H13441

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13441

LOCALITY

State(s):	Alaska
General Locality:	Bristol Bay
Sub-locality:	17NM WNW of Egegik

2021

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

H13441

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:	**Bristol Bay**
Sub-Locality:	**17NM WNW of Egegik**
Scale:	**40000**
Dates of Survey:	**07/31/2021 to 09/18/2021**
Instructions Dated:	**08/16/2021**
Project Number:	**OPR-R340-KR-21**
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 4N, 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 H13441

Project: OPR-R340-KR-21

Locality: Bristol Bay

Sublocality: 17NM WNW of Egegik

Scale: 1:40000

July 2021 - September 2021

Terrasond

Chief of Party: Andrew Orthmann

A. Area Surveyed

The survey area is located in Bristol Bay, Alaska. A number of rivers flow into the bay and host the world's largest salmon runs. Seasonal fishing activity, including in the nearby Egegik fishing district, is the major driver of the economic activity in the area.

The region is relatively remote. None of the area communities are accessible by road. Travel and resupply is done by air or water. The closest communities to the survey area are Pilot Point (pop. 101, 2019) and Egegik (pop. 58, 2019). Dillingham (pop. 2,215, 2019), about 70 NM to the north, is the hub of the region with direct daily flights to and from Anchorage.

Vessel traffic consists mostly of barges that service the local communities and fishing vessel activities, especially during the busy summer fishing season. Fishing activity usually begins in June, peaks in July, and is largely over by August. The Egegik fishing district can have as many as 800 fishing boats laying nets and working in close proximity to each other at the height of the season. This project was timed to take place late in the summer season when fishing activities had diminished.

Tides have a large range here, usually four to five meters between high and low each day. As a result tidal currents are also strong, frequently in the range of 2-3 knots.

The area is relatively shallow (approximately 30.8 m at the offshore extent) with a gradual slope towards shore. The seafloor is primarily composed of shifting sand, evidenced by bottom sample results and many sandwave features spread throughout the survey area.

Bathymetric data collection was carried out from late July through September of 2021 under project OPR-R340-KR-21, with final processing and reporting carried out from October through December, 2021. Work was completed concurrently with five other nearby sheets, and done in accordance with the Hydrographic Survey Project Instructions (original dated 2/22/21, updated 8/16/21), Statement of Work (2/24/21), and the Hydrographic Surveys Specifications and Deliverables (HSSD, May 2020 edition).

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
58° 27' 29.8" N 158° 9' 0.45" W	57° 59' 49" N 157° 31' 10.23" W

Table 1: Survey Limits

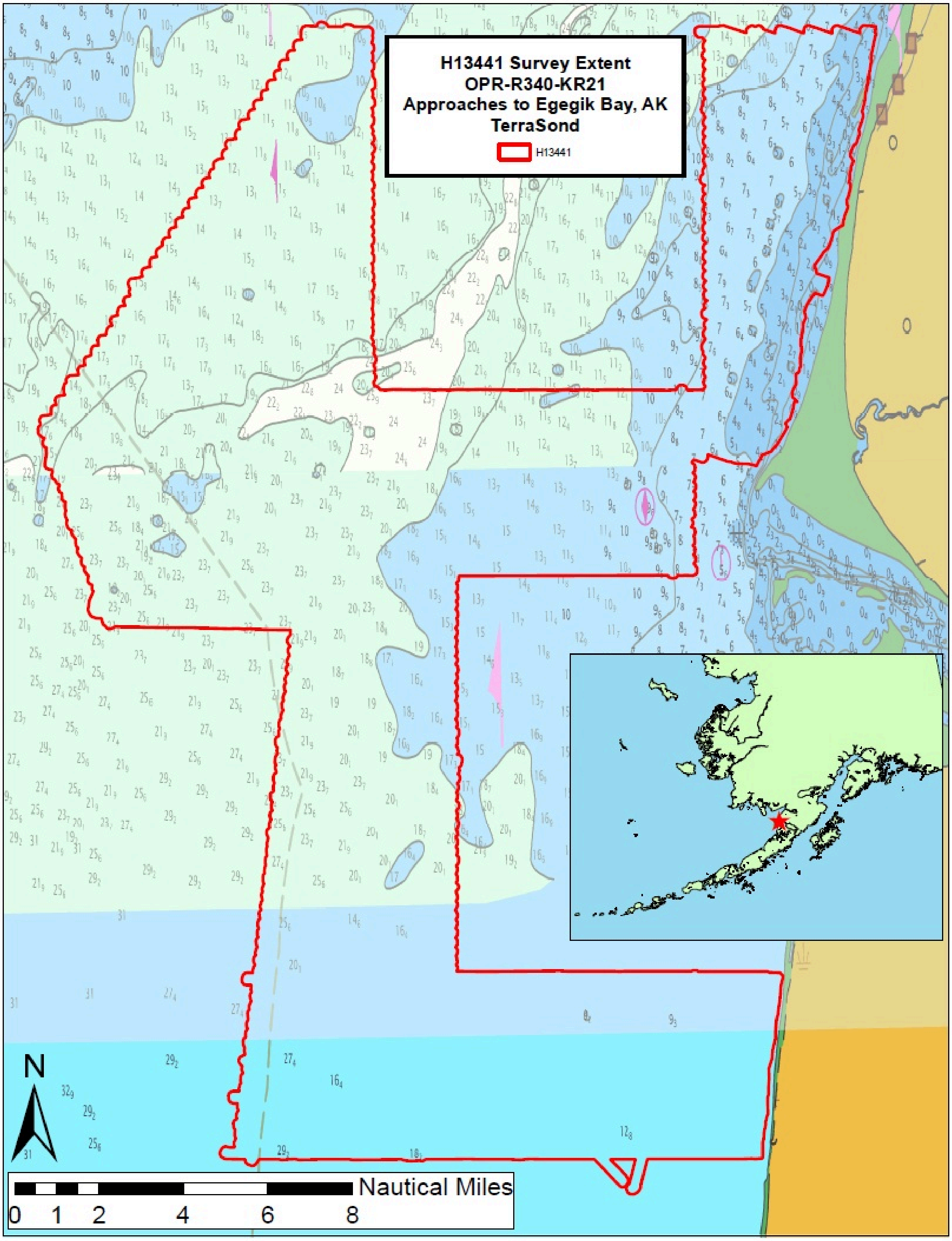

Figure 1: Image showing overview of survey extents.

Survey limits were acquired in accordance with the requirements in the Project Instructions and the HSSD.

A.2 Survey Purpose

The purpose of this survey is described as follows in the Project Instructions document:

The Approaches to Egegik Bay project located in Bristol Bay, Southwest Alaska, will provide contemporary surveys to update National Ocean Service (NOS) nautical charting products and services. The survey will provide modern bathymetry to update historic charted data, survey uncharted waters, and address concerns of navigational risk due to shoal formation.

Direct user feedback from the Western Alaska Tanker Lightering Best Practices Committee via the Alaska Maritime Prevention & Response Network, identified areas that support Ship-to- Ship transfers of oil products, commonly referred to as “lightering.” Together with the Automatic Identification Systems (AIS) traffic patterns feeding the Hydrographic Health model, the lightering areas helped to define the 749 square nautical mile survey extents. Areas to be surveyed include uncharted waters and historic data from 1914 to the 1940s.

This work will directly support the maritime services available to the remote native coastal community of Egegik (Igyagiiq) located within the mouth of the Egegik River.

Additionally, this project will provide support for other NOAA Hydrographic surveys and regional tidal products by installing two temporary water level measuring stations in the vicinities of Egegik and Pilot Point.

Modern charting products reduce the risk to navigation, increasing maritime safety and supporting the regions maritime infrastructure and commerce. Remote harbors and lightering sites are are essential to the maritime infrastructure of Alaska's communities. This project will provide that critical data for the updating of National Ocean Service (NOS) nautical charting products.

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 in Sheets 4, 5, and 6	Set Line Spacing MBES with concurrent backscatter at 400 m perpendicular to contours (Refer to HSSD Section 5.2.2.4, Option A)

Table 2: Survey Coverage

Coverage requirements were met. The following notes provide additional clarification.

The project required 5,726 LNM of survey data to be acquired project-wide. This consisted of the originally assigned 5,429 and an additional 297 authorized by the Government on 9/8/21 (see correspondence included with project deliverables).

6,007 LNM were acquired project-wide, exceeding the requirement by 281 LNM. The excess of 4.9% was collected to compensate for inefficiencies incidental to data collection such as crossline mileage that exceeded requirements, data acquired on run-ins or run-outs including on turns in shallow water in order to scout depths between lines, and excess overlap (if any). LNM quantities do not include transit or calibration data, or mileage that does not meet HSSD specifications.

The inshore limit for this survey was the NALL, which was normally 3.5 m water depth. 3.5 m depth (or shoaler) was reached along the entire inshore limit.

A large number of splits on charted soundings was required in this survey due to most charted soundings being shoaler than nearby survey data. Note that in some cases charted soundings landing on or near the border with junctioning sheets were addressed in the junctioning sheet.

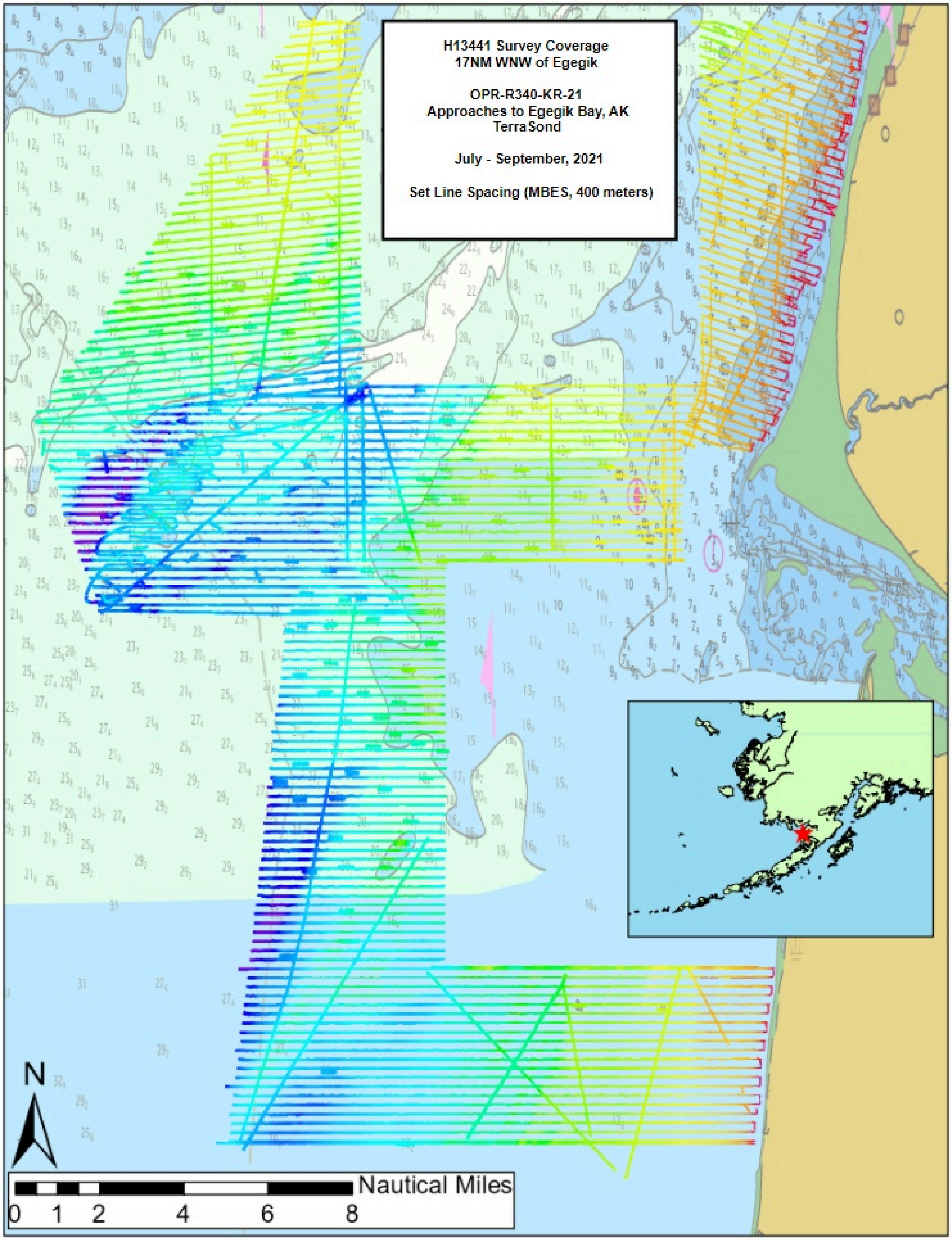

Figure 2: Image showing overview of survey coverage.

A.6 Survey Statistics

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

	HULL ID	*Qualifier 105*	*Sealegs*	*Total*
LNM	**SBES Mainscheme**	0.0	0.0	0.0
	MBES Mainscheme	1233.7	20.1	1253.8
	Lidar Mainscheme	0.0	0.0	0.0
	SSS Mainscheme	0.0	0.0	0.0
	SBES/SSS Mainscheme	0.0	0.0	0.0
	MBES/SSS Mainscheme	0.0	0.0	0.0
	SBES/MBES Crosslines	124.5	0.0	124.5
	Lidar Crosslines	0.0	0.0	0.0
Number of Bottom Samples				21
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				239.2

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
07/31/2021	212
08/01/2021	213
08/02/2021	214
08/03/2021	215
08/04/2021	216
08/05/2021	217
08/07/2021	219
08/08/2021	220
08/09/2021	221
08/12/2021	224
08/13/2021	225
08/14/2021	226
08/15/2021	227
08/16/2021	228
08/17/2021	229
08/18/2021	230
08/19/2021	231
08/20/2021	232
08/21/2021	233
08/22/2021	234
08/28/2021	240
08/29/2021	241
08/30/2021	242
08/31/2021	243
09/02/2021	245
09/03/2021	246
09/04/2021	247
09/08/2021	251
09/15/2021	258
09/16/2021	259
09/17/2021	260
09/18/2021	261

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	***Qualifier 105***	***Sealegs***
LOA	32.0 meters	5.5 meters
Draft	1.8 meters	0.5 meters

Table 5: Vessels Used

Figure 3: RV Qualifier 105 (Q105)

Figure 4: Sealegs skiff

The Qualifier 105 (Q105) is a 105' aluminum-hull vessel owned and operated by Support Vessels of Alaska (SVA). 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 tide buoys, conduct sound speed casts, conduct feature investigations, and deploy/support the Sealegs vessel.

The Sealegs is a 5.5 m RHIB-style skiff owned and operated by SVA. It was deployed via deck crane from the Q105 when conditions were favorable, and used to collect multibeam data in the shoalest portions of the survey area that were not readily accessible by the larger vessel.

B.1.2 Equipment

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

Manufacturer	Model	Type
Teledyne RESON	SeaBat T50-R	MBES
Teledyne RESON	SeaBat T20-P	MBES
Applanix	POS MV 320 v5	Positioning and Attitude System
Teledyne Oceanscience	rapidCAST	Sound Speed System
Valeport	SWiFT SVP	Sound Speed System
AML Oceanographic	MicroX SV	Sound Speed System
AML Oceanographic	SV-Xchange	Sound Speed System

Table 6: Major Systems Used

The survey vessels were configured for MBES data collection with similar survey equipment and software. Both vessels utilized Reson Seabat MBES systems (T-50 on the Q105, T-20 on the Sealegs), with surface sound speed measurements provided by AML Oceanographic Micro-X sensors. Both vessels used Applanix POSMVs (Wavemaster II) with submersible IP-68 rated IMUs for attitude and position measurements. Sound speed profiles were collected using a Valeport SWiFT sensor (deployed while underway using a Teledyne Oceanscience RapidCast system) on the Q105, while the Sealegs utilized a AML Oceanographic Minos-X (with P- and SV-Xchange sensors) deployed by hand. QPS QINSy software, running on Microsoft Windows 10-based PCs, was used for multibeam data logging and vessel navigation.

B.2 Quality Control

B.2.1 Crosslines

Crossline LNM totaled 9.9% of mainscheme.

Effort was made to ensure crosslines (XLs) 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 often collected while transiting across the survey area to reach a different survey priority such as bottom sample locations or infills, often leading to crosslines that were diagonal to the direction of mainscheme lines. This also resulted in total XL LNM that exceeded the minimum requirements (8% of mainscheme) since it was preferable to collect more data for QC purposes when crossing mainscheme instead of transiting without logging.

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.

0341-Q105-219-D3_XL3 -- 100.0% pass
1779-Q105-251-D5_XL1 -- 100.0% pass
1785-Q105-251-D5_XL2 -- 100.0% pass
1920-Q105-258-DINFL00014_XL -- 100.0% pass
1982-Q105-259-D_XL10 -- 100.0% pass
2068-Q105-260-D4_XL01 -- 100.0% pass
2078-Q105-261-D3_XL -- 100.0% pass
1027-Q105-240-D4_XL -- 100.0% pass
2074-Q105-261-D_XL -- 100.0% pass
1688-Q105-247-D3_XL -- 100.0% pass
0154-Q105-214-D3_XL2 -- 100.0% pass
0083-Q105-212-D4XL00001 -- 100.0% pass
0127-Q105-214-D4_XL2 -- 100.0% pass
2050-Q105-260-D2_XL -- 100.0% pass
0861-Q105-231-DXL00003 -- 100.0% pass
0205-Q105-216-D2_Boundary_Line -- 100.0% pass
2048-Q105-260-D2_XL2 -- 100.0% pass
0798-Q105-230-D1NS13200 -- 100.0% pass
2046-Q105-260-D2_XL -- 100.0% pass
0153-Q105-214-D3_XL1 -- 99.9% pass
0218-Q105-216-D2_XL -- 99.9% pass
1690-Q105-247-D1_XL -- 99.9% pass
0812-Q105-230-D1NS07600 -- 99.8% pass
0905-Q105-234-D2XL00002 -- 99.1% pass

Results: Agreement between them 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	0.15 meters	0.0 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
Qualifier 105	0 meters/second	1.6 meters/second	0 meters/second	0.025 meters/second
Sealegs	0 meters/second	1.0 meters/second	0 meters/second	0.025 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

The uncertainty layer of the final surface(s) was examined in CARIS HIPS, and also analyzed in Pydro QC Tools V3.5.14 Grid QA v6.

Uncertainty of the final grid cells range from 0.310 to 0.795 m. Greater than 99.5% of grid cells have TVU falling within the allowable range by depth. The larger values were observed to be in areas of variable seafloor, usually around sandwave features, where many soundings of different depths contribute to the value of the relatively large (4 m) grid cell, resulting in a higher standard deviation for the grid cell. All final grid cells are within specifications.

B.2.3 Junctions

During field operations, effort was made to ensure sufficient overlap was achieved between lines run in adjacent survey sheets in order to complete junction analysis.

The "Gridded Surface Comparison V19.4" utility within Pydro was used to compare survey junctions. The utility differences the surfaces from the two surveys and generates statistics that include the percentage of grid cells that compare to within allowable TVU for the depth. 4 m resolution CUBE surfaces were used for all comparisons.

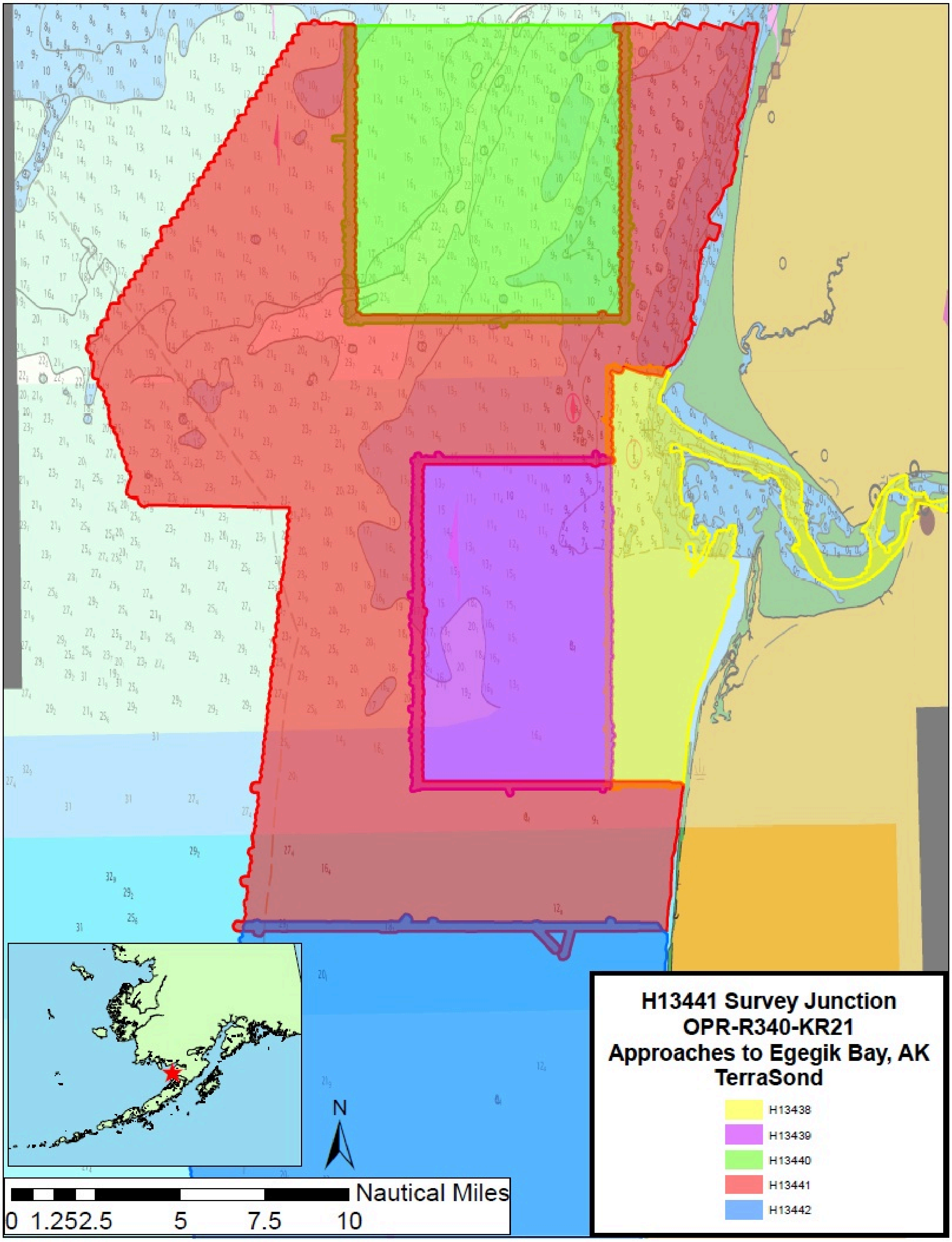

Figure 5: Image showing an overview of junctions with this survey.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13438	1:40000	2021	TerraSond	E
H13439	1:40000	2021	TerraSond	SE
H13440	1:40000	2021	TerraSond	N
H13442	1:40000	2021	TerraSond	S

Table 9: Junctioning Surveys

H13438

Ample overlap was achieved between the two surveys. The area of overlap was largely between the Complete Coverage area of H13438 and the run-ins and run-outs of a portion of the set-spaced mainscheme lines of H13441. In addition, substantial overlap was achieved along the south and north sides of H13438 where this sheet also junctioned.

Agreement between the two survey is excellent. The mean difference is 0.02 m with a standard deviation of 0.09 m. 100% of grid cells agree within the allowable TVU for their depth.

H13439

H13439 junctions with this survey on three sides. Mainscheme lines in the overlapping area of both surveys were collected parallel to each other. To ensure at least one swath width of overlap on all sides, an overlapping line was collected in both sheets along their common borders (both the north and south sides of H13439). On H13439's west side, a north-south oriented crossline was collected near its west edge to have ample overlap with mainscheme lines from H13441 which extended on their run-ins and run-outs eastward into H13439. In addition, crosslines were extended where practical from each sheet into the other sheet to obtain additional overlap.

Agreement between the two surveys is excellent. The mean difference is 0.01 m with a standard deviation of 0.08 m. 100% of grid cells agree within the allowable TVU for their depth.

H13440

H13440 junctions with this survey on three sides. To ensure at least one swath width of overlap on all sides, an overlapping line was collected in both sheets along their common border on the south side of H13440 where lines in both surveys were ran parallel to each other. Then, in H13440, north-south oriented crosslines were acquired on both its east and west sides close to the sheet edge so that the mainscheme lines from H13441 would regularly intersect H13440 on their run-ins and run-outs and provide a sufficient junction.

Agreement between the two surveys is excellent. The mean difference is 0.00 m with a standard deviation of 0.07 m. 100% of grid cells agree within the allowable TVU for their depth.

H13442

Lines on this survey were collected parallel to the lines collected on H13442. To ensure at least one swath width of overlap, an overlapping line was collected in both sheets along their common border. In addition, crosslines were extended where practical from each sheet into the other sheet to obtain additional overlap.

Agreement between the two survey is excellent. The mean difference is 0.02 m with a standard deviation of 0.10 m. 100% of grid cells agree within the allowable TVU for their depth.

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

Data Blowouts

During rough weather conditions, especially with following seas, air bubbles would occasionally be forced under the multibeam sonar head and result in temporary loss of bottom tracking or "blowouts", sometimes causing small along-track gaps. These were examined and only reran when the gap at nadir exceeded three nodes alongtrack (12 m horizontal distance) for mainscheme lines. Final data is within specifications.

Figure 6: Image of the final surface showing the effect of data blowouts on a line from rough weather. Line 0405-Q105-221-D3EW01600 at 58-17-49 N, 157-49-03 W.

B.2.6 Factors Affecting Soundings

Sound Speed Error

Most sound speed profiles exhibited a well mixed water column due to the strong currents of the area, and as a result sound speed error in the dataset is relatively small. This error, which is characterized by a general upward or downward across-track cupping of sounding data that increases in magnitude towards the outer beams, is evident in some areas, but where it was observed the effect on final surfaces is less than 0.20 m.

Bottom Change

Bottom change was observed over the course of the survey, especially between lines that were run days to weeks apart. There is evidence of sediment transport throughout the survey area, with sandwaves visible in most areas. When bottom change was observed between lines, no attempts were made to edit or otherwise "choose" a seafloor.

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 SWiFT sound speed profiler. The Sealegs used a manually-deployed AML Oceanographic Minos-X (with P- and SV- Xchange sensors).

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 normally favored to ensure that changes across the full water column were measured. The cast data was used to correct the sounding data using the "nearest in distance within time" (set to 3 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

Although vertical agreement between overlapping lines is generally very good, normally within 0.10 m or better, vertical busts attributable to GPS positioning error are apparent sporadically in the data set. On rare occasions these reach approximately 0.20 m in this area. Any that approached or exceeded IHO Order 1a for their depth were investigated and addressed in processing. All crosslines pass within IHO Order 1a, and final surfaces are within allowable TVU for the depth.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

No Delayed Heave:

One line segment did not have Delayed Heave loaded because it was not available. This was file 0594-Q105-225-D4EW14400_-_0001. It was corrected with Real-Time heave instead. There is no significant degradation to the final data, and final data is within specification.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Backscatter data was acquired but not processed for this survey. 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 V2021.

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
H13441_MB_4m_MLLW_Final	CARIS Raster Surface (CUBE)	4 meters	0.0 meters - 80.0 meters	NOAA_4m	MBES Set Line Spacing

Table 10: 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 2021 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 2020 HSSD. The surface was finalized, and designated soundings were applied where applicable.

Horizontal projection was selected as UTM Zone 4 North, NAD83(2011).

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 (V2021).

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	OPR-R340-KR-21_Egegik_ERTDM21_NAD83-MLLW_.csar

Table 11: 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.

Two tide stations, at Egegik and Dago Creek Mouth (Pilot Point) were installed as part of the overall project but were not used for reduction of soundings. A GNSS Buoy was also deployed as an ERTDM validation site. All gauge data and validation results have been separately provided to NOAA CO-OPS. Reports (with accompanying data packages) that have been submitted directly to CO-OPS are itemized in Section E of this report.

Note: During analysis of the GNSS Buoy data, which was installed as a check on the ERTDM model in an offshore portion of the project area, a discrepancy was observed. The NAD83 to MLLW separation was computed to be 11.790 m from the buoy data, while the ERTDM model had a separation value of 12.472 m at the buoy location, a difference of 0.682 m. Conversely, the NAD83 to MLLW separation values computed at the two project tide stations (Egegik and Dago Creek Mouth) agreed with the ERTDM model to 0.111 m and 0.079 m, respectively, which is within the uncertainty stated for the ERTDM model in the Work Instructions (0.15 m). This suggests the possibility of error in the tide model that exceeds specifications offshore. The discrepancy was brought to the COR's attention (see tides correspondence) but was unresolved at the time of this submittal. The result of higher than actual separation values applied to the GNSS altitude data would be a deep bias to final soundings; therefore further investigation is recommended.

H13441 was conducted in 2021. At the time, the field was provided a preliminary ERTDM SEP Model for the field party to reduce their sounding elevations from ellipsoidal heights to depths referenced to MLLW. As part of their survey operations, the field party set up a series of tide buoys to help improve ellipsoidal-to MLLW datum reduction modeling in the area. In early 2023, HSTB provided updated SEP models to the hydrographic branches, based on the tide data collected by the buoys. The hydrographic branch used two vertical shifts to transform submitted data depths. The first shift used the original 2021 SEP Model to return gridded depths to the ellipsoidally referenced elevations. The second shift used the improved 2023 SEP to reduce grid depths back to MLLW. The hydrographic branch did not re-process the individual soundings that generate the grids. All HDCS data remains referenced to MLLW, based on the original SEP model. Sounding depths of original HDCS sounding data vary from the grids approved for charting anywhere between +/- 0.25m.

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 4.

<u>The following PPK methods were used for horizontal control:</u>

- RTX

<u>PPP</u>

Post-processing of all navigation data for final positions was done in Applanix POSPac MMS (v8.5 or v8.7) software. Trimble PP-RTX was used as the processing methodology within POSPac.

RTK

Real-time positions were primarily RTK. Hemisphere SmartLink antennas on each vessel were set to receive the subscription-based Atlas H-10 service, which output RTCM corrections to each vessel's POSMV, allowing them to operate in RTK mode. This assisted with real-time positioning, especially helping to ensure depth requirements were met. However, all real-time positions were replaced in post-processing with PPK corrections, as described previously.

WAAS

The Wide Area Augmentation System (WAAS) was used incidentally for real-time positions when there were issues receiving RTK corrections. However, all real-time positions were replaced in post-processing with PPK corrections, as described previously.

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 final 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. ENC metadata and non-specific geographic area objects on the ENC(s) that overlap the survey area were not investigated.

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

The best agreement with the north side of this survey where it overlaps with US4AK51M. There most soundings agree to within 1-2 meters, with soundings from this survey deeper in most cases.

Discrepancy with US4AK52M is worst in the south side of this survey, where soundings disagree by up to 8 m, with this survey again showing deeper depths in most cases compared to what is charted. The figures below show charted soundings overlaid on shoal-biased survey soundings.

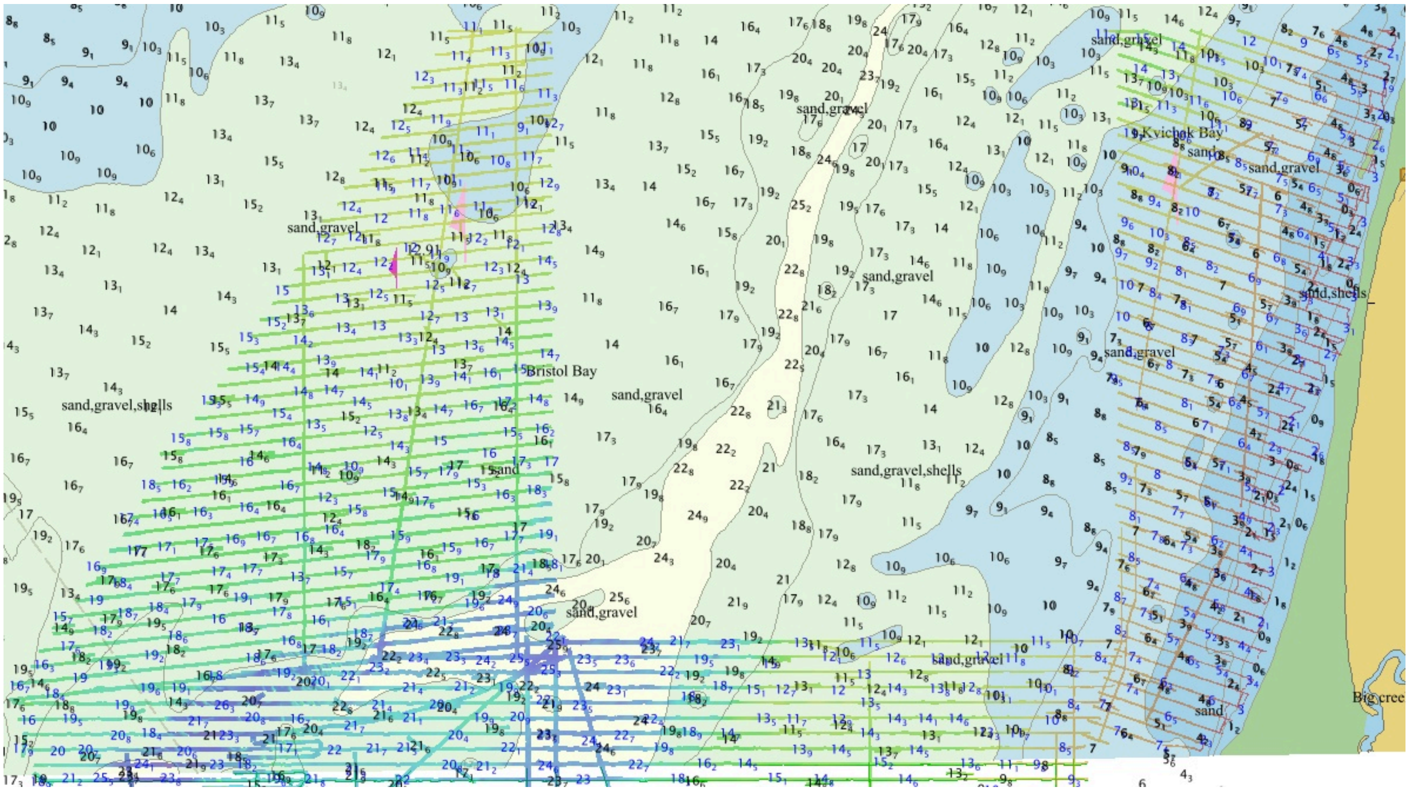

Figure 7: Soundings from this survey (blue) overlaid on US4AK51M (soundings in black). All soundings in meters. Most soundings agree to within 1-2 m, with soundings from this survey normally deeper.

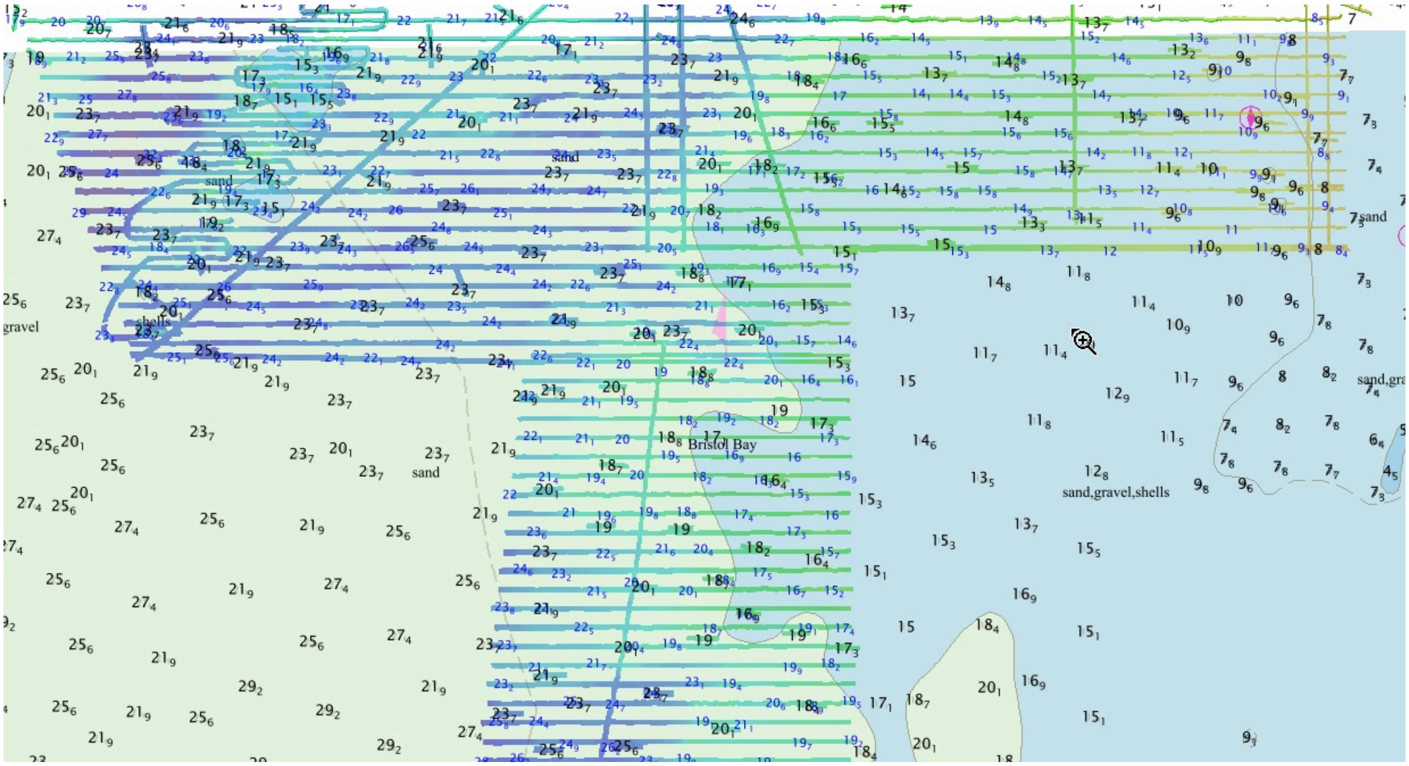

Figure 8: Soundings from this survey (blue) overlaid on US4AK52M (soundings in black) on the middle section of this survey. All soundings in meters. Most soundings agree to within 1-2 m, with soundings from this survey normally deeper.

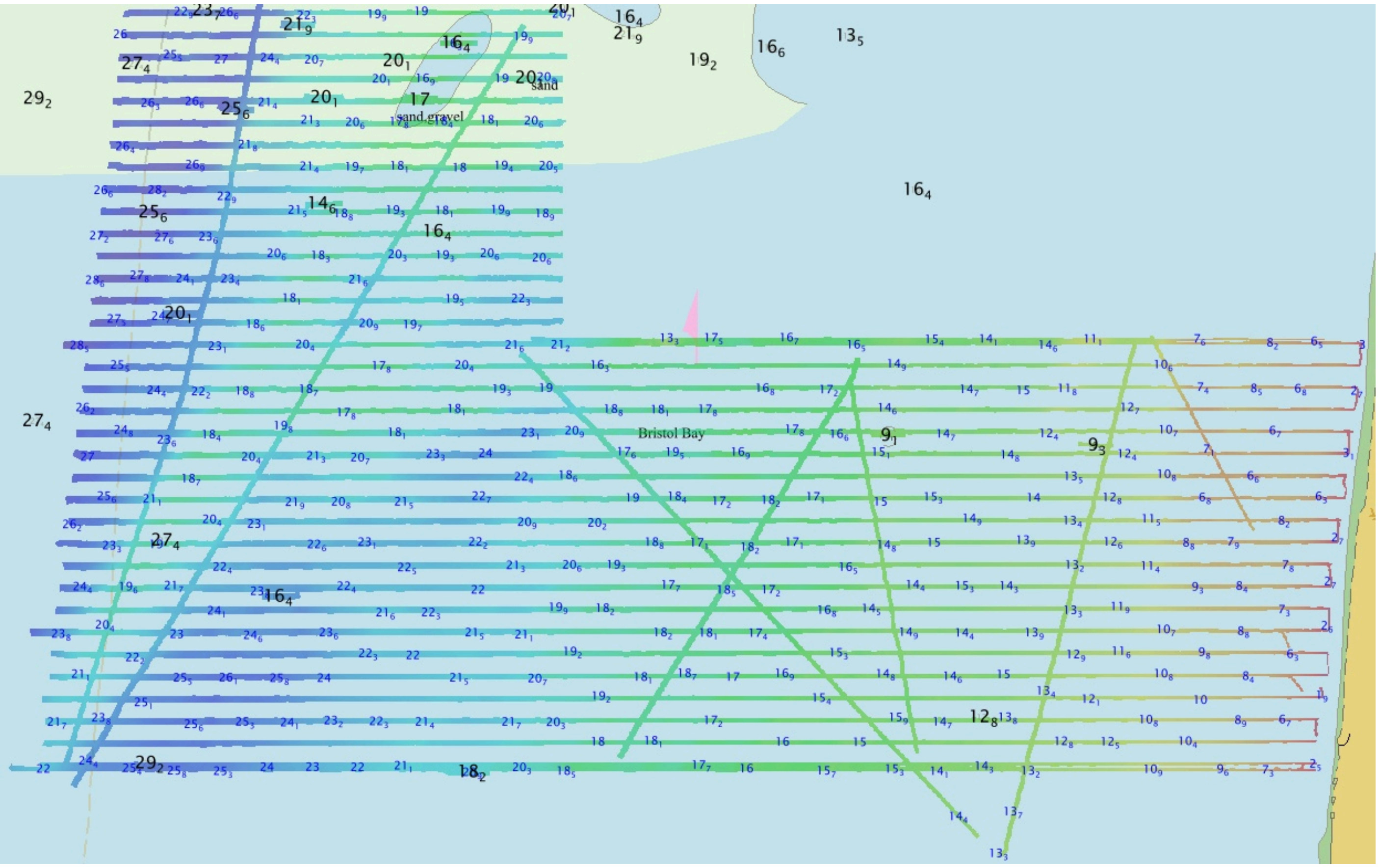

Figure 9: Soundings from this survey (blue) overlaid on US4AK52M (soundings in black) in the southern part of this survey. All soundings in meters. Agreement is worse in this area, with some soundings differing by up to 8 m, with this survey deeper in most cases.

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
US4AK52M	1:100000	4	12/27/2017	12/27/2017
US4AK51M	1:100000	5	05/08/2019	05/08/2019

Table 12: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey. No DTONs were submitted 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 Channels

No channels exist for this survey. There are no designated anchorages, precautionary areas, safety fairways, traffic separation schemes, or channel and range lines within the survey limits.

A pilot boarding area is charted within the survey extents on US4AK52M but was not investigated further. No unusual vessel activity was observed at the boarding area during survey operations.

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

21 bottom samples were assigned in this sheet. Samples were successfully obtained at all locations.

Most returned sand as the primary constituent, and sand was also a common secondary constituent in other samples. Gravel and pebbles were also common primary constituents, and often were secondary constituents where sand was the primary. Seen less often but present in some samples was mud and broken shells.

Samples were photographed but not retained. Refer to the FFF submitted with the survey deliverables for results.

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 that have not already been discussed in this report.

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 2020 NOS Hydrographic Surveys Specifications and Deliverables, 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 the Descriptive Report.

Report Name	Report Date Sent
Tide Station Recon Reports (Egegik and Pilot Point)	2021-06-21
9464874 Egegik Tide Station Install Report	2021-09-10
9464512 Dago Creek Tide Station Install Report	2021-09-11
Survey Outline Submittal	2021-10-15
Final Progress Report	2021-10-15
9464874 Egegik Tide Station One Day Removal Report	2021-11-06
9464512 Dago Creek Tide Station One Day Removal Report	2021-11-08
NCEI Sound Speed Data Submittal	2021-11-19
MMO Logsheets and Training Observer Log Submittal	2021-11-23
Coast Pilot Review Report	2021-12-06
9464874 Egegik Tide Station Removal / Tides Package	2021-12-12
9464512 Dago Creek Tide Station Removal / Tides Package	2021-12-14
9999778 Offshore Egegik GNSS Buoy Removal / Tides Package	2021-12-17

Approver Name	Approver Title	Approval Date	Signature
Andrew Orthmann, C.H.	Charting Program Manager	01/03/2022	Andrew Orthmann Digitally signed by Andrew Orthmann Date: 2022.01.03 17:03:45 -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