U.S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

HORIZONTAL AND VERTICAL CONTROL REPORT

Type of Survey Navigable Area

Project No. OPR-R385-KR-20

Time Frame June – September, 2020

LOCALITY

State Alaska

General Locality Norton Sound, AK

2020

CHIEF OF PARTY

THOMAS MORINO

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DATE

Horizontal and Vertical Control Report

OPR-R385-KR-20

Norton Sound, AK

January 12th, 2021

Staff Shots at Stebbins Tide Station

Project Name:	***Norton Sound, AK***
General Locality:	***Norton Sound***
Sub Localities:	***H13370 – St. Michael Bay and Stephens Pass*** ***H13371 – Orizaba Reef to 25nm NW of Stuart Island*** ***H13372 – Stuart Island*** ***H13373 – Vicinity of Egg Island*** ***H13374 – Approach to Unalakleet*** ***H13375 – Tolstoi Point to Healy***
Vessel(s):	***R/V Qualifier 105 and ASV C-Worker 5***
Field Unit:	***TerraSond***
Lead Hydrographer:	***Thomas Morino***

A. Vertical Control

Mean lower low water (MLLW) was the vertical control datum for this survey. All soundings are referenced to MLLW.

All time measurements were made in Universal Time Coordinated (UTC). The local time zone was offset from UTC by eight hours (Alaska Daylight Time = UTC – 8 hours). No measurements were made using local time.

A.1. Tide Corrector Stations

Two tertiary tide stations, at Stebbins and Koyuk, were installed under this project. The stations are summarized in the table below.

Tide Station (AK)	Station No.	Latitude (NAD83)	Longitude (NAD83)	Julian Days of Operation (2020)	Configuration
Stebbins	9468151	63-31-30 N	162-17-35 W	182 – 269	1 WaterLOG H350XL bubbler, 1 RBRsolo DTide16 pressure gauge, 1 GNSS Buoy
Koyuk	9469031	64-55-52 N	161-09-03 W	226 - 268	1 WaterLOG H350XL bubbler, 2 RBRsolo DTide16 pressure gauges, 1 GNSS-R

Table 1 – Tide Stations

In addition, ERTDM validation sites were installed at three separate locations. These are summarized in the table below.

ERTDM Validation Site (AK)	Station No.	Latitude (NAD83)	Longitude (NAD83)	Julian Days of Operation (2020)	Configuration
Western Norton Sound	9999771	63-44-31 N	162-24-36 W	187 - 222	1 GNSS buoy
Eastern Norton Sound	9999776	63-43-29 N	161-28-23 W	223 - 257	1 GNSS buoy
St. Michael	9999770	63-29-05 N	162-00-48 W	184 - 273	1 RBRsolo DTide16 pressure gauge, 1 GNSS-R station (pre-existing)

Table 2 – ERTDM Validation Sites

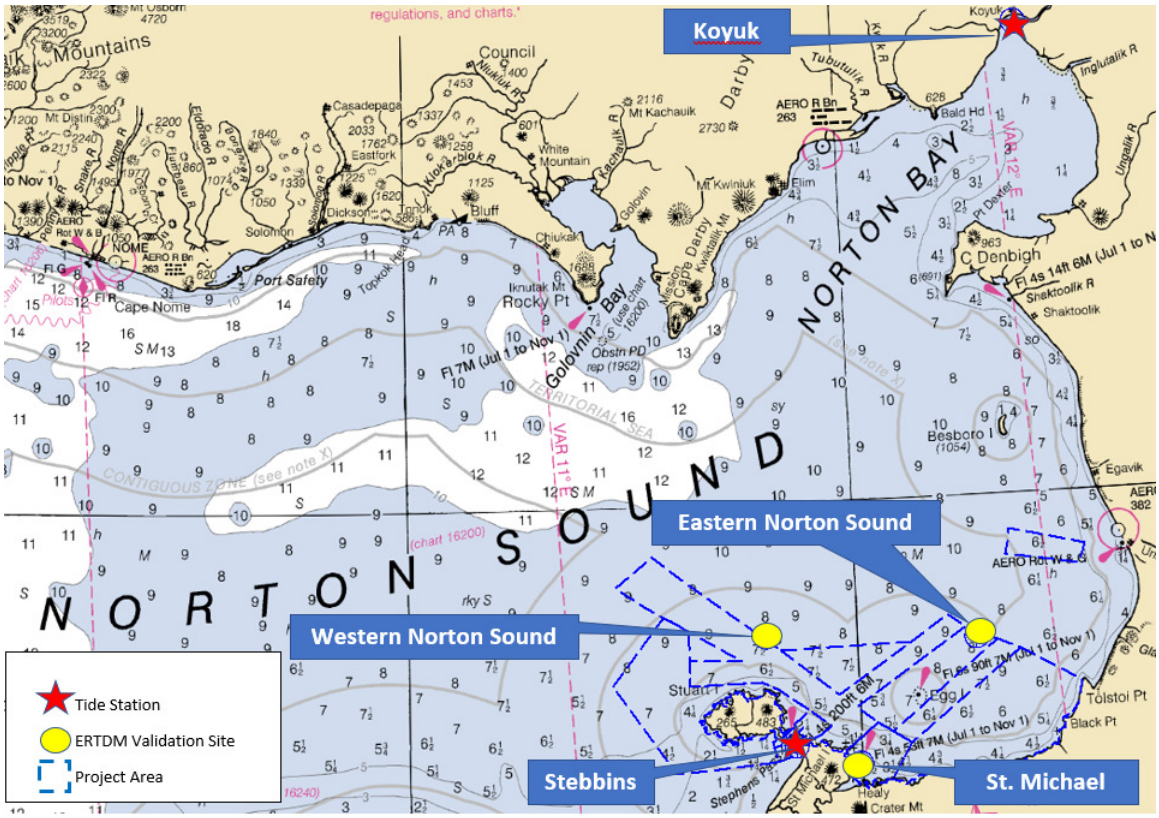

Figure 1 – Project overview including tide station locations

TerraSond contracted JOA Surveys, LLC (JOA) for tide support. JOA handled most tasks associated with the on-shore gauges as well as processing of tide data, datum computations, derivation of tide zones, and tide report compilation. TerraSond deployed and recovered all GNSS buoys and performed interim staff shots at Stebbins tide station.

A.2. Tide Equipment

A wide range of tide and supporting equipment were utilized on this project. An overview of equipment was provided in tables 1 and 2 above. Refer to the site reports in Appendix I for specific models as well as their configurations and calibrations.

A.3. Summary of Significant Tide Equipment Issues

Western Norton Sound: This GNSS buoy deployment was not originally planned. The deployment was planned for the Eastern Norton Sound location but placed at this location in error. The unplanned deployment was considered opportunistic and 35 days of data was collected before moving the buoy to the planned location, where an additional 34 days was collected.

St Michael: The RBR pressure sensor was damaged on installation and did not log data. NOAA accepted the unplanned Western Norton Sound dataset and an analysis of GNSS-R data at St. Michael instead. Correspondence related to this is included with the project DRs. Refer to Appendix II for the St. Michael GNSS-R Analysis Report.

Stebbins: The RBR pressure sensor at this site was also damaged on installation and did not log data. The two other sensors (bubbler and GNSS buoy) were used to form a complete data set.

Refer to the tide reports in Appendix I for additional details on all issues and their resolution.

A.4. Tide Correctors

Tidal corrections for hydrography was accomplished using ERS methodology. The NAD83 to MLLW grid file "OPR-R385-KR-20_ERTDM_NAD83-MLLW_04162020" provided by NOAA was used for all corrections. The grid file has an estimated uncertainty of 0.135 m (at one standard deviation). Refer to the DRs for correspondence relating to this grid file.

Discrete tide zones were computed but not used for correction of bathymetric data. Tide zones were used for comparison purposes only.

A.5. Tide Comparisons

The ERTDM grid was compared to an ERZT model made from tide zones generated for the project. The mean difference between the ERZT results and the ERTDM surface is 0.02 m with a standard deviation of 0.12 m.

Detailed results of the comparison, as well as additional vertical control analysis, is included in the Vertical Control Analysis Report in Appendix III.

B. Horizontal Control

The horizontal control datum used for this survey was NAD83 (2011). All final positions are NAD83 (2011).

Vessel positions were initially post-processed in the field in Applanix POSPac MMS (v8.4) software using the Trimble PP-RTX corrections service.

Following completion of field operations and availability of precise ephemeris data, vessel positions were re-processed in POSPac using Applanix Smart Base (ASB) methodology. ASB utilized publicly available precise ephemeris and GNSS data from CORS sites in the region to generate corrections within a network at each vessel position. CORS sites commonly utilized in the ASB network are listed below.

HVCR Site ID	Base Station ID
StMichael AK2018	AT01
Bethel WAAS	BET1
BaldHead Ak2006	AC31
Buckland AK2007	AC07
Unalakleet AK2008	AB17
Razorback AK2007	AB09
Mekoryuk AK2008	AB04
Savoonga AK2007	AB04

Figure 2 – CORS sites used in ASB processing

ASB yielded generally better positioning results and therefore ASB SBETs were applied for final corrections. In a few isolated cases PP-RTX SBETs were applied to lines. Cases where PP-RTX was used instead of ASB are itemized in the appropriate DRs.

Real-time positions were provided by FAA WAAS. Note that all real-time corrections were replaced in post-processing for final data.

Refer to the DAPR for details on positioning results and methodology.

Vessel position confidence checks were performed by comparing PPRTX and ASB methodology, with good results. These checks are available with each DR.

Correspondence relating to tides are also available with the project DRs. Note that all tide data and associated reports have been separately submitted to CO-OPS. The transmittal letters for the submissions are also included in the tides correspondence with the DRs, as well as in Appendix I of this report.

Post-processed positioning data and GNSS processing files are available with the survey deliverables.

APPROVAL SHEET

For

Horizontal and Vertical Control Report: H13370 to H13375

This report and the accompanying digital data are respectfully submitted.

Field operations contributing to the completion of this project were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report, digital data, and accompanying records have been closely reviewed and are considered complete and adequate per the Statement of Work and Project Work Instructions. Other reports submitted with this survey include the Descriptive Report (DR) (one for each survey sheet) and the Data Acquisition and Processing Report (DAPR).

This survey is complete and adequate for its intended purpose.

Thomas Morino
Digitally signed by Thomas Morino
Date: 2021.01.12 13:34:27 -09'00'

Thomas Morino
Lead Hydrographer
TerraSond

Andrew Orthmann
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