H13652

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13652

LOCALITY

State(s):	Michigan
General Locality:	Lake Huron
Sub-locality:	North of Thunder Bay Island

2022

CHIEF OF PARTY
LTJG Nicholas Azzopardi

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13652**

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):	**Michigan**
General Locality:	**Lake Huron**
Sub-Locality:	**North of Thunder Bay Island**
Scale:	**20000**
Dates of Survey:	**06/16/2022 to 07/18/2022**
Instructions Dated:	**06/30/2022**
Project Number:	**S-X913-NRTNL-22**
Field Unit:	**NOAA Navigation Response Team - New London**
Chief of Party:	**LTJG Nicholas Azzopardi**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Low Water Datum IGLD-1985**

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 17N, LWD. All references to other horizontal or vertical datums in this report are applicable to the processed hydrographic data provided by the field unit.

Table of Contents

A. Area Surveyed....1
A.1 Survey Limits....1
A.2 Survey Purpose....1
A.3 Survey Quality....2
A.4 Survey Coverage....3
A.6 Survey Statistics....3
B. Data Acquisition and Processing....5
B.1 Equipment and Vessels....5
B.1.1 Vessels....5
B.1.2 Equipment....7
B.2 Quality Control....7
B.2.1 Crosslines....7
B.2.2 Uncertainty....8
B.2.3 Junctions....9
B.2.4 Sonar QC Checks....11
B.2.5 Equipment Effectiveness....11
B.2.6 Factors Affecting Soundings....12
B.2.7 Sound Speed Methods....12
B.2.8 Coverage Equipment and Methods....12
B.3 Echo Sounding Corrections....12
B.3.1 Corrections to Echo Soundings....12
B.3.2 Calibrations....12
B.4 Backscatter....12
B.5 Data Processing....13
B.5.1 Primary Data Processing Software....13
B.5.2 Surfaces....13
C. Vertical and Horizontal Control....13
C.1 Vertical Control....14
C.2 Horizontal Control....14
D. Results and Recommendations....15
D.1 Chart Comparison....15
D.1.1 Electronic Navigational Charts....15
D.1.2 Shoal and Hazardous Features....15
D.1.3 Charted Features....15
D.1.4 Uncharted Features....16
D.1.5 Channels....16
D.2 Additional Results....17
D.2.1 Aids to Navigation....17
D.2.2 Maritime Boundary Points....17
D.2.3 Bottom Samples....17
D.2.4 Overhead Features....17
D.2.5 Submarine Features....17
D.2.6 Platforms....17

D.2.7 Ferry Routes and Terminals..... 17
D.2.8 Abnormal Seafloor or Environmental Conditions..... 17
D.2.9 Construction and Dredging..... 19
D.2.10 New Survey Recommendations..... 20
D.2.11 ENC Scale Recommendations..... 20
E. Approval Sheet..... 21
F. Table of Acronyms..... 22

List of Tables

Table 1: Survey Limits..... 1
Table 2: Survey Coverage..... 3
Table 3: Hydrographic Survey Statistics..... 4
Table 4: Dates of Hydrography..... 5
Table 5: Vessels Used..... 5
Table 6: Major Systems Used..... 7
Table 7: Survey Specific Tide TPU Values..... 8
Table 8: Survey Specific Sound Speed TPU Values..... 9
Table 9: Junctioning Surveys..... 9
Table 10: Submitted Surfaces..... 13
Table 11: ERS method and SEP file..... 14
Table 12: CORS Base Stations..... 14
Table 13: Largest Scale ENCs..... 15

List of Figures

Figure 1: Pydro derived histogram plot showing HSSD object detection compliance of H13652 MBES data within the 50cm CUBE surface..... 2
Figure 2: Survey coverage overlaid on ENC US4MI66M..... 3
Figure 3: NRT-NL vessel S3007 with NYC in background..... 6
Figure 4: Pydro generated graph showing comparison between mainscheme and crosslines in H13652..... 8
Figure 5: Overview of H13652 (blue) and H12964 (red) and their overlap (black)..... 10
Figure 6: Comparison Distribution graph between H13652 and H12964 showing 99.5% of nodes passed IHO specifications..... 11
Figure 7: Charted soundings (white) and H13652 soundings (black) are similar..... 16
Figure 8: Multiple scours along seafloor partially covered by a geologic feature..... 18
Figure 9: Another scour partially covered by a geologic feature..... 19

Descriptive Report to Accompany Survey H13652

Project: S-X913-NRTNL-22

Locality: Lake Huron

Sublocality: North of Thunder Bay Island

Scale: 1:20000

June 2022 - July 2022

NOAA Navigation Response Team - New London

Chief of Party: LTJG Nicholas Azzopardi

A. Area Surveyed

The survey is located east of Alpena, Michigan and north of Sugar Island and Thunder Bay Island.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
45° 9' 15.72" N 83° 18' 20.17" W	45° 2' 51.69" N 83° 12' 9.53" W

Table 1: Survey Limits

Survey limits were acquired in accordance with the requirements in the Project Instructions and the HSSD. There are 87 fliers and 9 holidays identified by Pydroexplorer's QC Tools. All fliers and holidays found were located along the edges of the sheet and were found to be either false or not navigationally significant.

A.2 Survey Purpose

This request is in support of NOAA's Office of Coast Survey, Thunder Bay National Marine Sanctuary and the Great Lakes Environmental Research Lab for a hydrographic survey for the area North of Thunder Bay Island. This area is heavily trafficked by commercial and recreational vessels, so marine commerce is economically vital for the region. The primary purpose of this project is to provide contemporary hydrographic data to update NOAA’s nautical charting products. Mapping data from this project will also be used to locate and assess cultural resources (primarily historic shipwrecks). The majority of the prior data in the project area was partial bottom coverage collected by the U.S. Army Corps of Engineers Lake

Survey before 1974. The data from this project will provide modern bathymetry for updating National Ocean Service nautical charting products, improving the safety of maritime traffic and commerce as well as supporting the Lakebed 2030 global mapping initiative. 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.

The Grid QC tool within QC Tools was used to analyze multibeam echosounder (MBES) data density. The MBES surface meets the HSSD data density requirement.

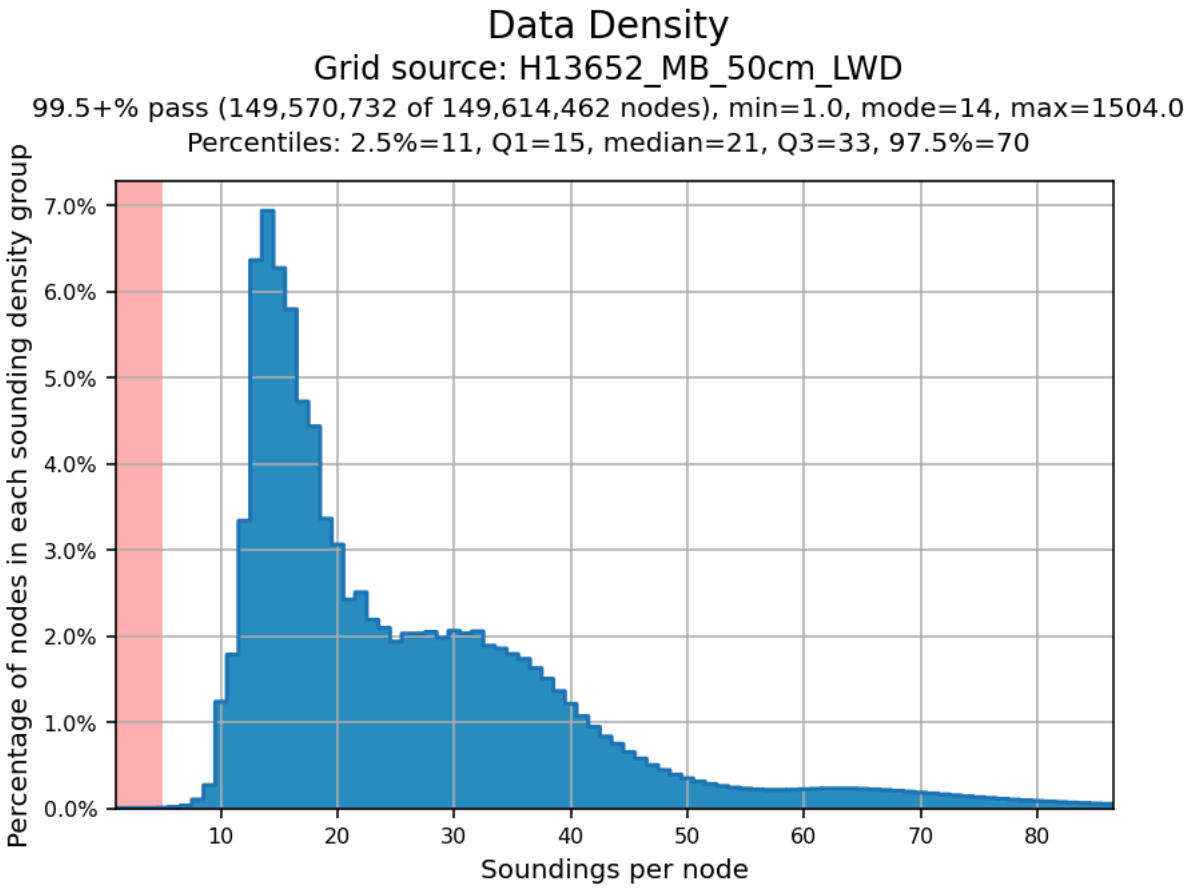

Figure 1: Pydro derived histogram plot showing HSSD object detection compliance of H13652 MBES data within the 50cm CUBE surface.

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 in survey area	Object Detection Coverage (Refer to HSSD Section 5.2.2.2)

Table 2: Survey Coverage

Survey coverage was in accordance with the requirements listed above and in the HSSD.

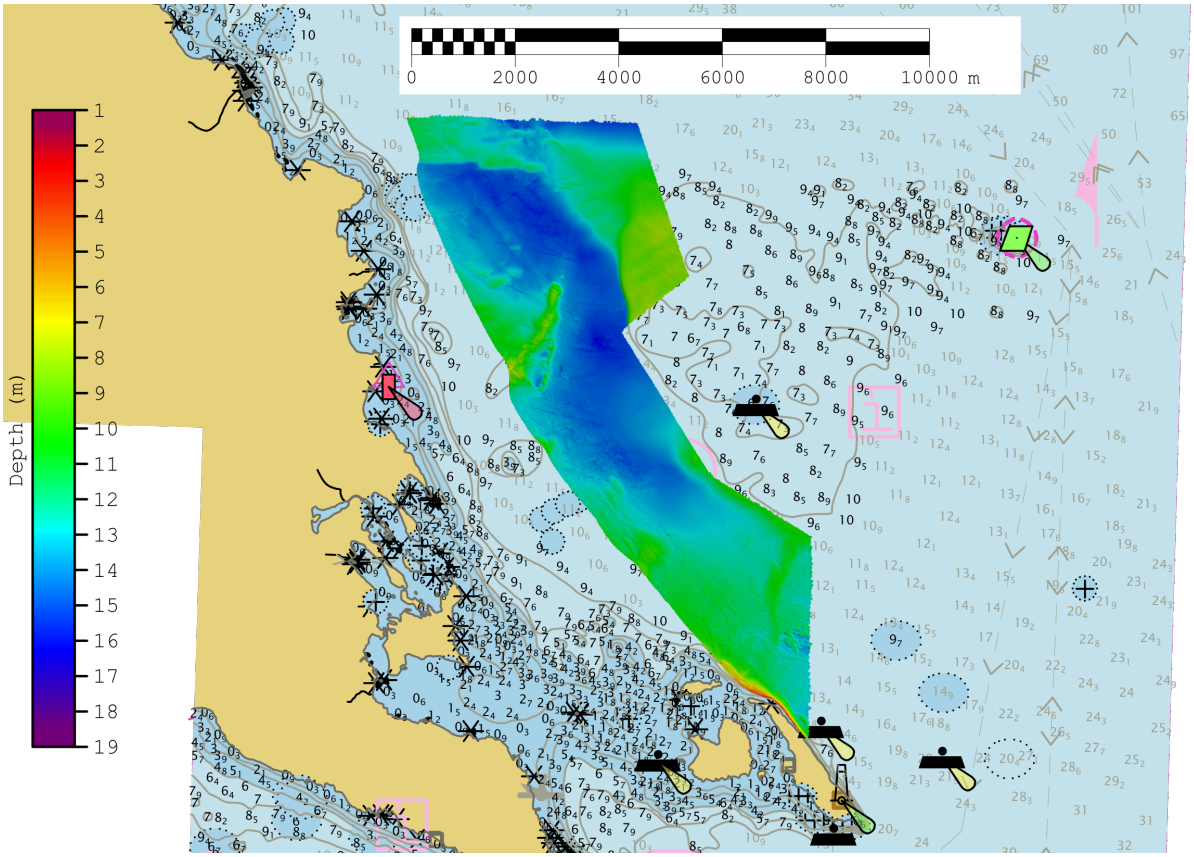

Figure 2: Survey coverage overlaid on ENC US4MI66M.

A.6 Survey Statistics

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

	HULL ID	*S3007*	*Total*
LNM	**SBES Mainscheme**	0.0	0.0
	MBES Mainscheme	623.31	623.31
	Lidar Mainscheme	0.0	0.0
	SSS Mainscheme	0.0	0.0
	SBES/SSS Mainscheme	0.0	0.0
	MBES/SSS Mainscheme	0.0	0.0
	SBES/MBES Crosslines	20.06	20.06
	Lidar Crosslines	0.0	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			10.9

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
06/16/2022	167
06/17/2022	168

Survey Dates	Day of the Year
06/19/2022	170
06/21/2022	172
06/22/2022	173
06/23/2022	174
06/24/2022	175
06/25/2022	176
06/26/2022	177
06/28/2022	179
06/29/2022	180
07/06/2022	187
07/07/2022	188
07/10/2022	191
07/12/2022	193
07/18/2022	199

Table 4: Dates of Hydrography

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	*S3007*
LOA	10.38 meters
Draft	0.6 meters

Table 5: Vessels Used

Figure 3: NRT-NL vessel S3007 with NYC in background.

B.1.2 Equipment

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

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

Table 6: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Multibeam crosslines acquired for this survey totaled 3.22% of mainscheme acquisition.

A 4m CUBE surface was created using only mainscheme lines and a second 4m CUBE surface was created using only crosslines. These surfaces were then input into the Pydro Tool "Compare Grids". The comparison passed HSSD specifications.

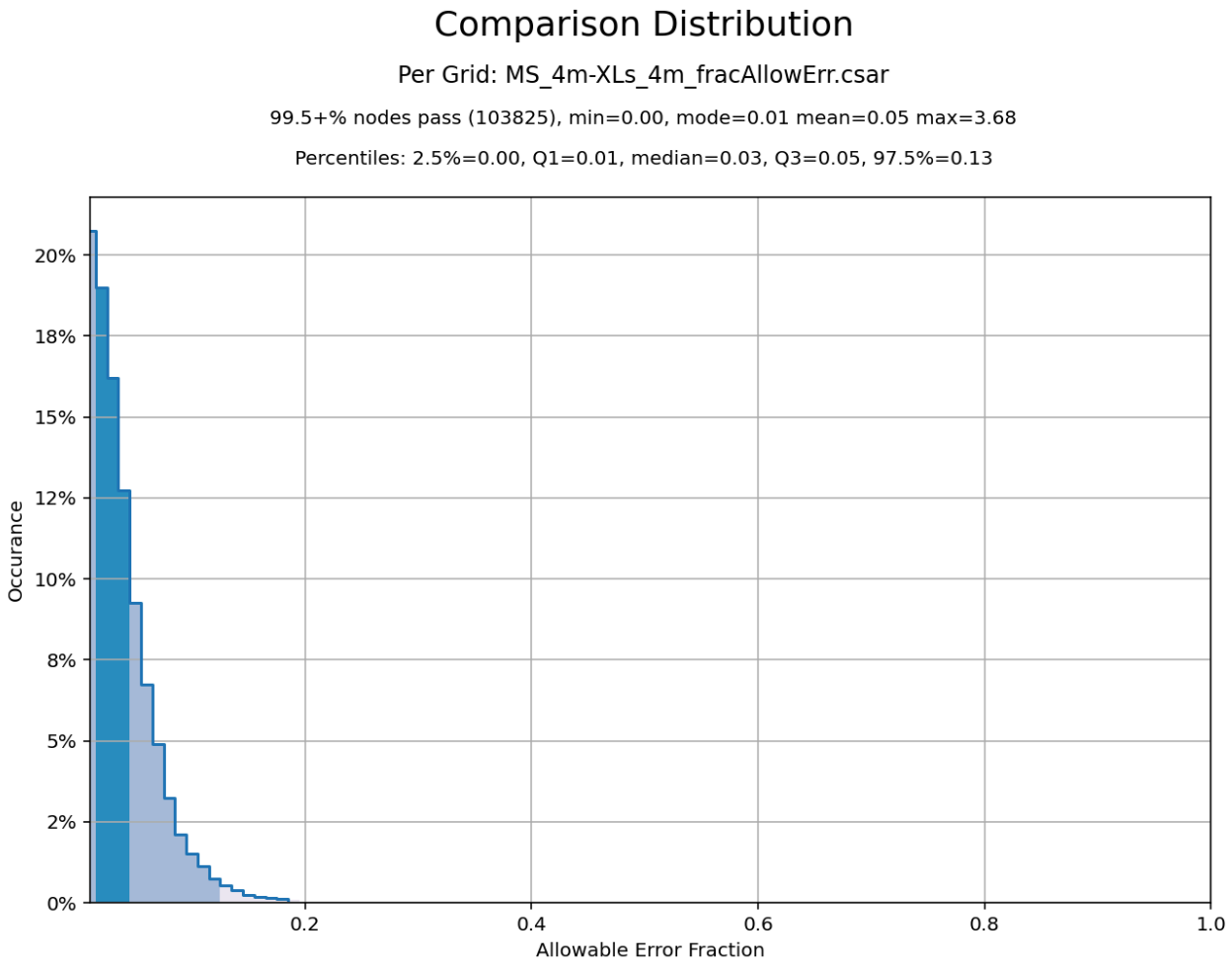

Figure 4: Pydro generated graph showing comparison between mainscheme and crosslines in H13652.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.0 meters	0.045 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
S3007	2 meters/second	0 meters/second	0 meters/second	0.5 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

Total Propagated Uncertainty (TPU) values for H13652 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 units in the Project Instructions. A visual inspection of the Uncertainty layer revealed the areas of higher uncertainty occur in the outer beams, and a visual inspection of the Density layer revealed the areas of lowest density are in the deepest areas of the survey and directly at nadir.

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 the survey. Real-time uncertainties from the Kongsberg MBES sonars were incorporated and applied during post processing. Uncertainties associated with vessel roll, pitch, gyro, navigation, and heave were applied during post-processing. All of the aforementioned uncertainties were applied in CARIS. As stated, H13652 is an ellipsoidally referenced survey (ERS) and the tidal component was accomplished with a separation model.

B.2.3 Junctions

H13652 junctions with one survey, H12964. A surface from each survey was run through Compare Grids within Pydro Explorer to create a difference surface. This surface was also visually inspected to notice any large differences between the surveys.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H12964	1:40000	2017	NOAA R/V Storm	E

Table 9: Junctioning Surveys

H12964

Overlap with survey H12964 was approximately 7km long and 200m wide, with depths between 8 to 15 meters. Analysis of the difference surface indicated a mean difference of 0.01m, and a one standard deviation of 0.10m. Over 99.5% of nodes pass IHO specifications.

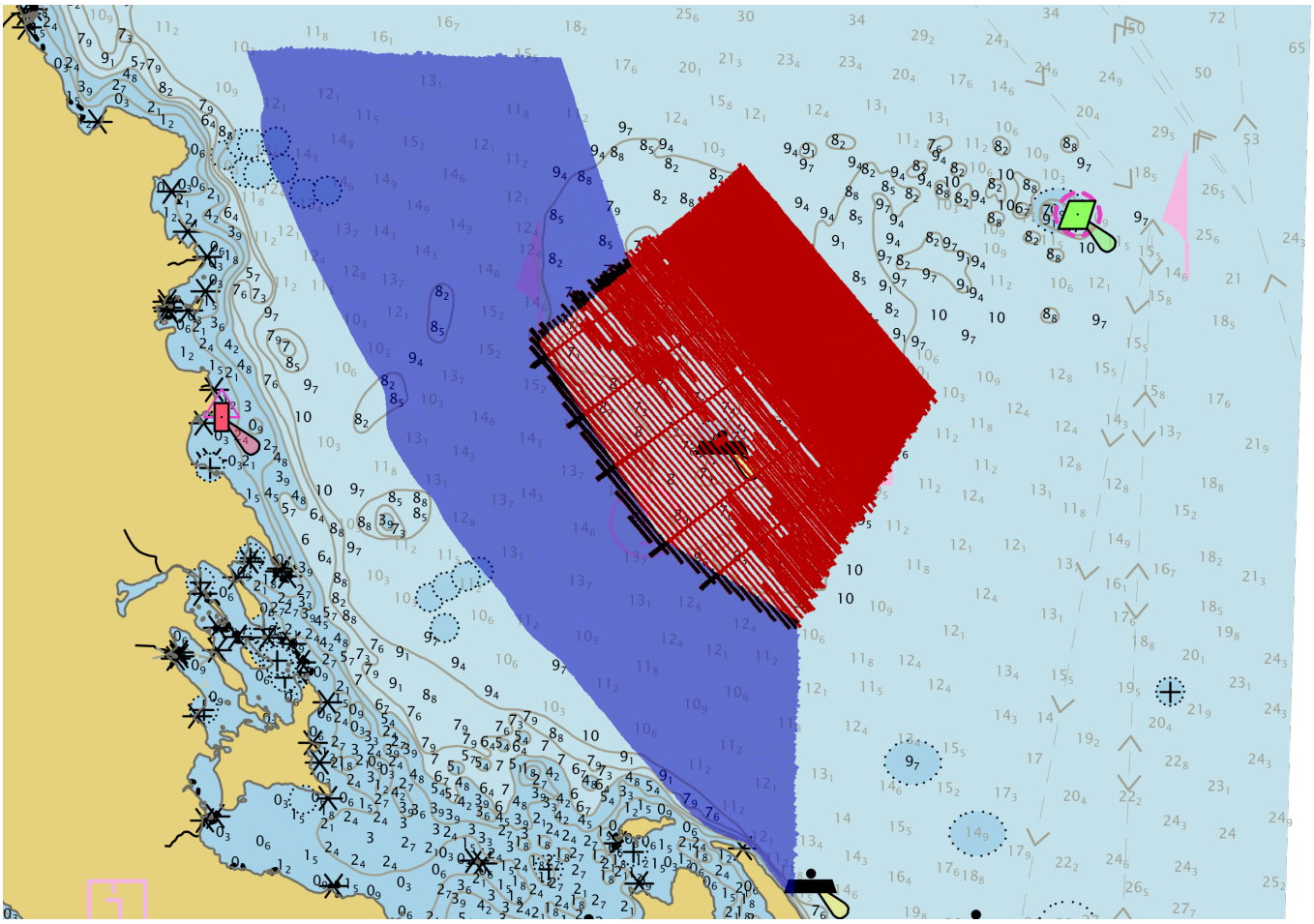

Figure 5: Overview of H13652 (blue) and H12964 (red) and their overlap (black).

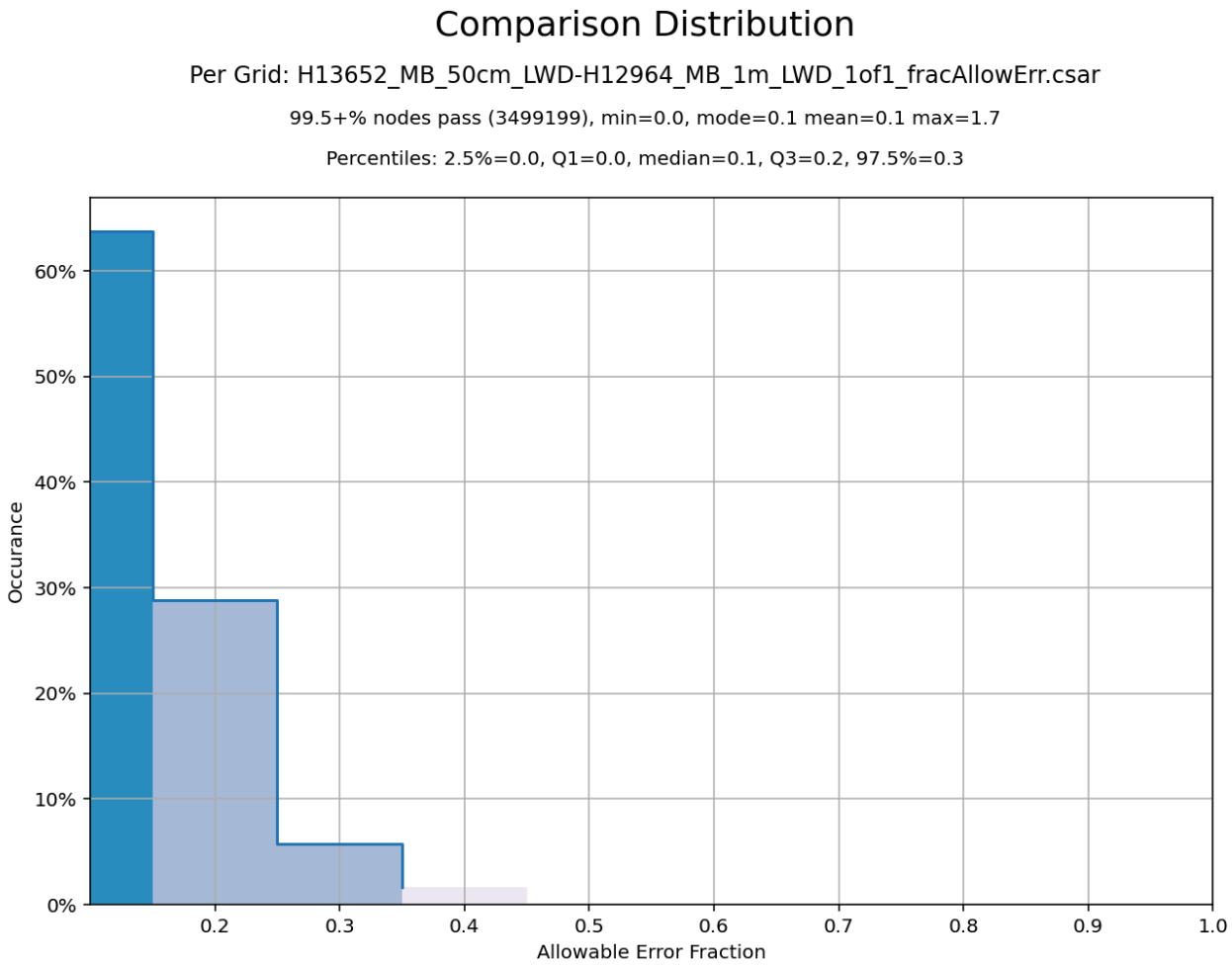

Figure 6: Comparison Distribution graph between H13652 and H12964 showing 99.5% of nodes passed IHO specifications.

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.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: At least once every 4 hours.

SVP casts were taken at least once every four hours in the deepest water nearest to the survey area being worked on. The SVP casts were applied to the MBES lines in CARIS using the "nearest in distance within time of 4 hours" method.

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

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 Feature Object Catalog was used: NOAA Profile Version 2022.

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
H13652_MB_50cm_LWD.csar	CARIS Raster Surface (CUBE)	0.5 meters	1.319 meters - 16.97 meters	NOAA_0.5m	Object Detection
H13652_MB_50cm_LWD_Final.csar	CARIS Raster Surface (CUBE)	0.5 meters	1.319 meters - 16.97 meters	NOAA_0.5m	Object Detection

Table 10: Submitted Surfaces

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 Low Water Datum IGLD-1985.

ERS Datum Transformation

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

Method	Ellipsoid to Chart Datum Separation File
ERS via VDATUM	S-X913-NRTNL-22_VDatum_100m_NAD83-LWD_IGLD85_geoid12b.csar

Table 11: ERS method and SEP file

C.2 Horizontal Control

The horizontal datum for this project is North American Datum 1983 (2011).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 17.

The following PPK methods were used for horizontal control:

- Smart Base

The following CORS Stations were used for horizontal control:

HVCR Site ID	Base Station ID
DRUMMOND ISLAND	MIDI
INDIAN RIVER	MIND
TAWAS CITY	MITW
ALPENA	NOR3
GODERICH	GOD2
MIAL ALPENA	MIAL

Table 12: CORS Base Stations

WAAS

The Wide Area Augmentation System (WAAS) was used for real-time horizontal control during data acquisition.

D. Results and Recommendations

D.1 Chart Comparison

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
US4MI66M	1:60000	11	03/31/2022	03/31/2022

Table 13: 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

All charted features are discussed in the FFF. Charted soundings and H13652 soundings generally agree in value.

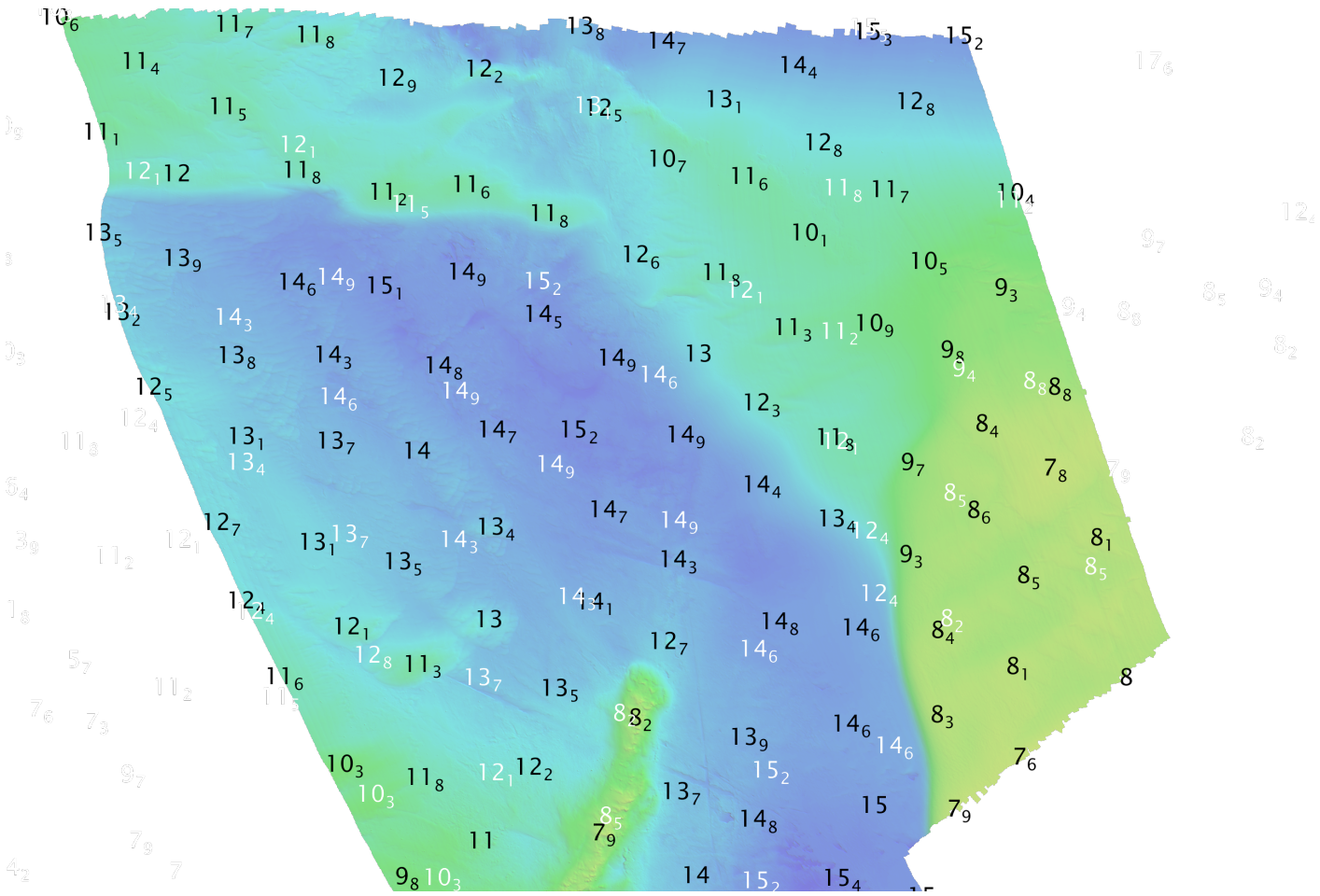

Figure 7: Charted soundings (white) and H13652 soundings (black) are similar.

D.1.4 Uncharted Features

Net stakes that were not charted correctly have been added to the FFF. It is the recommendation of the survey team to not add these features to the chart as they aren't navigationally significant and clutter the chart.

D.1.5 Channels

No channels exist 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

There is evidence of historic scours along the seafloor that are now starting to get covered up by other geologic features.

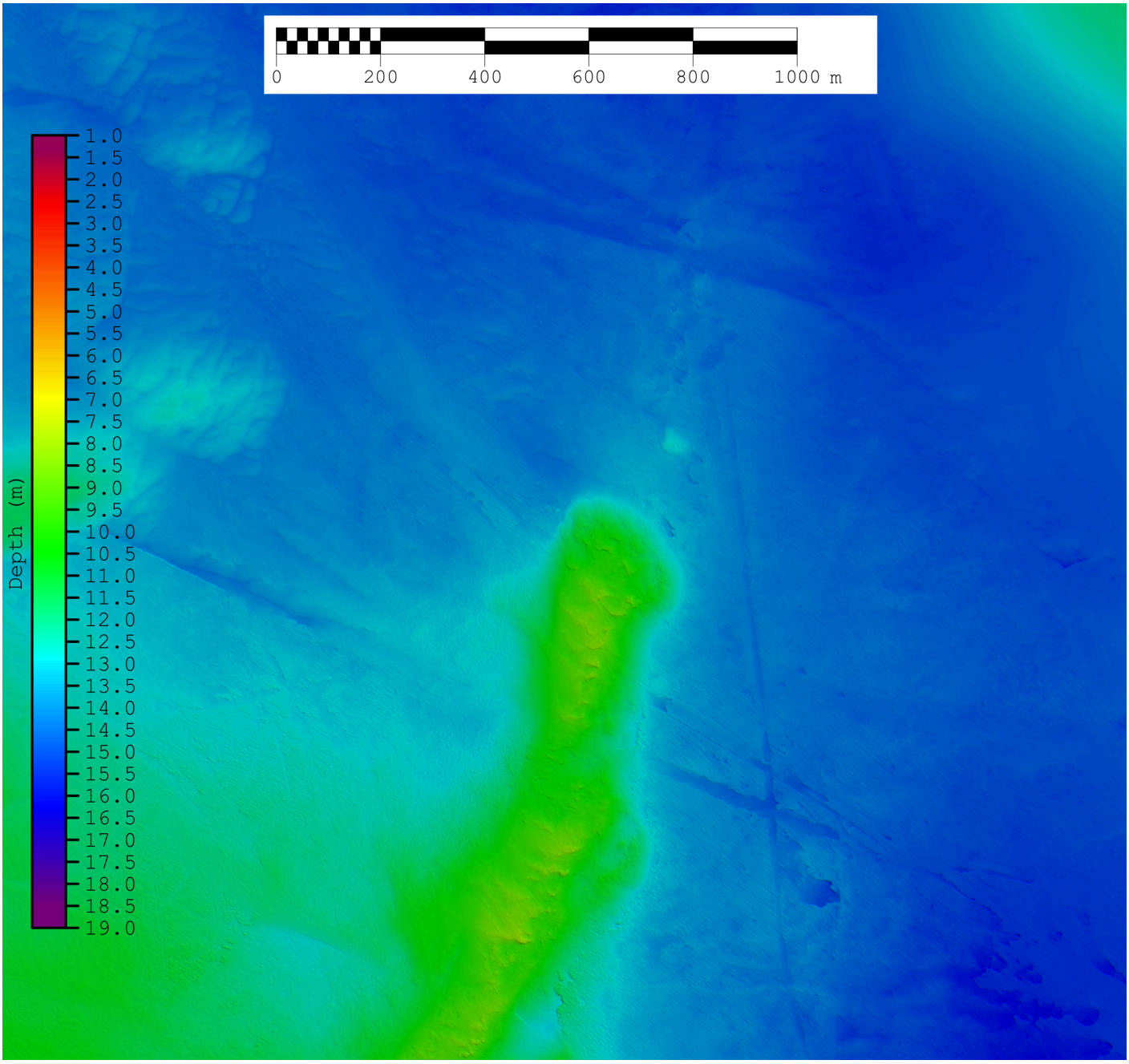

Figure 8: Multiple scours along seafloor partially covered by a geologic feature.

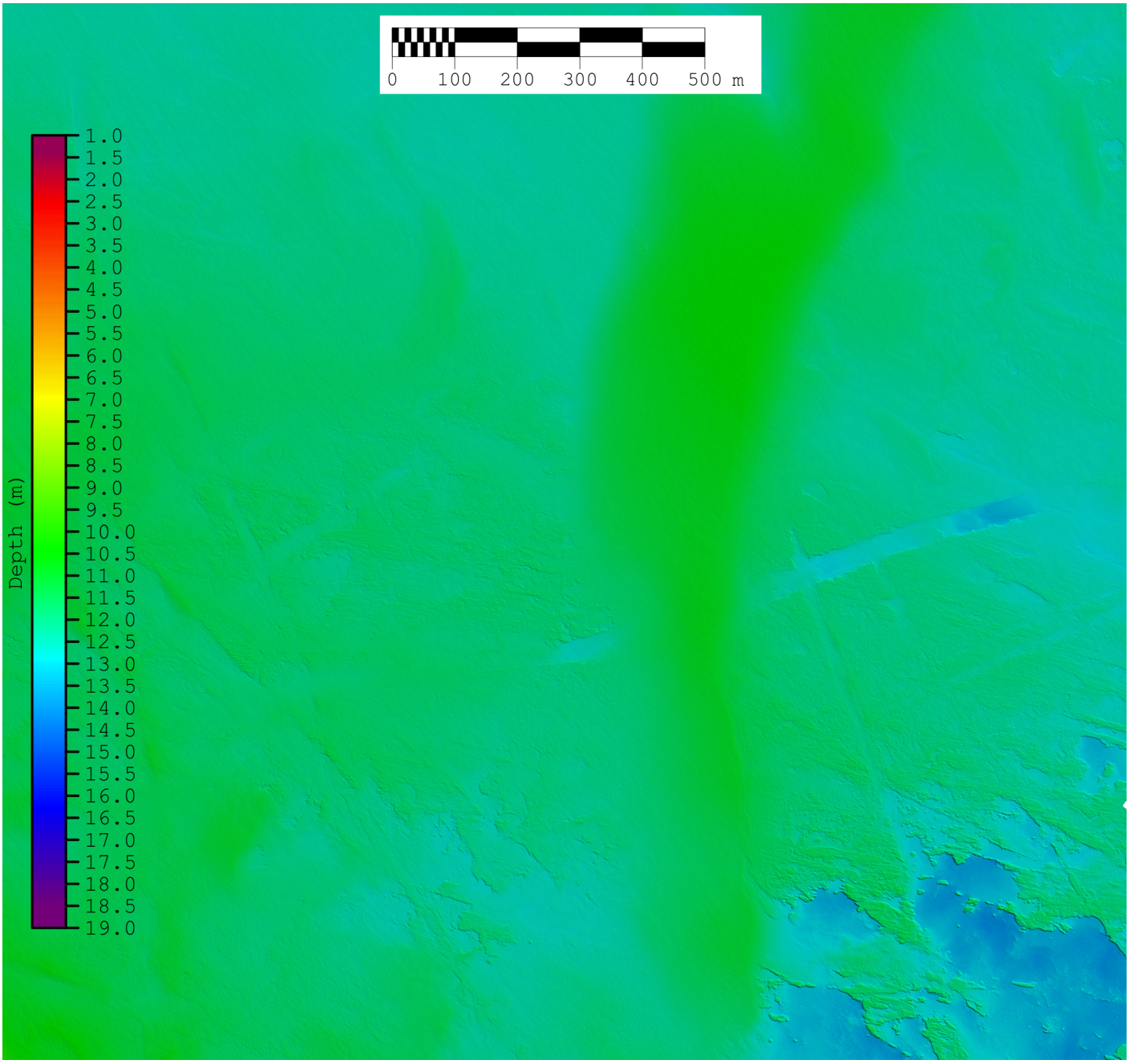

Figure 9: Another scour partially covered by a geologic feature.

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.

Approver Name	Approver Title	Approval Date	Signature
LTJG Nicholas Azzopardi	Chief of Party	10/24/2022	AZZOPARDI.NICHOLAS.JAMES.1539165093 Digitally signed by AZZOPARDI.NICHOLAS.JAMES.1539165093 Date: 2022.11.03 19:38:52 -04'00'
PST Michael Bloom	Sheet Manager	10/24/2022	BLOOM.MICHAEL.GRAHAM.1029463049 Digitally signed by BLOOM.MICHAEL.GRAHAM.1029463049 Date: 2022.11.03 11:03:48 -04'00'

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