H13249

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13249

LOCALITY

State(s):	Alaska
General Locality:	Kuskokwim Bay, AK
Sub-locality:	Cape Mendenhall, Nunivak

2019

CHIEF OF PARTY
Andrew Orthmann

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Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H13249

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:	**Kuskokwim Bay, AK**
Sub-Locality:	**Cape Mendenhall, Nunivak**
Scale:	**20000**
Dates of Survey:	**07/05/2019 to 07/18/2019**
Instructions Dated:	**05/10/2019**
Project Number:	**OPR-R341-KR-19**
Field Unit:	**Terrasond**
Chief of Party:	**Andrew Orthmann**
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 3N, 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 H13249

Project: OPR-R341-KR-19

Locality: Kuskokwim Bay, AK

Sublocality: Cape Mendenhall, Nunivak

Scale: 1:20000

July 2019 - July 2019

Terrasond, Ltd.

Chief of Party: Andrew Orthmann

A. Area Surveyed

The survey area is located in southwest Alaska, on the southeast side of Nunivak Island near Cape Mendenhall. The area is a relatively remote region of the Arctic, with the nearest community of Mekoryuk (population 202) located about 40 miles to the north. The nearest community with services for vessels is the regional hub of Bethel (population 6,456), approximately 160 miles to the ENE, or 230 nautical miles by water.

This area is one of the few relatively protected anchorages available off of Etolin Strait, which runs between Nunivak Island and the mainland. It is commonly transited by freighters and barges carrying cargo to and from points along Alaska's west and north coasts. Navigability of the area is restricted due to sea ice during the winter, generally November through April.

Bathymetric data collection was carried out in July of 2019 under project OPR-R341-KR-19, with final processing and reporting carried out from September through December, 2019. Supporting tide data was acquired from June through October, 2019. Additional sheets were surveyed concurrently to the southwest near Cape Mendenhall, and to the southeast in Kuskokwim Bay. Work was done in accordance with the Hydrographic Survey Project Instructions (dated May 10th, 2019) and the NOS Hydrographic Surveys Specifications and Deliverables (HSSD), March 2019 edition.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
59° 51' 59.7" N 166° 4' 49" W	59° 43' 1.2" N 165° 23' 19.2" W

Table 1: Survey Limits

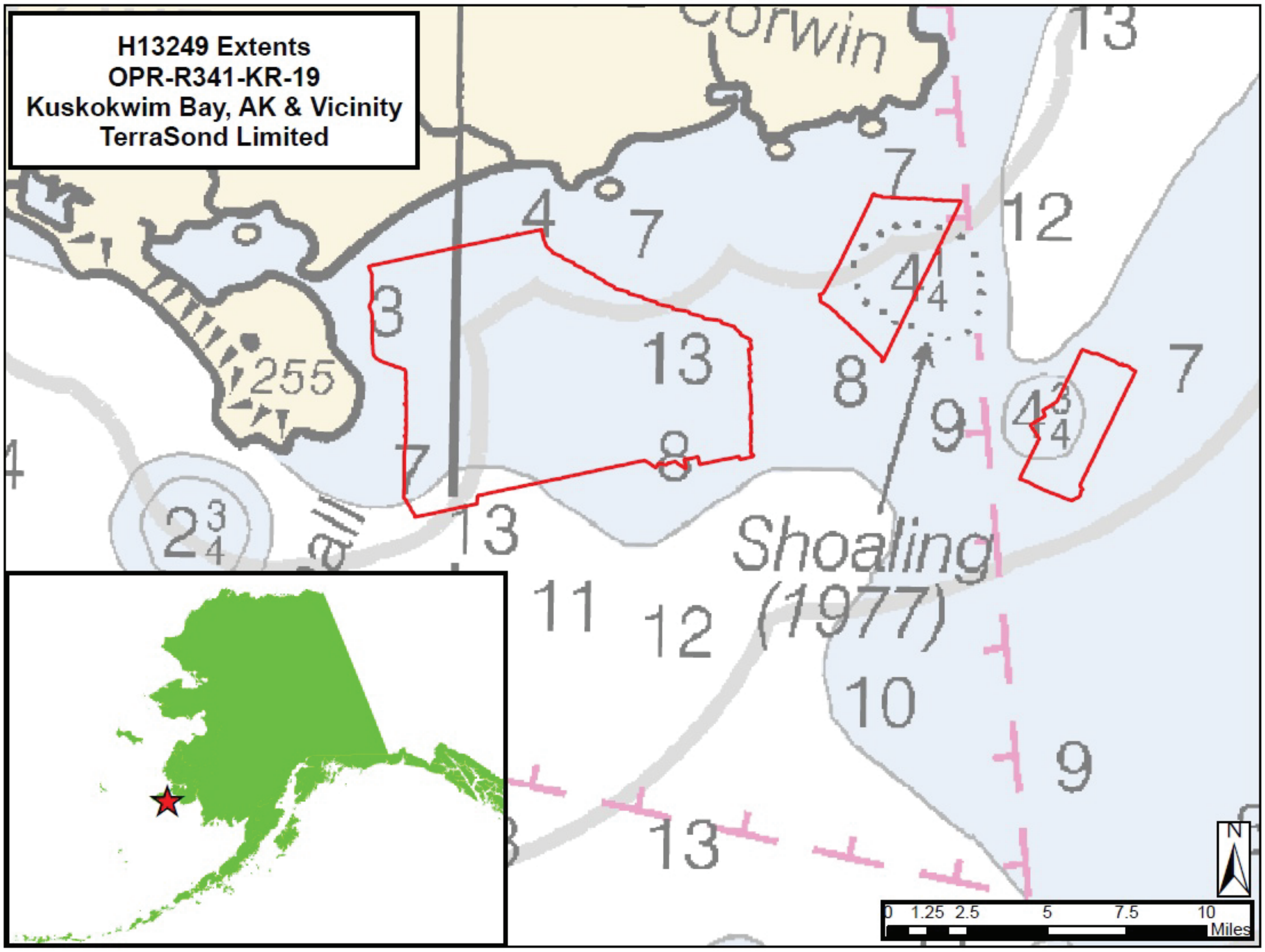


Figure 1: Image showing survey extents.

Survey limits were achieved.

In order to increase the amount of junction data available for comparison purposes with prior surveys from 2016, a line was collected between the eastern two unconnected survey blocks outside of the survey limits that transected the 2016 data. In addition, crosslines collected in the eastern most block were extended outside the survey limits to collect junction data in the vicinity of the charted shoal there, and an additional line was run outside the limits of the northern survey block to better overlap the 2016 data as well. The area is shown in the following image.

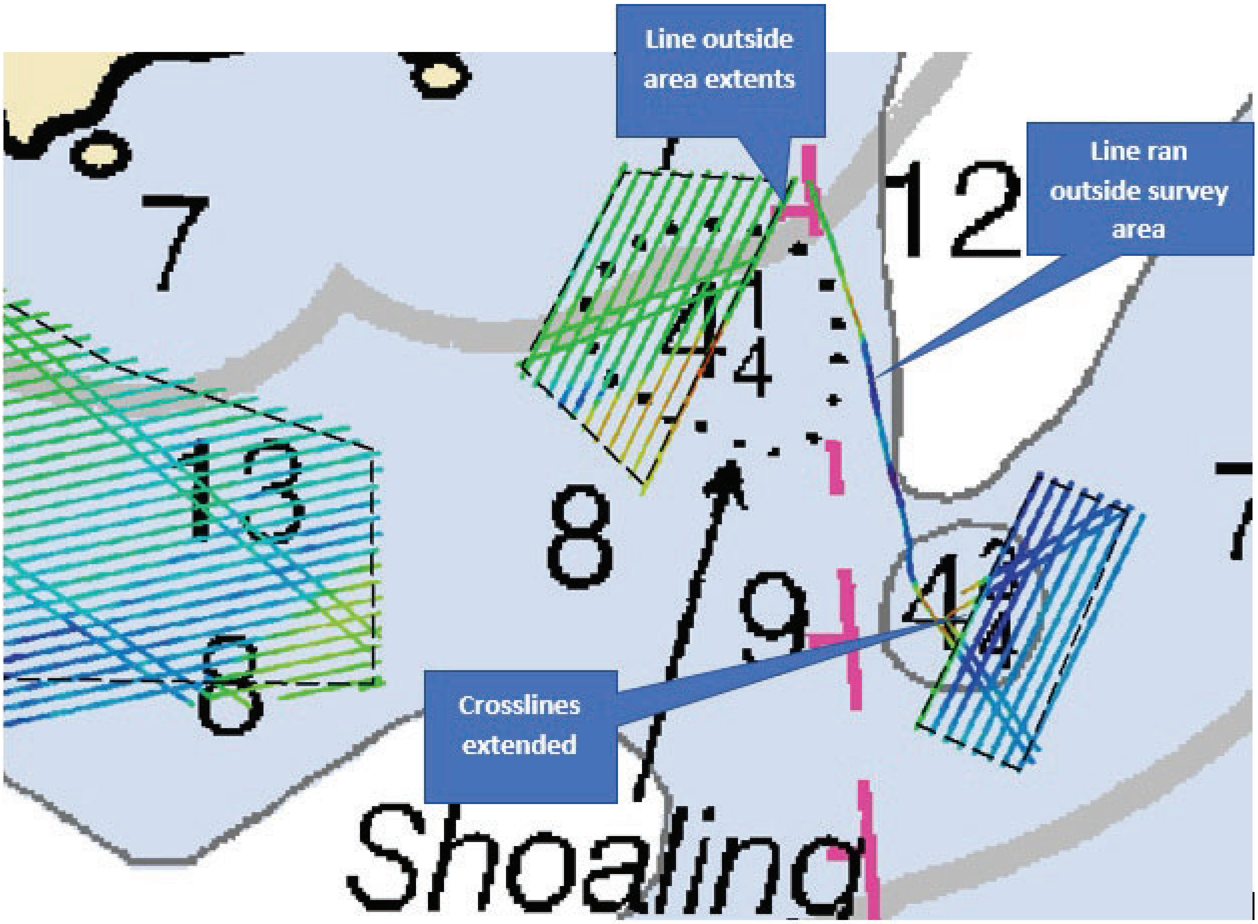


Figure 2: Additional data collected outside the survey extents to obtain good overlap with prior surveys from 2016

A.2 Survey Purpose

This survey area was defined based on user feedback and identify refuge areas where tug and tow, as well as tanker vessels, can hide from storms or find calm conditions that support Ship-to-Ship transfers of oil products, commonly referred to as "lightering". Surveying these areas will increase the safety of these operations by reducing the current environmental risk that is present due to unknown bathymetry.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

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 within Sheets 1 through 5 and Sheet 8	Set Line Spacing MBES at 400 m (Refer to HSSD Section 5.2.2.4 Option A)
All waters in survey area	Complete 5301 LNM. Transit mileage, system calibration mileage and data which do not meet HSSD specifications shall not count towards the completion of the LNM requirement. Notify the COR/Project Manager upon nearing completion of LNM requirement. The final survey area shall be squared off and ensure the full investigation of any features within the surveyed extent.

Table 2: Survey Coverage

Coverage requirements were met.

5,761 LNM was acquired project-wide, which exceeded the required minimum of 5,301 LNM. The overage of 460 LNM (about 8.7% of required LNM) was collected to compensate for any inefficiencies incidental to the execution of line collection such as excess crossline LNM, data acquired on turns in order to scout depths between lines in shallow water, or lines ran closer together than required.

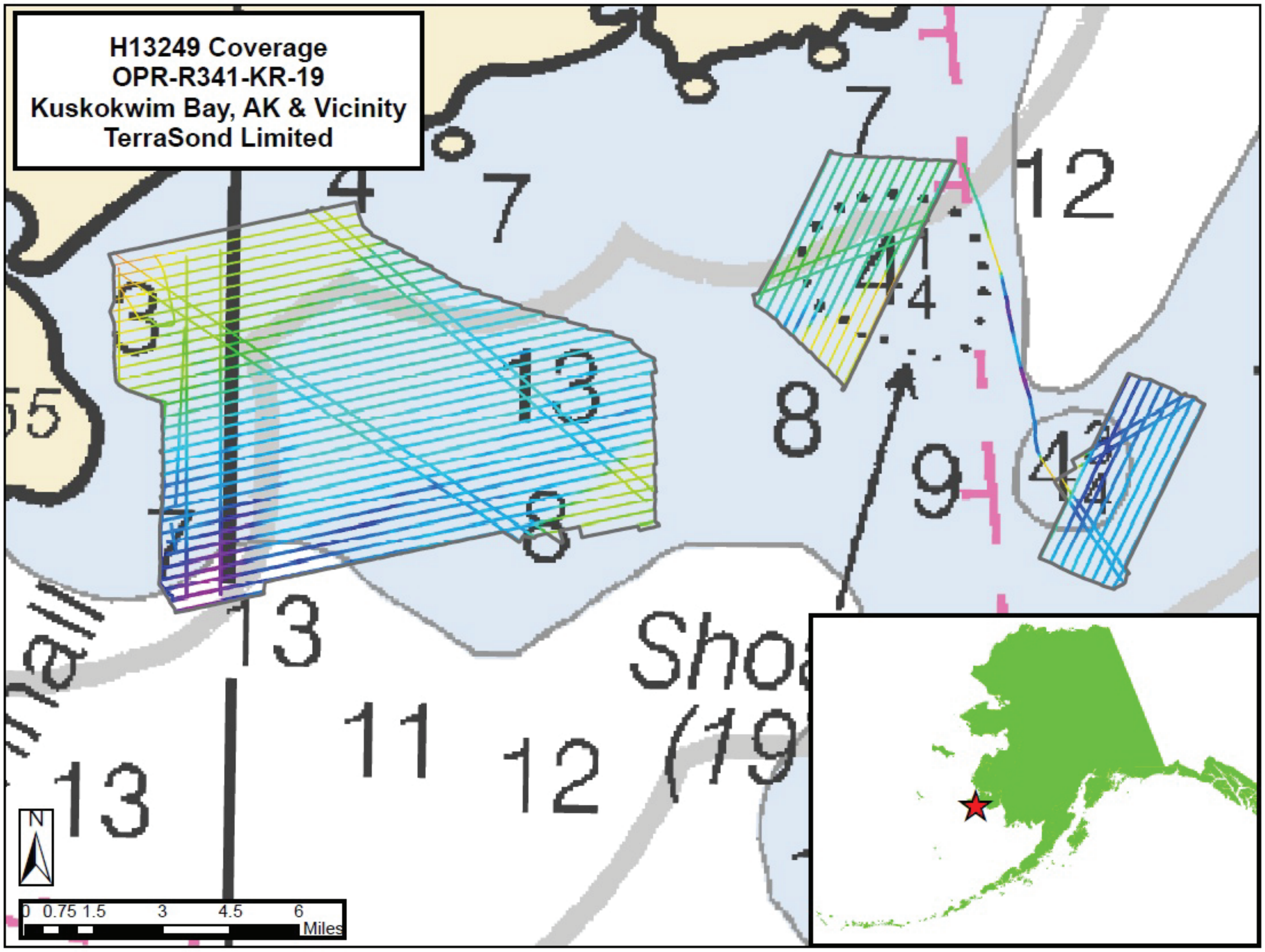


Figure 3: Image showing survey coverage.

A.6 Survey Statistics

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

	HULL ID	*ASV-CW5*	*Qualifier 105*	*Total*
LNM	**SBES Mainscheme**	0	0	0
	MBES Mainscheme	177.2	187.2	364.4
	Lidar Mainscheme	0	0	0
	SSS Mainscheme	0	0	0
	SBES/SSS Mainscheme	0	0	0
	MBES/SSS Mainscheme	0	0	0
	SBES/MBES Crosslines	32.8	36.5	69.3
	Lidar Crosslines	0	0	0
Number of Bottom Samples				3
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				70.4

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
07/05/2019	186

Survey Dates	Day of the Year
07/06/2019	187
07/18/2019	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	***ASV-CW5***	***Qualifier 105***
LOA	5.5 meters	32 meters
Draft	0.5 meters	1.8 meters

Table 5: Vessels Used

Figure 4: ASV-CW5 (foreground), and Q105 (background).

The Qualifier 105 (Q105) is a 32 m aluminum-hull vessel owned and operated by Support Vessels of Alaska. The Q105 acquired multibeam data and provided housing and facilities for on-site data processing. The vessel was also used to collect bottom samples, deploy/recover BMPG tide gauges, conduct sound speed casts, and deploy/recover the ASV-CW5 vessel.

The ASV-CW5 (C-Worker 5) is a 5.5 m aluminum-hull Autonomous Surface Vessel (ASV) owned and operated by L3-Harris ASV. The ASV was operated in an unmanned but monitored mode, collecting multibeam data in close proximity to the Q105.

B.1.2 Equipment

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

Manufacturer	Model	Type
Teledyne RESON	SeaBat 7125 SV	MBES
Teledyne RESON	SeaBat 7101	MBES
Applanix	POS MV 320 v5	Positioning and Attitude System
Teledyne Oceanscience	RapidCast	Sound Speed System
Valeport	rapidPro SVT	Sound Speed System

Table 6: Major Systems Used

Both survey vessels were outfit for MBES data collection with similar survey equipment. The ASV-CW5 was equipped with a Reson SeaBat 7125 MBES while the Q105 used a Reson SeaBat 7101 MBES. Both vessels used Applanix POSMV 320 V5 (Wavemaster II) units for attitude and position measurements. Sound speed profiles were collected using a Valeport rapidPro SVT sensor (deployed using a Teledyne Oceanscience RapidCast system) from the Q105 only.

B.2 Quality Control

B.2.1 Crosslines

Multibeam/single beam echo sounder/side scan sonar crosslines acquired for this survey totaled 19.02% of mainscheme acquisition.

Effort was made to ensure crosslines had good temporal and geographic distribution, were angled to enable nadir-to-nadir comparisons, and that the required minimum percent of mainscheme LNM was achieved.

Crosslines were conducted with both vessels to ensure there was ample overlap for inter-vessel comparisons, with each vessel crossing the other's mainscheme lines. Since the two vessels worked in close proximity and normally ran parallel lines, crosslines were collected in sets whenever both vessels were in simultaneous operation. The collection of crosslines in sets while spreading sets out across the survey area for good distribution led to incidental collection of additional crossline LNM beyond the required 8% of mainscheme.

Crosslines were also occassionally collected while transiting across the survey area to reach a different survey priority such as bottom sample locations or infills, leading to crosslines that were diagonal to the direction of mainscheme lines.

The crossline analysis was conducted using CARIS HIPS “Line QC Report” process. Each crossline (with all associated file segments) was selected and run separately through the process, which calculated the depth difference between each accepted crossline sounding and a "QC" BASE (CUBE-type) surface's depth layer created from the mainscheme data. The QC surface was created with the same parameters and resolution used for the final surface, with the important distinction that the QC surface did not include crosslines so as to not bias the results. Differences in depth were grouped by beam number and statistics were computed, including the percentage of soundings with differences from the QC surface falling within IHO Order 1a.

When at least 95% of the sounding differences exceed IHO Order 1a, the crossline was considered to "pass," but when less than 95% of the soundings compare within IHO Order 1, the crossline was considered to "fail." A 5% (or less) failure rate was considered acceptable since this approach compares soundings to a surface (instead of a surface to a surface), allowing for the possibility that noisy crossline soundings that don't adversely affect the final surface could be counted as a QC failure in this process.

Lines selected as crosslines and their percentage (%) of soundings passing IHO Order 1a, sorted from highest passing to lowest, are listed below.

0203-Q105-199-D1_XL -- 100.0% pass
0043-ASV-CW5-186-D1NS16400 -- 100.0% pass
0018-Q105-187-D1NS15200 -- 100.0% pass
0038-Q105-187-D1_XL1 -- 100.0% pass
0063-ASV-CW5-187-D1_XL1_ASV -- 100.0% pass
0040-Q105-187-D1_XL2_Q105 -- 100.0% pass
0065-ASV-CW5-187-D1_XL2_ASV -- 100.0% pass
0073-ASV-CW5-187-D2XL02 -- 100.0% pass
0047-Q105-187-D2XL01 -- 100.0% pass
0079-ASV-CW5-187-D3_XL2_Q105 -- 100.0% pass
0053-Q105-187-D3_XL2_ASV -- 100.0% pass
0052-Q105-187-D3_XL1_Q105 -- 100.0% pass
0078-ASV-CW5-187-D3_XL1_ASV -- 100.0% pass

Results: Agreement between the mainscheme surface and crossline soundings is excellent. At least 95% of crossline soundings compare to the mainscheme surface within IHO Order 1a for all crosslines.

Refer to Separate II: Digital Data for the detailed Crossline QC reports.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via ERTDM	0.13 meters	0 meters

Table 7: Survey Specific Tide TPU Values.

The NOAA-provided ERTDM model had an uncertainty of 0.13 meters. Refer to Appendix I for correspondence.

The uncertainty layer of the final surface was examined in CARIS HIPS. Uncertainty falls in the range of 0.262 to 0.732 m. Most grid cells are on the lower end of the uncertainty range, approximately 0.270 m. The larger values were observed to be in areas of highly variable seafloor where many soundings of different depths contribute to the value of the grid cell, resulting in a higher standard deviation for the grid cell.

The final surface was also analyzed in QCTools (3.1.2), which reported that greater than 99.5% of grid cells in the final surface have uncertainty within allowable TVU for the depth.

B.2.3 Junctions

NOAA's "Gridded Surface Comparison V19.4" utility was used to complete the junction comparisons. The utility differences the surfaces from the junctioning surveys and generates statistics, including the percentage of grid cells that compare to within allowable TVU for the depth. 4 m-resolution CUBE surfaces were used for all Current surveys.

The eastern two blocks, which are discontinuous from each other and the western (larger) block, have overlap with Prior surveys from 2016. To ensure sufficient overlap for jnction analysis, additional lines were run or extended outside the survey limits, including a 6.5 NM line transecting the prior surveys.

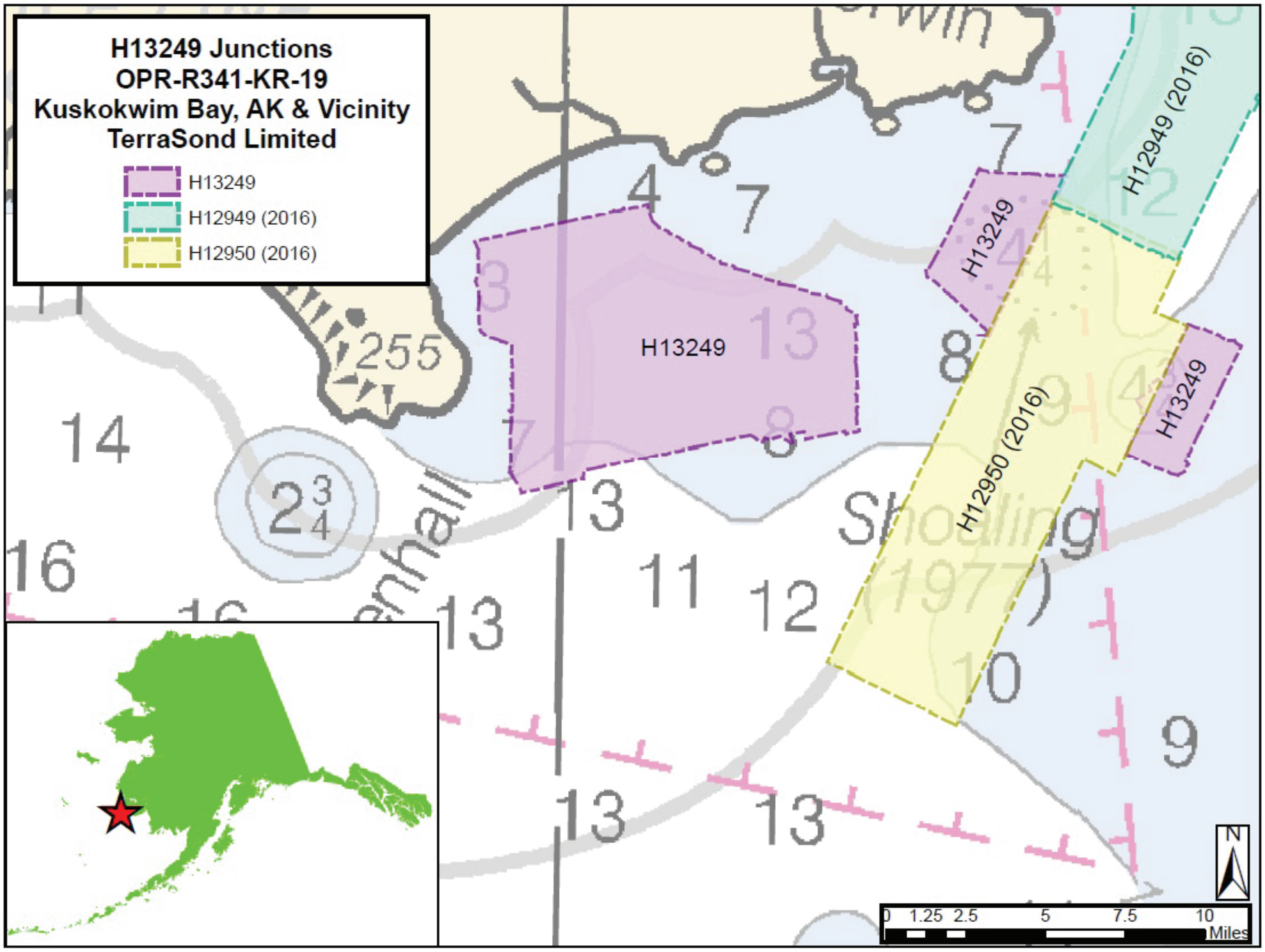


Figure 5: Image showing survey junctions.

The following junctions were made with this survey:

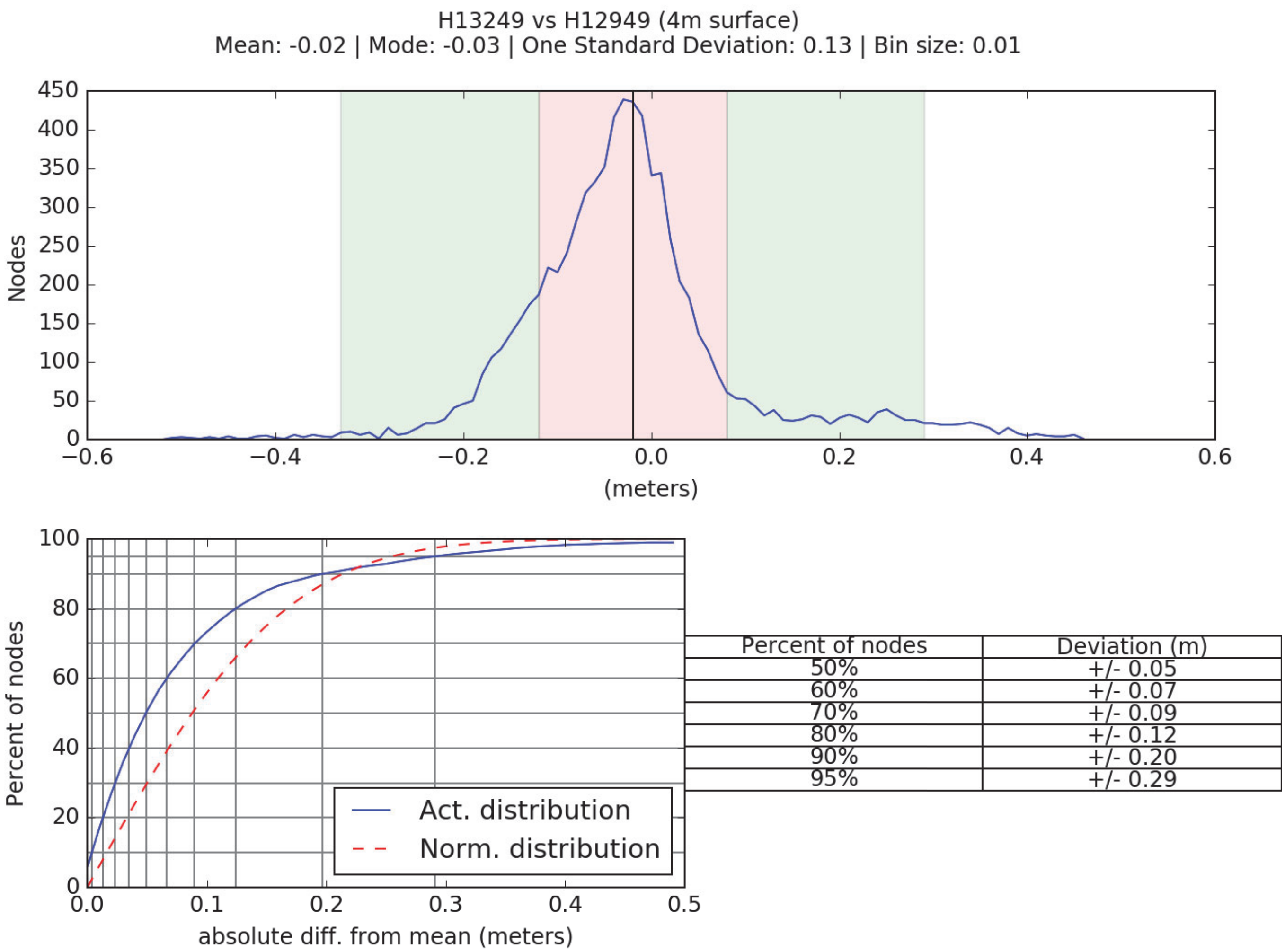
Registry Number	Scale	Year	Field Unit	Relative Location
H12949	1:40000	2016	Terrasond, Ltd.	NE
H12950	1:40000	2016	Terrasond, Ltd.	SE

Table 8: Junctioning Surveys

<u>H12949</u>

A 4 m resolution surface in BAG format for H12949 (H12949_MB_4m_MLLW_Combined.bag) was downloaded from NOAA NCEI and compared to the final 4 m resolution CSAR format surface from this survey.

Agreement between this survey and H12949, completed in 2016, is excellent. The mean difference is -0.02 m (this survey deeper on average), with a standard deviation of 0.13 m. 100% of overlapping grid cells compare within the allowable TVU for the depth.



Percent of nodes	Deviation (m)
50%	+/- 0.05
60%	+/- 0.07
70%	+/- 0.09
80%	+/- 0.12
90%	+/- 0.20
95%	+/- 0.29

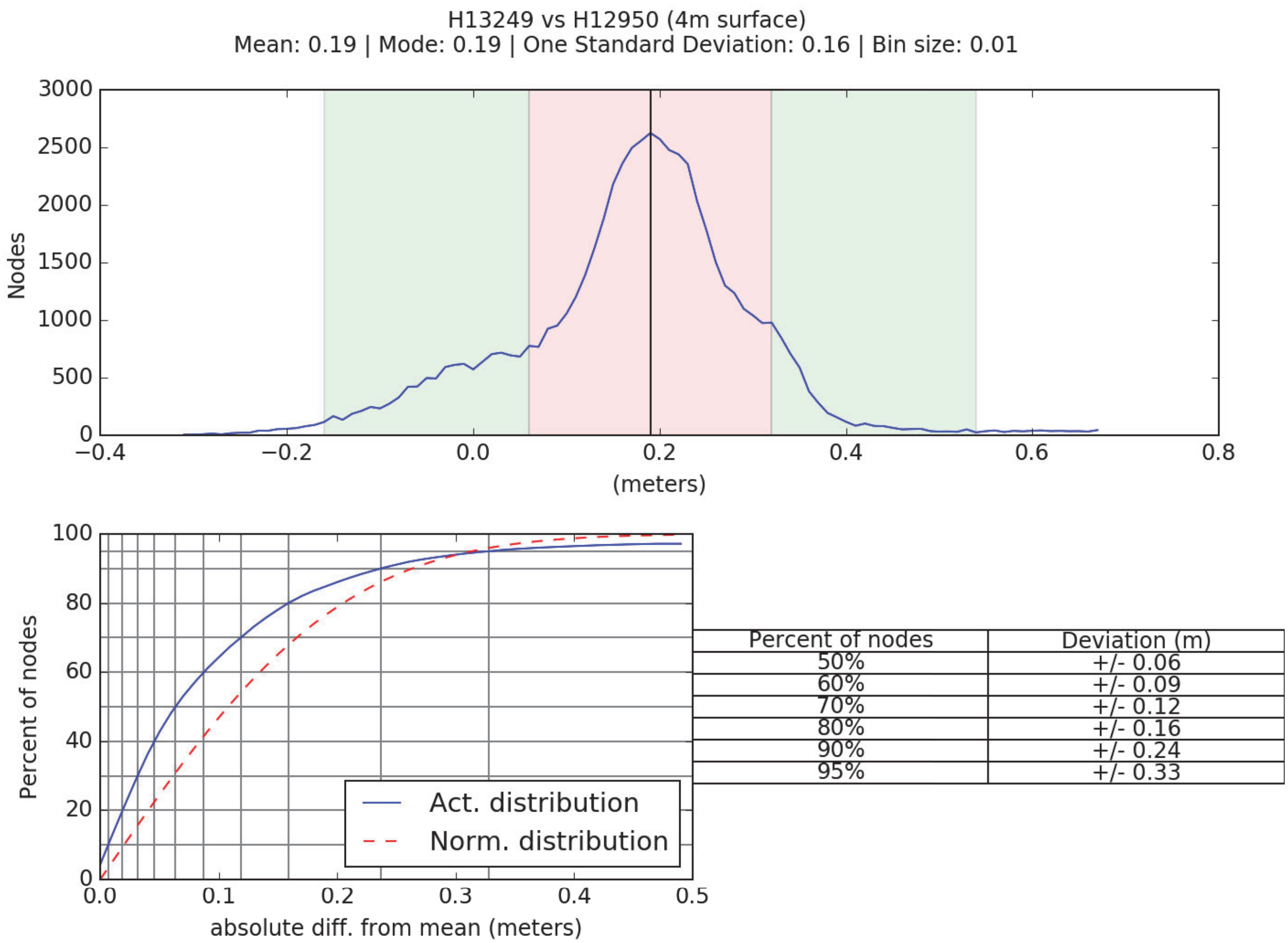
Figure 6: Difference plot comparison for H12949 versus H12949.

H12950

A 4 m resolution surface in BAG format for H12950 (H12950_MB_4m_MLLW_Combined.bag) was downloaded from NOAA NCEI and compared to the final 4 m resolution CSAR format surface from this survey.

Agreement between this survey and H12950 is good. The mean difference is 0.19 m (with this survey shoaler on average than the 2016 work) with a standard deviation of 0.16 m. 98% of grid cells agree within the allowable TVU for the depth.

To determine why 2% of nodes did not agree within allowable TVU, a difference surface was created and analyzed to check for areas of higher disagreement. Differences range from -0.419 m (this survey deeper) to 1.131 m (this survey shoaler). The largest differences are in areas showing sandwaves on the seafloor, indicating that bottom change due to sediment transport is the cause for the relatively small number of grid cell discrepancies that exceed allowable TVU.



Percent of nodes	Deviation (m)
50%	+/- 0.06
60%	+/- 0.09
70%	+/- 0.12
80%	+/- 0.16
90%	+/- 0.24
95%	+/- 0.33

Figure 7: Difference plot comparison for H12949 versus H12950.

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: 2 hours

Sound speed profiles or "casts" were acquired aboard the Q105 while underway with a Teledyne Oceanscience RapidCAST system, which utilized a Valeport rapidPro SVT sound speed profiler.

Surface sound speed at the sonar head was monitored continuously and a new cast was collected when the surface speed varied from the previous profile's speed at the same depth by greater than 2 m/s, leading to a cast interval of approximately 2 hours.

Casts were taken as deep as possible. On survey lines with significant differences in depth, the deeper portion of the line was favored to ensure that changes across the full water column were measured.

The cast data was used to correct the sounding data for both vessels, using the "nearest in distance within time" (set to 4 hours) within CARIS HIPS.

B.2.8 Coverage Equipment and Methods

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

B.2.9 GPS Vertical Busts

Vertical busts attributable to GPS positioning error between crosslines or overlapping mainscheme are apparent periodically in the data set. These are normally less than 0.15 m, with extreme cases showing up to 0.30 m of vertical separation. All crosslines, including those exhibiting or crossing areas exhibiting vertical busts, pass within IHO Order 1a, and final surfaces are well within allowable TVU for the depth.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

Deviations from the Correction to Echo Soundings section of the DAPR are itemized below. Note that in all cases final data is within specifications.

POSPac Processing Mode Exceptions

In a few case, Applanix Smart Base (ASB) processing mode was used instead of PP-RTX in Applanix POSPac MMS software to improve vertical agreement between overlapping lines. SBETs and associated files included with the survey deliverables include "ASB" in their filename to denote their use of the alternative processing methodl. Affected POS files and survey lines are itemized below.

POS files:

2019-187-0004-Q105
2019-187-1259-Q105

Survey line files:

0038-Q105-187-D1_XL1_Q105_-_0002
0047-Q105-187-D2XL01_-_0001
0047-Q105-187-D2XL01_-_0002
0048-Q105-187-D3NS00400_-_0001
0048-Q105-187-D3NS00400_-_0002
0049-Q105-187-D3NS01200_-_0001
0049-Q105-187-D3NS01200_-_0002
0050-Q105-187-D3NS02000_-_0001
0050-Q105-187-D3NS02000_-_0002
0051-Q105-187-D3NS02800_-_0001
0051-Q105-187-D3NS02800_-_0002
0052-Q105-187-D3_XL1_Q105_-_0001
0052-Q105-187-D3_XL1_Q105_-_0002
0053-Q105-187-D3_XL2_ASV_-_0001

Delayed Heave Exceptions

The following line could not have Delayed Heave loaded. Real-time heave was used instead during all processing phases including SVP correction, Compute GPS Tide, and Merge.

0056-ASV-CW5-186-D1EW08800_-_0003

GPS Height Smoothing

The following lines were loaded with GPS heights that had been smoothed to remove spikes and/or short term drifts using a 6-minute moving average. The GPS height data was loaded using CARIS' Generic Data Parser utility from text files at a rate of 1 Hz, which are included with the survey deliverables. Since the smoothing process removed heave data from the GPS record, the Apply Dynamic Heave option was set to "None" during computation of GPS Tide for these lines. More details are available in the DAPR.

0023-Q105-186-D1EW03600_-_0002
0033-Q105-186-D1EW10800_-_0001
0033-Q105-186-D1EW10800_-_0002
0033-Q105-186-D1EW10800_-_0004
0033-Q105-186-D1EW10800_-_0005
0036-Q105-187-D1EW11600_-_0005
0036-Q105-187-D1EW11600_-_0006
0038-Q105-187-D1_XL1_Q105_-_0001
0041-Q105-187-D2NS00000_-_0001
0052-ASV-CW5-186-D1EW06400_-_0001
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0057-ASV-CW5-186-D1EW09600_-_0001

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 Extended Attribute Files V2019.3.

NOAA Extended Attributes were used for the Final Feature File (FFF) submitted with the survey deliverables.

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
H13249_MB_4m_MLLW_Final	CARIS Raster Surface (CUBE)	4 meters	0 meters - 80 meters	NOAA_4m	MBES Set Line Spacing
H13249_MBAB_1m_ASV_400kHz_1of1	MB Backscatter Mosaic	1 meters	0 meters - 80 meters	N/A	MBES Set Line Spacing
H13249_MBAB_1m_Q105_240kHz_1of1	MB Backscatter Mosaic	1 meters	0 meters - 80 meters	N/A	MBES Set Line Spacing

Table 9: Submitted Surfaces

The final depth information for this survey was submitted as a CARIS BASE surface (CSAR format) which best represented the seafloor at the time of the 2019 survey. The surface was created from fully processed data with all final corrections applied.

The surface was created using NOAA CUBE parameters and resolutions by depth range in conformance with the 2019 HSSD. The surface was finalized, and designated soundings were applied where applicable. Horizontal projection was selected as UTM Zone 3 North, NAD83.

A non-finalized versions of the CSAR surface is also included which does not have a depth cutoff applied. This does not have the "_Final" designation in the filename.

An S-57 (.000) Final Feature File (FFF) was submitted with the survey deliverables as well. The FFF contains data not readily represented by the final surface, including bottom samples and shoreline verification results (if any). Each object is encoded with mandatory S-57 attributes and NOAA Extended Attributes (V2019.3).

Georeferenced multibeam backscatter mosaics (Geotif format in NAD83 UTM Zone 3N, 1 m resolution) were also produced and are provided with the survey deliverables. One mosaic was produced for each vessel. Note that backscatter processing and mosaic generation was not a requirement and the mosaics are provided as-is. The mosaics may have flaws or holidays which could be addressed through further processing. However, they are of sufficient quality to show the relative changes in seafloor type across the survey area.

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.

ERS Datum Transformation

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

Method	Ellipsoid to Chart Datum Separation File
ERS via ERTDM	R341KR2019_ERTDM_NAD83-MLLW

Table 10: ERS method and SEP file

All soundings were reduced to MLLW using the ERTDM NAD83 to MLLW separation model grid file provided by NOAA using ERS methodology.

Discrete tide zones were generated using project gauge data but were used for comparison purposes only.

A comparison between the provided ERTDM model and a ERZT model created using the tide zones was undertaken. There is generally good agreement between the models, with project-wide agreement averaging 0.033 m with a standard deviation of 0.271 m.

See the HVCR for additional information.

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 3.

The following PPK methods were used for horizontal control:

- Smart Base
- RTX

The Trimble PP-RTX subscription-based correction service within POSPac was used for final positioning. Results were good overall, usually at 0.10 m or better vertically. Refer to the DAPR for additional detail. Applanix Smart Base (ASB) was used on a small number of lines to improve vertical matchup with overlapping lines. Affected lines and POSMV files were itemized earlier in this report.

RTK

The survey vessels were configured to receive RTK-level correctors via Hemisphere AtlasLink SBAS (L-band) receivers. This was utilized throughout the survey on the ASV-CW5 but only briefly at the start of operations on the Q105. However, all real-time correctors were superseded in processing with PPK correctors from Applanix POSPac. Refer to the DAPR for additional detail.

WAAS

The FAA Wide Area Augmentation System (WAAS) was used for real-time positioning on the Q105 for the majority of the survey. These positions were superseded in processing with PPK correctors from Applanix POSPac, as described in the DAPR.

D. Results and Recommendations

D.1 Chart Comparison

The chart comparison was performed by examining the best-scale Electronic Navigational Charts (ENCs) that intersect the survey area. The latest edition(s) available at the time of report compilation were used.

The chart comparison was accomplished by overlaying the finalized BASE surface(s) with shoal-biased soundings and the final feature file (FFF) on the charts in CARIS HIPS. The general agreement between charted soundings and survey soundings was then examined and a more detailed comparison was undertaken for any shoals or other dangerous features. In areas where a large scale chart overlapped with a small scale chart, only the larger scale chart was examined.

When comparing to survey data, chart scale was taken into account so that 1 mm at chart scale was considered to be the valid radius for charted soundings and features.

Results are shown in the following sections. It is recommended that in all cases of disagreement this survey should supersede charted data.

USCG Notice to Mariners (NM) and USCG Local Notice to Mariners (LNM) for District 17 from week 26/2019 through 34/2019 were checked and no items were found that affected the survey area.

Note that the ENCs contain Restricted Area and Caution Area objects that overlap this area and pertain to ships of at least 400 gross tonnage, as well as Magnetic Variance and metadata objects. These were not investigated.

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	Preliminary?
US4AK6BN	1:80000	1	10/17/2018	10/17/2018	NO
US4AK6BO	1:80000	1	11/05/2018	11/05/2018	NO
US2AK95M	1:11534076	9	08/20/2018	10/16/2019	NO

Table 11: Largest Scale ENCs

<u>US4AK6BN</u>

There are very few soundings in common between this survey and US4AK6BN, with only six charted soundings lying within the survey extents. These are itemized below.

1. This survey found significantly deeper depths of approximately 12.4 m in the vicinity of charted 5.4 m sounding at 59-48-38.4 N, 166-03-35.2 W
2. This survey found significantly deeper depths of approximately 25.4 m in the vicinity of charted 12.8 m sounding at 59-44-18.5 N, 166-02-07.3 W
3. This survey agreed well (within about 0.5 m) with the charted 23.5 m sounding at 59-47-17.8 N, 165-47-49.8 W
4. This survey found a slightly deeper depth of approximately 15.7 m in the vicinity of charted 14.6 m sounding at 59-44-37.4 N, 165-48-01.5 W.
5. This survey agrees very well (within 0.2 m) with the charted 13.4 m sounding at 59-47-36.9 N, 165-36-50.6 W.
6. This survey agrees very well (within 0.1 m) with the charted 12.5 m sounding at 59-48-06.5 N, 165-36-23.7 W.

There is insufficient charted data to determine if there are shoaling or deepening trends.

The charted 10 m contour in vicinity of 59-49-24 N, 165-38-23.1 and 59-48-28 N, 165-58-15 W is incorrect, with this survey showing 6-9 m deeper along most of the charted 10 m contour. The 10 m contour should be updated based on the results of this survey.

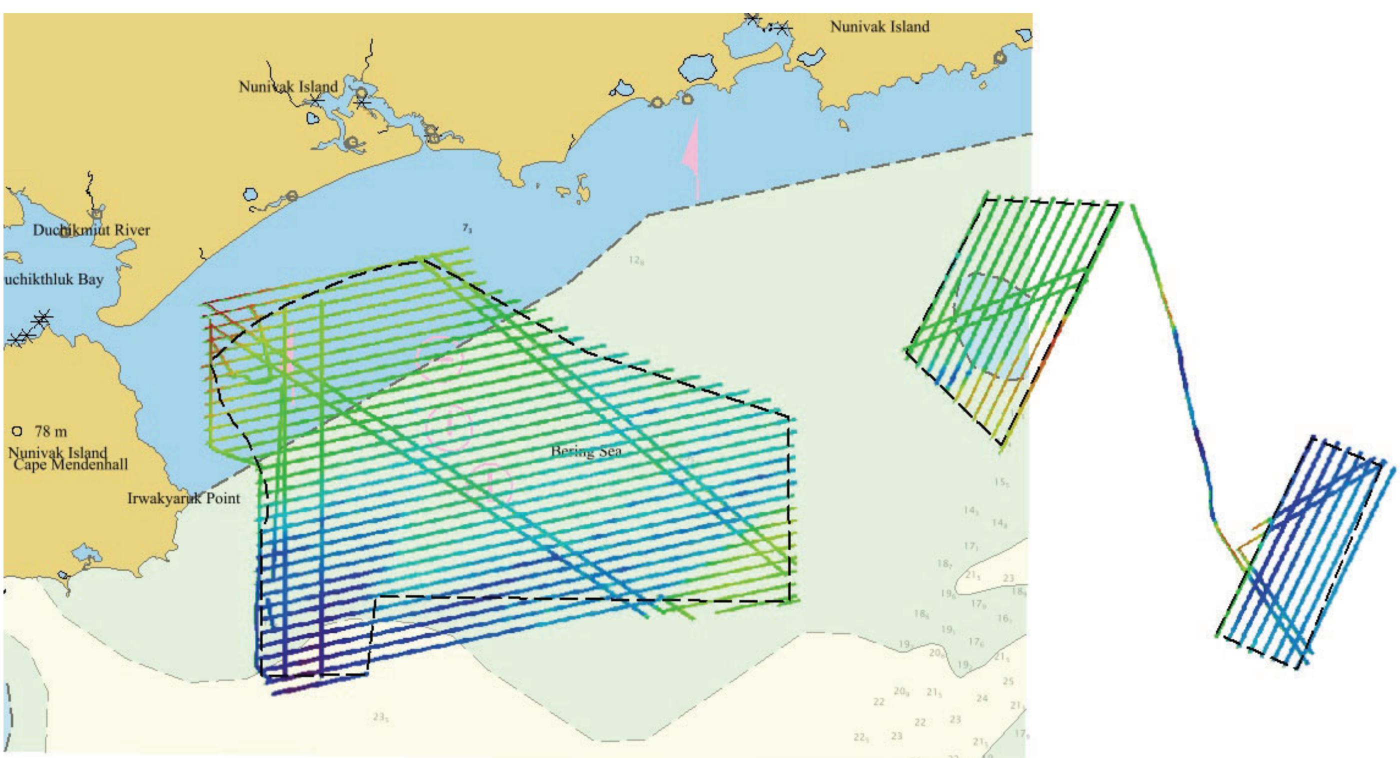

Figure 8: US4AK6BN relative to this survey.

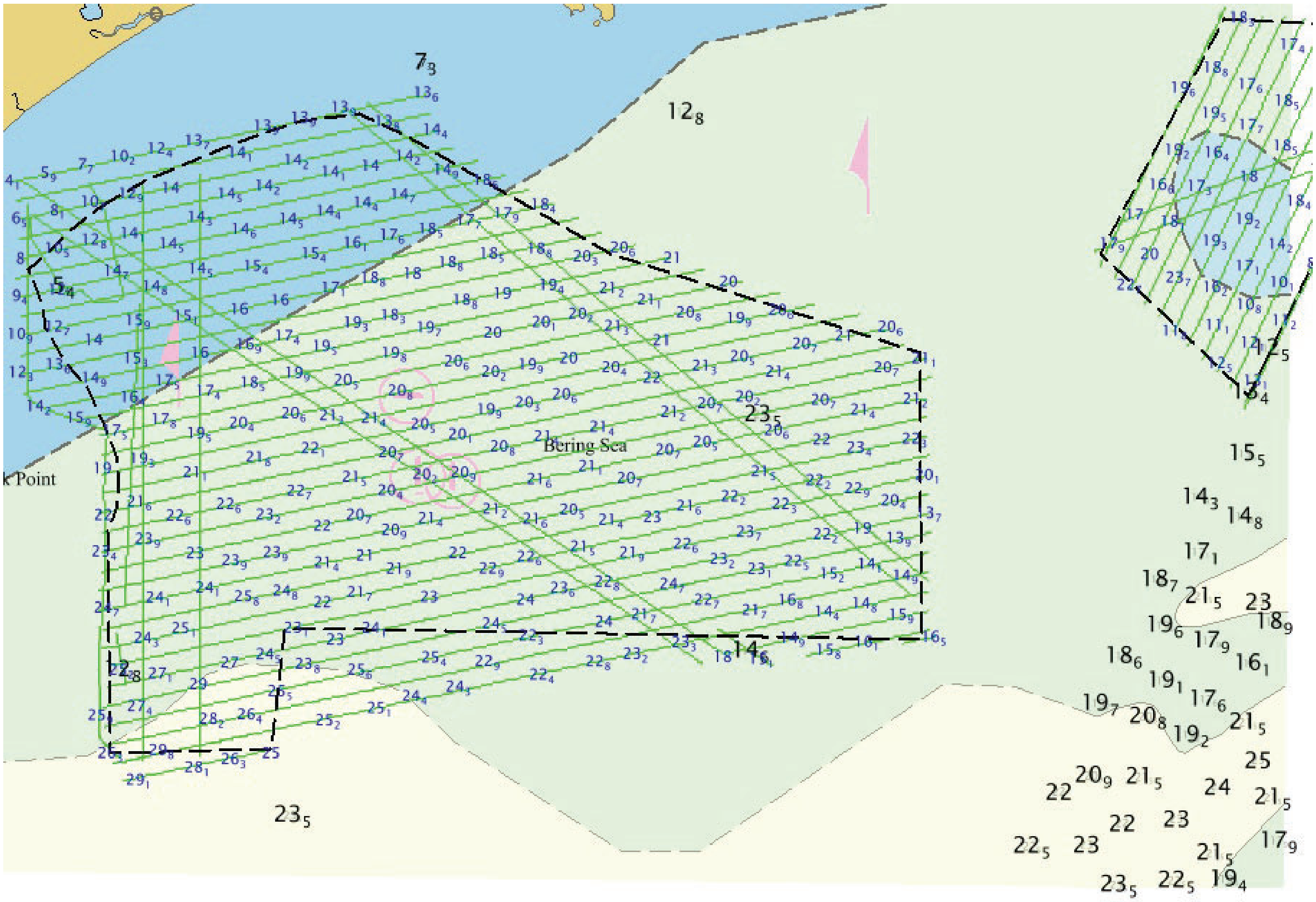

Figure 9: Soundings from this survey (blue) overlaid on US4AK6BN (black). Soundings in meters.

<u>US4AK6BO</u>

There is a small amount of overlap between this survey and US4AK6BO.

Soundings that overlap are in very good agreement with this survey, to within 0.5 m or better. Charted soundings were acquired relatively recently--in 2016--using the same survey vessels and similar equipment, which likely contributed to the good agreement. As described in the junction portion of this report, the small amount of disagreement is likely primarily due to bottom change.

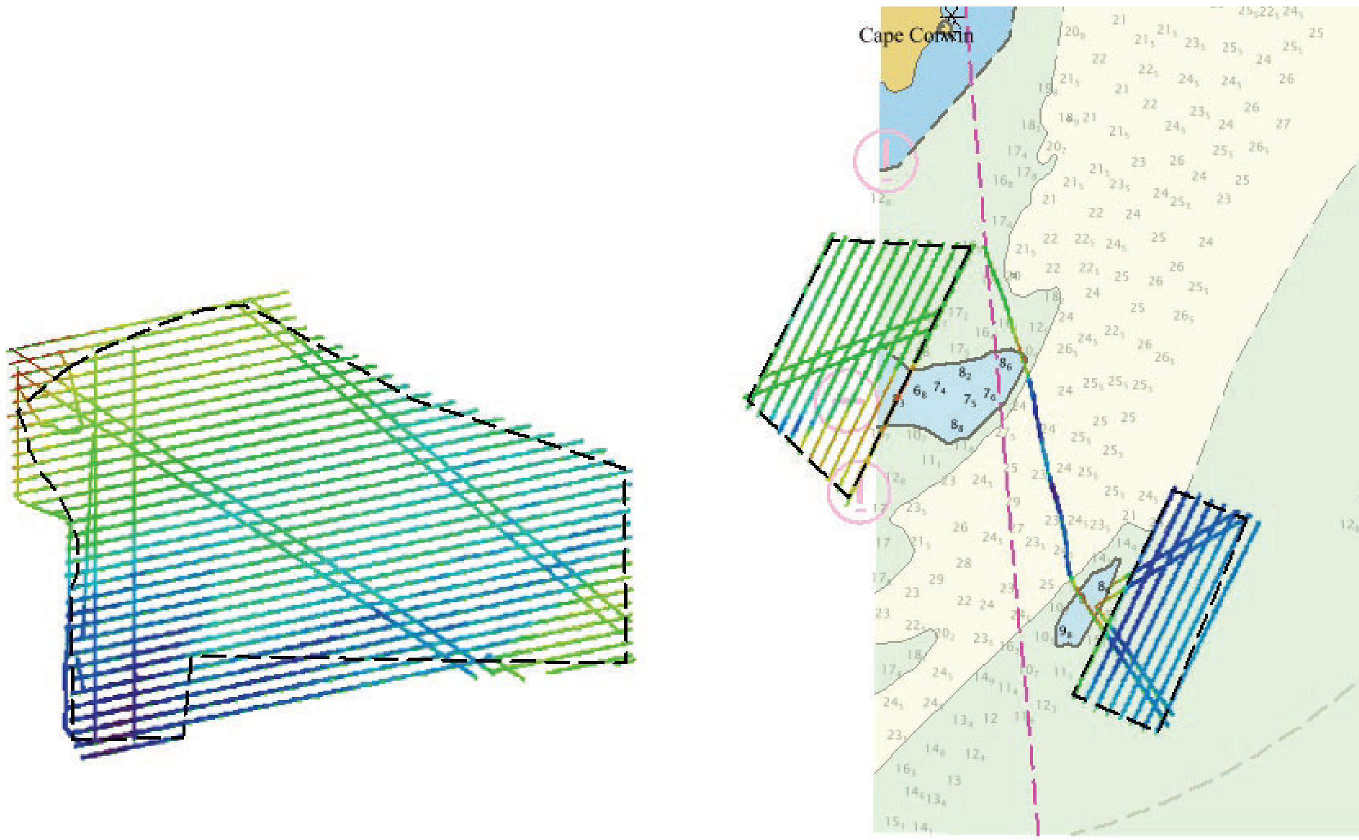

Figure 10: US4AK6BO relative to this survey.

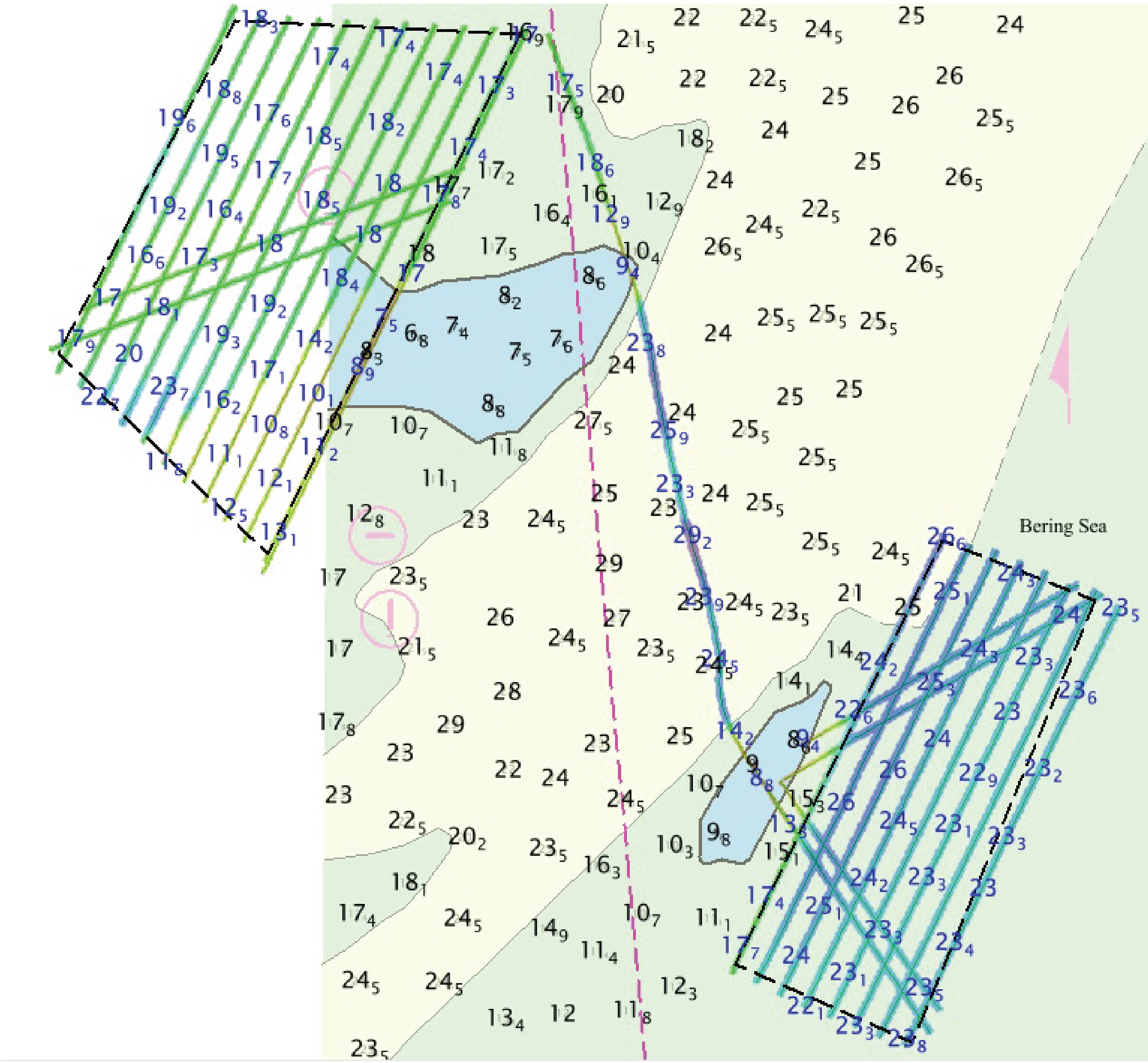

Figure 11: Soundings from this survey (blue) overlaid on US4AK6BO (black). Soundings in meters.

<u>US2AK95M</u>

The same observations for the overlapping large scale charts apply to this small scale chart, with one exception: The charted obstruction area on US2AK95M at 59-49-34.5 N, 165-34-45.1 W shows an incorrect least depth of 7.7 m. The correct least depth (correctly shown on large scale chart US4AK6BO) is 6.8 m at

59-49-20.731 N, 165-34-35.674 W. The least depth should be updated to the correct shoaler depth and the obstruction area feature should be deleted and replaced with a depth contour.

D.1.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.3 Charted Features

No charted features exist for this survey.

D.1.4 Uncharted Features

No uncharted features exist for this survey.

D.1.5 Shoal and Hazardous Features

Least depths already charted on US4AK6BO appear to adequately depict the two (6.8 m and 8.6 m) shoals near the survey area. This survey did not find depths shoaler there than already charted.

No DTONs were submitted for this survey.

D.1.6 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.1.7 Bottom Samples

Three bottom samples were assigned via the PRF. Samples were successfully obtained at each location.

Samples consisted primarily of black sand or black pebbles.

D.2 Additional Results

D.2.1 Shoreline

Shoreline was not assigned in the Hydrographic Survey Project Instructions or Statement of Work.

D.2.2 Aids to Navigation

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

D.2.3 Overhead Features

No overhead features exist for this survey.

D.2.4 Submarine Features

No submarine features exist for this survey.

D.2.5 Platforms

No platforms exist for this survey.

D.2.6 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.7 Abnormal Seafloor and/or Environmental Conditions

No abnormal seafloor and/or environmental conditions exist for this survey.

D.2.8 Construction and Dredging

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

D.2.9 New Survey Recommendation

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

D.2.10 Inset Recommendation

No new insets are recommended for this area.

E. Approval Sheet

Field operations and data processing contributing to the completion of this survey were conducted under my direct supervision with frequent personal checks of progress, integrity, and adequacy.

This report, digital data, and all other accompanying records are approved. All records are hereby respectfully submitted for final review and acceptance.

The survey data meets or exceeds the requirements set forth in the 2019 NOS Hydrographic Surveys Specifications and Deliverables document as well as the Hydrographic Survey Project Instructions and Statement of Work. This data is adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies (if any) noted in this Descriptive Report.

Report Name	Report Date Sent
Survey Outlines	2019-09-10
MMO Training Logsheet and Observation Logs	2019-09-12
NCEI Sound Speed Data Submission	2019-09-12
Coast Pilot Report	2019-09-13
Tides and Water Levels Package - 9465419 Levelock	2019-11-15
Tides and Water Levels Package - 9465993 Ishkowik	2019-11-15
Tides and Water Levels Package - 9463502 Port Moller	2019-11-16
Tides and Water Levels Package - 9465203 Naknek	2019-11-18
Tides and Water Levels Package - 9465137 Cape Pierce	2019-11-19
Tides and Water Levels Package - 9465265 Kulukak Point	2019-11-20
Tides and Water Levels Package - AAAAAAA Cape Mendenhall	2019-11-23
Tides and Water Levels Package - BBBBBBB SW Kuskokwim Bay	2019-11-23
Tides and Water Levels Package - CCCCCCC Cape Corwin	2019-11-27

Approver Name	Approver Title	Approval Date	Signature
Andrew Orthmann, C.H.	TerraSond Charting Program Manager	12/15/2019	Andrew Orthmann Digitally signed by Andrew Orthmann Date: 2019.12.15 14:31:25 -09'00'

F. Table of Acronyms

Acronym	Definition
AHB	Atlantic Hydrographic Branch
AST	Assistant Survey Technician
ATON	Aid to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BAG	Bathymetric Attributed Grid
BASE	Bathymetry Associated with Statistical Error
CO	Commanding Officer
CO-OPS	Center for Operational Products and Services
CORS	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