F00805

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	F00805

LOCALITY

State(s):	Washington
General Locality:	Portage Bay
Sub-locality:	Portage Bay

2020

CHIEF OF PARTY
Michelle M. Levano, LTJG/NOAA

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Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

F00805

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:	**Portage Bay**
Sub-Locality:	**Portage Bay**
Scale:	**5000**
Dates of Survey:	**09/10/2020 to 09/11/2020**
Instructions Dated:	**03/23/2020**
Project Number:	**S-N918-NRT3-20**
Field Unit:	**NOAA Navigation Response Team - Seattle**
Chief of Party:	**Michelle M. Levano, LTJG/NOAA**
Soundings by:	**EM 2040C Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Lake Washington Low Water Datum**

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, LWL (Lake Washington Low Water). 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 F00805

Project: S-N918-NRT3-20

Locality: Portage Bay

Sublocality: Portage Bay

Scale: 1:5000

September 2020 - September 2020

NOAA Navigation Response Team - Seattle

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

A. Area Surveyed

The survey area is in the vicinity of the University of Washington School of Oceanography pier located in Portage Bay, Seattle, WA. Prior to the completion of the Montlake Cut in 1916, the Duwamish, first people of Seattle, had a portage from Lake Washington to Lake Union in this area called Skhwacugwit :"portage" in Lushootseed the Puget Sound Salish language.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
47° 39' 0.33" N 122° 18' 52.25" W	47° 38' 51.46" N 122° 18' 34.93" W

Table 1: Survey Limits

Data were acquired to the survey limits in accordance with the requirements in the Project Instructions and the May 2020 NOS Hydrographic Surveys Specifications and Deliverables (HSSD) (Figure 1). 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 sea walls, docked vessels, and/or aquatic vegetation.

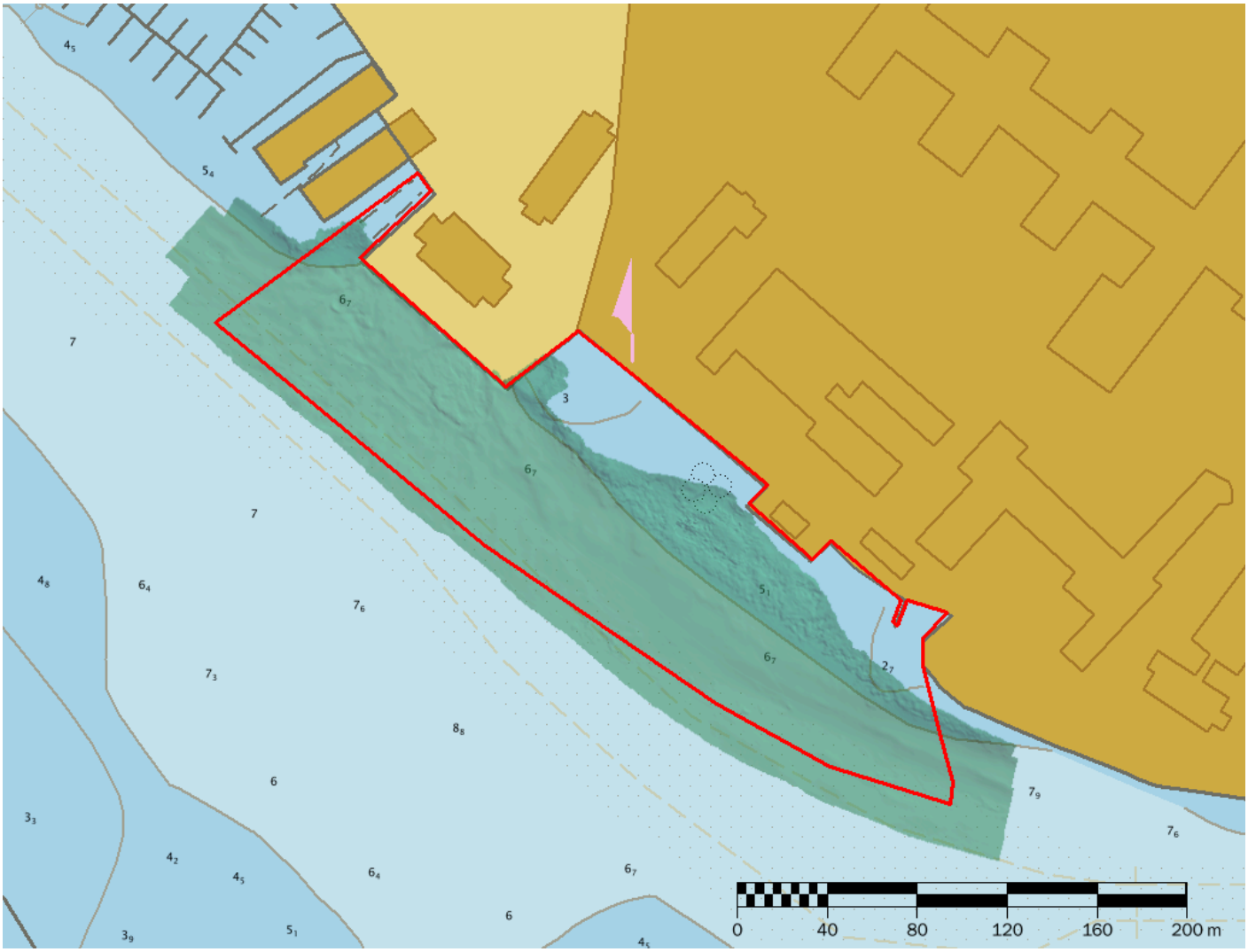


Figure 1: F00805 Sheet Limits (in red) overlaid on ENC US5WA13M

A.2 Survey Purpose

University of Washington School of Oceanography has requested a hydrographic survey around their pier. University of Washington received R/V Rachael Carson in 2018, to conduct operations and participate in the UNOLS fleet (Figure 2). This vessel has a draft of 14 feet which is significantly deeper than their previous small research vessel. The last survey of the area was in 2016 by a student and the survey's limiting contour was 20 ft. A new survey of the pier will help better determine where R/V Rachael Carson can safely moor. Survey data from this project is intended to supersede all prior survey data in the common area.

Sounding plots were provided to the University and are included in the Public Relations Constituent Products submitted with this survey.

Figure 2: R/V Rachael Carson at the university pier. The bow logo is of a "heraldic dolphin urinant' (i.e. in the head-down diving attitude) which was the logo of the University Marine Biological Station, Millport (now University Marine Biological Station, Millport) , where she was commissioned and operated as the RV Aora until 2013.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired in F00805 meets multibeam echo sounder (MBES) coverage requirements for object detection, as required by the HSSD. This includes crosslines (see Section B.2.1), NOAA allowable uncertainty, and density requirements. Additional compliance statistics can be found in the Standards and Compliance located in Appendix II of this survey deliverable.

The surface was analyzed using the HydrOffice QC Tools Grid QA feature (Figure 3,4). Density requirements for F00805 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 few nodes that did not meet density requirements are due to sparse data in the outer beams, especially near steep sand waves, slopes and rocky areas where acoustic shadowing occurred, and at the edges of the survey limits.

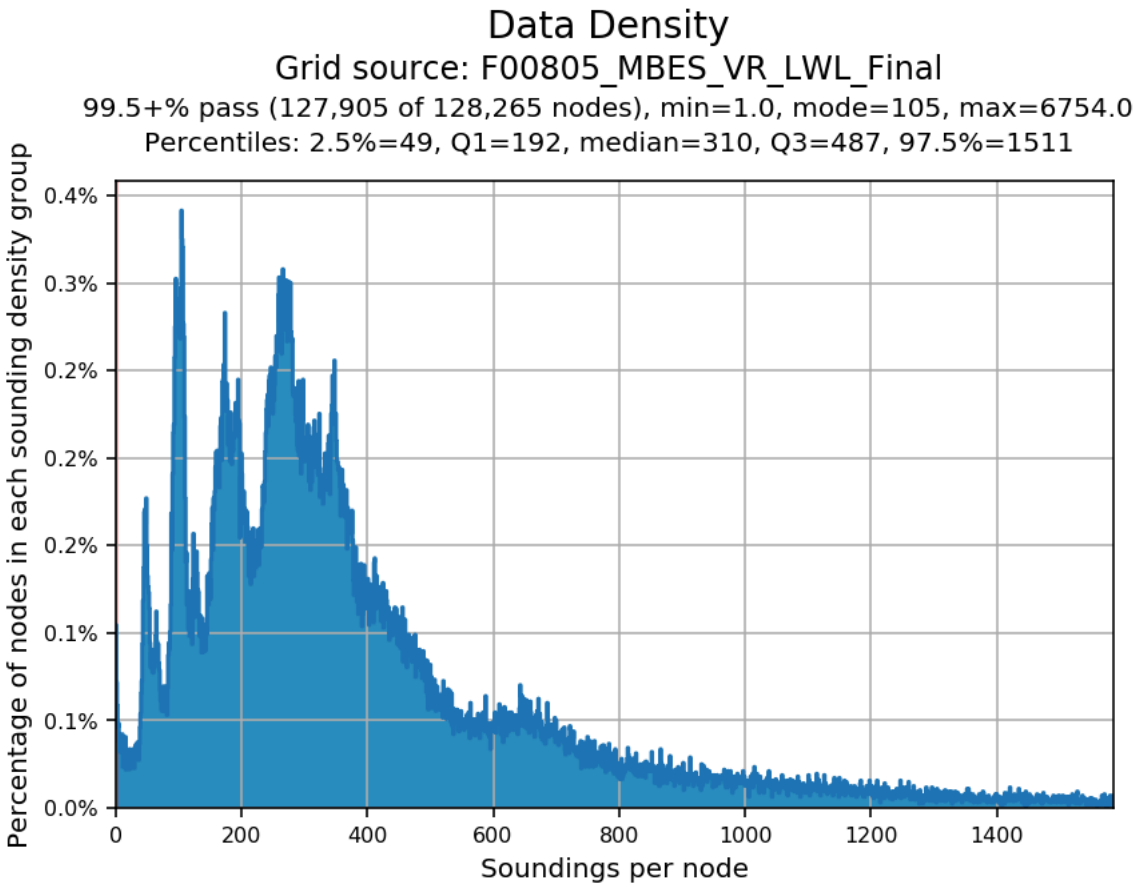


Figure 3: Data density distribution for F00805

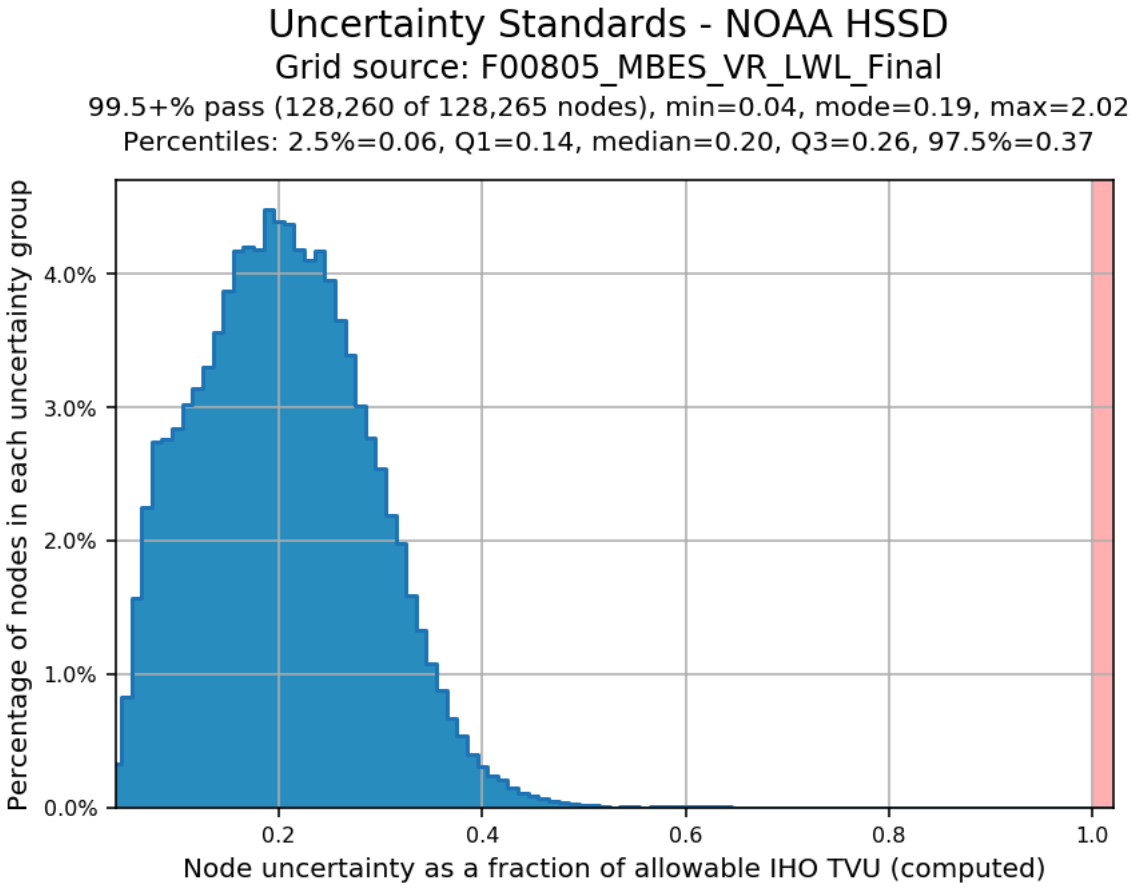


Figure 4: Uncertainty distribution for F00805

A.4 Survey Coverage

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

Water Depth	Coverage Required
All waters in survey area	Object Detection Coverage (Refer to HSSD Section 5.2.2.2)
All waters in survey area	Acquire backscatter data during all multibeam data acquisition (Refer to HSSD Section 6.2)

Table 2: Survey Coverage

The entirety of F00805 was acquired in accordance with the Object Detection MBES coverage standard, meeting the requirements listed above and in the HSSD (Figure 5). Multibeam coverage was achieved within the limits of hydrography as defined in the project instructions with some exceptions.

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 sea walls, docked vessels and/or aquatic vegetation (Figure 6).

F00805 data were reviewed in CARIS HIPS and SIPS for holidays in accordance with Section 5.2.2.3 of the HSSD. Zero 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.

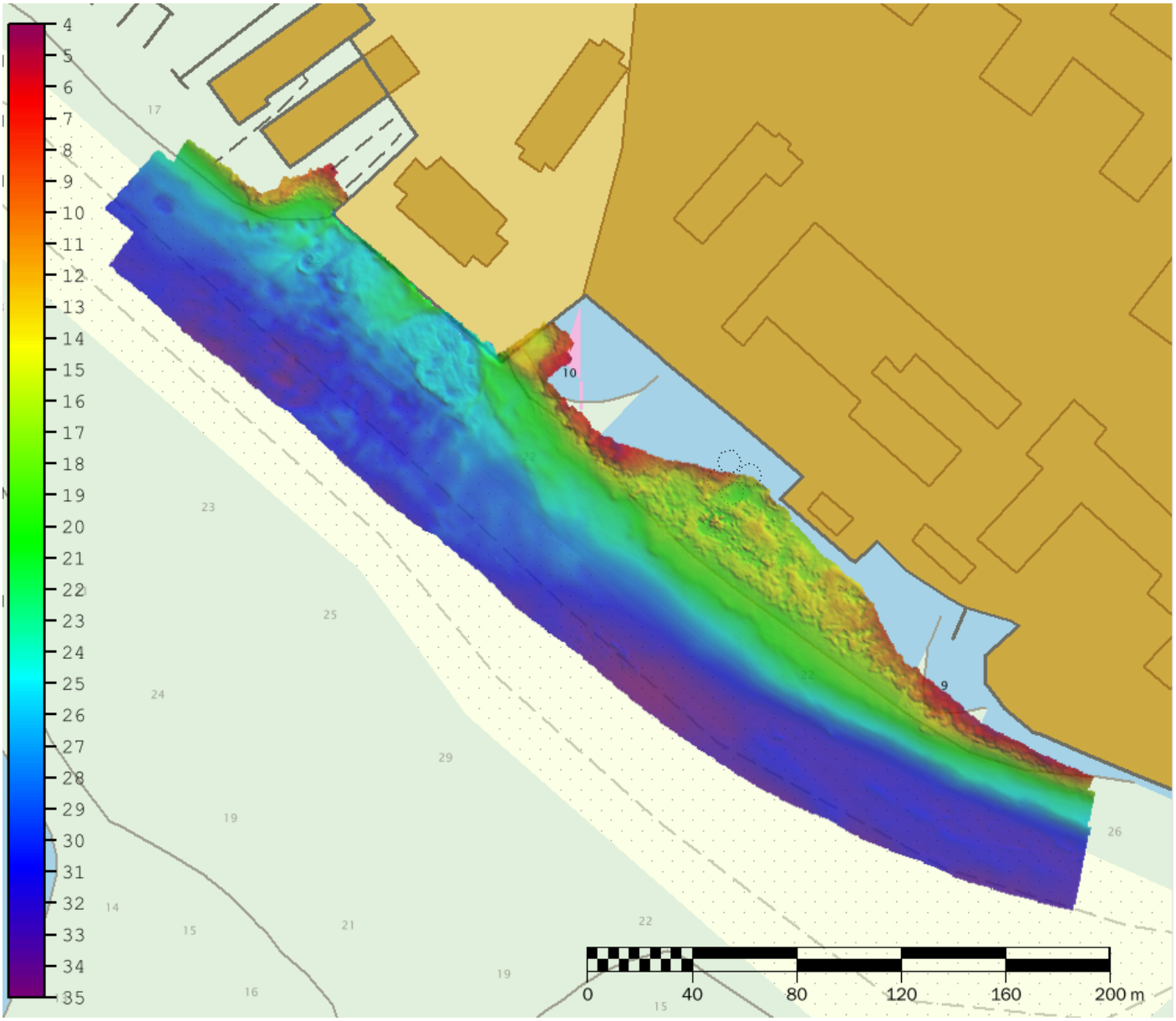


Figure 5: F00805 survey coverage overlaid onto ENC US5WA13M

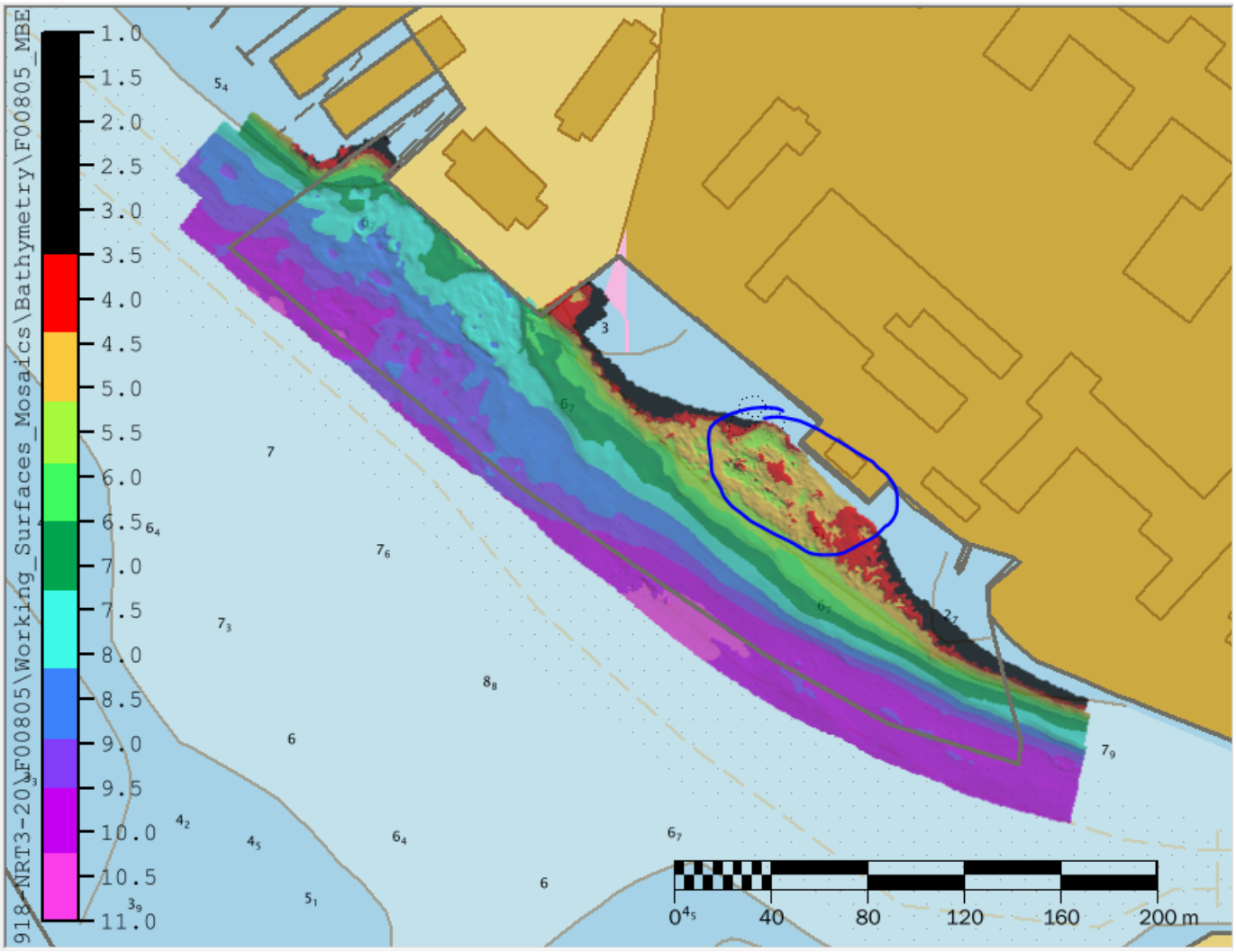


Figure 6: F00805 inshore limit of 3.5m shown in black. Area circled in blue showing where the inshore NALL was defined by maneuverability.

A.6 Survey Statistics

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

	HULL ID	*NRT3_S3006*	*Total*
LNM	**SBES Mainscheme**	0	0
	MBES Mainscheme	1.6547	2.0209
	Lidar Mainscheme	0	0
	SSS Mainscheme	0.0	0.0
	SBES/SSS Mainscheme	0	0
	MBES/SSS Mainscheme	0	0
	SBES/MBES Crosslines	0.3662	0
	Lidar Crosslines	0	0
Number of Bottom Samples			0
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			0.0093

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
09/11/2020	255
09/10/2020	254

Table 4: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

All data for survey F00805 was acquired by S3006. The vessel acquired multibeam depth soundings, sound speed profiles, and bottom samples. Refer to the S-N918-NRT3-20 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	***NRT3_S3006***
LOA	10.5 meters
Draft	1.2 meters

Table 5: Vessels Used

Figure 7: S3006

B.1.2 Equipment

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

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

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

Multibeam crosslines were collected by S3006 across a variety of depth ranges and water masses (Figure 8). Crosslines were collected, processed and compared in accordance with Section 5.2.4.2 of the HSSD. 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 tool's Compare Grids by subtracting the crossline only surface from the mainscheme surface (mainscheme- crosslines= difference surface), from which statistics were derived. Statistics show the mean difference between the depths derived from mainscheme data and crossline data was 0.08 meters (with mainscheme being shoaler and 95% of nodes falling within 0.14 meters (Figure 9).

For the respective depths, the difference surface was compared to the allowable NOAA uncertainty standards (Figure 10). 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 where crossline data is deeper than mainscheme data. In total, 99.5% of the depth differences between F00805 mainscheme and crossline data were within allowable NOAA uncertainties (Figure 11).

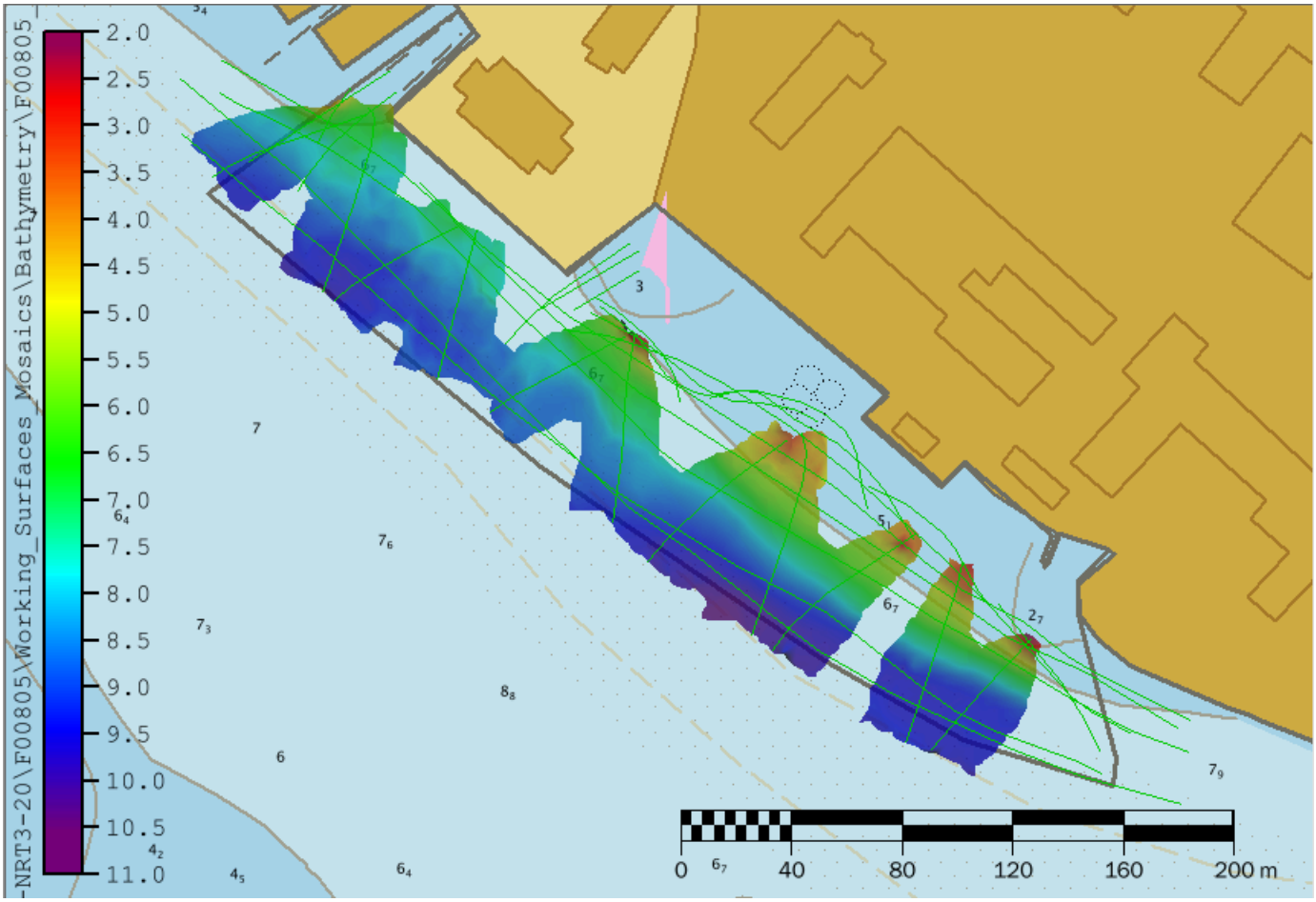
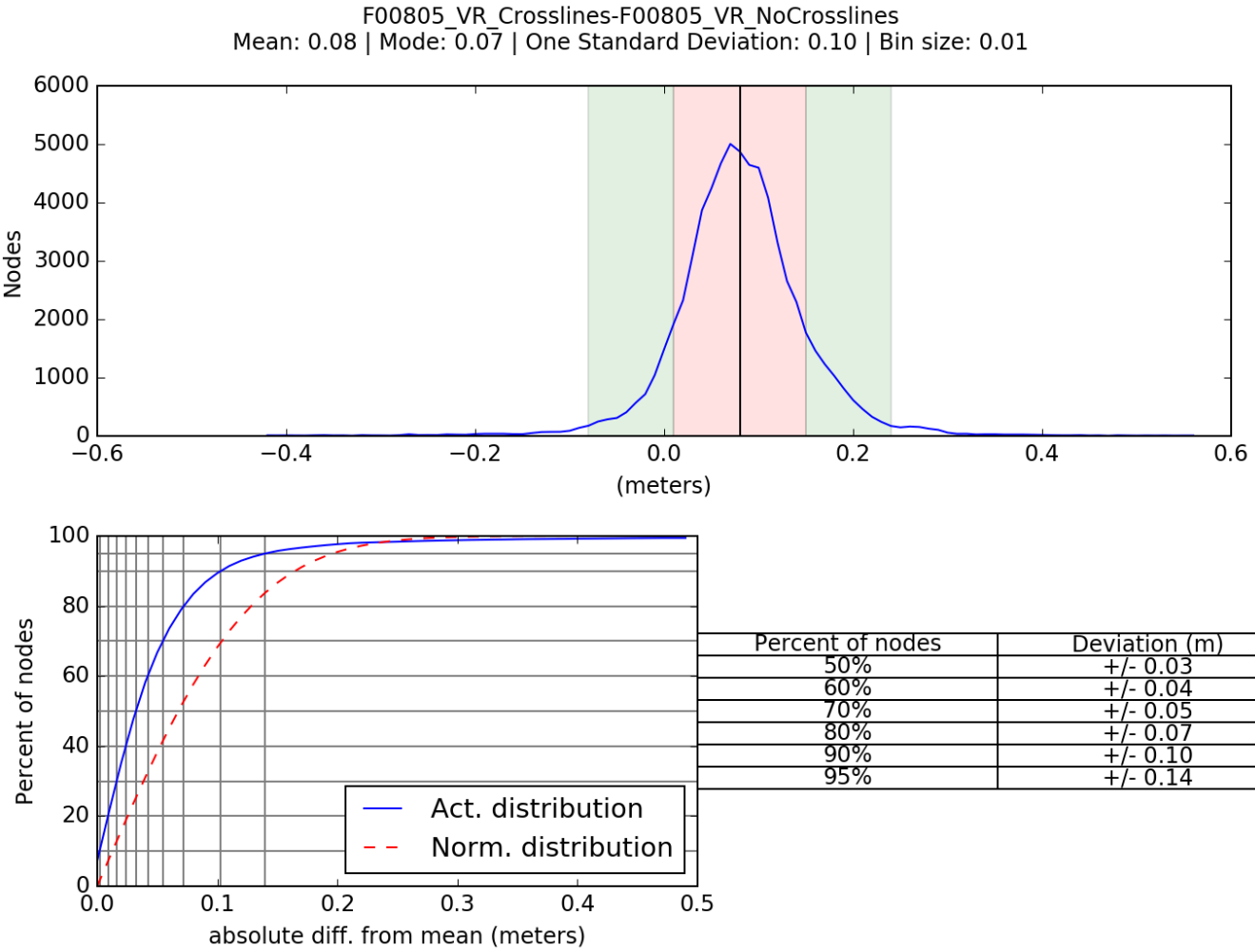


Figure 8: F00805 Crosslines



Percent of nodes	Deviation (m)
50%	+/- 0.03
60%	+/- 0.04
70%	+/- 0.05
80%	+/- 0.07
90%	+/- 0.10
95%	+/- 0.14

Figure 9: The statistics and distribution summary plot of the difference between F00805 mainscheme and crossline data.

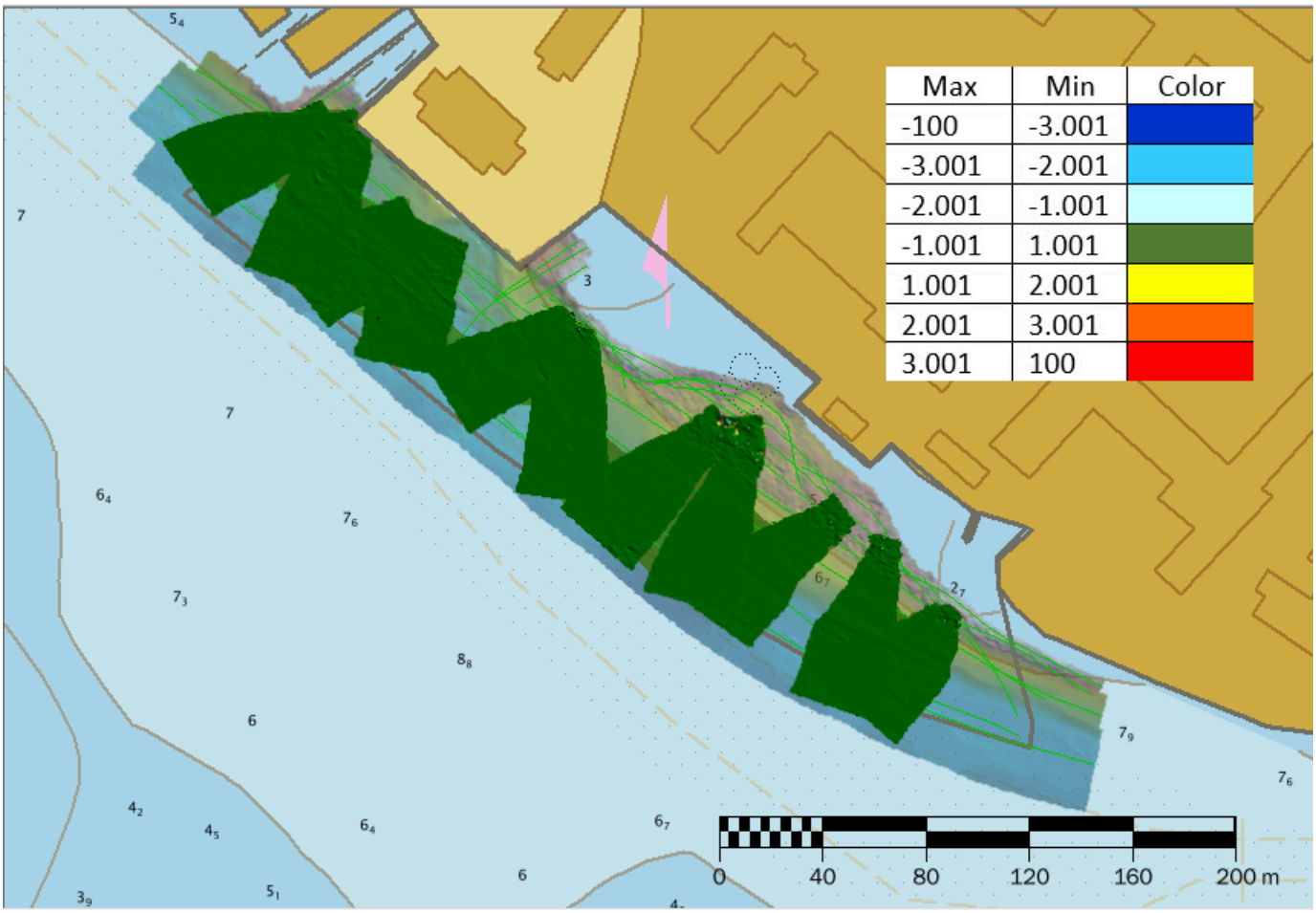


Figure 10: Depth differences between F00805 mainscheme and crossline data as compared to NOAA allowable uncertainty standards for the associated depths.

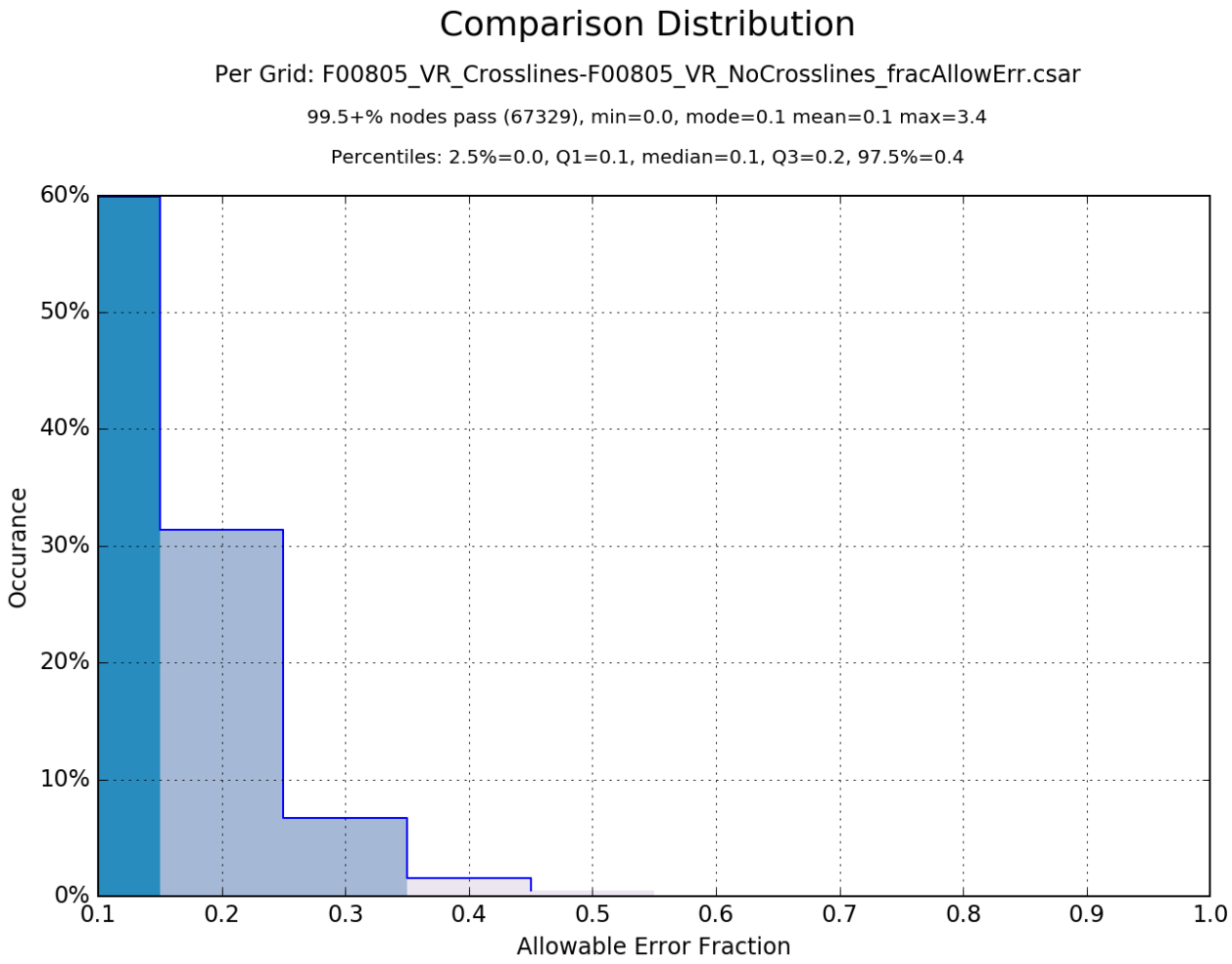


Figure 11: Histogram plot utilizing the magnitude of the Allowable Error Fraction to show the indication of what percentage of the total number of comparisons pass the TVU max test for F00805

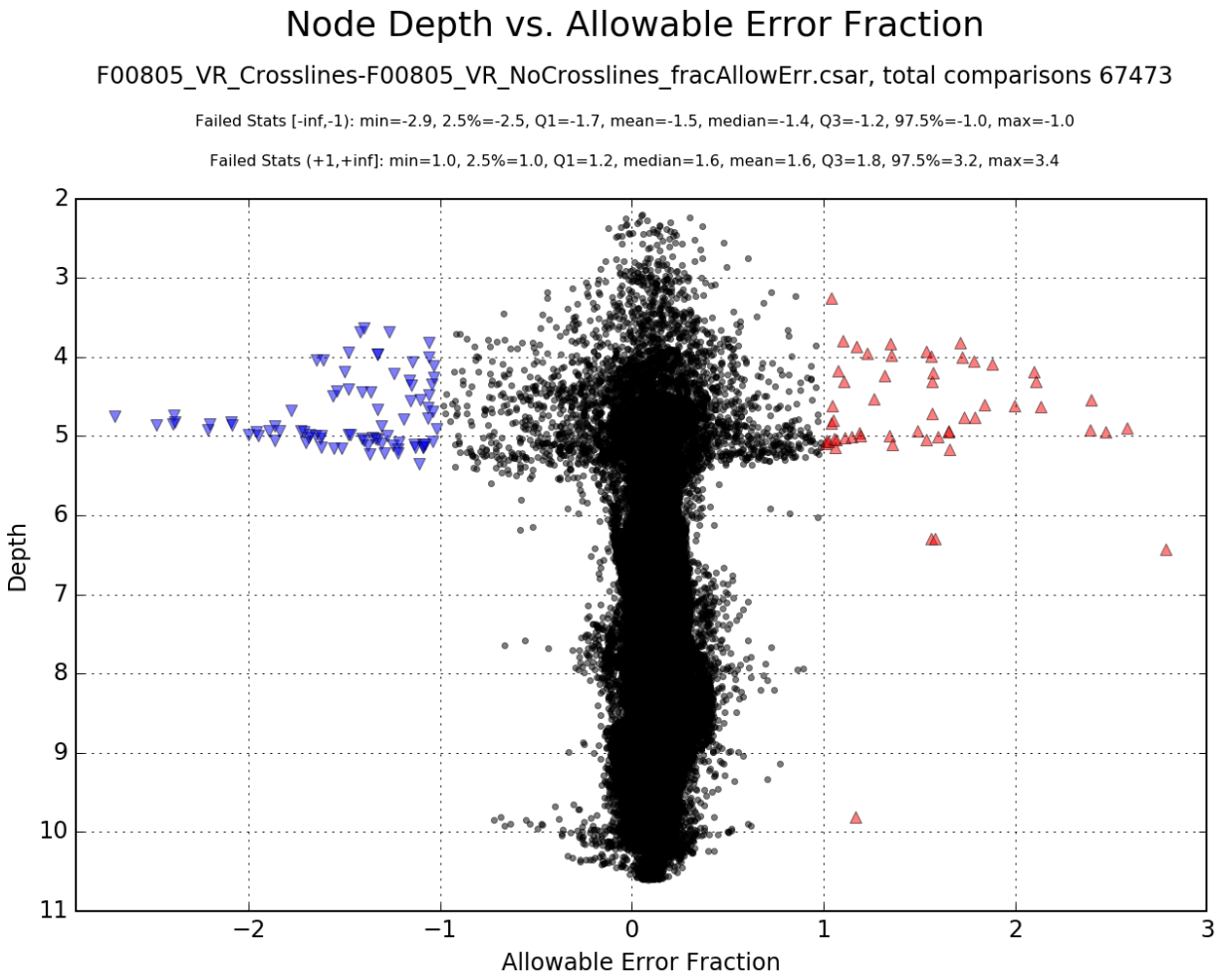


Figure 12: F00805 crosslines Node vs. allowable error fraction

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.076 meters	0 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
S3006	4 meters/second	n/a meters/second	n/a meters/second	0.15 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

Total Propagated Uncertainty (TPU) values for F00805 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 was provided to the field unit.

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 F00805. 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. F00805 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. F00805 is an ellipsoidally referenced survey (ERS) and the tidal component was accomplished via separation model.

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 for F00805.

B.2.3 Junctions

There are no contemporary surveys that junction with this survey.

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

Aquatic Vegitation

Aquatic vegetation was present in the shallower portions of the survey and at times was indistinguishable from the seafloor (Figure 13). In areas where they were distinguishable, the soundings on the vegetation were rejected to enable more accurate representation of the true seafloor. Where vegetation was indistinguishable, all soundings were retained. Furthermore, in some areas, patches of dense vegetation prohibited safe navigation of the survey vessels. The limits of these areas were then used to define the NALL. A kelp area was digitized showing the area of dense vegetation and is included in the final feature file submitted with this survey.

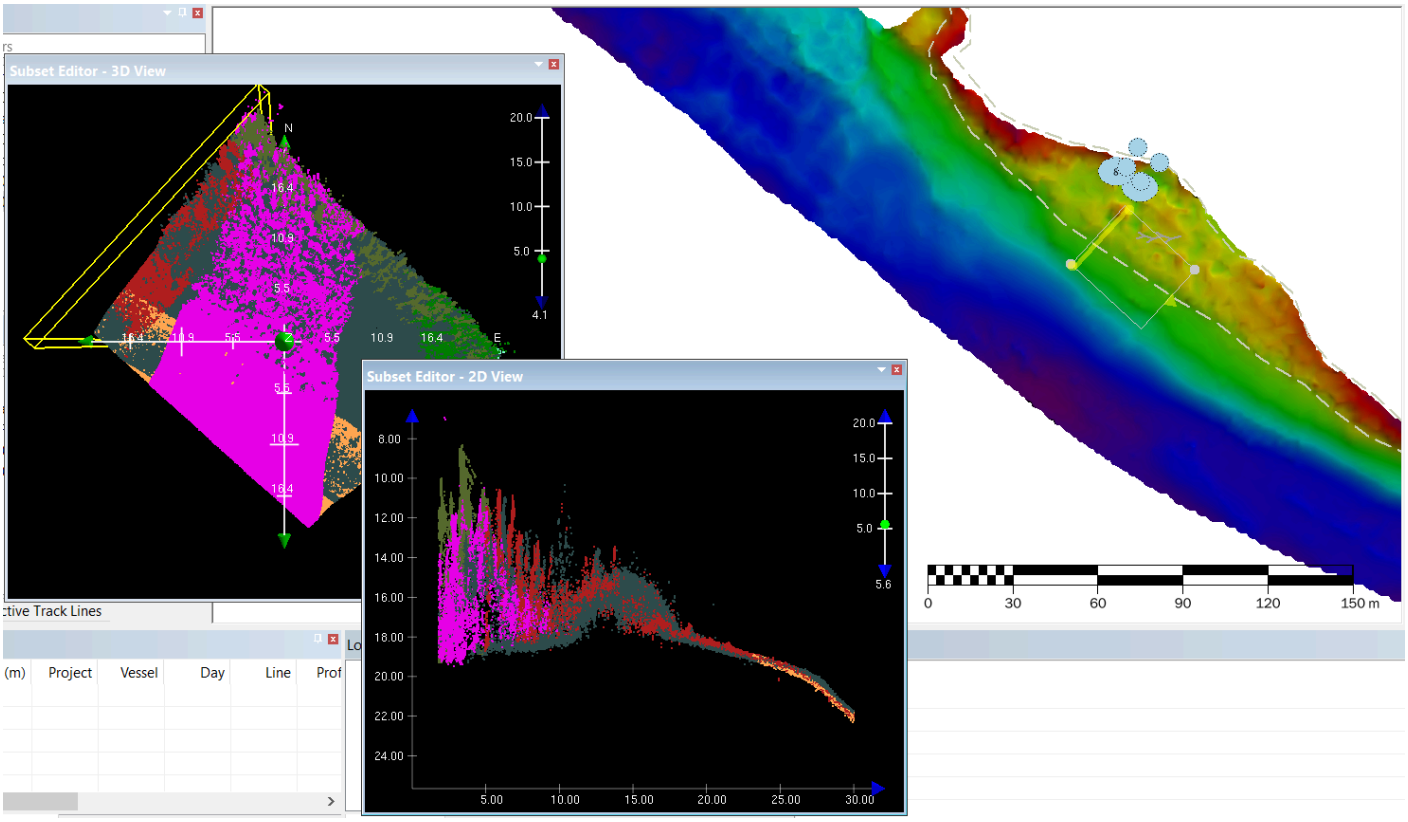


Figure 13: Aquatic Vegetation effecting the surface as seen in Caris Subset editor. In the 2D window (center bottom), vegetation is present and visible on the left of the window and absent on the right.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Every four hours

Casts were conducted at a minimum of one every four hours in the deepest water nearest to the active survey area during launch acquisition. Casts were conducted more frequently in areas where the influx of freshwater had an effect on the speed of sound in the water column, when there was a change in surface sound speed greater than four meters per second, and over varying depths (Figure 14). SVP casts were applied to the MBES lines in CARIS using the “nearest in distance within time of 4 hours” method. All sound speed methods were used as detailed in the DAPR.

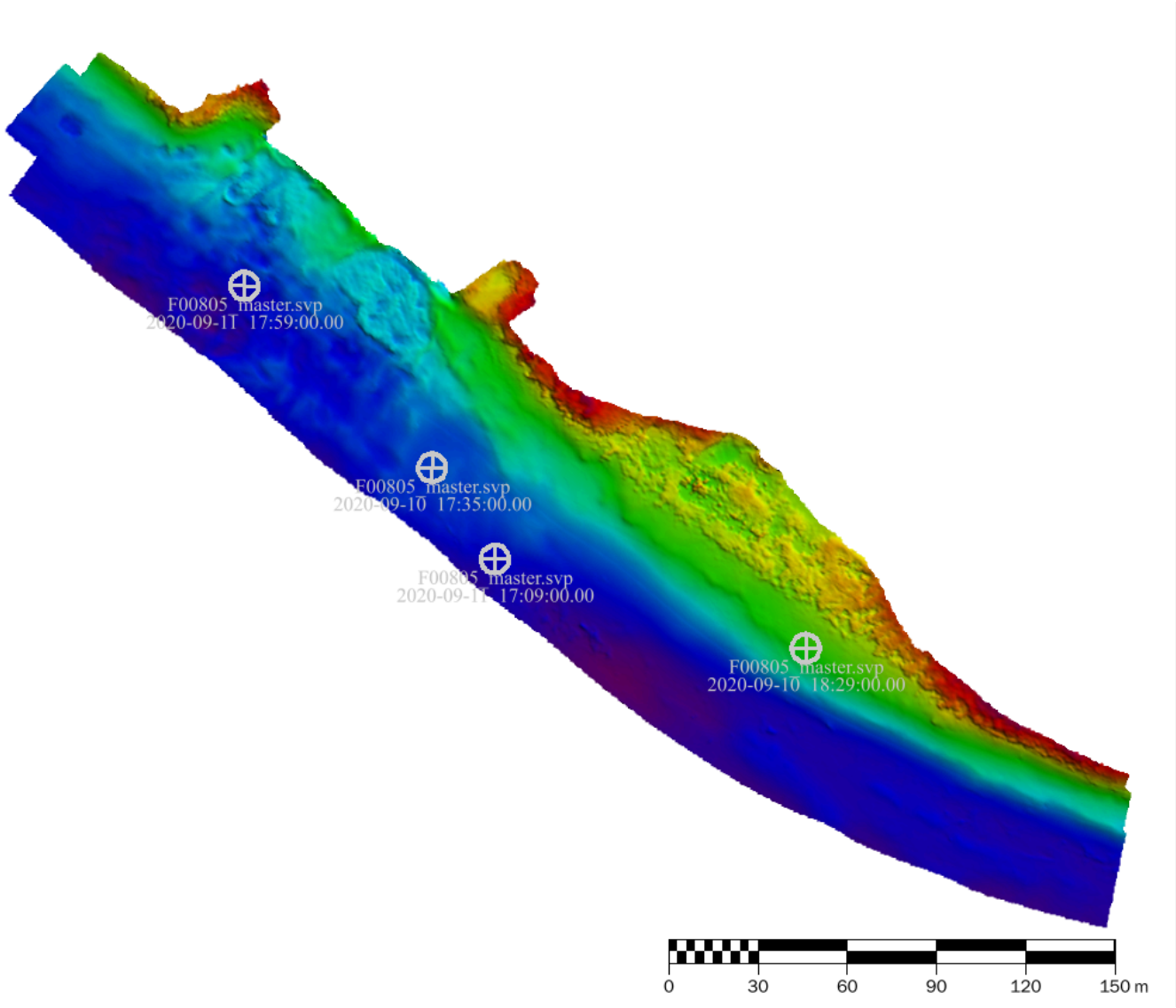


Figure 14: Sound speed cast Locations in gray

B.2.8 Coverage Equipment and Methods

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

B.2.9 Density

The surface was analyzed using the HydrOffice QC Tools Grid QA feature (Figure 15). Density requirements for F00805 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 few nodes that did not meet density requirements are due to sparse data in the outer beams, especially near steep slopes and rocky areas where acoustic shadowing occurred, and at the edges of the survey limits. For the individual graph of density requirements, see the Standards and Compliance Review located in Appendix II.

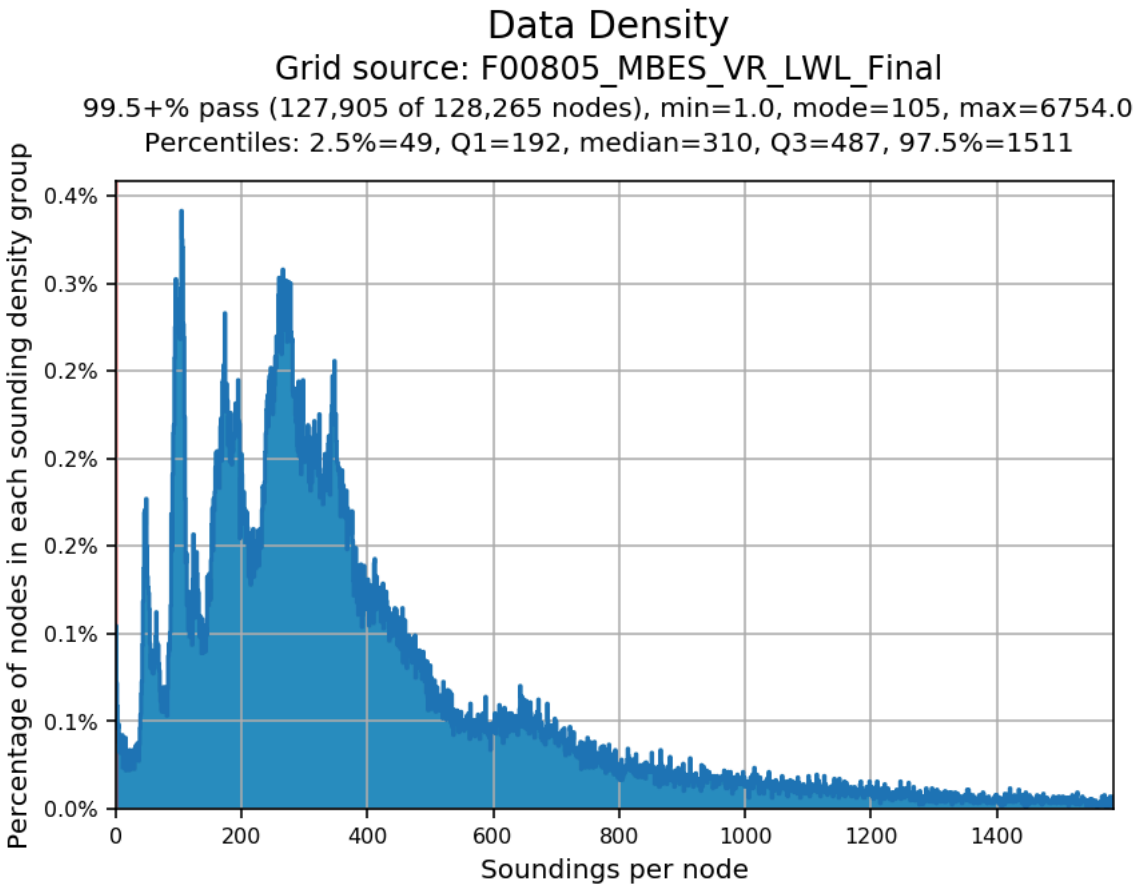


Figure 15: Data Density distribution for F00805

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 2020 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
Teledyne CARIS	HIPS and SIPS	11.3.1

Table 9: Primary bathymetric data processing software

The following Feature Object Catalog was used: NOAA Extended Attribute Files 2020.

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
F00805_MBES_VR_LWL_Final	CARIS VR Surface (CUBE)	Variable Resolution	4.3 meters - 34.9 meters	NOAA_VR	Object Detection

Table 10: Submitted Surfaces

The NOAA CUBE parameters defined in the HSSD were used for the creation of all CUBE surfaces for F00805. The surfaces have been reviewed where noisy data, or "fliers," are incorporated into the gridded solutions causing the surface to be shoaler or deeper than the true sea floor. Where these spurious soundings cause the gridded surface to be shoaler or deeper than the reliably measured seabed by greater than the maximum allowable Total Vertical Uncertainty at that depth, the noisy data have been rejected by the hydrographer and the surface recomputed.

Flier Finder, part of the QC Tools package within HydrOffice, was used to assist the search for spurious soundings following gross cleaning. Flier Finder was run iteratively until all remaining flagged fliers were deemed to be valid aspects of the steep slopes and dynamic nature of the seafloor. No fliers are present in the final surface submitted with this survey.

C. Vertical and Horizontal Control

Field installed tide and GPS stations were not utilized for this survey. No HVCR report is included with the submission of F00805 Per Section 5.2.2.1.3 of the 2014 Field Procedures Manual.

C.1 Vertical Control

The vertical datum for this project is Lake Washington Low Water Datum.

ERS Datum Transformation

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

Method	Ellipsoid to Chart Datum Separation File
ERS via Constant Separation Model	S-N918-NRT3-20_NAD83(2011)-LWL_xGeoid18B_20March2020

Table 11: ERS method and SEP file

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.

The following PPK methods were used for horizontal control:

- Smart Base

Precise Positioning-Real Time Extended (PP-RTX) processing methods were used in Applanix POSpac MMS 8.4 software to produce SBETs for post-processing horizontal correction. All of F00805 meets HSSD horizontal accuracy requirements.

D. Results and Recommendations

D.1 Chart Comparison

A comparison was performed between survey F00805 and ENC US5WA13M using CARIS HIPS and SIPS sounding and contour layers derived from the finalized VR surface. The contours and soundings were overlaid on the charts to assess differences between the surveyed soundings and charted depths. All data from F0805 should supersede charted data. In general, surveyed soundings agree with the majority of charted depths. A full discussion of the disagreements follows below.

D.1.1 Electronic Navigational Charts

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

ENC	Scale	Edition	Update Application Date	Issue Date
US5WA13M	1:25000	35	08/26/2020	08/26/2020

Table 12: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.3 Charted Features

Charted features exist and are addressed in the Final Feature File.

D.1.4 Uncharted Features

Survey F00805 has 3 new features that are addressed in the F00805 Final Feature File (Figure 16). Of these features, there are 2 repositioned (new/delete) Obstructions, and one new WDKLP area. No features were submitted as DtoNs.

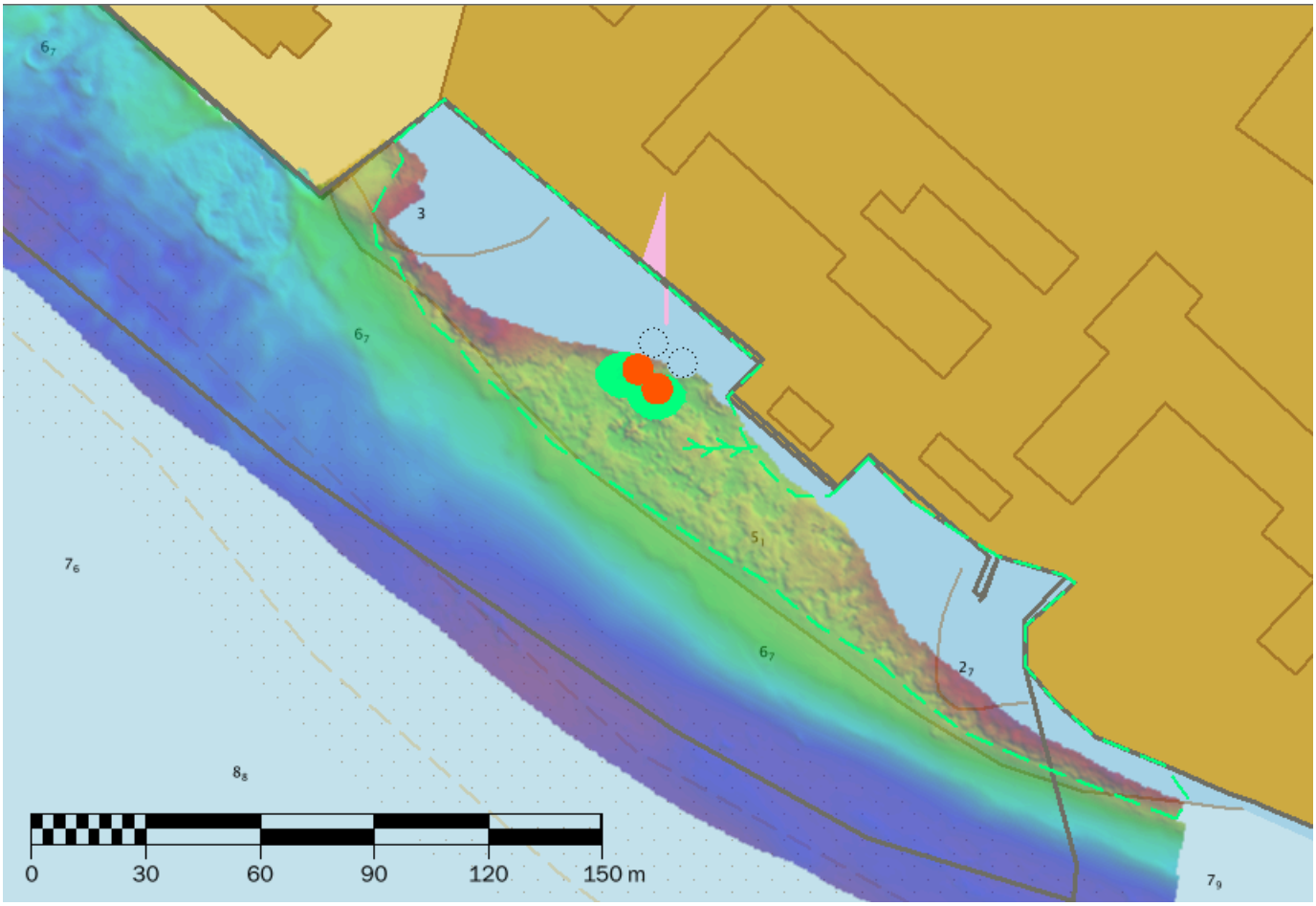


Figure 16: F00805 features: new shown in green, delete shown in red.

It was found that the OBSTRN objects identified by the field were actually kelp beds. OBSTRN features were not recommended for charting updates.

D.1.5 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.2 Additional Results

D.2.1 Aids to Navigation

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

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

No bottom samples were required 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 Platforms

No platforms exist for this survey.

D.2.7 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.8 Abnormal Seafloor or Environmental Conditions

No abnormal seafloor or environmental conditions 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 ENC Scale Recommendations

No new ENC scales 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.

No Coast Pilot requirement was assigned for this survey.

Report Name	Report Date Sent
S-N918-NRT3-20_DAPR	2020-11-17

Approver Name	Approver Title	Approval Date	Signature
Annie Raymond	Hydrographer	11/30/2020	RAYMOND.ANNEMIEKE.SMITH.1365883048 Digitally signed by RAYMOND.ANNEMIEKE.SMITH.1365883048 Date: 2020.11.30 15:36:37 -08'00'
Michelle M. Levano, LTJG/NOAA	Chief of Party	11/30/2020	Digitally signed by LEVANO.MICHELLE.MARIE.1516645888

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