H13037

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13037

LOCALITY

State(s):	Alaska
General Locality:	Aleutian Islands
Sub-locality:	West of Unga Island

2017

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

H13037

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:	**Aleutian Islands**
Sub-Locality:	**West of Unga Island**
Scale:	**40000**
Dates of Survey:	**07/15/2017 to 09/26/2017**
Instructions Dated:	**06/09/2017**
Project Number:	**OPR-P384-KR-17**
Field Unit:	**TerraSond Limited**
Chief of Party:	**Andrew Orthmann**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

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Descriptive Report to Accompany Survey H13037

Project: OPR-P384-KR-17

Locality: Aleutian Islands

Sublocality: West of Unga Island

Scale: 1:40000

July 2017 - September 2017

TerraSond Limited

Chief of Party: Andrew Orthmann

A. Area Surveyed

The survey area is located in the vicinity of Unga Strait, a frequently transited passage for vessels between Unga Island to the south and the Alaska Peninsula to the north. The closest community is Sand Point, population 1,044 (2016), located southeast of the survey area on Popof Island. Area characteristics include rugged, rocky coastline and highly variable bottom topography with depths that change rapidly over short distances, especially as shore is approached. Unga Strait is relatively protected, with additional protection for vessels available in nearby bays.

Field work was carried out on this project between July and September 2017, with bathymetric data collection occurring in July and August. Office work including final data processing and reporting was completed from October through December, 2017. Work was done in accordance with the Hydrographic Survey Project Instructions (dated June 9th, 2017), Hydrographic Survey Services Statement of Work (dated May 19, 2017), and the Hydrographic Surveys Specifications and Deliverables (April 2017 edition).

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
55° 24' 22.89" N 161° 17' 58.59" W	55° 16' 25.65" N 160° 49' 14.52" W

Table 1: Survey Limits

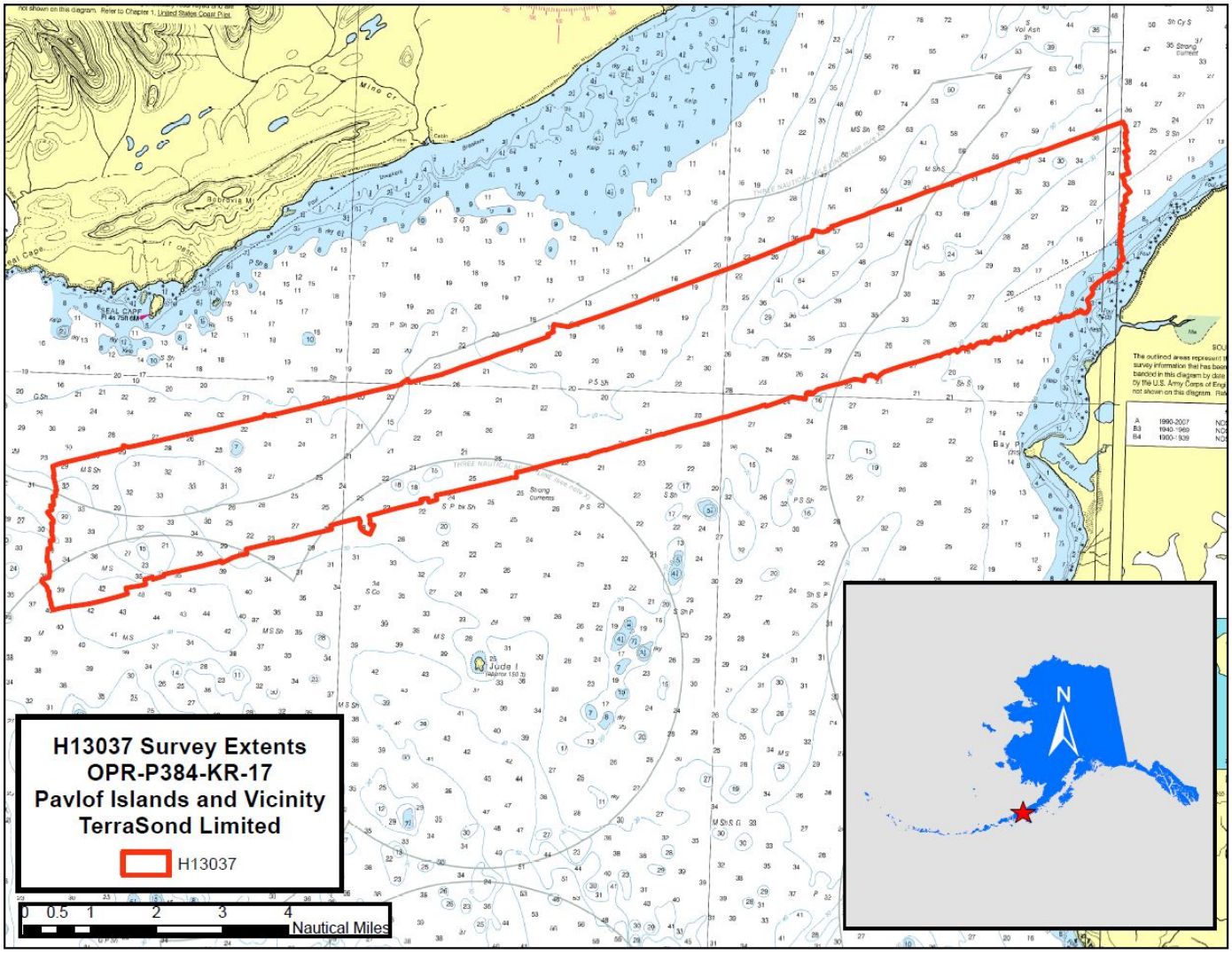

Figure 1: Survey extents and overview

The geographical survey limits assigned via the Project Reference File (PRF) were achieved. The inshore limit, the 8 m contour, was achieved in all areas where it was safe for personnel and equipment to do so.

A.2 Survey Purpose

The purpose of this project is to provide contemporary surveys to update National Ocean Service nautical charts to support an increase in vessel traffic in Unga Strait. This survey area includes protected waters for vessels transiting from areas to the east in the Gulf of Alaska and Shelikof Strait to the very busy Unimak Passage, which is the gateway to the Bering Strait utilized by cargo, fishing, and trans-pacific vessels. This passage and nearby areas are utilized by the fishing fleet in Bristol Bay and the Bering Sea as well as the tug and tow traffic delivering goods to the Aleutian Islands, western Alaska, and the Arctic. This area was last

surveyed using partial bottom coverage techniques. 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.

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 survey areas	100-meter multibeam set line spacing (HSSD Section 5.2.2.4 Option A). Feature developments/disprovals shall be done to complete coverage (HSSD Section 5.2.2.3) requirement.
All waters in survey area	Acquire backscatter data during all multibeam data acquisition (HSSD Section 6.2)

Table 2: Survey Coverage

Coverage requirements were generally met, with the following important notes and/or exceptions:

Set Line Spacing areas:

1. Despite requirements for 100-m set line spacing, Complete Coverage was actually achieved for most of the area due to water depth. This generally occurred in depths of 30-40 meters and deeper.

Bathymetric splits were acquired where appropriate to address charted soundings falling between lines and adequately define shoals, contours, and significant deeps. These were rare for this survey because much of the set spaced area received complete coverage.

SAR: There was a small section along the north edge of the sheet limits where there was a small gap in coverage. Given this was a set spacing survey and there is a junctioning survey on that edge, it was deemed insignificant by the reviewer.

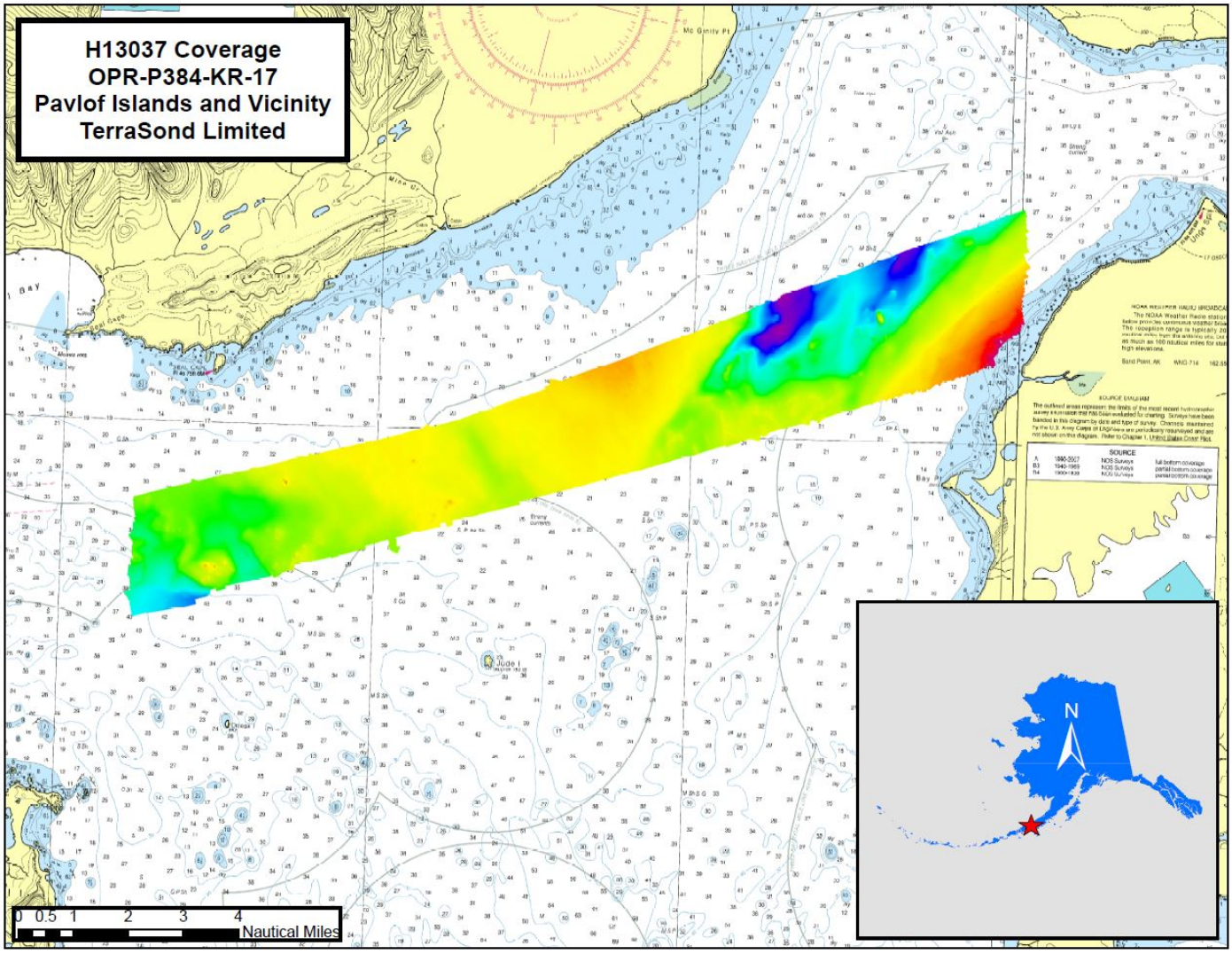

Figure 2: Coverage Graphic Image

A.6 Survey Statistics

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

	HULL ID	*Qualifier 105*	*ASV-CW5*	*Total*
LNM	**SBES Mainscheme**	0	0	0
	MBES Mainscheme	286	191	477
	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	26	13	39
	Lidar Crosslines	0	0	0
Number of Bottom Samples				4
Number Maritime Boundary Points Investigated				0
Number of DPs				19
Number of Items Investigated by Dive Ops				0
Total SNM				35.6

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
07/15/2017	196

Survey Dates	Day of the Year
07/16/2017	197
07/17/2017	198
07/23/2017	204
07/26/2017	207
08/09/2017	221
08/11/2017	223
08/14/2017	226

Table 4: Dates of Hydrography

Bathymetry collection was completed on 8/14. Bottom samples were completed on 9/26.

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 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***	***ASV-CW5***
LOA	32 meters	5.5 meters
Draft	1.8 meters	0.5 meters

Table 5: Vessels Used

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 ASV Global. The ASV was operated in an unmanned but monitored mode, collecting multibeam data in close proximity to the Q105.

Refer to the DAPR for vessel photos, offset diagrams, and more information on vessel operations.

B.1.2 Equipment

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

Manufacturer	Model	Type
Teledyne RESON	Seabat 7101	MBES
Applanix	POSMV 320 V5	Positioning and Attitude System
Applanix	POSMV 320 Wavemaster II	Positioning and Attitude System
Valeport	Rapid SVT 200Bar	Sound Speed Profiler
Teledyne Oceanscience	RapidCAST	Sound Speed Profiler Deployment System
Trimble	5700	Base Station
Sea-Bird Electronics	SBE 26 Plus	Submerged Tide Gauge
AML Oceanographic	MinosX with Xchange Sensors	Conductivity and Temperature Gauges

Table 6: Major Systems Used

Details on equipment specifications, configurations, quality control, and methods of operation are available in the DAPR.

B.2 Quality Control

B.2.1 Crosslines

Multibeam/single beam echo sounder/side scan sonar crosslines acquired for this survey totaled 8.18% of mainscheme acquisition.

Effort was made to ensure crosslines had good temporal and geographic distribution, were run so as to enable maximal nadir-to-nadir comparisons, and percent of mainscheme LNM requirements were 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 ran parallel lines, crosslines were often collected in sets.

The crossline analysis was conducted using CARIS HIPS “Line QC Report” process. Each crossline was selected individually and run through the process, which calculated the depth difference between each accepted crossline sounding and a "QC" BASE (CUBE-type, 4 m resolution) surface’s depth layer created from the mainscheme data. QC surfaces were created with the same parameters used for 4 m surfaces as the final surfaces, with the important distinction that the QC surfaces did not include crosslines so as to not bias the results. Differences in depth were grouped by beam number and statistics computed, which included 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(s) would be counted as a QC failure in this process if the difference from the sounding to the surface exceeded the allowable TVU.

Results: Agreement between the mainscheme surface and crossline soundings is excellent. For each crossline, at least 99.1% of soundings compared within the allowable TVU.

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
Discrete Zoning	0.034 meters	0.061 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Surface
Qualifier 105	0 meters/second	1.404 meters/second	0.025 meters/second
ASV-CW5	0 meters/second	1.404 meters/second	0.025 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

All soundings were assigned a horizontal and vertical value for estimated total propagated uncertainty (TPU).

Real-time (dynamic) error estimates were computed and loaded for all applicable data. This replaced the static error estimates for attitude, positioning, and tide during final TPU computation. Exceptions, if they exist, are rare and are listed in Section B.3 of this report. Note that the tide error values for measured and zoning shown above are maximum errors for reference only -- actual tidal errors were computed dynamically. Refer to the DAPR for more information on derivation of TPU estimates.

The BASE surfaces were finalized in CARIS HIPS so that the uncertainty value for each grid cell is the greater of either standard deviation or uncertainty. The uncertainty layer of each final surface was then examined for areas of uncertainty that exceeded allowable TVU for the depth (Order 1a for depths less than 100 m, and Order 2 for depths 100 m and deeper). Uncertainty for the surfaces are 0.10 m to 1.28 m for the 4 m surface and 0.18 m to 1.28 m for the 8 m surface.

The vast majority of grid cells have uncertainty values within allowable TVU. Highest uncertainties were found in areas of varying bottom topography such as slopes and near bottom features where high standard deviations are caused by the wide depth ranges of soundings contributing to each grid cell, outer edges of multibeam swathes without adjacent line overlap, and areas exhibiting sound speed or motion artifact error. Despite elevated TPU values for these grid cells, the data is within specifications.

B.2.3 Junctions

The project instructions specified junction analysis be undertaken between current project sheets (current junctions) as well as specific overlapping contemporary surveys (prior junctions). For this survey, four junctions were examined, three of which were current junctions.

Difference surface methodology was used for the junction comparisons. Surfaces from the junctioning surveys were differenced from each other in CARIS HIPS. The differences were then extracted, statistics computed, and examined where differences exceeded the allowable TVU for the depth multiplied by 1.414 at a 95% C.I. (per the HSSD).

For current junction comparisons, 4 m resolution CUBE BASE surfaces were used for the comparisons.

For prior junction comparisons, sounding data from the prior survey was first downloaded from NCEI. These consisted of BAG surfaces, and in some cases XYZ data which was gridded to CSAR format in CARIS BathyDataBase. Current surveys were gridded at the same resolution as the prior survey as CUBE BASE surfaces before proceeding with differencing.

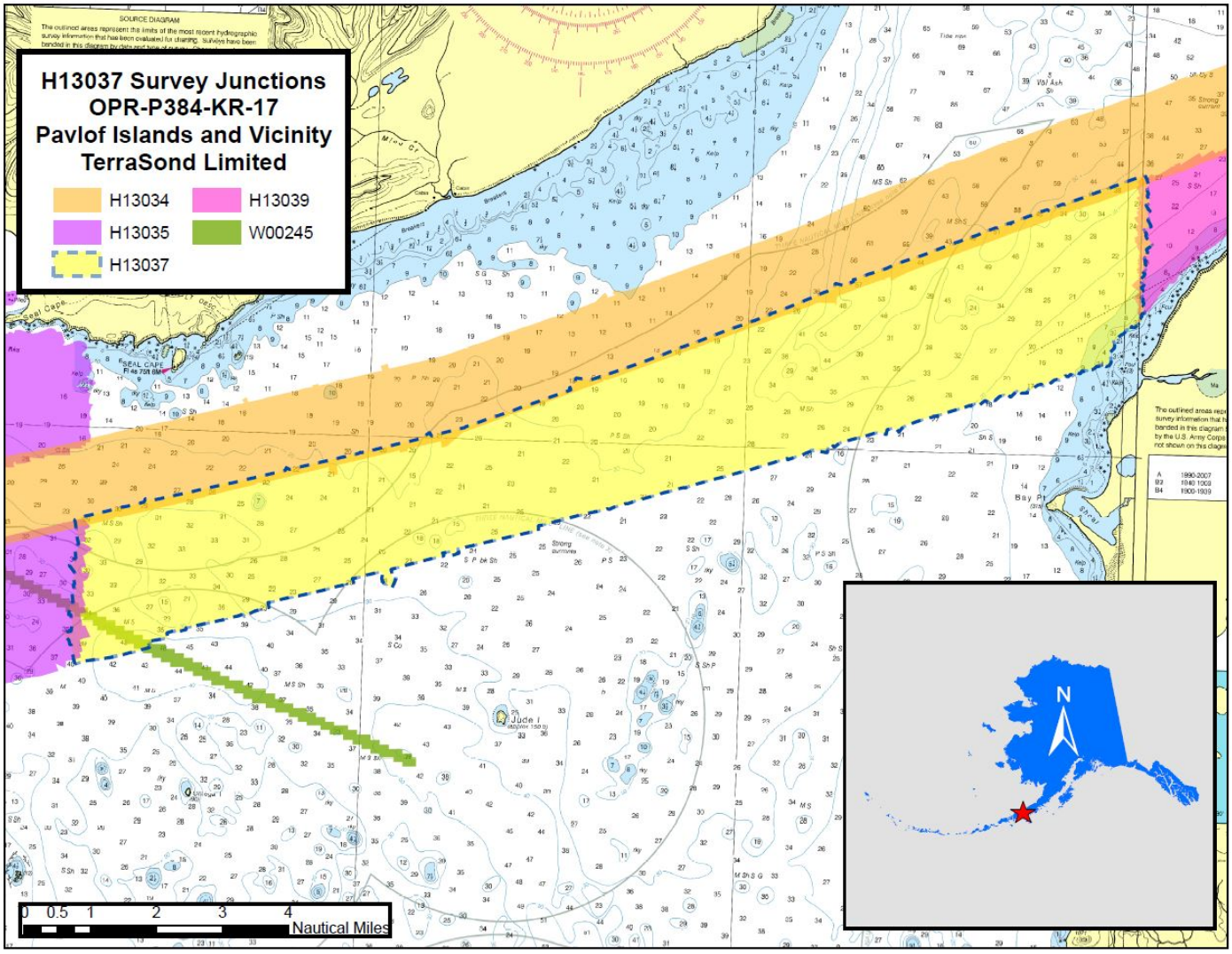

Figure 3: Survey extents and overview

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13034	1:40000	2017	Terrasond, Ltd.	N
H13035	1:40000	2017	Terrasond, Ltd.	W
H13039	1:40000	2017	Terrasond, Ltd.	E
W00245	1:20000	2011	NOAA Ship Oscar Dyson	SW

Table 9: Junctioning Surveys

H13034

4 m CUBE CSAR surfaces for H13034 and H13037 were differenced from each other and the results were extracted and analyzed. These surveys compare well within specifications. The average difference between these surveys is 0.043 m with a standard deviation of 0.193 m. At least 98.9% of overlapping grid cells compare within the allowable TVU (multiplied by 1.414) for the depth.

H13035

4 m CUBE CSAR surfaces for H13035 and H13037 were differenced from each other and the results were extracted and analyzed. These surveys compare well within specifications. The average difference between these surveys is 0.048 m with a standard deviation of 0.132 m. At least 99.9% of overlapping grid cells compare within the allowable TVU (multiplied by 1.414) for the depth.

SAR: Staticstics generated from QC Tools indicates 100% grid cells are within the allowable TVU. Looking below, the reported results from the H13035 and H13039 analysis may be reversed.

H13039

4 m CUBE CSAR surfaces for H13037 and H13039 were differenced from each other and the results were extracted and analyzed. These surveys compare well within specifications. The average difference between these surveys is 0.021 m with a standard deviation of 0.113 m. 100% of overlapping grid cells compare within the allowable TVU (multiplied by 1.414) for the depth.

SAR: Staticstics generated from QC Tools indicates 99.5+% grid cells are within the allowable TVU. Looking above, the reported results from the H13035 and H13039 analysis may be reversed.

W00245

Overlap between these surveys is minimal, with only about 2.5 km of trackline from W00245 overlapping this survey's SW corner.

8 m BAG surface data for W00245 was differenced from a 8 m CUBE CSAR surface for this survey. W00245 was found to be 0.744 m deeper on average than this survey, with a standard deviation of 0.248 m. The average difference is relatively significant and indicates a bust. However, 99.7% of the overlapping grid cells agree within the allowable TVU (multiplied by 1.414) for the depth. Therefore, comparison results are marginal but within acceptable parameters.

B.2.4 Sonar QC Checks

Echosounder confidence checks consisting of bar checks, lead lines, and inter-vessel acoustic comparisons were undertaken on this project. Results were excellent, with agreement averaging 0.008 m for bar checks, 0.007 m for lead lines, and 0.056 m for inter-vessel acoustic comparisons . Refer to the bar check, lead line,

and echosounder depth comparison logs available in Separate I: Acquisition and Processing Logs for specific results. Refer to the project DAPR for more information regarding QC checks methodology.

B.2.5 Equipment Effectiveness

7101 Errant Pings

The 7101 MBES sonars often output an errant, skewed swath. These were relatively common but generally did not occur consecutively, therefore having little effect on data quality or density. These were rejected manually in CARIS swath editor when encountered, or in CARIS subset mode if they adversely affected final surfaces. Refer to the DAPR, Section B, for more information and an example.

ASV-CW5 Rotated Head

The ASV-CW5 MBES sonar head was rotated 30 degrees to starboard (starboard-up) from JD211 onwards to more effectively survey near-shore areas. Although this configuration was advantageous for surveying steep, rocky areas, the rotation made starboard beams more subject to errors including those from sound speed, motion, and acoustic noise, especially when surveying flat offshore areas. While in this configuration, care was taken to ensure appropriate overlap and reject erroneous outer beam data in processing. Unrejected (accepted) soundings collected in this configuration showed good agreement with crosslines as well as overlapping lines. Final data is within specifications. Refer to the DAPR Section B for more information.

B.2.6 Factors Affecting Soundings

Sound Speed Error

A general downward or upward across-track cupping in multibeam data, indicative of sound speed error, is present sporadically in the data set. For ASV-CW5 data collected with the 30 degree rotated sonar head, this appears instead as an upward or downward curving swath on the starboard side only. When it occurred, the sound speed error adversely affected outer beams by up to 0.50 m in places, to 1 m or more on rotated head data. To minimize the error, sound speed profiles were collected every 2 to 4 hours during multibeam operations, and filters were used in processing to remove the outermost beams. Additionally, in processing, outer beam data was rejected manually where sound speed error adversely affected the surface by an amount greater than the allowable TVU for the depth. The effect of sound speed error on final surfaces is relatively minor, normally not exceeding 0.5 m, and is within specifications.

Motion Artifact

Motion artifact, though uncommon, is occasionally visible in the final multibeam surfaces. This is the result of uncompensated effects of motion, particularly due to roll. The primary contributer was motion induced

on the survey vessels by poor sea states. A survey-grade Applanix POSMV units were used for motion compensation but residual error within the manufacturer specifications for the system remains nonetheless. The problem was addressed in acquisition by avoiding surveying in higher sea states whenever practical, and running with line spacing that allowed significant overlap between lines in Complete Coverage areas. In processing, filtering removed outer beams that were most affected, and remaining soundings that adversely affected the surfaces greater than the allowable TVU for the depth were manually rejected. Following the additional filtering and editing, the effect on the final surface is normally 0.25 m or less, which is within specifications.

Note that the ASV-CW5, at 3.5 m in length was a much smaller survey platform than the Q105 at 32 m in length, and therefore, experienced greater induced motion at the same sea states, resulting in more motion artifact for lines run simultaneously.

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 an Oceanscience RapidCAST system, which utilized a Valeport sound speed profiler. The interval between subsequent casts was normally 2 hours, though an interval of 4 hours was used from JD196 to JD207. During each cast, the sound speed sensor was lowered as close as possible to the seafloor, and then retracted to the vessel and downloaded. When surveying lines covering widely varying water depths, deeper portions of lines were favored for casts to ensure that the sound speed variance through as much water column as possible was measured.

The ASV-CW5 vessel was not equipped to collect sound speed profiles. Instead, the profile data collected aboard the Q105 was used to correct all ASV-CW5 data. This was possible because the ASV-CW5 worked in close proximity (up to 3 km, but usually within 1 km) of the Q105 at all times.

In processing, the sound speed profiles were examined and outliers rejected. Up and down portions of the profiles were averaged and a combined profile at a standardized 0.10 m depth increment was output to CARIS SVP format with time and position. Sound speed profiles were applied with the “nearest in distance within time” method in CARIS HIPS, with time set to 4 hours up until JD207, and 2 hours from JD207 onwards. Exceptions, if they occurred, are listed in section B.3 of this report.

B.2.8 Coverage Equipment and Methods

Refer to the DAPR, section B.2.4 "Data Coverage and Density," for details on the equipment, software, and methodology used to meet object detection, coverage, and data density requirements.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

Corrections applied to echo soundings are detailed in the project DAPR. No deviations occurred except for those listed below. Note that despite exceptions, affected data is within specifications.

Delayed Heave (TrueHeave) could not be applied to the following lines because POS raw file logging was stopped too early during acquisition. Real-time heave was used instead:

0059-ASV-197-D2MS00000_-_0002
0247-ASV-204-D2MS03300_-_0002

Note: Two versions of the HIPS Vessel File (HVF) exist for each vessel in the CARIS project (standard and "-DH" versions). This was done to address differences in raw multibeam record types for the lines associated with each HVF. Refer to Section B of the DAPR for additional information.

B.3.2 Calibrations

Calibrations were undertaken as described in the DAPR. No deviations occurred.

B.4 Backscatter

Multibeam backscatter was logged at all times during this survey, but not processed. Raw DB and XTF files, submitted with the survey deliverables, contain the backscatter records.

B.5 Data Processing

B.5.1 Primary Data Processing Software

The following Feature Object Catalog was used: V5.6.

There were no software configuration changes after the DAPR was submitted.

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
H13037_MB_4m_MLLW_Final	CUBE	4 meters	0 meters - 80 meters	NOAA_4m	Set Line Spacing MBES
H13037_MB_8m_MLLW_Final	CUBE	8 meters	72 meters - 160 meters	NOAA_8m	Set Line Spacing MBES

Table 10: Submitted Surfaces

The final depth information for this survey was submitted as CARIS BASE surfaces (CSAR format) which best represented the seafloor at the time of the 2017 survey. The surfaces were created from fully processed data with all final corrections applied.

Surfaces were created using NOAA CUBE parameters and resolutions by depth range in conformance with the 2017 HSSD. Surfaces were finalized, and designated soundings were applied where applicable. Horizontal projection was selected as UTM Zone 4 North, NAD83.

Non-finalized versions of the CSAR surfaces are also included. These do not have the _Final designation in the filename.

A CARIS HOB file was submitted (H13037_FFF.HOB) with the survey deliverables as well. The final feature file (FFF) contains meta-data and other data not readily represented by the final surfaces, including bottom samples and shoreline verification results, if applicable. Each object is encoded with mandatory S-57 attributes and NOAA Extended Attributes (V#5.6).

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.

Traditional Methods Used:

Discrete Zoning

The following National Water Level Observation Network (NWLON) stations served as datum control for this survey:

Station Name	Station ID
Sand Point, AK	9459450
King Cove, AK	9459881

Table 11: NWLON Tide Stations

The following subordinate water level stations were established for this survey:

Station Name	Station ID
Zachary Bay	9459465

Table 12: Subordinate Tide Stations

File Name	Status
9459450.tid	Final Approved

Table 13: Water Level Files (.tid)

File Name	Status
OPRR300KR2017_20171031.zdf	Final

Table 14: Tide Correctors (.zdf or .tc)

The Zachary Bay (9459465) station was used for tidal zoning purposes only. Final corrections used the NWLON station Sand Point, AK (9459450).

C.2 Horizontal Control

The horizontal datum for this project is NAD83 (2011).

The projection used for this project is UTM Zone 4N.

The following PPK methods were used for horizontal control:

Smart Base

Positioning and attitude data was post-processed for this project.

The Continually Operating Reference Station (CORS) site AB07 (Sand Point) was used as the primary base station for GPS post-processing. The site was used in an Applanix SmartBase (ASB) algorithm configuration, yielding final positioning results well within requirements. Project base stations installed in Sand Point (0056 and 5240) were not used for final positioning, but were utilized for independent position quality checks on the AB07-derived results.

Real-time positions for both vessels were replaced during data processing with post-processed kinematic (PPK) solutions, with few exceptions (noted if applicable earlier in this report).

Quality control confidence checks were performed at least weekly on the survey vessels as well as the project base stations. RMS error estimates for positioning results were very good, with RMS error generally estimated at 0.10 m (or better). Confidence check results are available in Separate I.

Refer to the project DAPR for additional details on quality control checks, results, and PPK processing methodology.

Final positions are NAD83 (2011).

The following CORS Stations were used for horizontal control:

HVCR Site ID	Base Station ID
AB07	Sand Point CORS

Table 15: CORS Base Stations

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
0056	Sand Point 1
5240	Sand Point 2

Table 16: User Installed Base Stations

WAAS was used for real-time corrections only.

The following WAAS Stations were used for horizontal control:

DGPS Stations
n/a

Table 17: FAA WAAS Stations

D. Results and Recommendations

D.1 Chart Comparison

The chart comparison was performed by examining all Electronic Navigational Charts (ENCs) that intersect the survey area. The latest editions available at the time of the review (12/4/17) were used.

The chart comparison was accomplished by overlaying the finalized BASE surfaces with shoal-biased soundings, and final feature file 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 80 m (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) were checked for updates affecting the area. None of note were found within this survey area that were issued subsequent to issuance date of the project instructions nor prior to the completion of operations.

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?
US4AK55M	1:80000	20	08/11/2017	08/11/2017	NO
US4AK56M	1:80000	4	12/04/2015	12/04/2015	NO
US4AK57M	1:80000	15	12/01/2015	12/01/2015	NO

Table 18: Largest Scale ENCs

US4AK55M

This survey's overlap with US4AK55M is incidental, with only slight overlap on this survey's west side. Refer to the DRs for concurrent junctioning surveys H13034 and H13035 for comparisons with this chart.

US4AK56M

General agreement between this survey and US4AK56M is good. The majority of charted soundings agree with this survey to within 2 m, with many agreeing to within 1 m or better. Charted soundings showing significant discrepancy from this survey are listed below.

1. Depths of about 81 m were found in the area of charted 76.8 m sounding at 55-16-45.552 N, 161-16-19.9848 W
2. Depths of about 44 m were found in the area of charted 53 m sounding at 55-17-27.9564 N, 161-13-07.3344 W
3. Depths of about 51 m were found in the area of charted 45.7 m sounding at 55-17-48.9228 N, 161-12-59.6736 W
4. Depths of about 56 m were found in the area of charted 64 m sounding at 55-21-54.24192 N, 160-54-16.40412 W
5. Depths of about 3.6 m were found in the area of charted 6.4 m sounding at 55-21-52.6104 N, 160-50-18.5928 W

There were no discernible trends in the chart agreement.

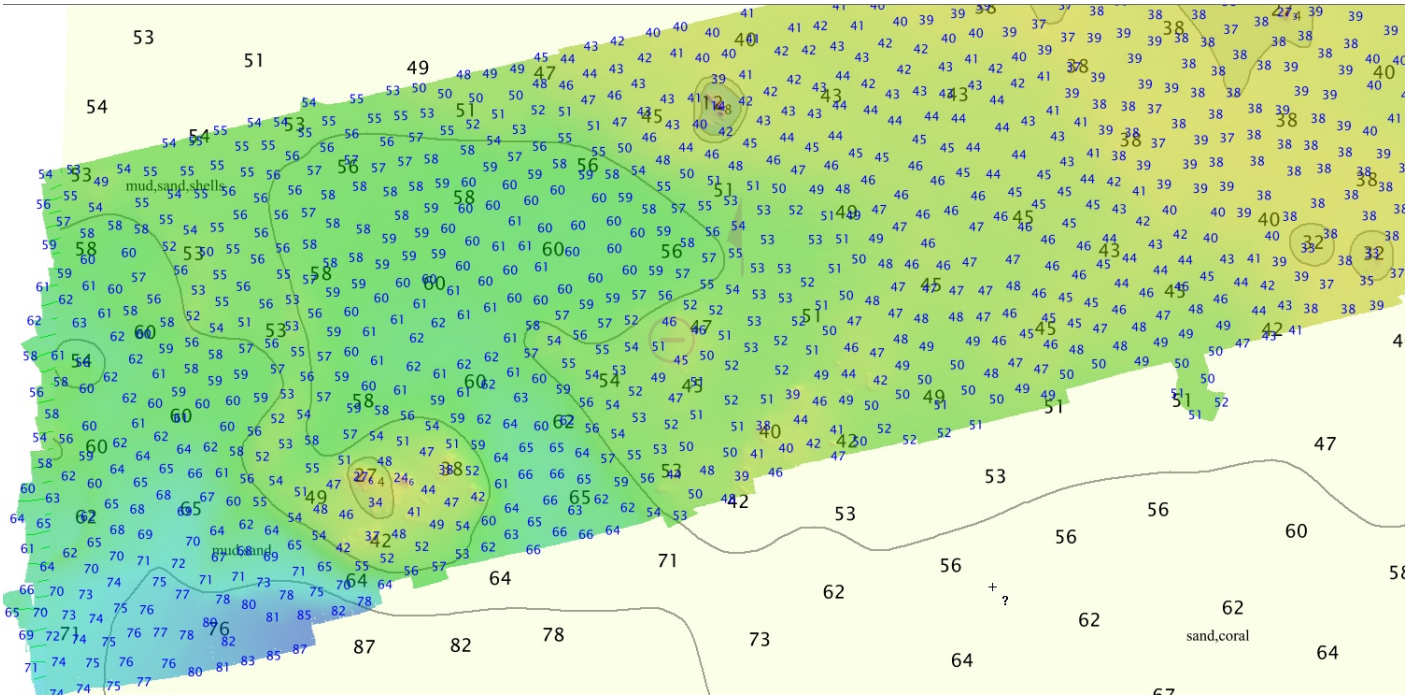

Figure 4: Soundings from this survey (blue) overlaid on ENC US4AK56M, showing generally good agreement. Image 1 of 4, west side of survey area. Soundings in meters.

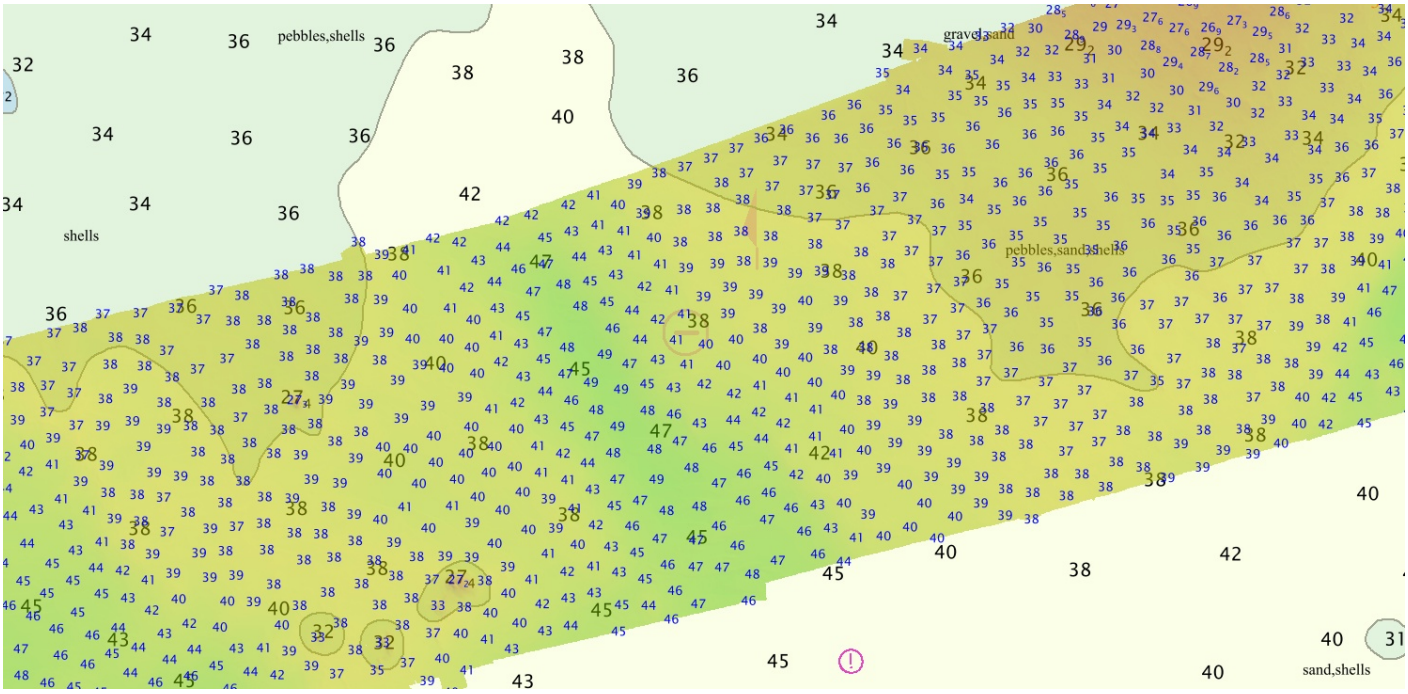

Figure 5: Soundings from this survey (blue) overlaid on ENC US4AK56M, showing generally good agreement. Image 2 of 4, west side of survey area. Soundings in meters.

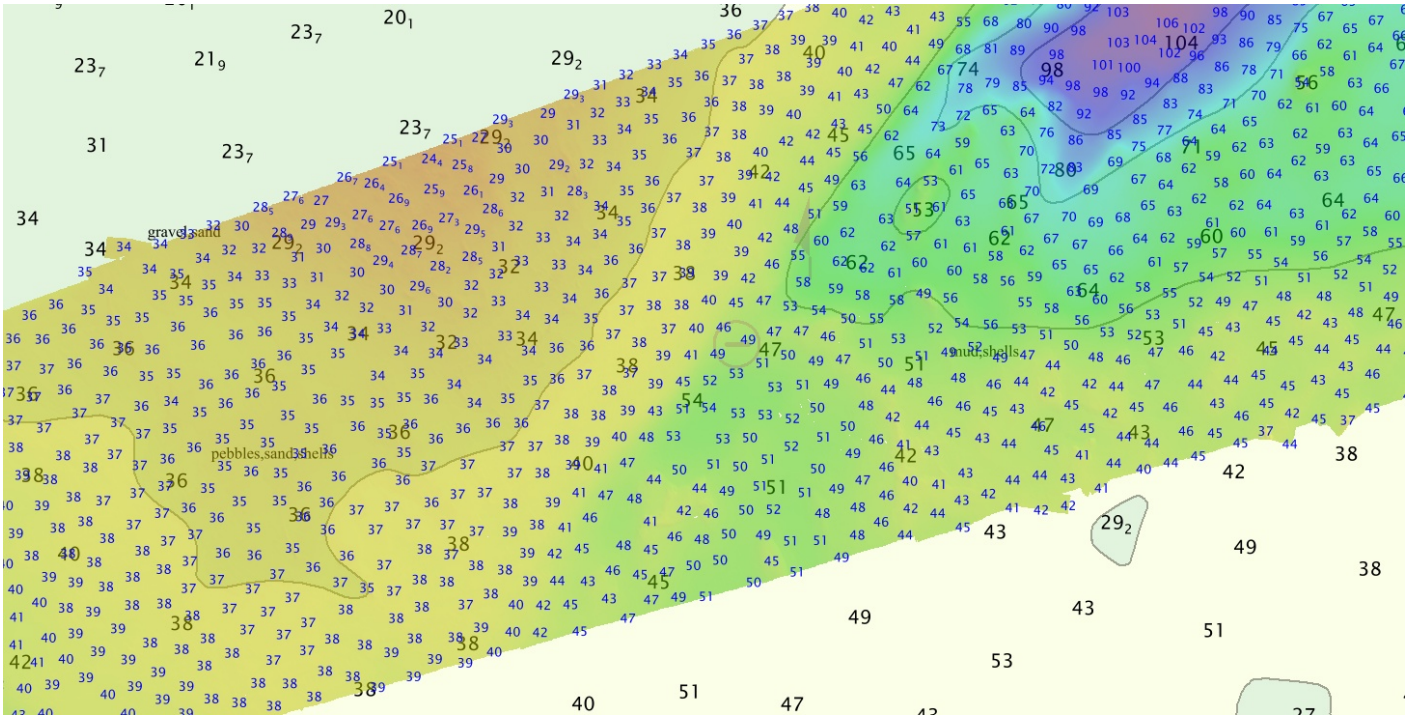

Figure 6: Soundings from this survey (blue) overlaid on ENC US4AK56M, showing generally good agreement. Image 3 of 4, east side of survey area. Soundings in meters.

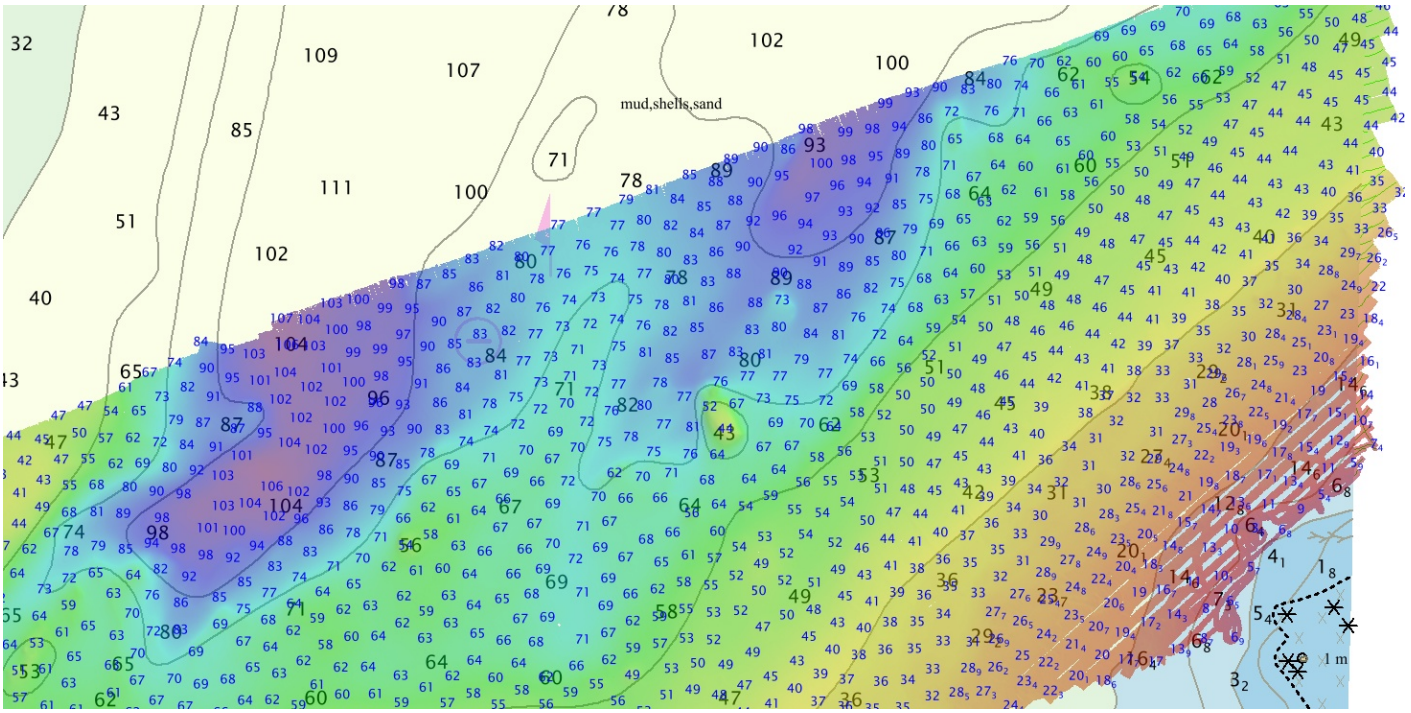

Figure 7: Soundings from this survey (blue) overlaid on ENC US4AK56M, showing generally good agreement. Image 4 of 4, east side of survey area. Soundings in meters.

US4AK57M

This survey's overlap with US4AK57M is incidental, with only slight overlap on this survey's east side. Refer to the DRs for the junctioning surveys to the east for discussion on agreement for this chart.

D.1.2 Maritime Boundary Points

No maritime boundary points were assigned for this survey.

D.1.3 Charted Features

There are no charted features labeled PA, ED, PD, or Rep. within the survey extents.

D.1.4 Uncharted Features

New features (such as kelp, rocks, reefs, ledges, and foul areas) were identified in the near-shore zone during limited shoreline verification and are portrayed in the FFF. Other significant uncharted features including DTONs, if applicable, are discussed elsewhere in this report

D.1.5 Shoal and Hazardous Features

No charted shoals or potentially hazardous features were identified for investigation. Near-shore rocks and other features were investigated during limited shoreline verification as discussed elsewhere in this report.

No DTONs were submitted for this survey.

D.1.6 Channels

No channels exist in the survey area.

D.1.7 Bottom Samples

Bottom samples were collected for this survey.

Of the assigned bottom sample locations in the Project Reference File (PRF), four intersected this survey area. Samples were successfully obtained at all locations.

For primary constituents, three samples returned sand while one returned pebbles. Shells were secondary constituents in all samples.

Discrepancies (for primary constituents) found between this survey's bottom samples and charted samples are:

1. Sand was returned at 55-18-34.56 N, 161-16-43.92012 W where the chart indicates mud. However, the chart notes sand as a secondary constituent.
2. Sand was returned at 55-20-06.9 N, 161-03-22.61988 W where the chart indicates pebbles. However, pebbles were returned as a secondary constituent as well.
3. Pebbles were returned at 55-20-36.12012 N, 160-58-22.73988 W where the chart indicates mud.

Samples were not retained. However, photos were taken prior to discarding. Bottom characteristics were encoded as SBDARE objects in the FFF, with photos in the accompanying "Multimedia" directory, included with the survey deliverables.

D.2 Additional Results

D.2.1 Shoreline

Limited shoreline verification was assigned and accomplished for this project.

A Composite Source File (CSF) was provided with the Work Instructions. Assigned features were extracted from the CSF and systematically investigated. The primary method of investigation was through low-altitude inspection using a UAS (unmanned aerial system) at low tide. Structure from Motion (SfM) software was used to build orthophotomosaics of approximately 3.5 cm resolution and tide-corrected DEM point clouds of approximately 10 cm resolution over assigned feature locations and the surrounding area within the assigned search radius (80 m, or 1 mm at chart scale). These were then correlated with the assigned features and attributed accordingly in CARIS HIPS to assemble the Final Feature File (FFF) submitted with the survey deliverables.

The vast majority of features were verified to exist within 80 m of their source location. However, most required modification to their positions or extents. Features originating from the chart showed the greatest discrepancy from this survey, but usually were still within 80 m.

GC-sourced features agreed to this survey well, often to within 5 m.

Conflicting features (pairs of features), sourced from GC and the chart, were common in the CSF. These were deconflicted, usually resulting in one revised (new) feature.

Only a small amount of shoreline on the NW side of Unga Island intersected this sheet. The shoreline was mostly noted as foul, with with many rocks shoreward and heavy kelp offshore.

Refer to the FFF for investigation results including recommendations. Refer to the DAPR for details on shoreline verification acquisition, processing, and quality control. Refer to the Multimedia directory submitted with the survey deliverables for orthophotomosaics and DEM TIF images (projected as NAD83 UTM Zone 4).

D.2.2 Prior Surveys

Comparison with prior, contemporary surveys was undertaken. Results are described previously in this report under Junctions.

D.2.3 Aids to Navigation

No charted ATONs existed in the survey area. No uncharted ATONs were observed.

D.2.4 Overhead Features

No overhead features existed within the survey area.

D.2.5 Submarine Features

No submarine cables, pipelines, tunnels, or similar features existed within the survey area.

D.2.6 Platforms

Platforms do not exist within the survey area.

D.2.7 Ferry Routes and Terminals

No established ferry routes or terminals exist within the survey area.

D.2.8 Abnormal Seafloor and/or Environmental Conditions

No abnormal seafloor or environmental conditions of special note were encountered.

D.2.9 Construction and Dredging

No construction or dredging was occurring within the survey extents, nor are there any known future plans for construction or dredging in the survey area.

D.2.10 New Survey Recommendation

No new surveys are recommended in this area.

D.2.11 Inset Recommendation

No new chart insets are recommended in this area.

E. Approval Sheet

Field operations contributing to the completion of survey H13037 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 respectfully submitted for final review and acceptance.

The survey data was collected in accordance with the Hydrographic Survey Project Instructions and Statement of Work, and meets or exceeds the requirements set in the 2017 NOS Hydrographic Surveys Specifications and Deliverables (HSSD) document. This data is adequate to supersede charted data in common areas. This survey is complete and no additional work is required with the exception of any deficiencies, if any, noted in this Descriptive Report. The Data Acquisition and Processing Report (DAPR) and Horizontal and Vertical Control Report (HVCR) were submitted concurrently with this report and the survey deliverables. Other significant reports and data packages submitted separately are listed below.

Report Name	Report Date Sent
OPR-P384-KR-17 Tide Zoning Report	2017-12-04
Coast Pilot Review Report	2017-11-30
Marine Mammal Observers Training Logsheet and Observation Logs	2017-11-30
Tides and Water Levels Package and Removal Reports for Zachary Bay (9459465)	2017-11-27
NCEI Sound Speed Data	2017-10-25
Tide Station Installation Report for Zachary Bay (9459465)	2017-08-17

Approver Name	Approver Title	Approval Date	Signature
Andrew Orthmann, C.H.	TerraSond Charting Program Manager	12/23/2017	Andrew Orthmann Digitally signed by Andrew Orthmann Date: 2017.12.23 19:46:55 -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	Continually Operating Reference Staiton
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
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
HSSD	Hydrographic Survey Specifications and Deliverables

Acronym	Definition
HSTP	Hydrographic Systems Technology Programs
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
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NAIP	National Agriculture and Imagery Program
NALL	Navigable Area Limit Line
NM	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
PRF	Project Reference File

Acronym	Definition
PS	Physical Scientist
PST	Physical Science Technician
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPE	Total Propagated Error
TPU	Topside Processing Unit
USACE	United States Army Corps of Engineers
USCG	United Stated Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDA	Global Positiong System timing message
ZDF	Zone Definition File

APPROVAL PAGE

H13037

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NCEI for archive

- Descriptive Report
- Collection of Bathymetric Attributed Grids (BAGs)
- Collection of backscatter mosaics
- Processed survey data and records
- Bottom samples
- GeoPDF of survey products

The survey evaluation and verification has been conducted according current OCS Specifications, and the survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Approved: 

Digitally signed by
HAUSER.OLIVIA.A.1275636009
Date: 2018.08.13 18:15:34 -07'00'

Lieutenant Commander Olivia Hauser, NOAA
Chief, Pacific Hydrographic Branch