

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY No OPR-O190-FA-16
HYDROGRAPHIC TITLE SHEET		FIELD No NOAA Ship Fairweather
<p> INSTRUCTIONS – The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office. </p> <p> State <u>Alaska</u> </p> <p> General Locality <u>Bering Strait and Vicinity</u> </p> <p> Sub-Locality <u>Port Clarence</u> </p> <p> Scale <u>40000</u> Date of Survey <u>July-September 2017</u> </p> <p> Instructions dated <u>6/9/2017</u> Project No. <u>OPR-R365-FA-17</u> </p> <p> Vessel <u>NOAA Ship Fairweather</u> </p> <p> Chief of party <u>CDR Mark Van Waes, NOAA</u> </p> <p> Surveyed by <u>Fairweather Personnel</u> </p> <p> Soundings by echo sounder, hand lead, pole <u>Multi-beam echo sounder</u> </p> <p> Graphic record scaled by <u>N/A</u> </p> <p> Graphic record checked by <u>N/A</u> Automated Plot <u>N/A</u> </p> <p> Verification by <u>Pacific Hydrographic Branch</u> </p> <p> Soundings in <u>Meters at MLLW</u> </p>		
<p> REMARKS: <u>All times are in UTC.</u> </p> <p> <u>This is a basic Hydrographic Survey.</u> </p> <p> <u>Projection is UTM Zone 03N.</u> </p> <p> <u>The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products.</u> </p>		

HORIZONTAL AND VERTICAL CONTROL REPORT

Project OPR-R365-FA-17
Port Clarence and Vicinity, AK
July-September 2017
NOAA Ship *Fairweather*
Chief of Party: CDR Mark Van Waes, NOAA

A. VERTICAL CONTROL

Vertical control for OPR-R365-FA-17 was achieved via a Tidal Constituent and Residual Interpolation (TCARI) grid provided by the Center for Operational Oceanographic Products and Services (CO-OPS).

The sounding datum for the project was Mean Lower Low Water (MLLW), with heights computed from Mean High Water (MHW). All soundings were initially reduced to MLLW via the verified R365FA2017.tc TCARI grid provided by CO-OPS.

This project has a requirement to reference the survey data to the ellipsoid. An Ellipsoidally Referenced Zoned Tides (ERZT) model was generated and differenced with a Poor Man's VDatum (PMVD) model (PMVD is an estimated separation surface provided by the Hydrographic Systems and Technologies Branch (HSTB) for areas where VDATUM does not yet exist). The PMVD was de-biased (PMVD-ERZT). The resulting bias was subtracted from the PMVD to generate a composite PMVD. GPS tides were computed using the composite PMVD model to reference all soundings to MLLW.

B. HORIZONTAL CONTROL

Horizontal control activities were conducted on Port Spencer, at the western extent of Port Clarence. A horizontal control mark stamped "9237 A" was recovered and serves as the reference position.

NOAA Ship *Fairweather* personnel conducted all fieldwork. The field parties were not equipped with weather instruments; therefore weather data were not collected at the site.

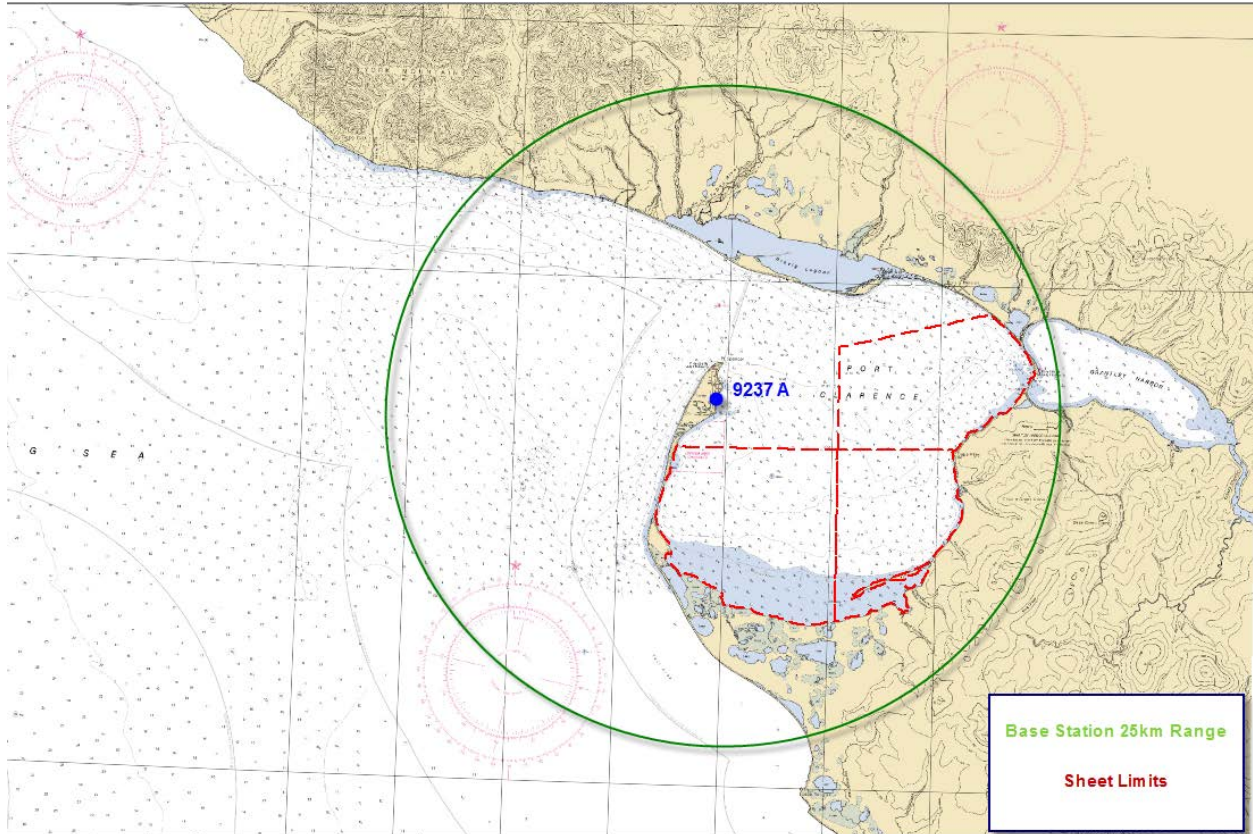


Figure 1, Overview of horizontal control activities for OPR-R365-FA-17

I. Soundings and Detached Positions

The GPS base station was set up in a location that provided good satellite coverage with minimal data gaps and cycle slips. Following installation, the base station was successfully tested for remote download. The base station was monitored for a period of five days without any operational issues. The base station was used for post-processing vessel kinematic data that were acquired within 40 km of the station location.

Data acquisition on OPR-R365-FA-17 was conducted between July and September of 2017, during which *Fairweather* was operating in Port Clarence, AK. The base station on Port Spencer was set up to collect data on a continual basis while survey operations were in effect. An equipment malfunction occurred on day numbers 220-222. For these days Applanix POSPac RTX processing was used to generate the Smoothed Best Estimates of Trajectory (SBET).

The Wide Area Augmentation System (WAAS) was used for real time horizontal position correction for OPR-R365-FA-17.

Applanix POSPac MMS Version 7.2 Single Base Station Processing was the primary method used to generate SBETs to correct the positioning of soundings on all surveys. Applanix POSPac MMS Version 8.1 RTX processing was used for day numbers 220-222 to cover the days where the installed base station was not functioning. Congruence between data corrected by SBETs generated by RTX methods and data corrected by SBETs generated by Single Base methods is discussed within the Descriptive Reports of the affected surveys.

Quality control checks were done using the POSPac automated QC tool to ensure compliance with the positional accuracy requirements of NOS Hydrographic Surveys Specifications and Deliverables, March 2017 (HSSD). The following checks were conducted:

- ***GNSS QC tab:*** Primary and Secondary antennas were checked for cycle slips. PDOP values were checked, anomalies were found to be related to sudden changes of vessel speed and weather conditions and loss of satellites. See individual SBET processing logs for specific days and errors.
- ***IMU Model Stats tab:*** Accelerometer Bias and gyro bias plots were inspected to ensure data were within specifications. Some errors were found. See individual SBET processing logs for specific days and errors.
- ***SBET QC tab:*** The altitude time series plot was reviewed for anomalous jumps corresponding to rapid oscillation of the x, y, or z accelerometer bias. The altitude time series can indicate poor quality solutions that are not reflected in the RMS values. See individual SBET processing logs for specific days and errors.
- ***Reference QC tab:*** North, East, and Down position error Root Mean Square (RMS) time series plots were reviewed. Some errors were found. See individual SBET processing logs for specific days and errors.

For surveys H12798, H12799, and H12800 all SBET and SMRMSG files have been applied to all multibeam data in CARIS HIPS, allowing all MBES data to be referenced to the ellipsoid. The digital raw base station and ephemeris data used for this project are submitted with this report. The digital SBET and SMRMSG files and their associated processing logs are submitted with each survey. A record of their application can be seen by querying the HDCS lines in CARIS HIPS.

II. Fixed Aids to Navigation

There were no assigned fixed aids to navigation within the limits of project OPR-R365-FA-17.

III. Horizontal Control Activities

On 20 July 2017 a base station (Trimble NetR9 9677) was installed on a preexisting tidal benchmark on Port Spencer stamped “9237 A”. Two 12 volt batteries and two solar panels were installed to power the station.

On 8 August 2017 the base station lost power and stopped recording data. This was realized on 10 August 2017, and the base station was visited to assess the cause. It was found that the solar panels were wired incorrectly, allowing the batteries to drain completely of power. This issue was fixed, and the base station ran continuously without issue for the remaining duration of the project.

For the horizontal control activities with the Trimble NetR9 receiver, the recording interval was set to one second. The elevation mask was set to 10 degrees. An adjustable tripod was set on the horizontal control mark. The tripod height was set to give an Antenna Reference Point (ARP) height of 1.3 meters over the occupied horizontal control mark. Table 1 shows the equipment specifications used in this project.

Site	Day Numbers	Receiver Model	Receiver SN	Firmware	Antenna Model
9237 A	201-244	Trimble Net R9	5034K69677	4.43	Zephyr Geodetic 2

Table 1, Equipment specifications

Table 2 below shows the latitude, longitude and ellipsoidal elevation of the base station used for this project. The coordinates below are a position calculated by NGS Online Positioning User Service, Static (OPUS-S) from a 24-hour observation. This position was used for all Applanix POSPac MMS Single Base Processing for the launches and ship. See Appendix A -I for the NGS OPUS-S solution. The observation log is provided in Appendix A-II and provides the physical setup of the station.

Station Name	IGS 2008		Ellipsoidal Height (m)
	Latitude	Longitude	
9237 A	65 15 29.94286	166 50 50.41154	8.928

Table 2, Control position

IV. Site Descriptions

Port Spencer Site Description and Photos

The mark is located on Port Spencer, a spit on the western extent of Port Clarence, on a concrete slab located on a pebble beach approximately 200m due east of the northern extent of the Port Spencer airstrip. A decommissioned United States Coast Guard storage facility can be seen approximately 400 meters to the northwest. The mark is a bronze azimuth disk set on a flat topped rock at an ellipsoidal height of 8.928 meters and is stamped “9237 A”. The GPS antenna was installed on an adjustable height tripod set to 1.3 meters and secured to duckbill anchors recovered from the FA horizontal control installation in 2010. The omni-directional transmit antenna was set up approximately 5 meters north of the GPS antenna with a clear view in all directions facilitate remote download by the field unit.

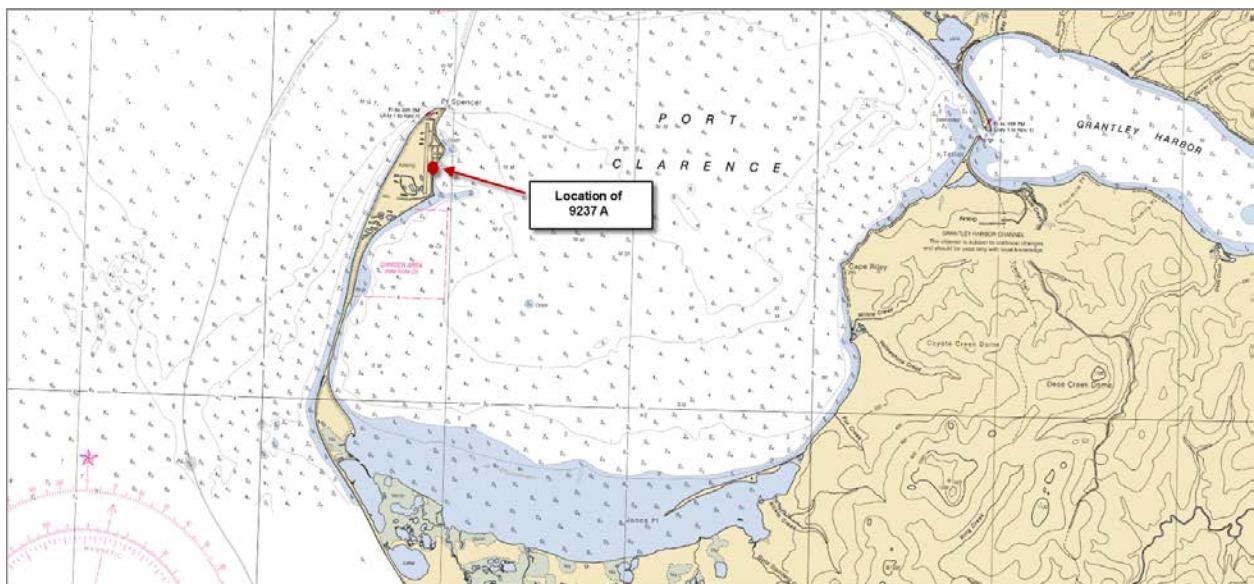


Figure 2, Location of installed base station

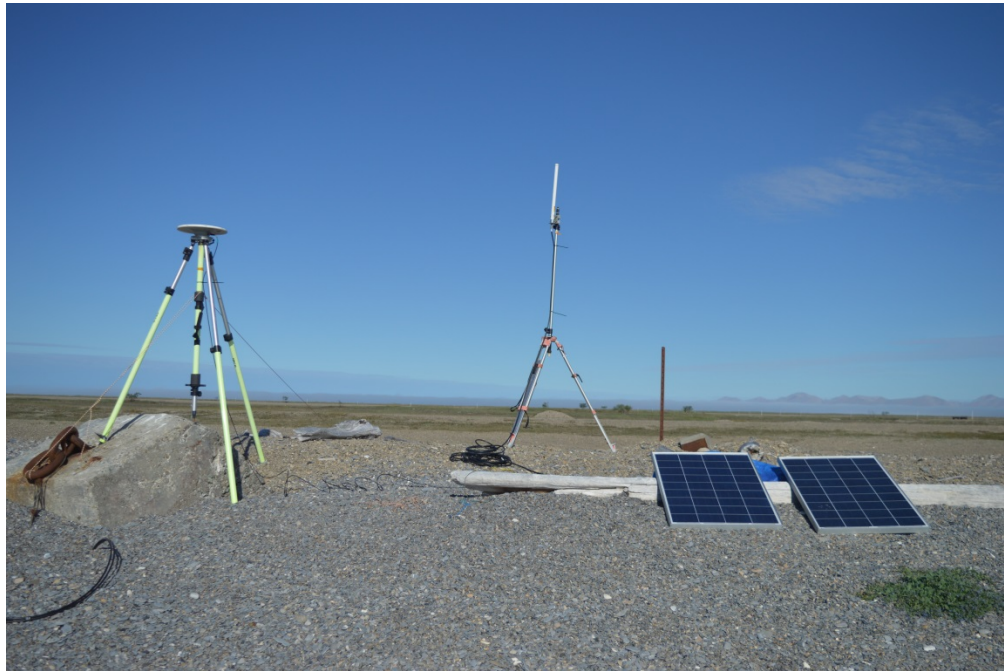


Figure 3, Horizontal control station on Port Spencer facing west

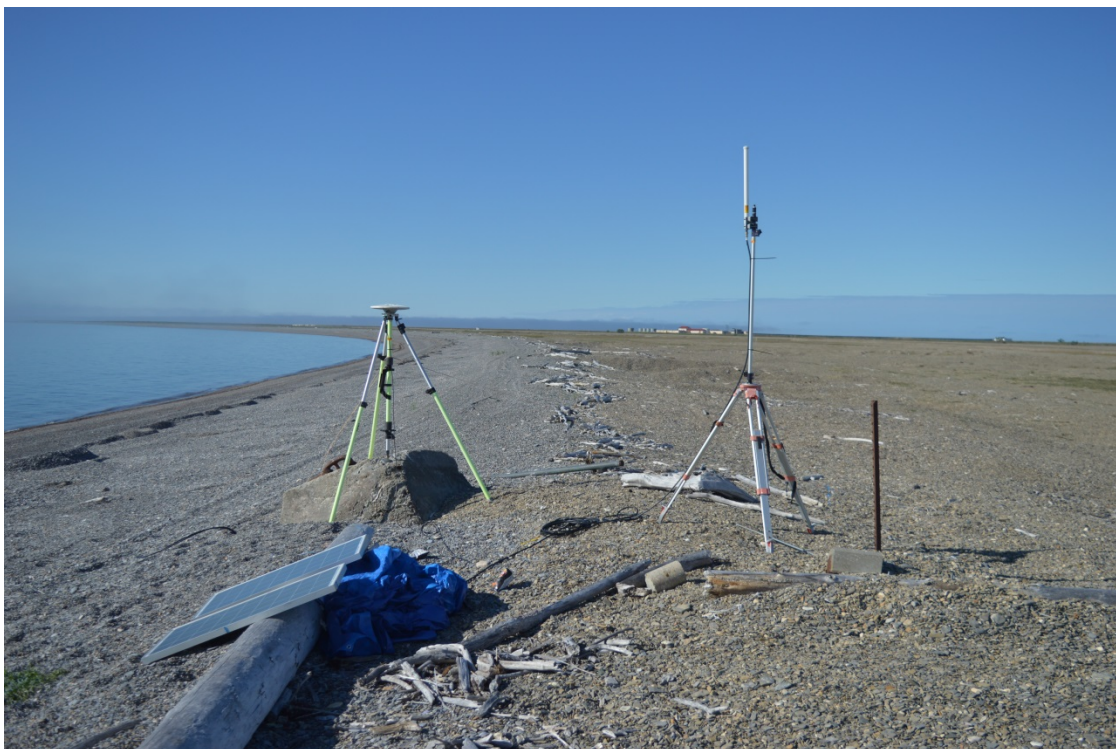


Figure 4, Horizontal control mark occupied by GNSS antenna facing south



Figure 5, Installed horizontal control mark “9237A”

Appendix A-I
OPUS SOLUTION



Samuel Candio - NOAA Federal <samuel.candio@noaa.gov>

OPUS solution : 9677201a_deci15sec.17o OP1513365912251

1 message

opus <opus@ngs.noaa.gov>
 Reply-To: ngs.opus@noaa.gov
 To: samuel.candio@noaa.gov

Fri, Dec 15, 2017 at 11:26 AM

FILE: 9677201a_deci15sec.17o OP1513365912251

NGS OPUS SOLUTION REPORT
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All computed coordinate accuracies are listed as peak-to-peak values.
 For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: samuel.candio@noaa.gov DATE: December 15, 2017
 RINEX FILE: 9677201s.17o TIME: 19:26:08 UTC

SOFTWARE: page5 1603.24 [master70.pl](#) 160321 START: 2017/07/20 18:20:00
 EPHEMERIS: igs19584.eph [precise] STOP: 2017/07/20 23:59:00
 NAV FILE: brdc2010.17n OBS USED: 15356 / 16209 : 95%
 ANT NAME: TRM55971.00 NONE # FIXED AMB: 76 / 80 : 95%
 ARP HEIGHT: 1.300 OVERALL RMS: 0.011(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2017.5504)

X:	-2606610.769(m)	0.012(m)	-2606611.913(m)	0.012(m)
Y:	-609104.735(m)	0.009(m)	-609103.738(m)	0.009(m)
Z:	5769830.493(m)	0.020(m)	5769830.875(m)	0.020(m)

LAT:	65 15 29.96359	0.012(m)	65 15 29.94275	0.012(m)
E LON:	193 9 9.68270	0.011(m)	193 9 9.58784	0.011(m)
W LON:	166 50 50.31730	0.011(m)	166 50 50.41216	0.011(m)
EL HGT:	8.194(m)	0.019(m)	8.912(m)	0.019(m)
ORTHO HGT:	4.368(m)	0.033(m)	[NAVD88 (Computed using GEOID12B)]	

UTM COORDINATES STATE PLANE COORDINATES

	UTM (Zone 03)	SPC (5008 AK 8)
Northing (Y) [meters]	7238507.789	1254365.107
Easting (X) [meters]	413738.874	460419.006
Convergence [degrees]	-1.67783681	-0.76954050
Point Scale	0.99969110	0.99991917
Combined Factor	0.99968982	0.99991789

US NATIONAL GRID DESIGNATOR: 3WVN1373838507(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DL7650	AC50 BALDYMTN__AK2007	CORS ARP	N653313.869 W1643359.553	110962.6
DL6423	AB11 NOME_ANVILAK2006	CORS ARP	N643352.198 W1652224.357	104162.6
DL6669	AB04 SAVOONGA__AK2007	CORS ARP	N633924.727 W1703402.710	252761.4

NEAREST NGS PUBLISHED CONTROL POINT

UW4186	CON PT SPENCER CONT TWR 1950	N651545.450 W1665104.374	513.2
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BASE STATION INFORMATION

STATION NAME: ac50 a 1 (BaldyMtn__AK2007; Taylor, AK USA)

MONUMENT: NO DOMES NUMBER

XYZ -2551627.7635 -704437.4208 5784007.1661 MON @ 2005.0000 (M)
 XYZ -0.0198 -0.0002 -0.0086 VEL (M/YR)
 NEU -0.0000 0.0000 0.0083 MON TO ARP (M)
 NEU 0.0012 0.0008 0.0860 ARP TO L1 PHASE CENTER (M)
 NEU 0.0006 -0.0006 0.1184 ARP TO L2 PHASE CENTER (M)
 XYZ -0.2482 -0.0030 -0.1082 VEL TIMES 12.5502 YRS
 XYZ -0.0033 -0.0009 0.0076 MON TO ARP
 XYZ -0.0331 -0.0099 0.0788 ARP TO L1 PHASE CENTER
 XYZ -2551628.0481 -704437.4346 5784007.1442 L1 PHS CEN @ 2017.5504
 XYZ -0.0000 0.0000 0.0000 + XYZ ADJUSTMENTS
 XYZ -2551628.0482 -704437.4346 5784007.1442 NEW L1 PHS CEN @ 2017.5504
 XYZ -2551628.0151 -704437.4247 5784007.0655 NEW ARP @ 2017.5504
 XYZ -2551628.0118 -704437.4238 5784007.0579 NEW MON @ 2017.5504
 LLH 65 33 13.85095 195 26 0.34646 516.9468 NEW L1 PHS CEN @ 2017.5504
 LLH 65 33 13.85092 195 26 0.34641 516.8608 NEW ARP @ 2017.5504
 LLH 65 33 13.85092 195 26 0.34641 516.8525 NEW MON @ 2017.5504

STATION NAME: ab11 a 1 (Nome_AnvilAK2006; Nome, AK United States)

MONUMENT: NO DOMES NUMBER

XYZ -2658010.2323 -693674.8144 5737338.5910 MON @ 2005.0000 (M)
 XYZ -0.0196 -0.0002 -0.0090 VEL (M/YR)
 NEU -0.0000 0.0000 0.0083 MON TO ARP (M)
 NEU 0.0012 0.0008 0.0860 ARP TO L1 PHASE CENTER (M)
 NEU 0.0006 -0.0006 0.1184 ARP TO L2 PHASE CENTER (M)
 XYZ -0.2464 -0.0025 -0.1127 VEL TIMES 12.5502 YRS
 XYZ -0.0034 -0.0009 0.0075 MON TO ARP
 XYZ -0.0345 -0.0098 0.0782 ARP TO L1 PHASE CENTER
 XYZ -2658010.5167 -693674.8276 5737338.5640 L1 PHS CEN @ 2017.5504
 XYZ -0.0001 -0.0001 -0.0000 + XYZ ADJUSTMENTS
 XYZ -2658010.5167 -693674.8276 5737338.5640 NEW L1 PHS CEN @ 2017.5504
 XYZ -2658010.4822 -693674.8178 5737338.4858 NEW ARP @ 2017.5504
 XYZ -2658010.4787 -693674.8169 5737338.4783 NEW MON @ 2017.5504
 LLH 64 33 52.17987 194 37 35.54636 349.5467 NEW L1 PHS CEN @ 2017.5504
 LLH 64 33 52.17983 194 37 35.54631 349.4607 NEW ARP @ 2017.5504
 LLH 64 33 52.17983 194 37 35.54631 349.4524 NEW MON @ 2017.5504

STATION NAME: ab04 a 1 (Savoonga__AK2007; Savoonga, AK USA)

MONUMENT: NO DOMES NUMBER

XYZ -2799600.4439 -465105.4138 5692966.4022 MON @ 2005.0000 (M)
 XYZ -0.0194 -0.0002 -0.0094 VEL (M/YR)
 NEU -0.0000 0.0000 0.0083 MON TO ARP (M)
 NEU 0.0012 0.0008 0.0860 ARP TO L1 PHASE CENTER (M)
 NEU 0.0006 -0.0006 0.1184 ARP TO L2 PHASE CENTER (M)
 XYZ -0.2437 -0.0020 -0.1182 VEL TIMES 12.5502 YRS
 XYZ -0.0036 -0.0006 0.0074 MON TO ARP
 XYZ -0.0365 -0.0068 0.0776 ARP TO L1 PHASE CENTER
 XYZ -2799600.7278 -465105.4233 5692966.3690 L1 PHS CEN @ 2017.5504
 XYZ 0.0001 -0.0001 -0.0000 + XYZ ADJUSTMENTS
 XYZ -2799600.7277 -465105.4234 5692966.3690 NEW L1 PHS CEN @ 2017.5504
 XYZ -2799600.6912 -465105.4166 5692966.2915 NEW ARP @ 2017.5504
 XYZ -2799600.6876 -465105.4160 5692966.2840 NEW MON @ 2017.5504
 LLH 63 39 24.70589 189 25 57.20289 136.6576 NEW L1 PHS CEN @ 2017.5504
 LLH 63 39 24.70585 189 25 57.20283 136.5716 NEW ARP @ 2017.5504
 LLH 63 39 24.70585 189 25 57.20283 136.5633 NEW MON @ 2017.5504

REMOTE STATION INFORMATION

STATION NAME: 9677 1

MONUMENT: NO DOMES NUMBER

XYZ -2606612.2498 -609103.9703 5769830.9962 MON @ 2017.5500 (M)
 NEU -0.0013 0.0002 1.3000 MON TO ARP (M)
 NEU 0.0013 -0.0002 0.0667 ARP TO L1 PHASE CENTER (M)
 NEU 0.0004 0.0006 0.0577 ARP TO L2 PHASE CENTER (M)
 XYZ -0.5309 -0.1243 1.1801 MON TO ARP
 XYZ -0.0261 -0.0059 0.0611 ARP TO L1 PHASE CENTER
 XYZ -2606612.8068 -609104.1005 5769832.2374 L1 PHS CEN @ 2017.5504

BASELINE NAME: ac50 9677

XYZ 0.3294 0.2352 -0.1161 + XYZ ADJUSTMENTS
 XYZ -2606612.4774 -609103.8652 5769832.1213 NEW L1 PHS CEN @ 2017.5504
 XYZ -2606612.4513 -609103.8593 5769832.0602 NEW ARP @ 2017.5504
 XYZ -2606611.9204 -609103.7351 5769830.8801 NEW MON @ 2017.5504
 LLH 65 15 29.94263 193 9 9.58748 10.2863 NEW L1 PHS CEN @ 2017.5504
 LLH 65 15 29.94258 193 9 9.58750 10.2196 NEW ARP @ 2017.5504
 LLH 65 15 29.94263 193 9 9.58748 8.9196 NEW MON @ 2017.5504

BASELINE NAME: ab11 9677

XYZ 0.3415 0.2350 -0.1142 + XYZ ADJUSTMENTS
 XYZ -2606612.4653 -609103.8654 5769832.1233 NEW L1 PHS CEN @ 2017.5504
 XYZ -2606612.4392 -609103.8595 5769832.0621 NEW ARP @ 2017.5504
 XYZ -2606611.9083 -609103.7353 5769830.8820 NEW MON @ 2017.5504
 LLH 65 15 29.94299 193 9 9.58771 10.2832 NEW L1 PHS CEN @ 2017.5504
 LLH 65 15 29.94295 193 9 9.58772 10.2165 NEW ARP @ 2017.5504
 LLH 65 15 29.94299 193 9 9.58771 8.9165 NEW MON @ 2017.5504

BASELINE NAME: ab04 9677

XYZ 0.3385 0.2261 -0.1338 + XYZ ADJUSTMENTS
 XYZ -2606612.4683 -609103.8743 5769832.1036 NEW L1 PHS CEN @ 2017.5504
 XYZ -2606612.4422 -609103.8684 5769832.0425 NEW ARP @ 2017.5504
 XYZ -2606611.9113 -609103.7442 5769830.8624 NEW MON @ 2017.5504
 LLH 65 15 29.94259 193 9 9.58832 10.2674 NEW L1 PHS CEN @ 2017.5504
 LLH 65 15 29.94254 193 9 9.58834 10.2007 NEW ARP @ 2017.5504
 LLH 65 15 29.94259 193 9 9.58832 8.9007 NEW MON @ 2017.5504

G-FILES

Axx2017 720 17 720

B2017 7201819 17 7202359 1 page5 v1603.24IGS 126 1 2 27NGS 20171215IFDDPX
 IIGS08_1930 IGS 20170101
 C00090004 549839086 6 -953336887 4 141761778 12 X2017A9677X2017AAC50
 D 1 2 3175734 1 3 -8109496 2 3 -5284126

Axx2017 720 17 720

B2017 7201819 17 7202359 1 page5 v1603.24IGS 126 1 2 27NGS 20171215IFDDPX
 IIGS08_1930 IGS 20170101
 C00090003 -513985704 6 -845710817 3 -324924037 14 X2017A9677X2017AAB11
 D 1 2 4760871 1 3 -7704196 2 3 -1791141

Axx2017 720 17 720

B2017 7201819 17 7202359 1 page5 v1603.24IGS 126 1 2 27NGS 20171215IFDDPX
 IIGS08_1930 IGS 20170101
 C00090001-1929887763 8 1439983282 4 -768645784 17 X2017A9677X2017AAB04
 D 1 2 2884970 1 3 -7434598 2 3 -6438542

POST-FIT RMS BY SATELLITE VS. BASELINE

OVERALL 01 02 03 05 06 09 12 14
 ac50-9677| 0.011 ... 0.009 0.020 0.010 0.011 0.018 0.014 0.011
 16 17 19 20 21 22 23 24 25
 ac50-9677| 0.009 0.011 0.016 0.011 0.011 0.018 0.017 0.012 0.011
 26 27 29 31 32
 ac50-9677| 0.008 0.012 0.009 0.008 0.009

OVERALL 01 02 03 05 06 09 12 14

```

ab11-9677| 0.011 ... 0.009 0.016 0.011 0.010 0.019 0.013 0.010
          16 17 19 20 21 22 23 24 25
ab11-9677| 0.011 0.020 0.009 0.012 0.009 0.023 0.017 0.011 0.009
          26 27 29 31 32
ab11-9677| 0.008 0.012 0.008 0.008 0.011

```

```

OVERALL 01 02 03 05 06 09 12 14
ab04-9677| 0.010 ... 0.008 0.017 0.012 0.009 0.018 0.013 0.011
          16 17 19 20 21 22 23 24 25
ab04-9677| 0.008 0.009 0.008 0.009 0.009 ... 0.016 0.014 0.008
          26 27 29 31 32
ab04-9677| 0.008 ... 0.010 0.008 0.010

```

OBS BY SATELLITE VS. BASELINE

```

OVERALL 01 02 03 05 06 09 12 14
ac50-9677| 5577 ... 484 213 257 389 228 71 368
          16 17 19 20 21 22 23 24 25
ac50-9677| 202 129 221 163 221 188 249 226 580
          26 27 29 31 32
ac50-9677| 318 38 210 525 297
OVERALL 01 02 03 05 06 09 12 14
ab11-9677| 5522 ... 484 211 257 388 218 71 367
          16 17 19 20 21 22 23 24 25
ab11-9677| 187 134 222 163 221 179 243 237 571
          26 27 29 31 32
ab11-9677| 318 42 211 497 301
OVERALL 01 02 03 05 06 09 12 14
ab04-9677| 4257 ... 394 67 240 280 132 70 308
          16 17 19 20 21 22 23 24 25
ab04-9677| 173 90 170 82 180 ... 95 187 516
          26 27 29 31 32
ab04-9677| 318 ... 205 470 280

```

ITRF position of 9677 as determined by individual baselines

	X	Y	Z
ac50	-2606611.920	-609103.735	5769830.880
ab11	-2606611.908	-609103.735	5769830.882
ab04	-2606611.911	-609103.744	5769830.862

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North	Up
ac50	-0.007	0.003	0.005	-0.005	-0.003	0.007
ab11	0.005	0.003	0.007	-0.002	0.008	0.004
ab04	0.002	-0.006	-0.012	0.006	-0.005	-0.012

Covariance Matrix for the xyz OPUS Position (meters^2).

0.0000003022	0.0000000055	-0.0000000519
0.0000000055	0.0000000756	-0.0000000125
-0.0000000519	-0.0000000125	0.0000015133

Covariance Matrix for the enu OPUS Position (meters^2).

0.0000000848	0.0000000412	-0.0000000187
0.0000000412	0.0000004684	0.0000004315
-0.0000000187	0.0000004315	0.0000013379

Horizontal network accuracy = 0.00138 meters.

Vertical network accuracy = 0.00227 meters.

Derivation of NAD 83 vector components

Position of reference station ARP in NAD_83(2011)(EPOCH:2010.0000).

	Xa(m)	Ya(m)	Za(m)		
AC50	-2551626.88863	-704438.44777	5784006.68559	2010.00	
AB11	-2658009.35624	-693675.84192	5737338.10728	2010.00	
AB04	-2799599.55478	-465106.43907	5692965.88696	2010.00	

Position of reference station monument in NAD_83(2011)(EPOCH:2010.0000).

	Xr(m)	Yr(m)	Zr(m)		
AC50	-2551626.88533	-704438.44687	5784006.67799	2010.00	
AB11	-2658009.35284	-693675.84102	5737338.09978	2010.00	
AB04	-2799599.55118	-465106.43847	5692965.87956	2010.00	

Velocity of reference station monument in NAD_83(2011)(EPOCH:2010.0000).

	Vx (m/yr)	Vy (m/yr)	Vz (m/yr)
AC50	0.00270	0.00050	-0.00090
AB11	-0.01960	-0.00020	-0.00900
AB04	0.00270	0.00040	-0.00090

Vectors from unknown station monument to reference station monument in NAD_83(2011)(EPOCH:2010.0000).

	Xr-X= DX(m)	Yr-Y= DY(m)	Zr-Z= DZ(m)		
AC50	54983.88367	-95333.71187	14176.18499	2010.00	
AB11	-51398.58384	-84571.10602	-32492.39322	2010.00	
AB04	-192988.78218	143998.29653	-76864.61344	2010.00	

***** New Reference Frame Preview *****

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 3.388 (m) [PROTOTYPE (Computed using xGeoid17B,GRS80,IGS08)]

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

Appendix A-II
Control Observation Log

HORCON/VERCON OBSERVATION LOG

DATE: 7/20/2017 SESSION:	PROJECT NAME:																				
WX CONDITIONS: Fog, wind light	SITE NAME: 9237A SITE PHOTO(S): <input checked="" type="checkbox"/> Y / <input type="checkbox"/> N																				
OBSERVER(S): Cordi of Siegenthaler	SITE TYPE: <input checked="" type="checkbox"/> HORZ / VERT. / ATON / BM / NEW / _____																				
DN: 201	RECEIVER #: 5034K69697 FIXED HEIGHT? <input checked="" type="checkbox"/> Y / <input type="checkbox"/> N																				
4 CHAR. SITE ID:	ANTENNA #: 1441031361 SPACER? Y <input checked="" type="checkbox"/> N																				
SESS. FILE NAME:	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2">ANT. MEASUREMENTS</th> <th colspan="2">ANT. CONSTANTS</th> </tr> <tr> <th colspan="2">ANT. SLANT HEIGHT (S)</th> <th>ANT. RAD. (R)</th> <th>V. OFFSET (C)</th> </tr> <tr> <th>START</th> <th>STOP</th> <td></td> <td></td> </tr> <tr> <td>1.3 m</td> <td>1.3 m</td> <td>_____ m</td> <td>_____ m</td> </tr> <tr> <td>_____ ft</td> <td>_____ ft</td> <td></td> <td></td> </tr> </table>	ANT. MEASUREMENTS		ANT. CONSTANTS		ANT. SLANT HEIGHT (S)		ANT. RAD. (R)	V. OFFSET (C)	START	STOP			1.3 m	1.3 m	_____ m	_____ m	_____ ft	_____ ft		
ANT. MEASUREMENTS		ANT. CONSTANTS																			
ANT. SLANT HEIGHT (S)		ANT. RAD. (R)	V. OFFSET (C)																		
START	STOP																				
1.3 m	1.3 m	_____ m	_____ m																		
_____ ft	_____ ft																				
ELEV. MASK: 10 degrees																					
RECORDING INTERVAL: 1.0 sec.s																					

OBSERVATION TIMES AND STATUS

RECEIVER TIME (UTC)	PDOP	LOCAL TIME	# of SV's	POWER
START: 1815	1.3	1015	20	48%
STOP:				

INSTRUCTIONS:

Horizontal control mark recovery

Office Check by:

HI to ARP = $((\text{SQRT}(S^2 - R^2) - C)$: _____ (m)

SITE SKETCH/LOC./NOTES:

Recovered previously established tidal benchmark (9237A 2005) on the North eastern part of Port Spencer Spit, due east of the northern extent of the airstrip on a concrete slab on the pebble beach 220m from the shoreline.

OBSTRUCTION DIAGRAM

MONUMENT RUBBING / DESCRIPTION

