W00427

NOAA Form 76-35A

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

DESCRIPTIVE REPORT

Type of Survey: Support NMFS

Registry Number: W00427

LOCALITY

State: Alaska

General Locality: Bering Sea

Sub-locality: Pribilof Islands

2016

CHIEF OF PARTY
N/A

LIBRARY & ARCHIVES

Date:

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET		**W00427**

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:	**Alaska**
General Locality:	**Bering Sea**
Sub-Locality:	**Pribilof Islands**
Scale:	N/A
Dates of Survey:	**05/23/2016 to 8/31/2016**
Instructions Dated:	**09/12/2011**
Project Number:	**OPR-PHB-18**
Field Unit:	**Saildrone**
Chief of Party:	**N/A**
Soundings by:	**Singlebeam Echo Sounder**
Imagery by:	
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

The purpose of this survey is to test saildrone technology and collect environmental data using unmanned systems. Sounding data collected provided updates to National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Centers for Envitronmental Information (NCEI) and can be retrieved via http://www.ncei.noaa.gov/.

PMEL/AFSC/NOAA 2016 Saildrone Project 2016

NOAA's Pacific Marine Environmental Laboratory and Alaska Fisheries Science Center are testing new technologies that, if successful, will enable autonomous collection of environmental data using unmanned systems. As part of this effort, two wind-propelled and solar-powered Saildrones were deployed in the Bering Sea in May of 2016. The Saildrones were outfitted with a split beam echo-sounder and capable of continuously operating 24 hours a day at 3-5 knots depending on wind speeds. Each Saildrone collected oceanographic and biological data that were used to better understand endangered and commercially important species living in remote areas near the Pribilof Islands. NOAA's Hydrographic Systems and Technology Branch (HSTB) extracted the seafloor return from this system, applied corrections to reduce the data to mean-lower low water, and assessed the precision and accuracy of these measurements. We recommend the depths from this system be used to update the charts in this area.

Both Saildrones are equipped with a Kongsberg Wide Band Transceiver autonomous scientific echo-sounder. The receiver on Saildrone 128 was replaced half-way through the project with a prototype Wide Band Transceiver Mini (WBAT-Mini). Because of this switch, there are three separate sets of data used for this comparison (Fig 1). Vessel position was logged using a Trimble C1919 "Condor" GPS and attitude was logged using a Yost Labs TSS-EM "3Space" IMU. Position data were matched to the extracted bathymetry by matching time stamps. While we could have used the attitude data from the IMU for heave correction, this would have required significant post-processing, so we used a low-pass filter to remove the heave signal.

Method

HSTB developed Python code to read the Saildrone sonar data and create bottom detections. This code extracts the seafloor using a simple peak-amplitude bottom detection. The depths were reduced to mean lower low water datum by applying static draft and water-level correctors from TCARI file "FA1603_SDwl_2016-05-22_09-03.tc." Tidal corrections range from -0.26 to 1.85 meters with a mean of 0.81 meters. Heave was removed using a fifth order low-pass Butterworth filter with 20 second critical frequency. This filter effectively removes the wave-induced heave signal, but at the cost of spatial smoothing of the seafloor. At typical vessel speeds of 3-4 knots, this filter limits the spatial resolution of measurements to 30-50 meters. The corrected soundings are included with this submission as .txt files. Each file has six columns of data. The columns contain the following information: time, latitude, longitude, TCARI water-level, depth (MLLW), depth (MLLW filtered to remove heave).

Quality Control

For analysis and quality control, we loaded the MLLW, filtered depths into CARIS BDB using the Basic Weighted Mean method for comparison to reference data. We gridded the data to .0005 decimal degree cells (approximately 31m X 56m) for data analysis and .04 decimal degree cells (approximately 2486m X 4445m) for image creation. We performed all statistical analysis within this report using the .0005 decimal degree grid only. The size of the .0005 decimal degree grid roughly aligns with the spatial resolution of the filter output. Pre-acquisition vertical uncertainty was estimated to be +/- 0.35 cm at 1 sigma computed from the RMS of the following components: (tide-0.1m, offsets-0.1m, waterline-.05m, and sounding uncertainty-0.1m). The range scale for the system was set to 200 meters in all areas. We trimmed the soundings geographically to remove spurious data from deep areas such as south of the Pribilof Islands and near the deployment area at Dutch Harbor (Fig 2).

The processing branch added an uncertainty layer to the gridded data in meters instead of centimeters. +/- 0.35cm seemed too low of a value for this type of vessel so +/- 0.35m was used instead when processing uncertainty.

Chart Comparison

We compared the soundings from this system to a TIN of the charted (16006) soundings. The grids shown in this report are colored by difference from the charted soundings, with red indicating survey depths shallower than the chart, green deeper, and gray with little difference. Overall, the depths from this survey agree with the chart. Saildrone 126 is on average 0.4m deeper than charted depths with one standard deviation of 4.3 meters. Saildrone 128 is on average 2.9m shallower than charted depths with one standard deviation of 12 meters. Saildrone 128 (Mini) is on average 0.7m deeper than charted depths with one standard deviation of 3 meters. The general bias is likely due to the small scale of the chart and the shoal-biased compilation process. We did observe a few significant differences. An area southwest of Nunivak Island has a single charted depth of 25 fathoms (46 meters). Data from both Saildrones show the area to be roughly 18 meters deeper (Fig 3). North of St. Paul Island, surveyed soundings

are approximately seven to eight meters shoaler than charted depths (Fig 4). Another example is found northwest of St. Paul Island where surveyed soundings are 14.5 meters shallower than charted depths (Fig 5).

PARS Comparison

All Saildrone data were then compared to a 16 meter grid collected by the NOAA Ship Rainier. The Rainier acquired this data for the Port Access Route Study (PARS) project OPR-R976-RA-15 for the United States Coast Guard. An overview of where all Saildrone data intersects with PARS data is provided with this document (Fig 6). The PARS surface used for comparison is 'D00198_MB_16m_MLLW_Combined'. Data are internally consistent between both Saildrone and PARS. Surface 'SD_126_Combined_.0005dd' is on average 0.6m shallower than PARS surveyed depths with one standard deviation of 1.9 meters. North of Unimak Pass, surface 'SD_128_WBAT_Combined_.0005dd' is on average 1.9m shallower than PARS surveyed depths with one standard deviation of 4.0 meters. South of Nunivak Island, 'SD_128_Mini_Combined_.0005dd' is on average 0.1m deeper than Rainier's PARS surface with one standard deviation of 0.4 meters.

Recommendation

The data from this system is internally consistent, compares well with the Rainier with little observable bias, and generally is consistent with currently charted soundings. We recommend updating charted depths with the gridded depths from this system, particularly in areas currently with sparse or no coverage.

PMEL/AFSC/NOAA 2016 Saildrone Project 2016

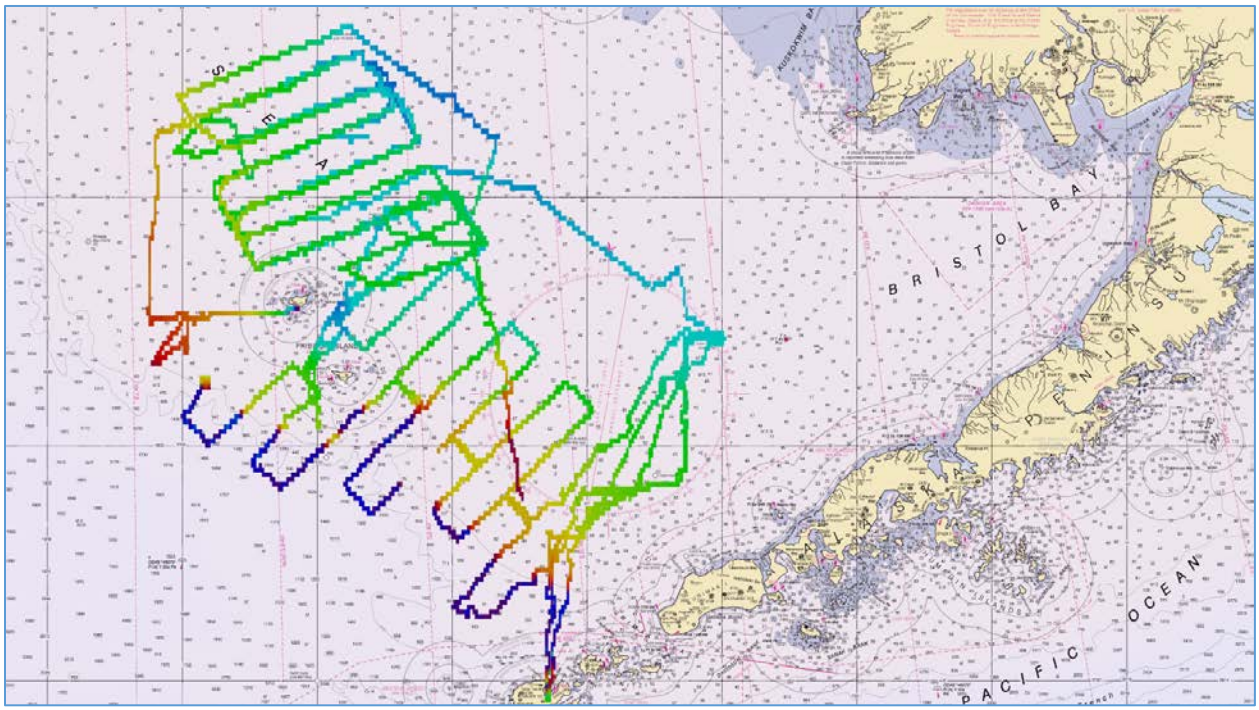

Figure 1: All Saildrone Data Overview

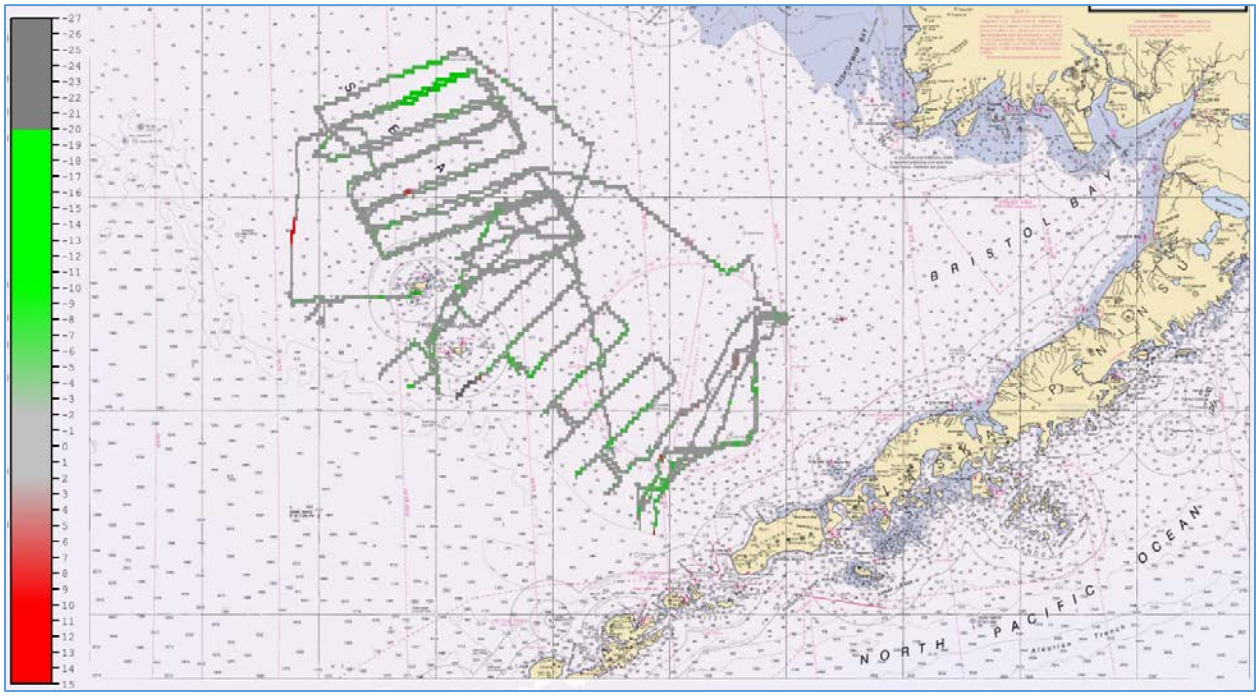

Figure 2: Extracted Saildrone Data Overview Colored by Depth Difference

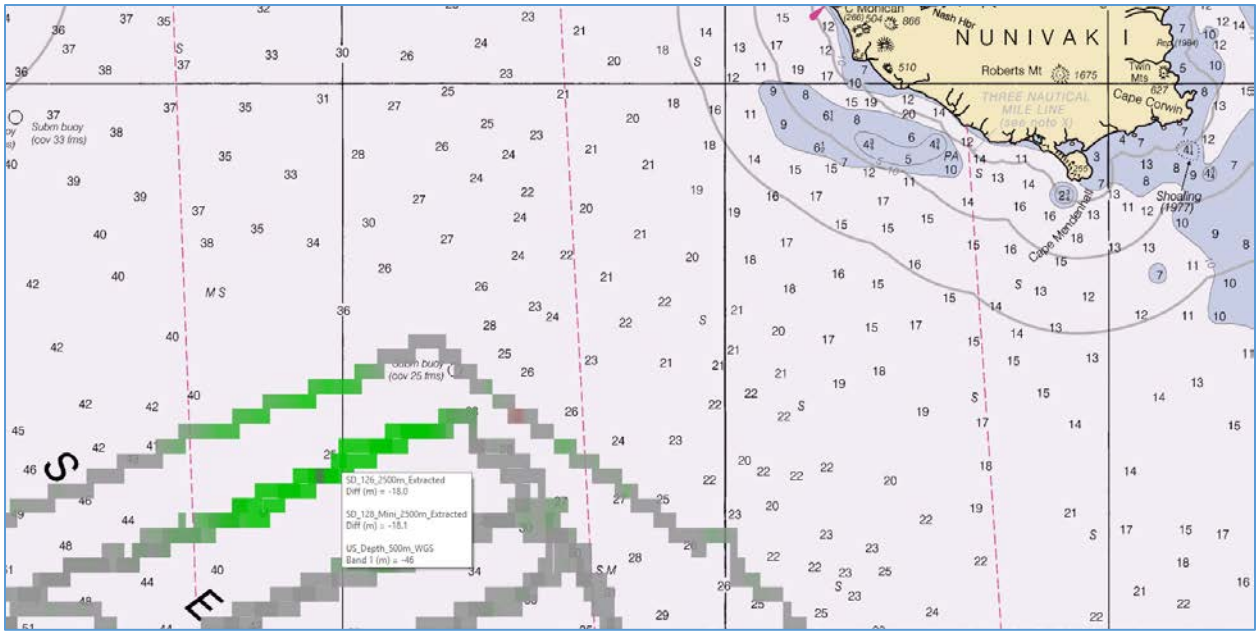

Figure 3: Deeper Area Southwest of Nunivak Island

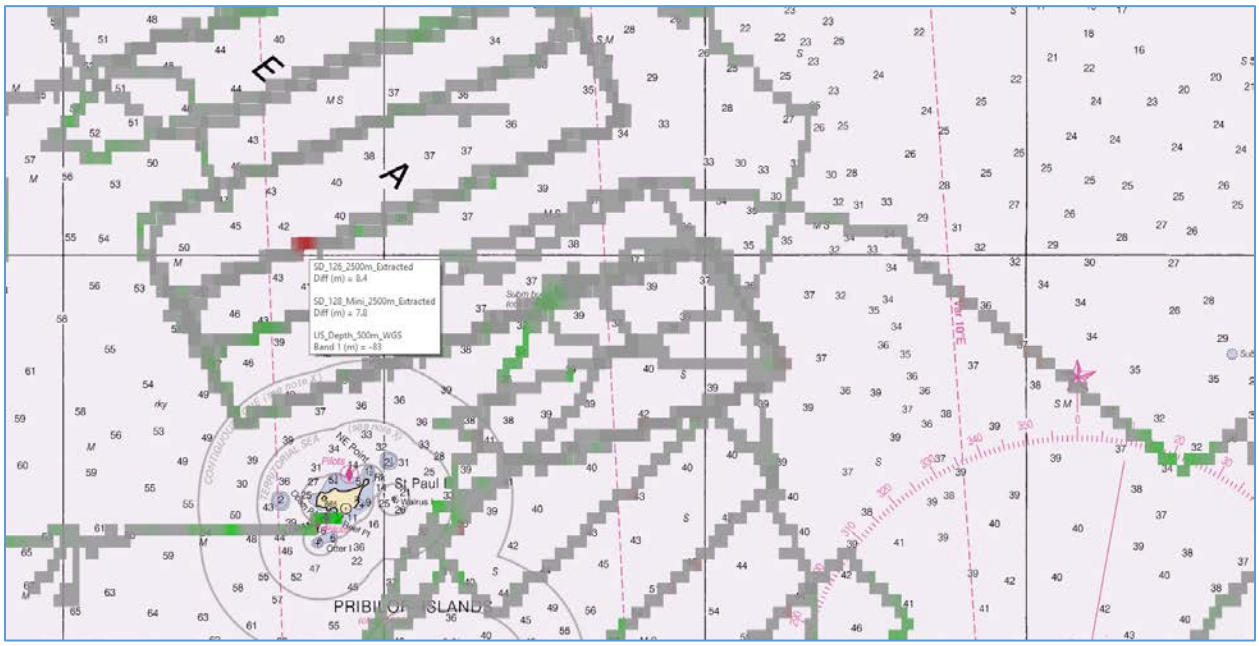

Figure 4: Shallow Area North of St. Paul Island

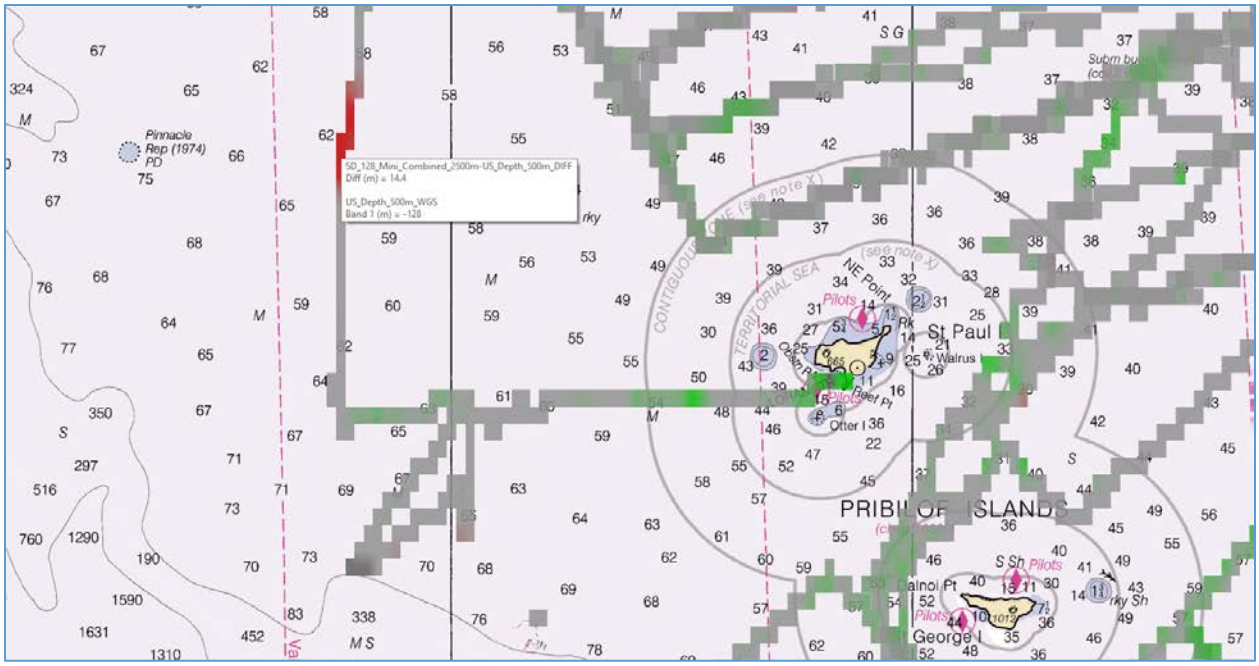

Figure 5: Shallow Area Northwest of St. Paul Island

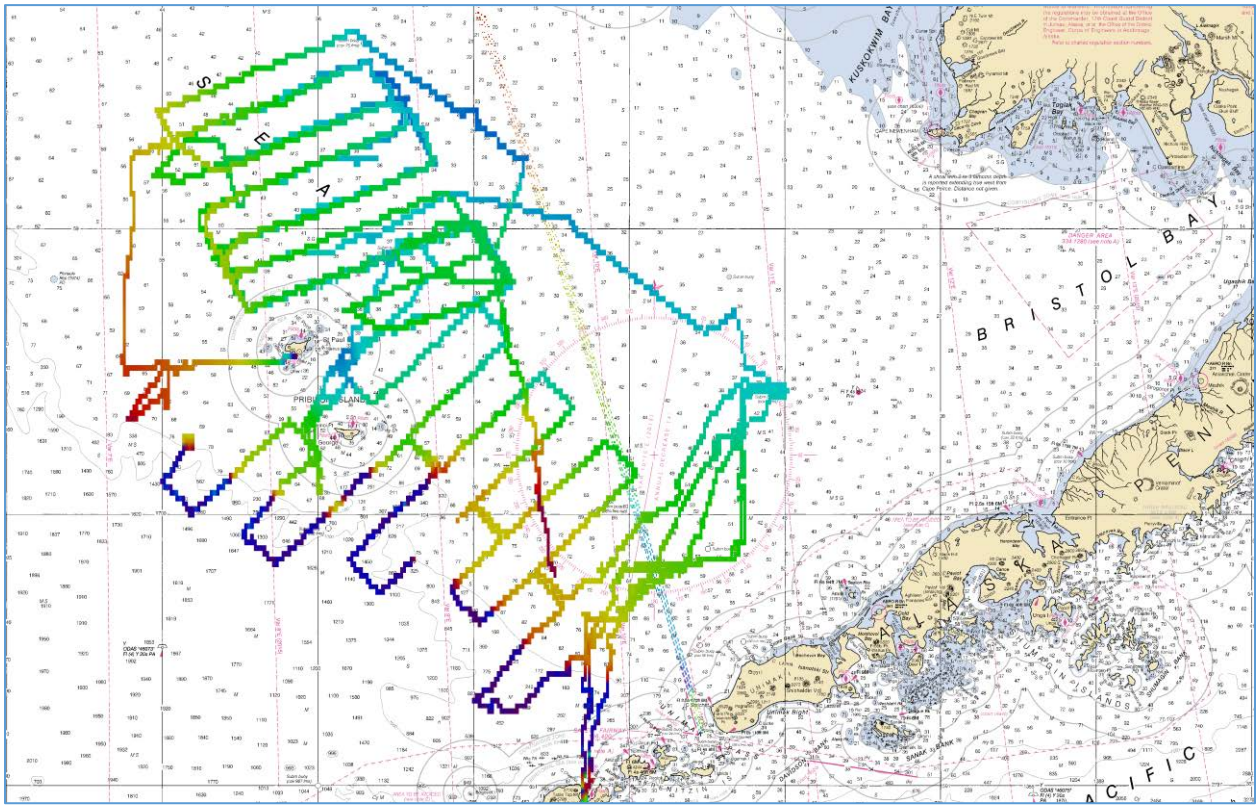

Figure 6: Saildrone and PARS Crosslines

APPROVAL PAGE

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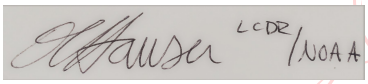
Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NCEI for archive

- Descriptive Report
- Collection of Bathymetric Attributed Grids (BAGs)
- Processed survey data and records
- 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: 2018.08.27 14:53:23 -07'00'

Lieutenant Commander Olivia Hauser, NOAA
Chief, Pacific Hydrographic Branch