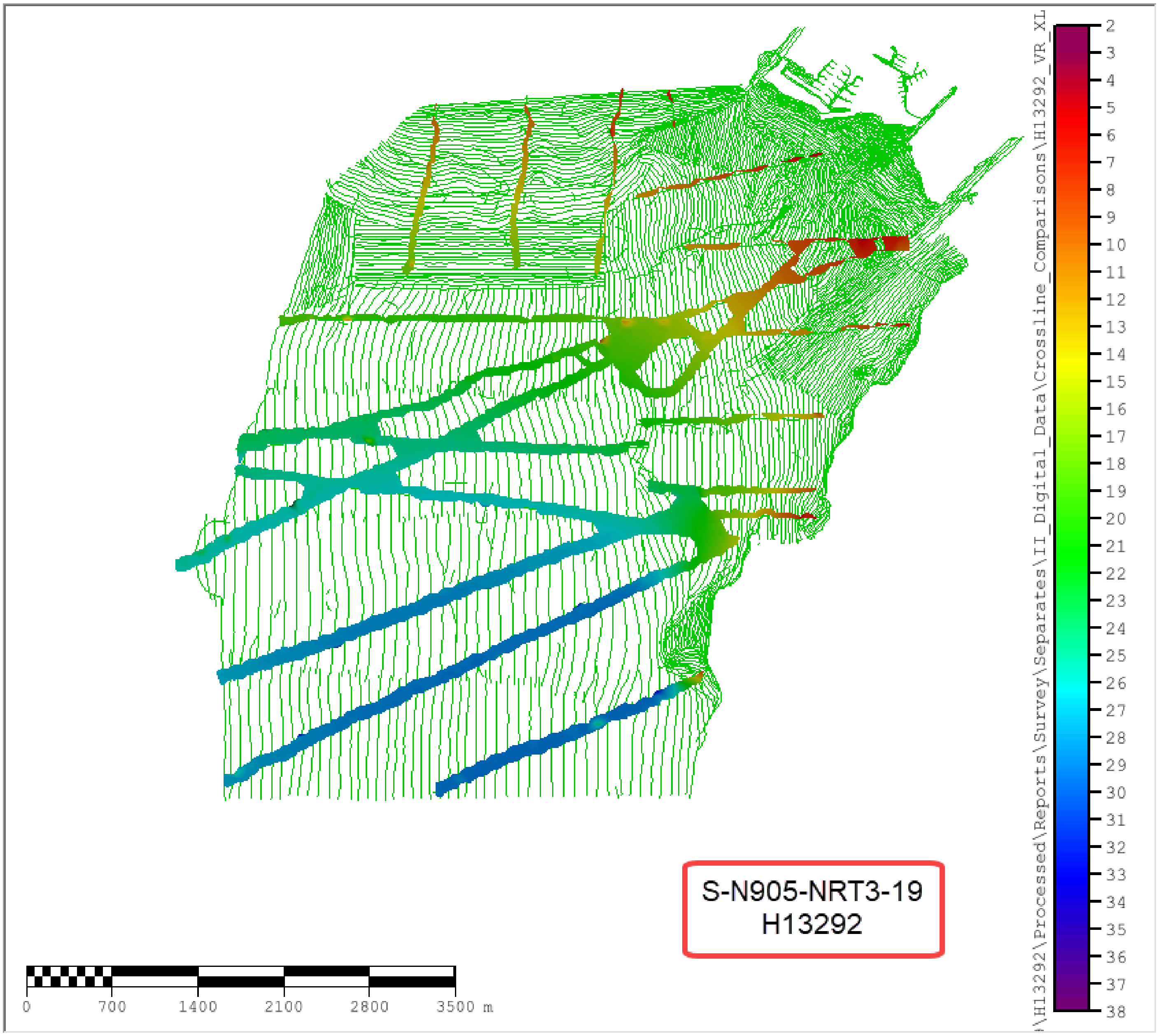


Figure 10: H13292 crossline surface overlaid on mainscheme tracklines showing good temporal and geographic distribution.

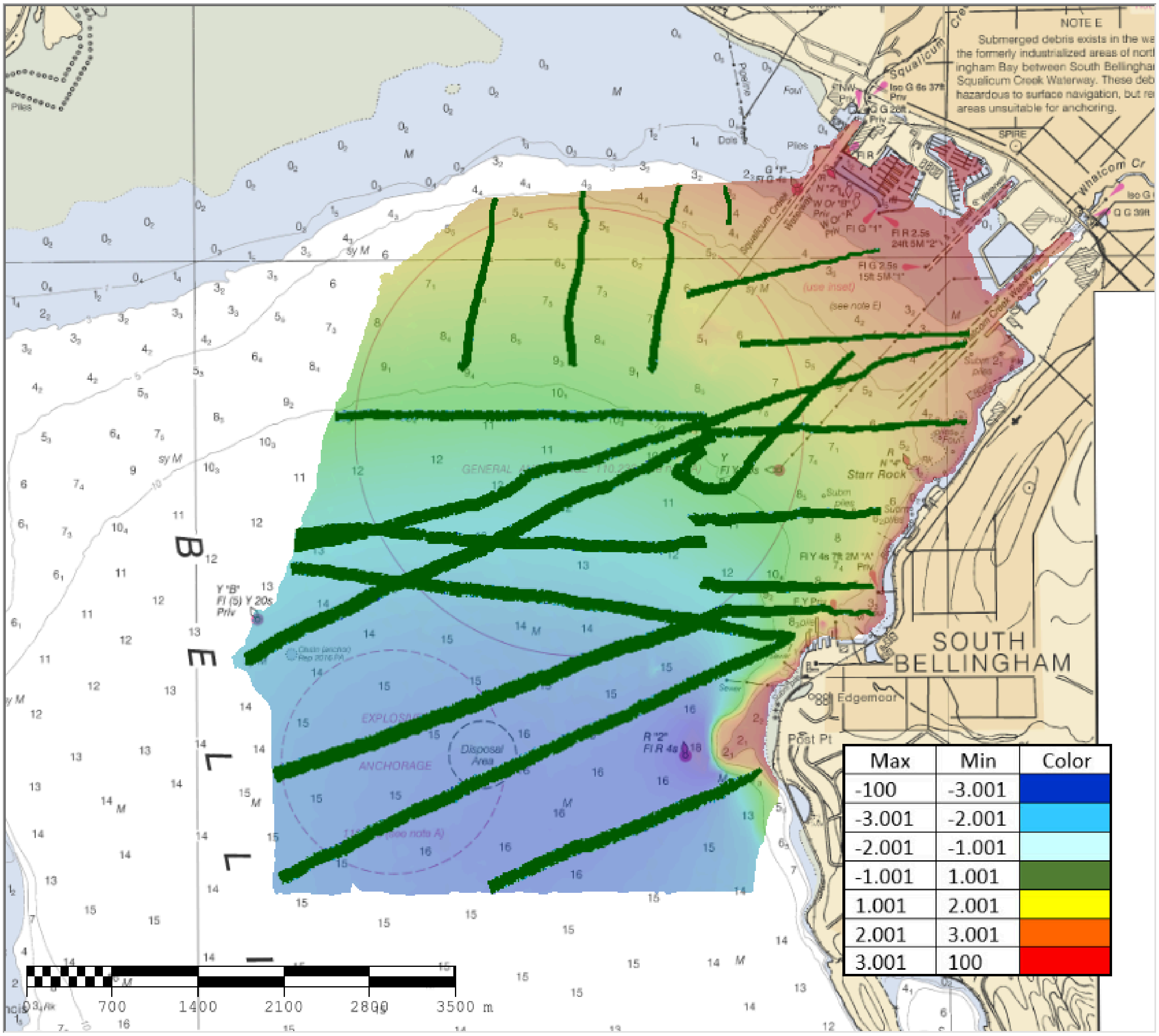


Figure 11: Depth differences between H13292 mainscheme and crossline data as compared to NOAA allowable uncertainty standards for associated depths.

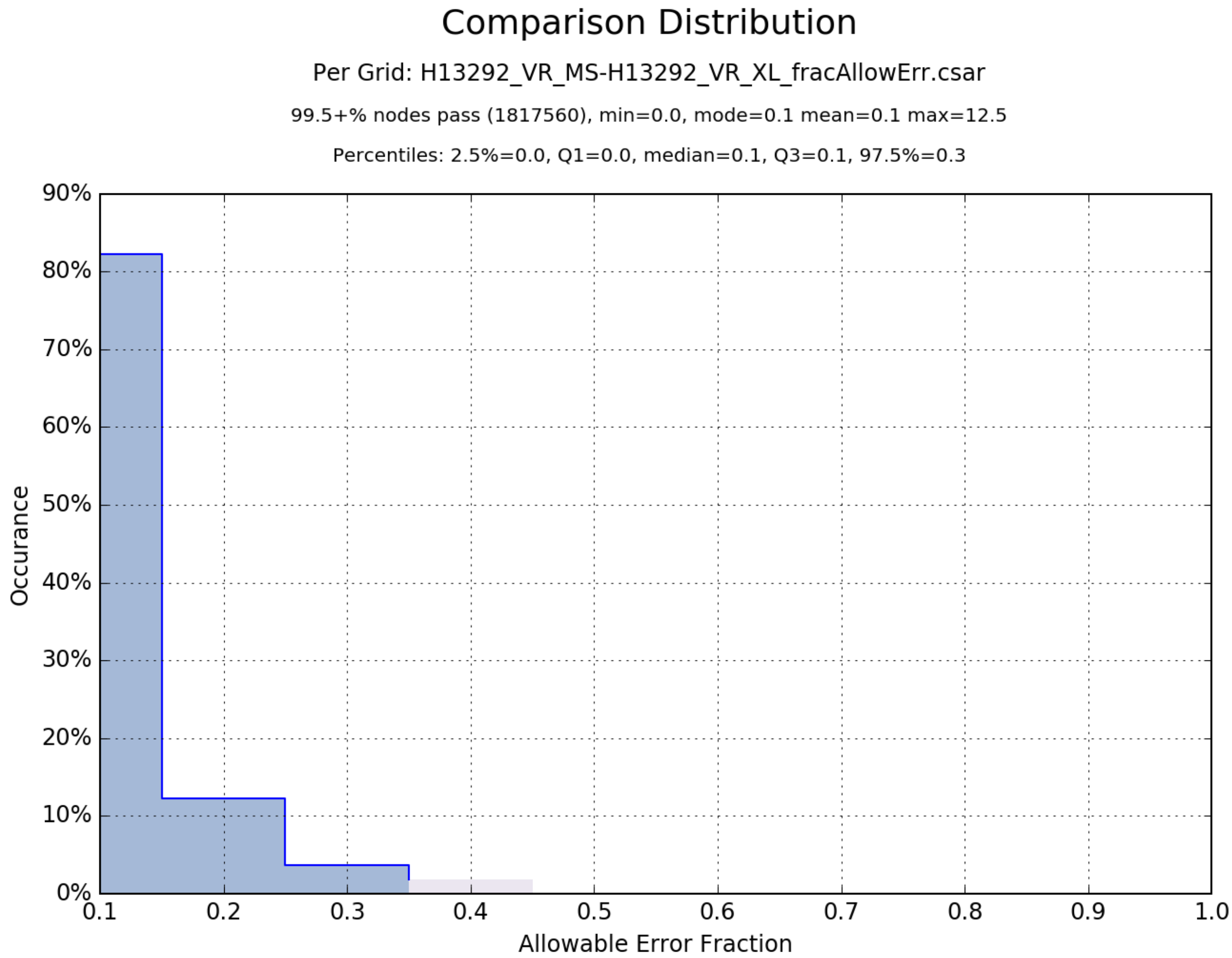
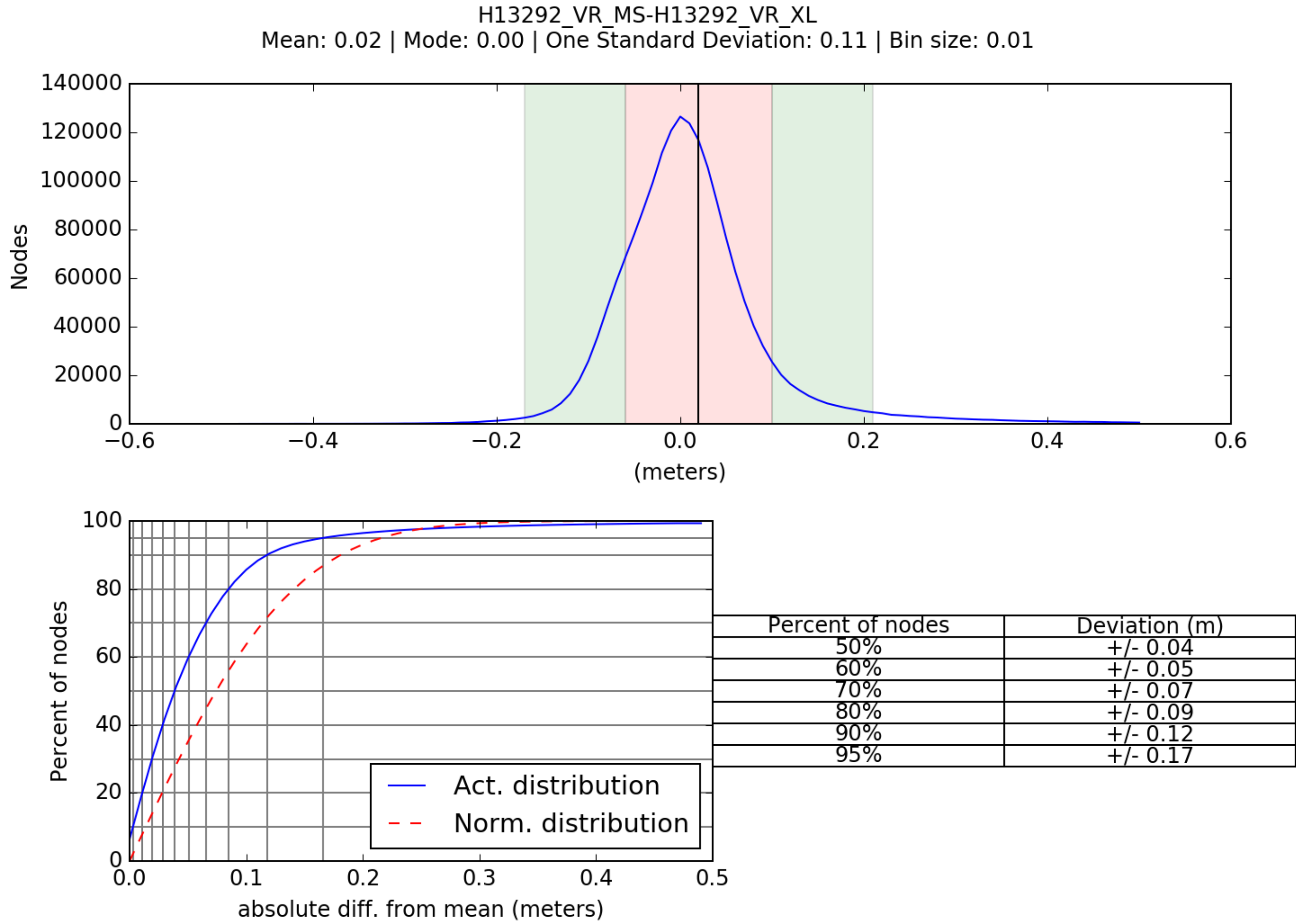


Figure 12: Histogram plot utilizing the magnitude (absolute value) of the Allowable Error Fraction to show the indication of what percentage of the total number of the comparisons pass the TVUmax test.



Percent of nodes	Deviation (m)
50%	+/- 0.04
60%	+/- 0.05
70%	+/- 0.07
80%	+/- 0.09
90%	+/- 0.12
95%	+/- 0.17

Figure 13: The statistical distribution summary plot of the difference between H13292 mainscheme and crossline data

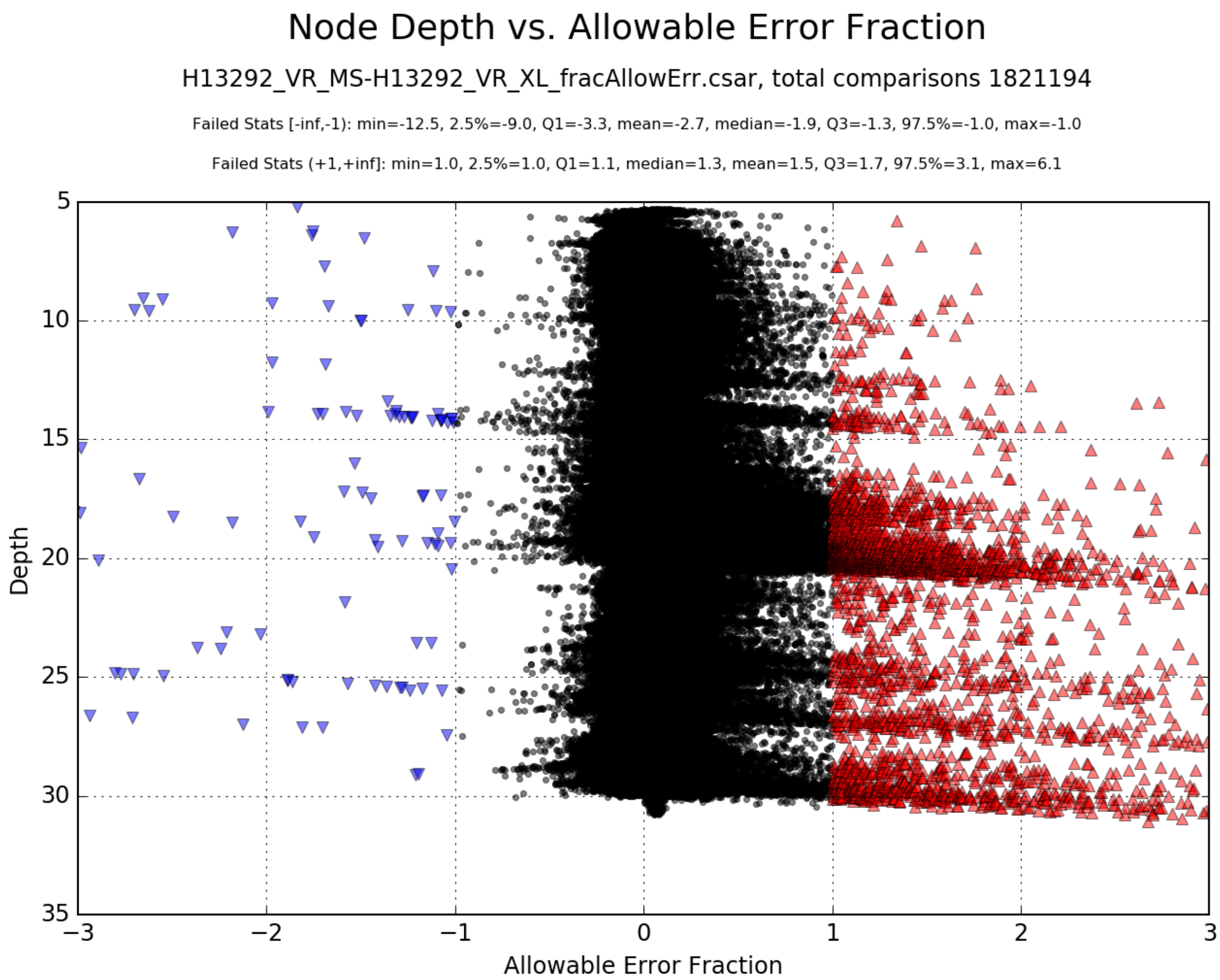


Figure 14: The depth dependent plot of the Allowable Error Fraction, with values between and including +/-1 representing comparisons.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.0 meters	0.133 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
3006	4.0 meters/second	0.0 meters/second	0.0 meters/second	0.15 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

Total Propagated Uncertainty (TPU) values for H13292 were derived from a combination of fixed values for equipment and vessel characteristics, as well as field assigned values for sound speed uncertainties. The uncertainty for the VDatum model as provided to the field unit in the project instructions.

In addition to the usual a priori estimates of uncertainty provided via device models for vessel motion, ERS, real time and post processed uncertainty sources were also incorporated into the depth estimates of H13292. Real-time uncertainties from the Kongsberg 2040C MBES sonars were incorporated and applied during post processing. Uncertainties associated with vessel roll, gyro, and navigation were applied real-time. H13292 utilized kinematic (RTK) positioning service. The recorded delayed heave Applanix files included an estimate of the heave uncertainty and were applied during post processing. All of the aforementioned uncertainties were applied in CARIS. H13292 is an ellipsoidally referenced survey (ERS) and the tidal component was accomplished via separation model. Additional information about RTK and the separation model are located in Section C.1 and C.2 of this report.

The surface was analyzed using the HydrOffice QC Tools Grid QA feature to determine compliance with specifications. Overall, 99.5+% of nodes within the surface meet NOAA Allowable Uncertainty specifications outlined in Section 5.1.3 of the 2019 HSSD for H13292 (Figure 15).

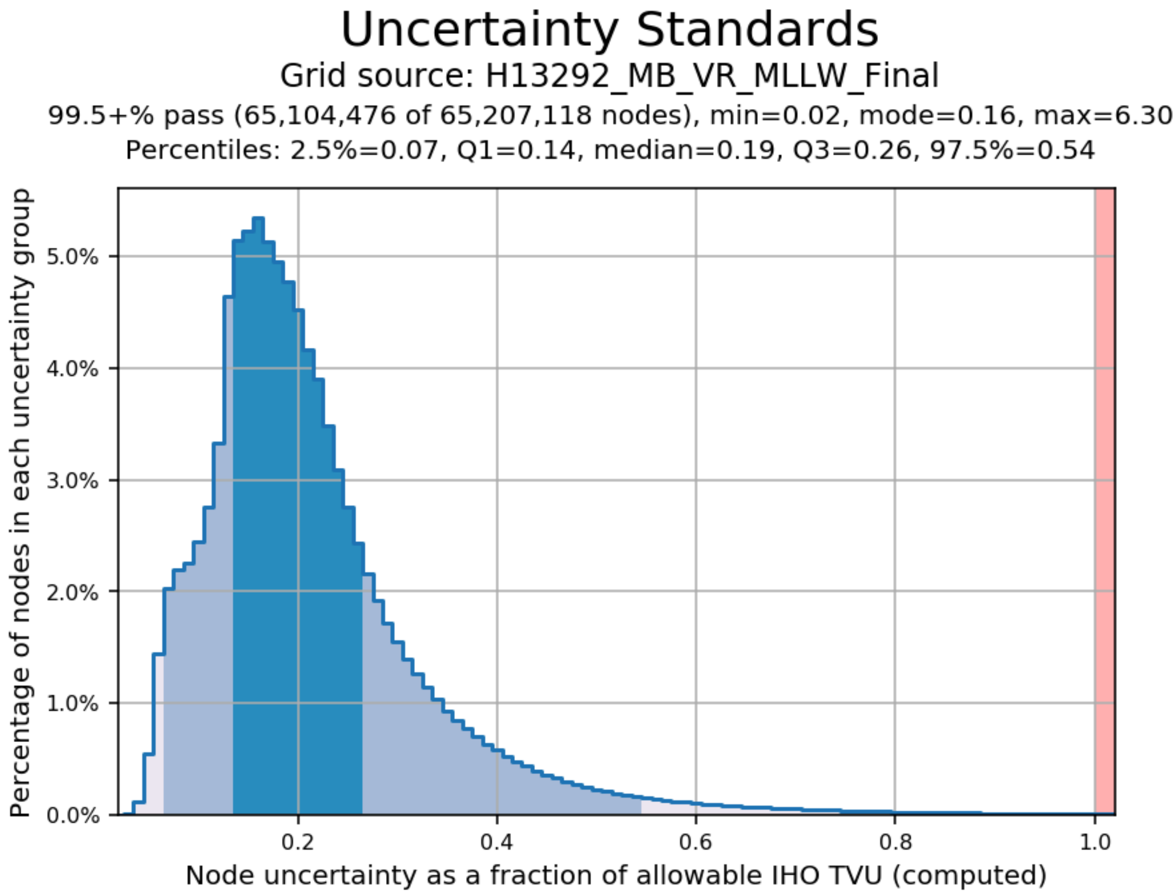


Figure 15: Pydro derived histogram plot showing HSSD uncertainty standards compliance of H13292 finalized VR surface

B.2.3 Junctions

One junction comparison was completed for H13292 with survey H11419, which was acquired by NOAA Ship RAINIER (S-221) in 2005.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H11419	1:10000	2005	NOAA Ship RAINIER	S

Table 9: Junctioning Surveys

<u>H11419</u>

Overlap with survey H11419 was approximately 4080 meters wide and 960 meters long along the southern boundary of the survey (Figure 16). Depth within this junction area range from 25 to 30 meters. Contemporary H13292 data at a variable resolution CARIS .csar surface was compared to H11419 1 meter surface, section 14 (H11419_1m_MLLW_14of20) and 16 (H11419_MLLW_16of20).

A comparison was made with Pydro Explorer's Compare Grids tool to create a difference surface between a For the respective depths, the difference surface was compared to the allowable TVU standards specified in the 2019 HSSD (Figure 17). In total 99.5% of the depth difference between H11419 and H13292 are within allowable uncertainties (Figure 18,19). Analysis of the absolute difference surface indicated a mean difference of 0.12 meters above H13292 data, with a standard deviation of 0.11 meters (Figure 20-23). The biggest differences (greater than 1 meter) occurred in areas >20 meters that were not accurately represented by the 1 meter .csar surfaces.

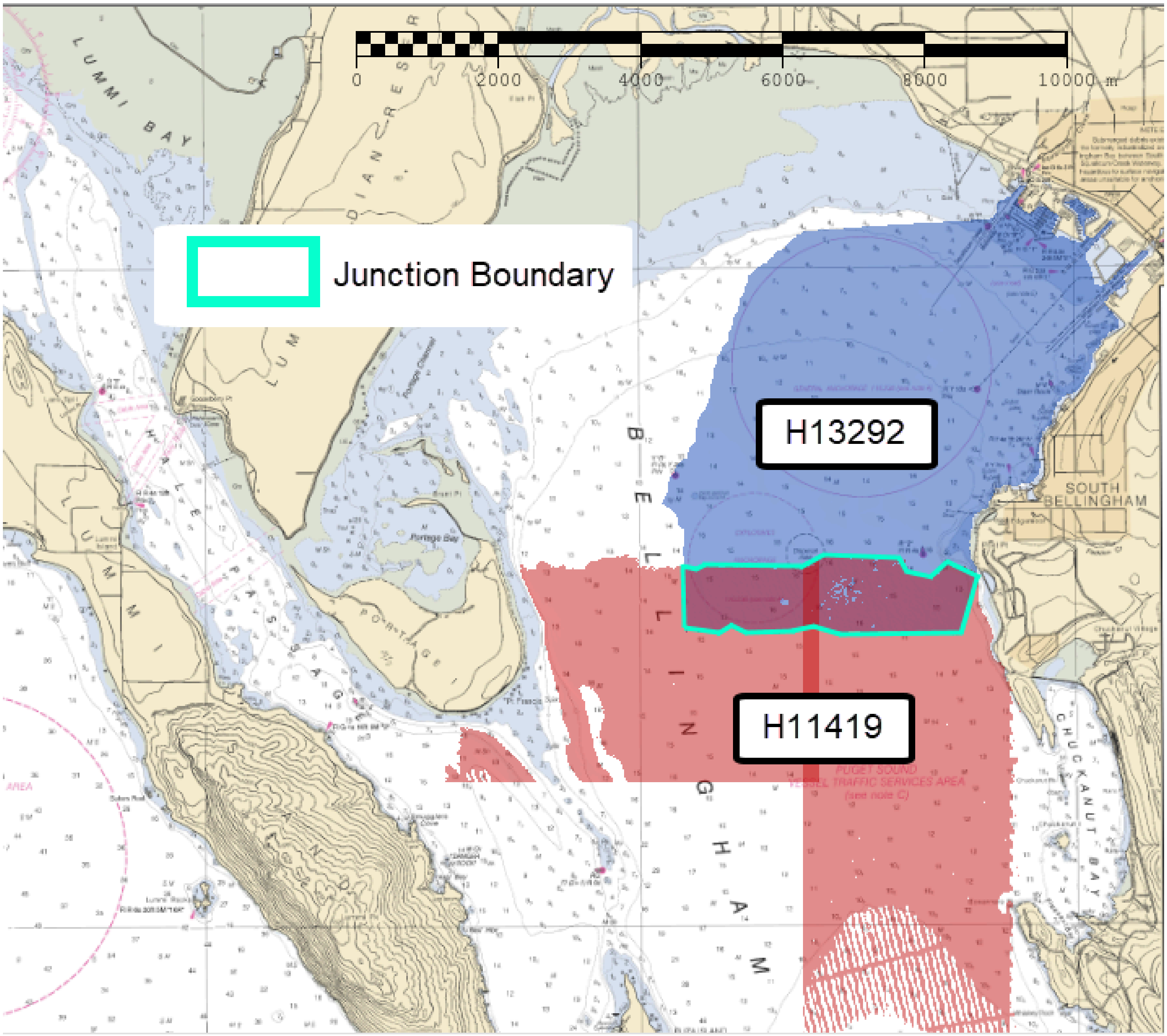


Figure 16: Overview of the survey junction with H11419

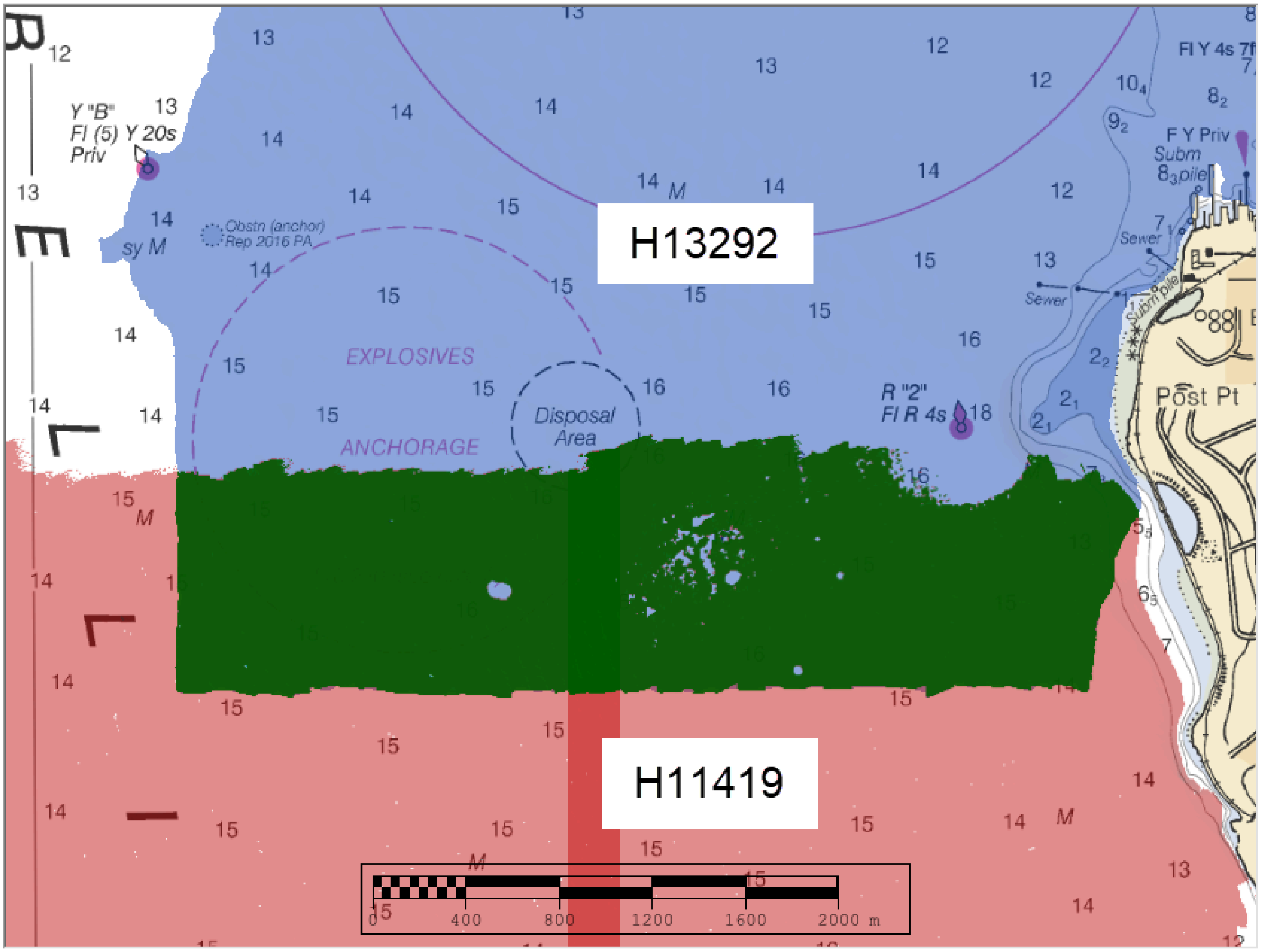


Figure 17: The allowable error surface of the junctions between H13292 and H11419

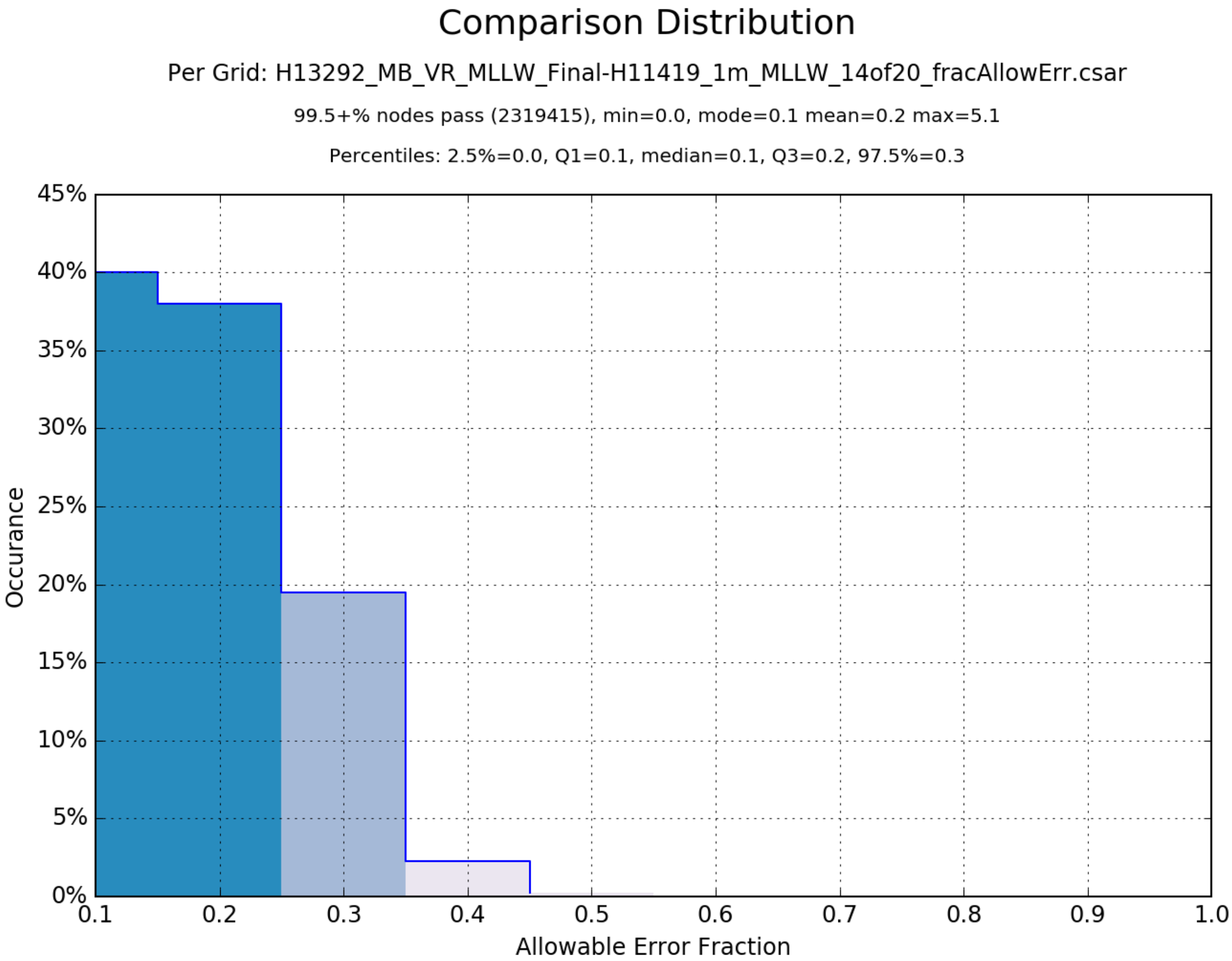


Figure 18: Junction between H13292 and the surface H13419_1m_MLLW_14of20

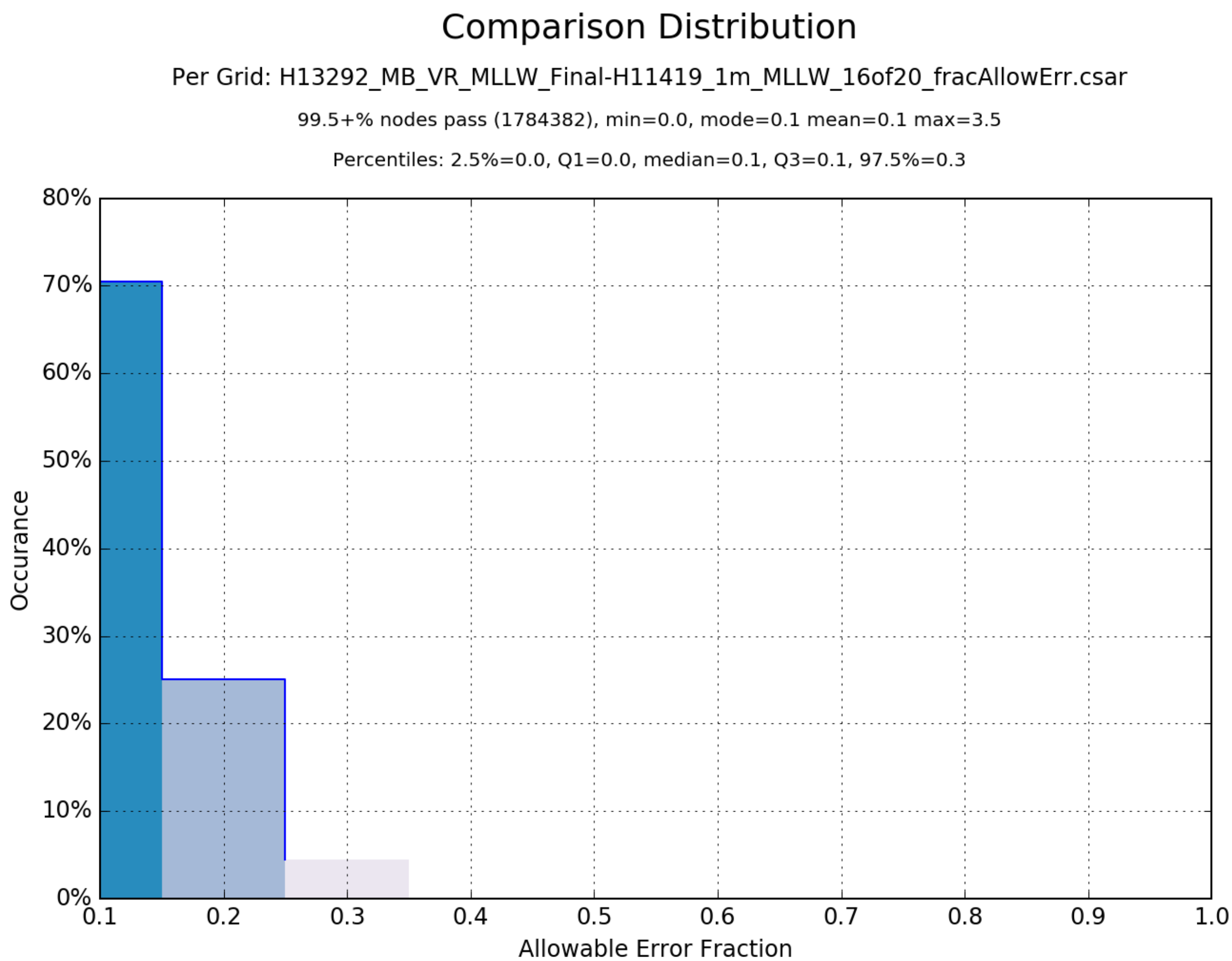
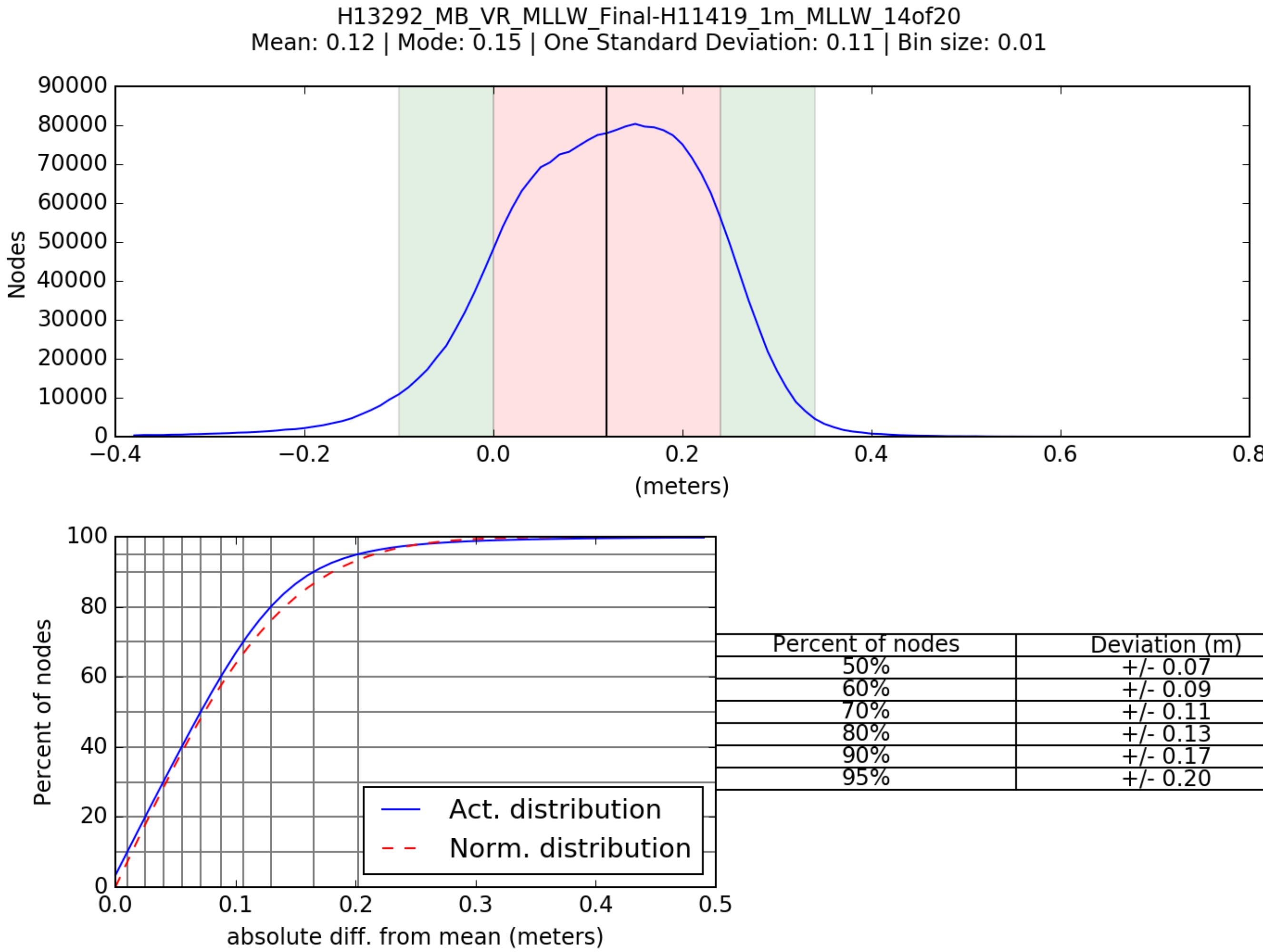
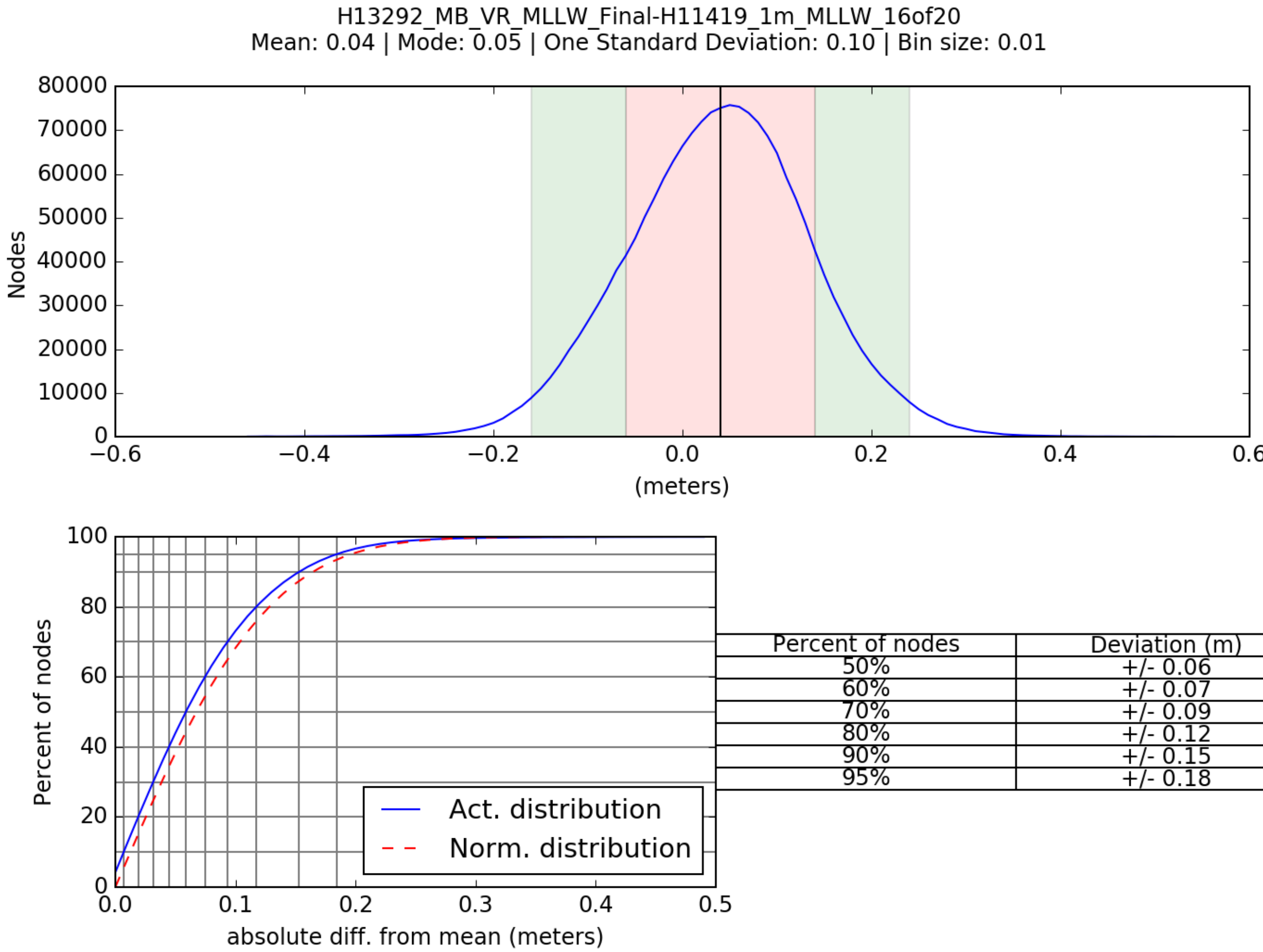


Figure 19: Junction between H13292 and the surface H13419_1m_MLLW_16of20



Percent of nodes	Deviation (m)
50%	+/- 0.07
60%	+/- 0.09
70%	+/- 0.11
80%	+/- 0.13
90%	+/- 0.17
95%	+/- 0.20

Figure 20: Junction between H13292 and the surface H13419_1m_MLLW_14of20



Percent of nodes	Deviation (m)
50%	+/- 0.06
60%	+/- 0.07
70%	+/- 0.09
80%	+/- 0.12
90%	+/- 0.15
95%	+/- 0.18

Figure 21: Junction between H13292 and the surface H13419_1m_MLLW_16of20

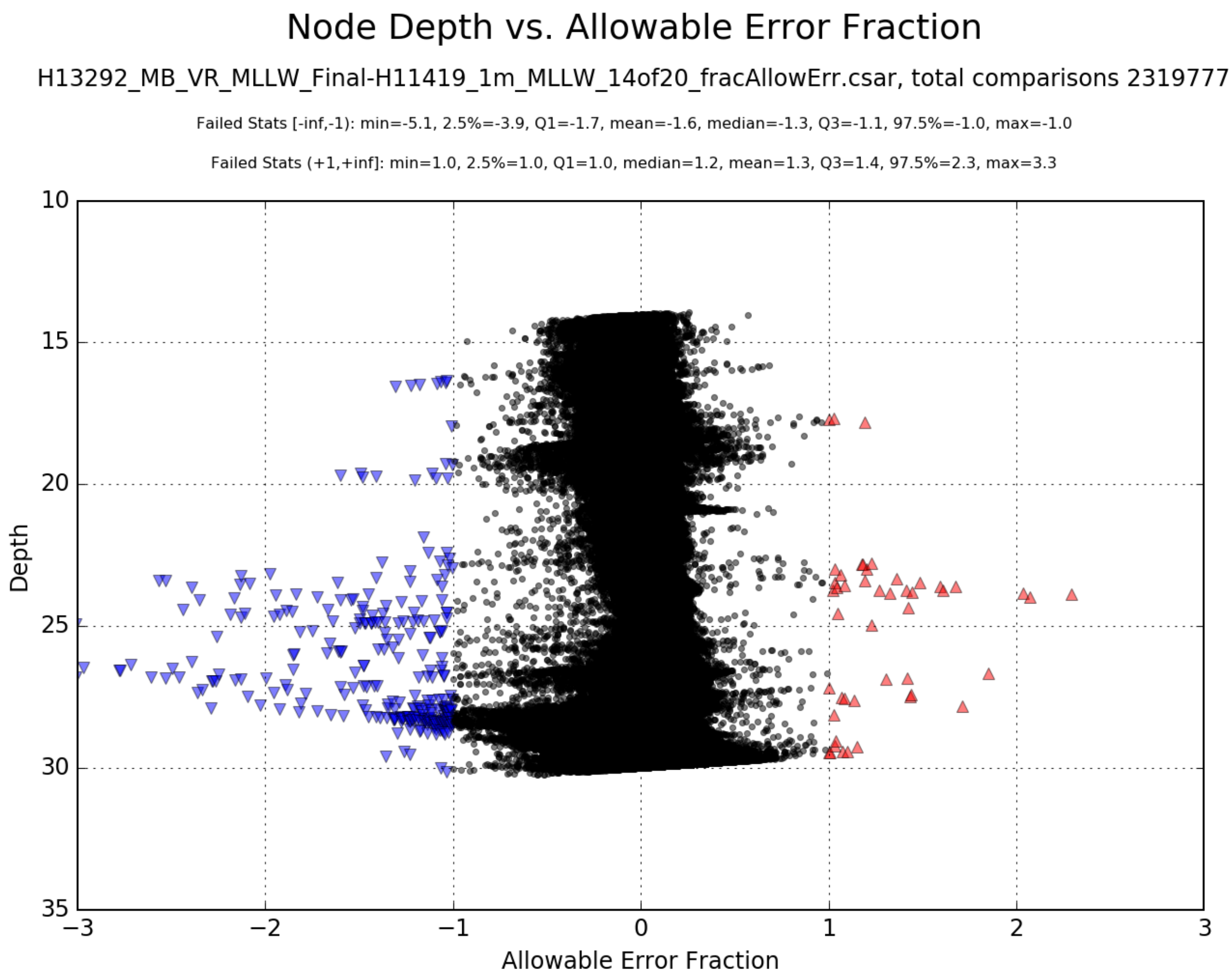


Figure 22: Junction between H13292 and the surface H13419_1m_MLLW_14of20

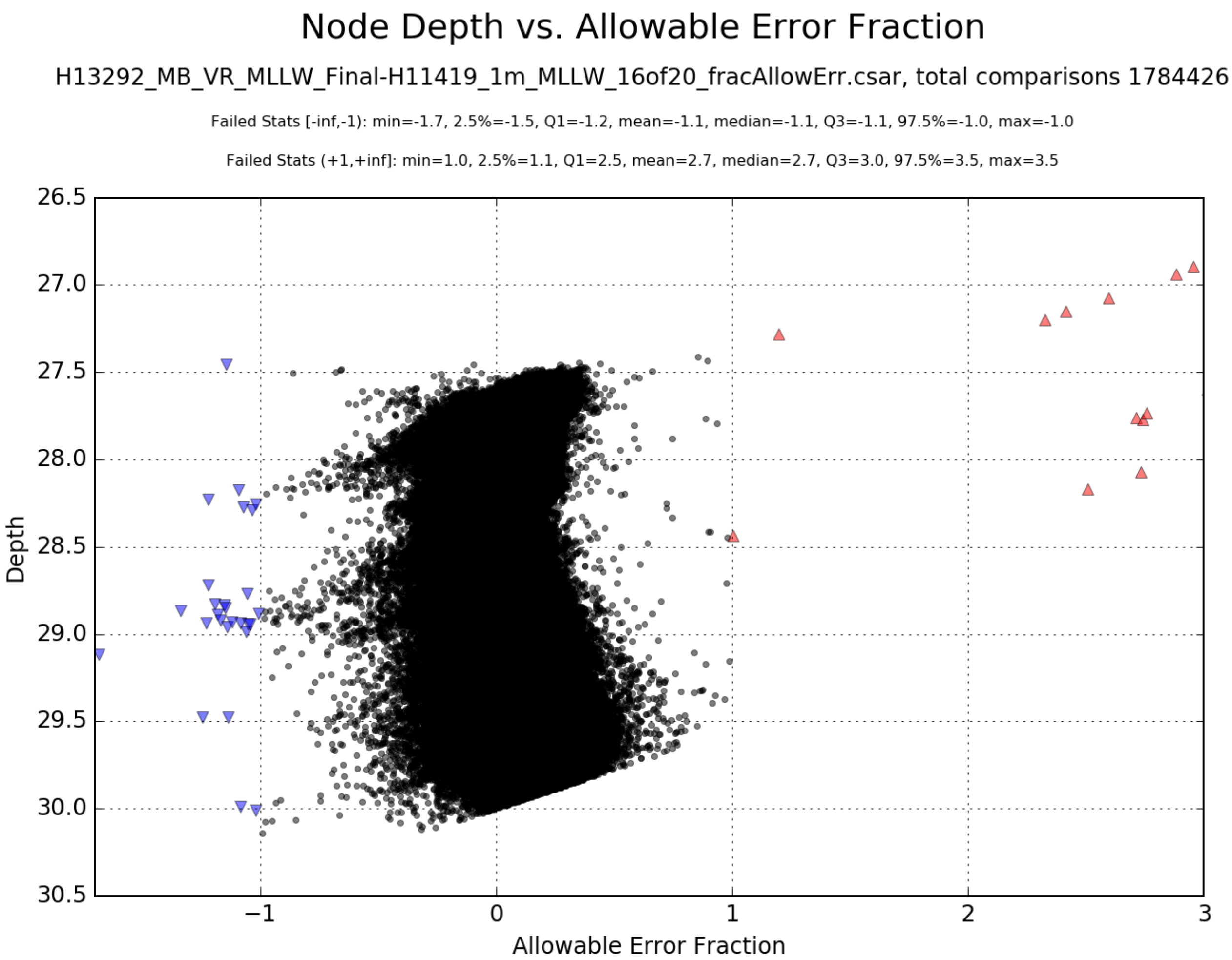


Figure 23: Junction between H13292 and the surface H13419_1m_MLLW_16of20

B.2.4 Sonar QC Checks

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

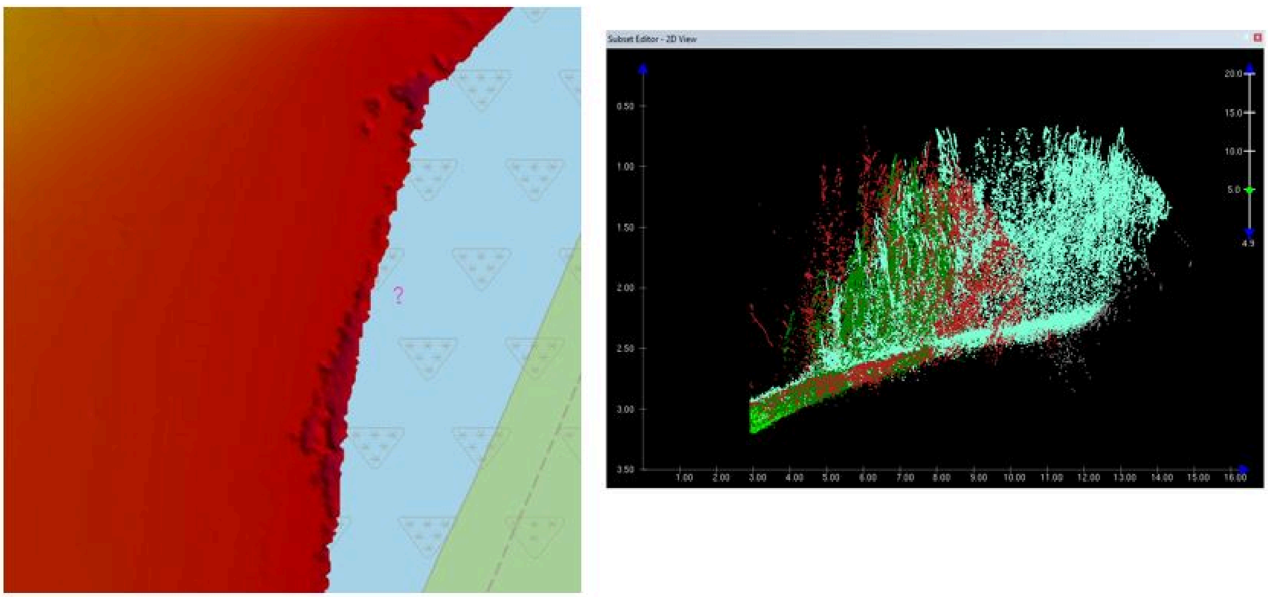
B.2.5 Equipment Effectiveness

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

B.2.6 Factors Affecting Soundings

There were no other factors that affected corrections to soundings.

Concur with clarification. Due to kelp or some other things in the water column, it is difficult to observe the real bottom of the ocean floor and to detect other objects in those areas. This impacted the survey's ability to detect the least depth and features in those areas of kelp. These areas were removed from the surface using the traditional subset data review and process in Caris Hips and Sips.



Kelp areas

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: At least once every four hours with sufficient frequency, density, depth and accuracy as outlined in section 5.2.3.3 of the 2019 HSSD.

Sound Velocity Profiles (SVP) casts were taken at least once every four hours in the deepest water nearest to the active survey area and when there was a change in sound speed values over varying depths (Figure 24). The SVP casts were applied to the MBES lines in CARIS using the "nearest in distance within time of 4 hours" method.

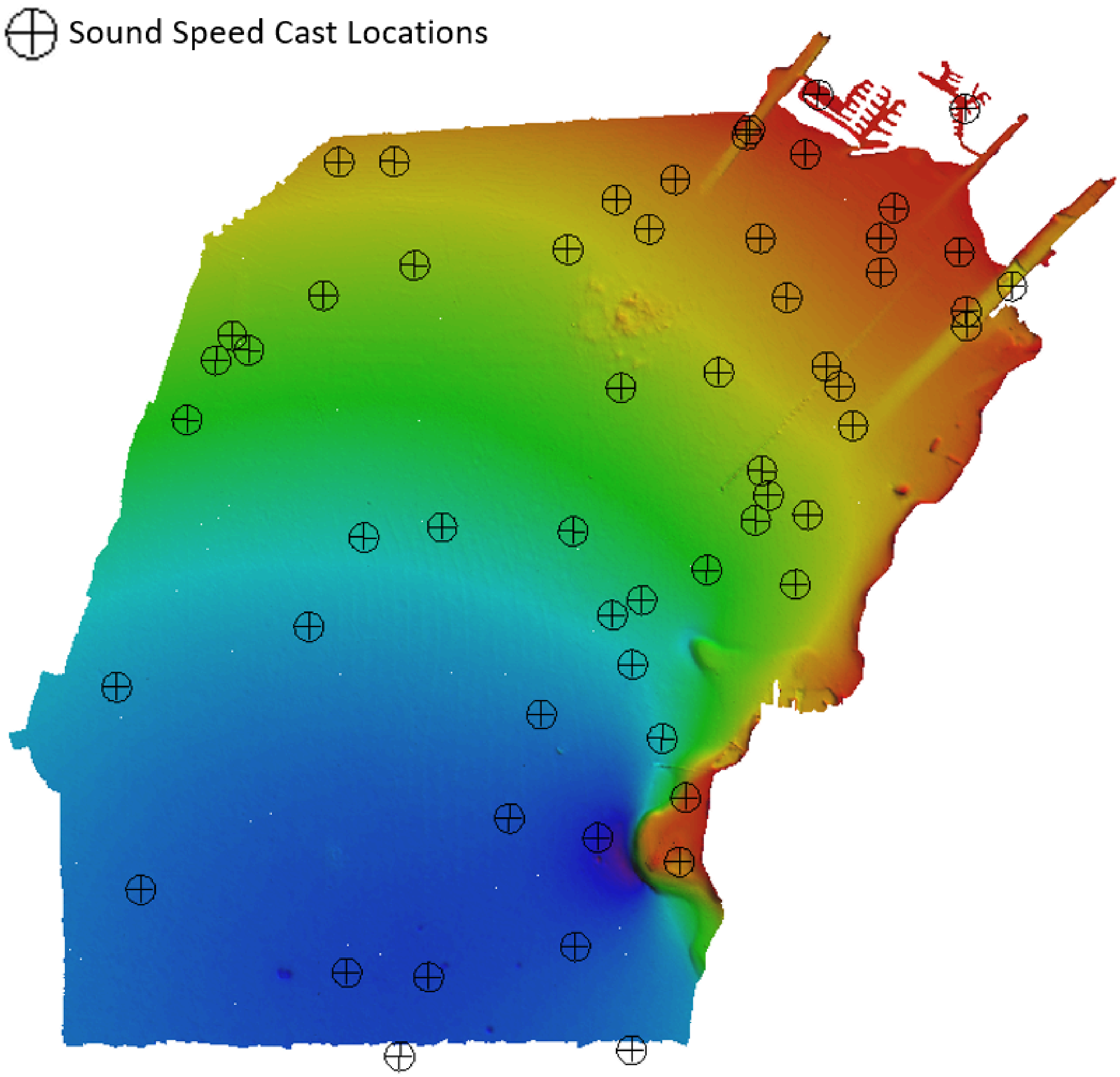


Figure 24: H13292 Sound Speed Cast Locations

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

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Raw backscatter data is logged as .all file for delivery to NOAA's Pacific Hydrographic Branch. NOAA's Navigation Response Branch field units are waived from producing backscatter mosaics for the 2019 field season. All equipment and survey methods were used as detailed in the DAPR.

B.5 Data Processing

B.5.1 Primary Data Processing Software

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

Manufacturer	Name	Version
Caris	HIPS/SIPS	11.1.6

Table 10: Primary bathymetric data processing software

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

Manufacturer	Name	Version
QPS	Fledermaus	7.9.6

Table 11: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Profile Version 2019.

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
H13292_MB_VR_MLLW	CARIS VR Surface (CUBE)	Variable Resolution	0.3 meters - 36.1 meters	NOAA_VR	Object Detection
H13292_MB_VR_MLLW_Final	CARIS VR Surface (CUBE)	Variable Resolution	0.3 meters - 36.1 meters	NOAA_VR	Object Detection

Table 12: Submitted Surfaces

The survey was carried out to meet the Object Detection MBES Coverage requirements as defined by Section 5.2.2 of the 2019 Hydrographic Survey Specifications and Deliverables.

QC Tolls in Pydro Explorer was used to analyze the surface for fliers. There were 3 fliers identified on the finalized surface. Upon review these were found to be false positives.

C. Vertical and Horizontal Control

Field installed tide GPS stations were not utilized for this survey; there is no HVCR report included with submission of H13292.

C.1 Vertical Control

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

ERS Datum Transformation

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

Method	Ellipsoid to Chart Datum Separation File
ERS via VDATUM	S-N905_VDatumLimits_100m_NAD83-MLLW_geoid12b.csar

Table 13: ERS method and SEP file

Sounding elevations relative to the ellipsoid were collected through Ellipsoidal Referenced Survey (ERS) with post-processing of the daily logger POSPac data to create a statistical best estimate of trajectory (SBET) file, as detailed in the DAPR. All H13292 meets HSSD vertical accuracy requirements.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD 83).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 10.

RTK

Precise Positioning-Real Time Extended (PP-RTX) processing methods were used in Applanix POSpac MMS 8.3 software to produce SBETs for post-processing horizontal correction. All of H13292 meets HSSD horizontal accuracy requirements.

D. Results and Recommendations

D.1 Chart Comparison

Electronic Navigational Charts (ENCs) were compared by extracting all soundings from the chart for general agreement and to identify areas of significant change. All data from H13292 should supersede charted data. In general, surveyed soundings agree with the majority of charted depths. A discussion of several of the disagreements in section D 1.1 of this report.

The chart comparison was made using a CARIS sounding and contour layer derived from the finalized VR surface. The contours and sounders were overlaid on the chart and compared.

D.1.1 Electronic Navigational Charts

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

ENC	Scale	Edition	Update Application Date	Issue Date
US5WA45M	1:4000	22	06/27/2019	06/27/2019

Table 14: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

H13292 data included the Sqaulicum Harbor marina, a small boat marina ranging in depths of 3.9-2.9 meters. The Post Point shoal area is charted shoaler than depths retrieved from H13292 survey data (Figure 30).

There are no Danger to Navigation Reports submitted for this survey. All features are addressed in the final feature file.

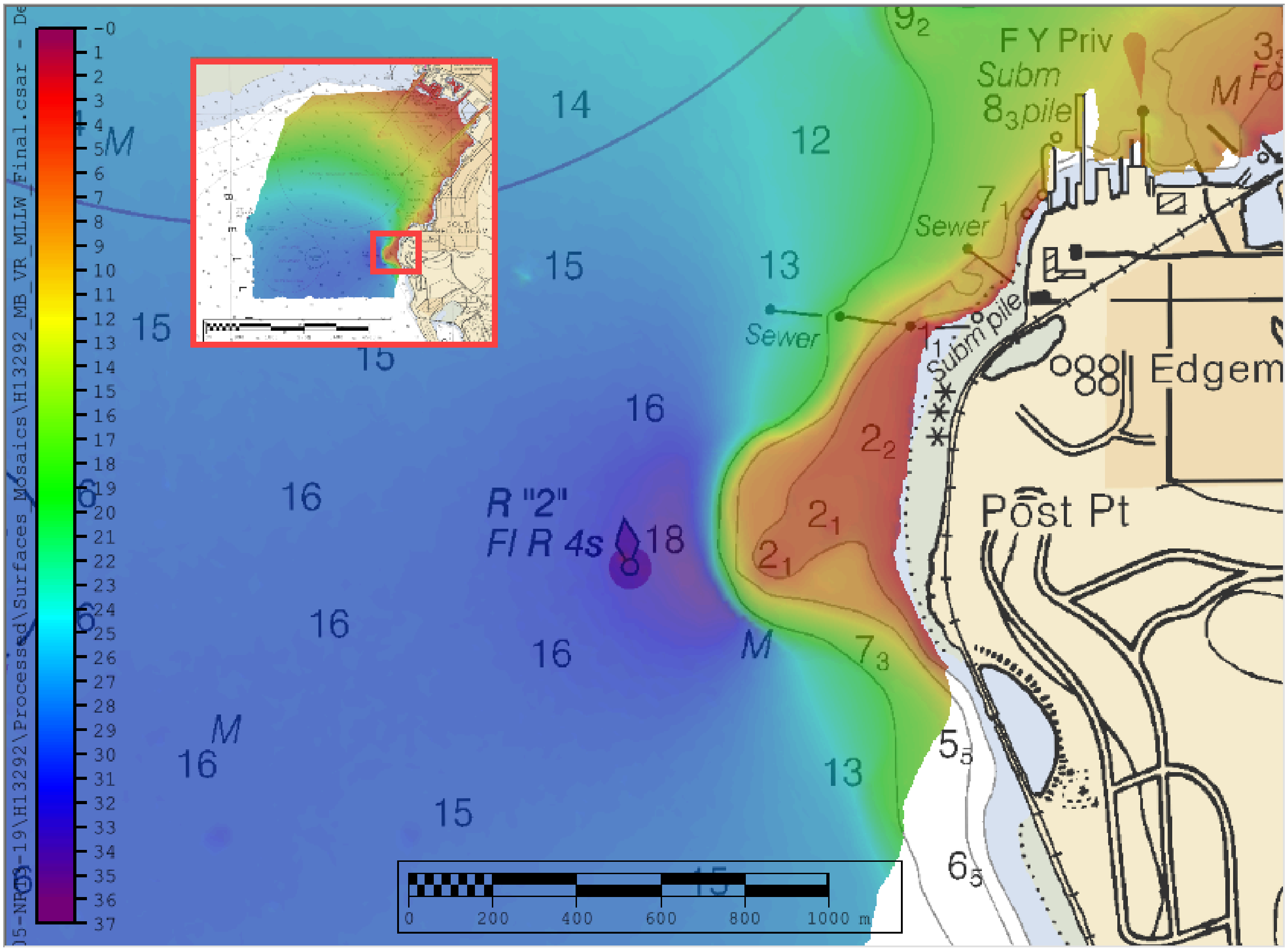


Figure 25: H13292 survey derived depths (in meters) compared to charted depths.

D.1.3 Charted Features

The Obstruction Position Approximate (PA) on chart 18544_1 in the Bellingham Bay area was not observed in H13292 survey data. H13292 data shows depths consistent with the charted soundings.

There are 55 new features included in the Final Feature File submitted with this report. Many of the DESCRP-New feathers are of previously charted features, with an updated location and VALSOU. Due to the nature of the Variable Resolution (VR) surface, there are two underwater obstructions where the S-57 feature will not import directly onto the critical sounding. This results in an error in Pydro Explorer's QC tools VALSOU Check. These instances are all under 0.02 meters, and should supersede previously charted data (Figure 29). NOAA's Caris liaison and QC tools development team have been made aware of this occurrence. For more information see the Appendix II, Supplemental Survey Records Correspondence.

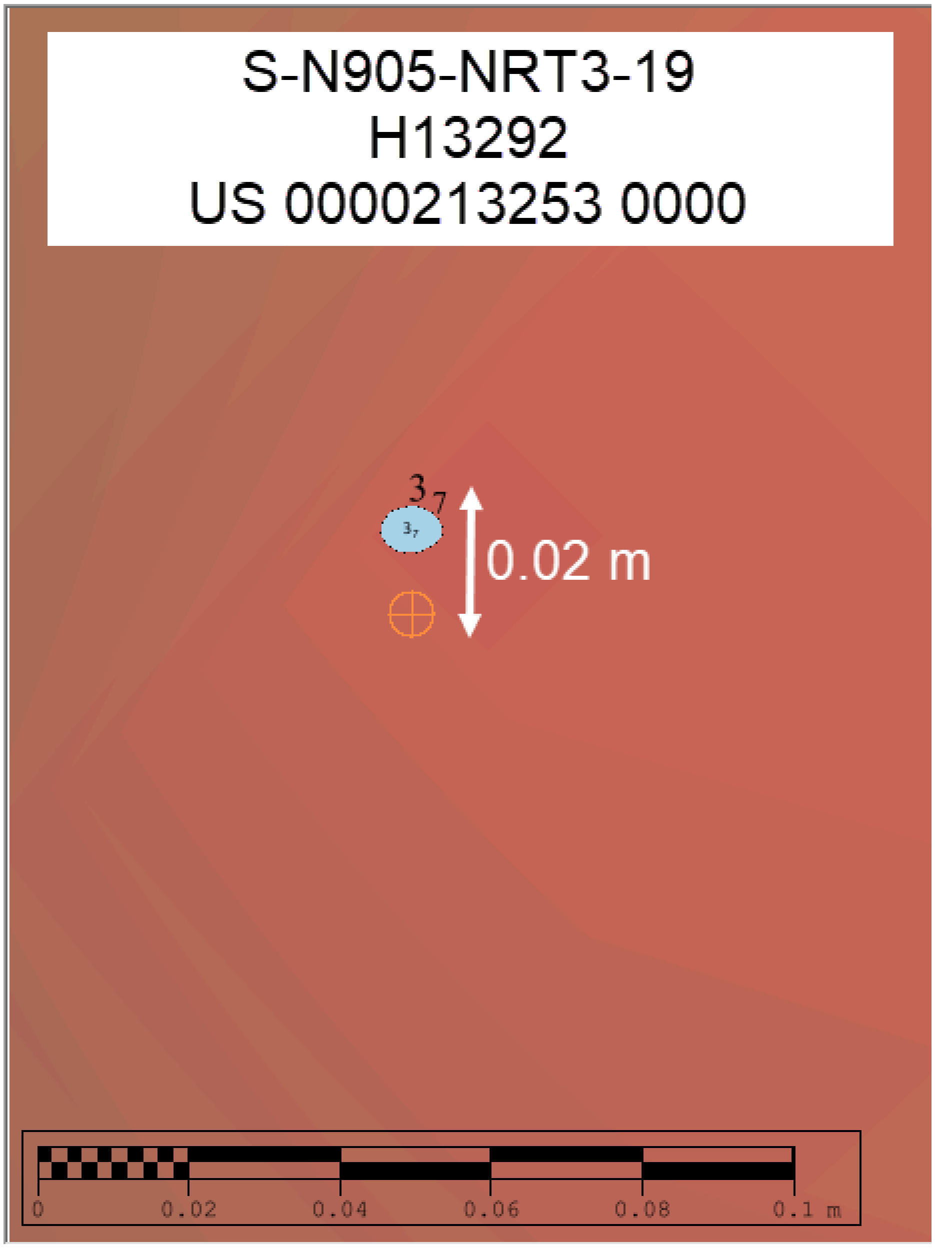


Figure 26: An example of an S-57 feature that will not import directly onto the critical sounding from the VR surface.

D.1.4 Uncharted Features

Both within the formerly industrialized areas of Bellingham Bay and the Squalicum Harbor there are numerous new features that were found and positioned. All features new and assigned are detailed in the Final Feature File submitted with this report.

D.1.5 Channels

The United States Army Corp of Engineers maintain three waterways within the the Port of Bellingham. H13292 depths were consisted with the charted depths in the I&J Street Waterway. The northern portions of both the Whatcom Creek and Squalicum Creek Waterways were significantly deeper compared to the tabulated depths with soundings disagreeing by more than 18 feet (Figure 31).

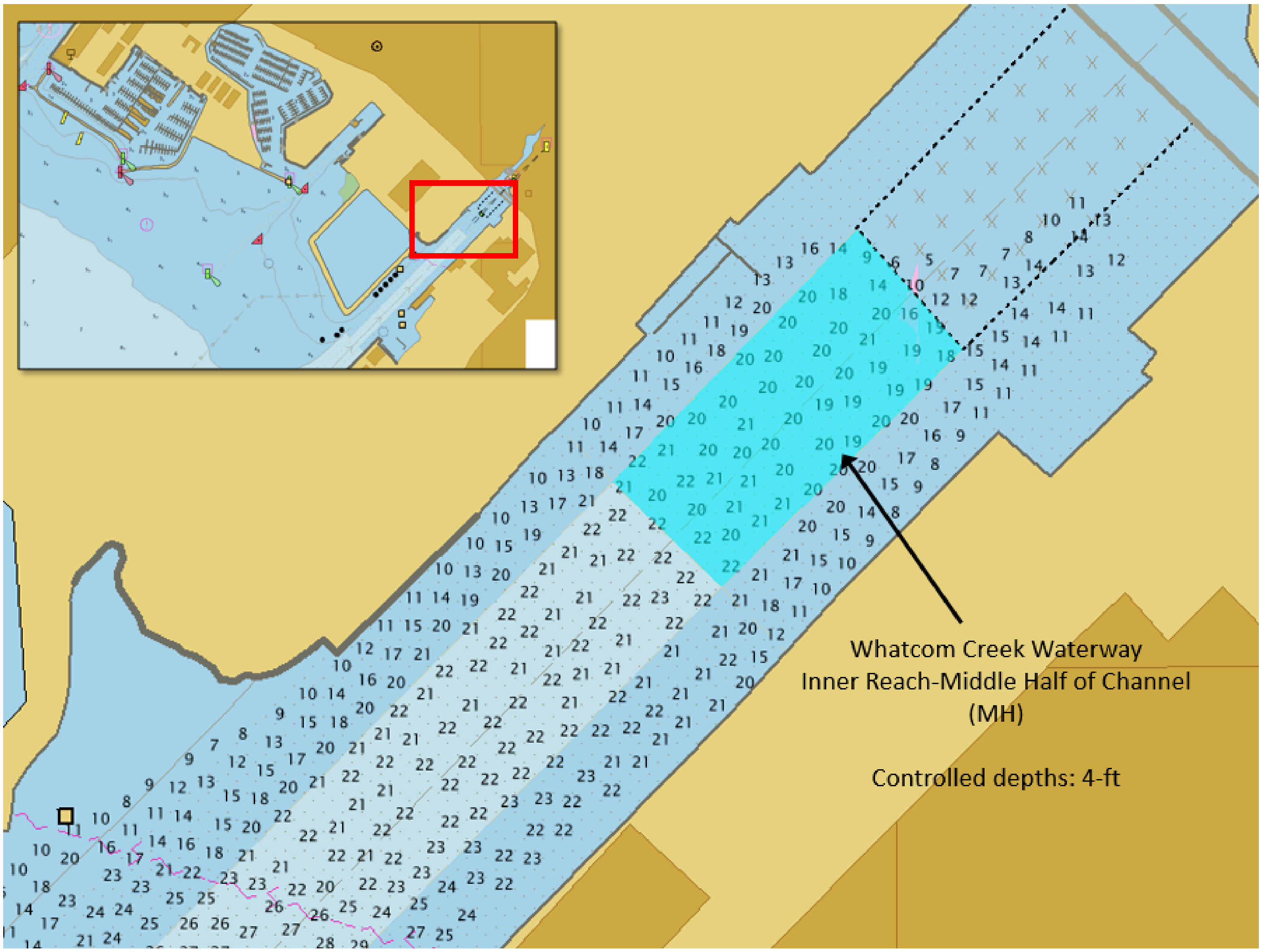


Figure 27: Whatcom Creek Waterway overlaid with H13292 soundings.

D.2 Additional Results

D.2.1 Aids to Navigation

Twelve aids to navigation were assigned and investigated in the survey area for H13292. These aids were observed serving their intended purpose and nine of the twelve were on Station. Two private aids, Bellingham Harbor Shoal Buoys A and B, U.S. Coast Guard Light List #s 19272, 19273 were positioned incorrectly on the chart by 175 and 142 meters respectively. One other private aid, Georgia Pacific Outfall Lighted Buoy, U.S. Coast Guard Light List # 19230 was positioned incorrectly on the chart by 147 meters. The updated locations were reported to the United States Coast Guard (USCG) via the USCG Navigation Center's Online ATON Discrepancy Report Form (per HSSD 1.6.2.2) and were updated as off station in the USCG Local Notice to Mariners. Please refer to the Supplemental Survey Records Correspondence in the Appendices section of this report.

The structures were all observed but the light characteristics were not observed due to day time operations.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

Four bottom samples were conducted in the assigned locations. There are no drop camera images submitted with these bottom samples. A sample was received for all four locations (Figure 32). Refer to the results included in the H13292 Final Feature File submitted with this report.

Figure 28: Example of a bottom sample collected within the H13292 survey area.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

Two charted pipelines were confirmed. One was positioned correctly and one was adjusted to meet the multibeam coverage. This is addressed in the H13292 Final Feature File (FFF). A submarine cable exists in The Whatcom Waterway, the posted sign was observed at the location.

D.2.6 Platforms

No platforms exist for this survey.

D.2.7 Ferry Routes and Terminals

There are no charted ferrry routes within the survey limits of survey H13292. The Alaska Marine Highway System operates ferry service between Bellingham and Ketchikan, Alaska from the terminal in the southeast portion of the survey area. Daily service to and from Friday Harbor in the San Juan Islands operates from the same terminal from June through September.

D.2.8 Abnormal Seafloor or Environmental Conditions

Five large depressions exist in the southern portion of the survey that are 30-90 meters in width and 1-3 meters in depth (Figure 33). These depressions are similar to ones found in the adjacent survey H11419. Appear to be either pockmarks or micro-depressions of unknown origin.

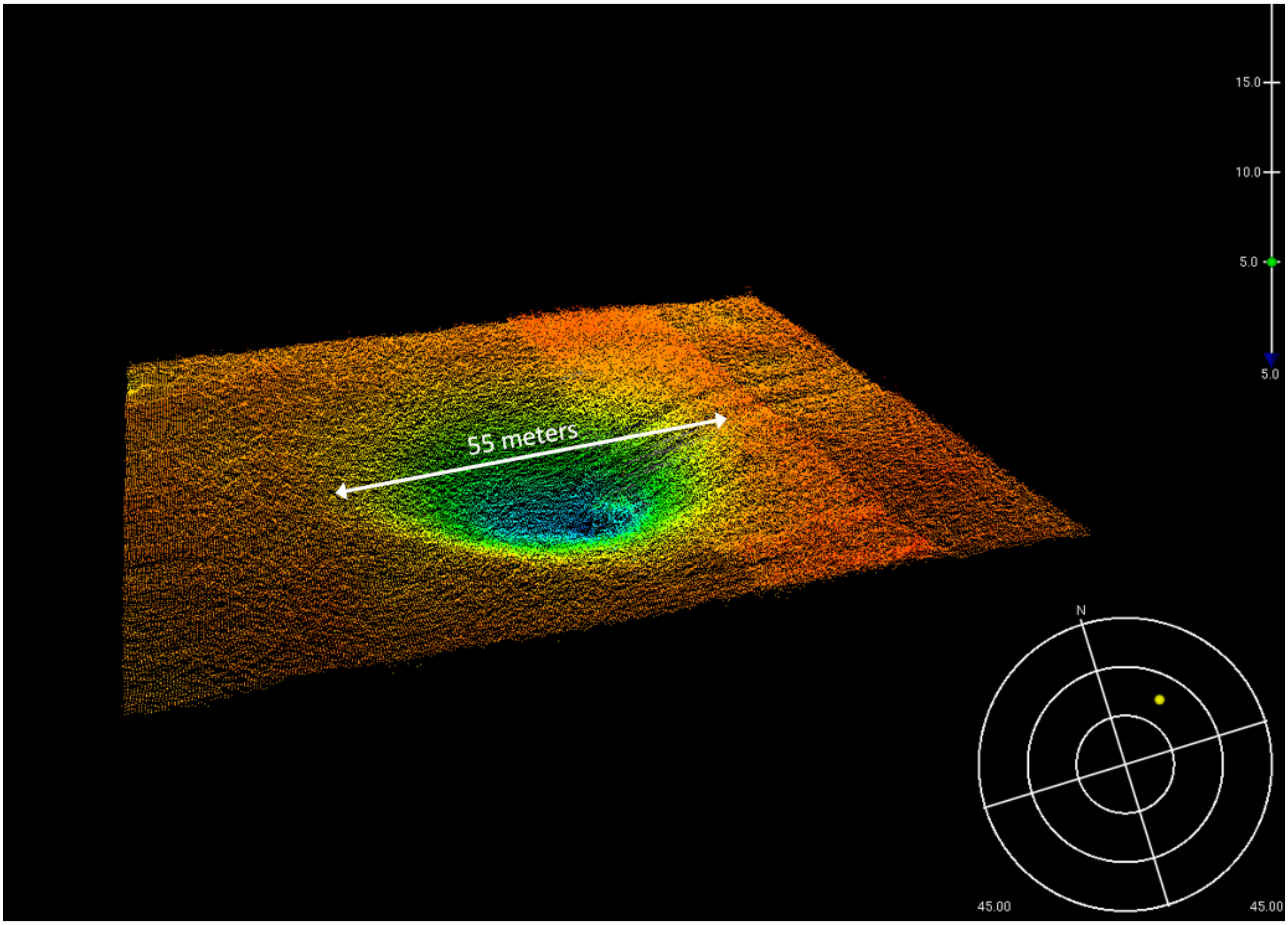


Figure 29: Depression in H13292 survey coverage.

D.2.9 Construction and Dredging

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

D.2.10 New Survey Recommendations

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

D.2.11 ENC Scale Recommendations

No new insets are recommended for this area.

E. Approval Sheet

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

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

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys Specifications and Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. 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
Michelle M. Levano, LTJG/NOAA	Chief of Party	01/24/2020	Digitally signed by LEVANO.MICHELLE.MARIE.1516645888 Date: 2020.01.24 11:37:18 -08'00'
PST Timothy Wilkisnon	Hydrographer	01/24/2020	WILKINSON.TIMOTHY.DAVID.1383074440 Digitally signed by WILKINSON.TIMOTHY.DAVID.1383074440 Date: 2020.01.24 13:36:32 -08'00'

F. Table of Acronyms

Acronym	Definition
AHB	Atlantic Hydrographic Branch
AST	Assistant Survey Technician
ATON	Aid to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BAG	Bathymetric Attributed Grid
BASE	Bathymetry Associated with Statistical Error
CO	Commanding Officer
CO-OPS	Center for Operational Products and Services
CORS	Continuously Operating Reference Station
CTD	Conductivity Temperature Depth
CEF	Chart Evaluation File
CSF	Composite Source File
CST	Chief Survey Technician
CUBE	Combined Uncertainty and Bathymetry Estimator
DAPR	Data Acquisition and Processing Report
DGPS	Differential Global Positioning System
DP	Detached Position
DR	Descriptive Report
DTON	Danger to Navigation
ENC	Electronic Navigational Chart
ERS	Ellipsoidal Referenced Survey
ERTDM	Ellipsoidally Referenced Tidal Datum Model
ERZT	Ellipsoidally Referenced Zoned Tides
FFF	Final Feature File
FOO	Field Operations Officer
FPM	Field Procedures Manual
GAMS	GPS Azimuth Measurement Subsystem
GC	Geographic Cell
GPS	Global Positioning System
HIPS	Hydrographic Information Processing System
HSD	Hydrographic Surveys Division

Acronym	Definition
HSSD	Hydrographic Survey Specifications and Deliverables
HSTB	Hydrographic Systems Technology Branch
HSX	Hypack Hysweep File Format
HTD	Hydrographic Surveys Technical Directive
HVCR	Horizontal and Vertical Control Report
HVF	HIPS Vessel File
IHO	International Hydrographic Organization
IMU	Inertial Motion Unit
ITRF	International Terrestrial Reference Frame
LNM	Linear Nautical Miles
MBAB	Multibeam Echosounder Acoustic Backscatter
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NALL	Navigable Area Limit Line
NTM	Notice to Mariners
NMEA	National Marine Electronics Association
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRT	Navigation Response Team
NSD	Navigation Services Division
OCS	Office of Coast Survey
OMAO	Office of Marine and Aviation Operations (NOAA)
OPS	Operations Branch
MBES	Multibeam Echosounder
NWLON	National Water Level Observation Network
PDBS	Phase Differencing Bathymetric Sonar
PHB	Pacific Hydrographic Branch
POS/MV	Position and Orientation System for Marine Vessels
PPK	Post Processed Kinematic
PPP	Precise Point Positioning
PPS	Pulse per second

Acronym	Definition
PRF	Project Reference File
PS	Physical Scientist
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
RTX	Real Time Extended
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
SSSAB	Side Scan Sonar Acoustic Backscatter
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPU	Total Propagated Uncertainty
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDF	Zone Definition File