

<p>NOAA FORM 76-35A</p> <p>U.S. DEPARTMENT of COMMERCE NATIONAL OCEANIC and ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE</p> <p>Horizontal and Vertical Control Report</p>
<p>Type of Survey: <u>Multibeam and Side Scan Sonar</u></p> <p>Project No. <u>OPR-D302-KR-06</u></p> <p>Time Frame: <u>1 June 2006 – 9 September 2006</u></p>
<p>LOCALITY</p> <p>State: <u>Delaware</u></p> <p>General Locality: <u>Atlantic Ocean</u></p> <p><u>2006</u></p> <p>CHIEF of PARTY</p> <p><u>Jason M. Infantino, Gary R. Davis & Paul L. Donaldson</u></p> <p><u>Science Applications International Corporation</u></p>
<p>LIBRARY & ARCHIVES</p> <p>DATE: _____</p>

NOAA FORM 77-28 (11-72) <div style="text-align: center;"> U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION </div> <div style="text-align: center; margin-top: 20px;"> HYDROGRAPHIC TITLE SHEET </div>	REGISTRY NO. <div style="text-align: center;"> H11554 H11555 </div>
INSTRUCTIONS - The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.	FIELD NO. A, B
State: <u>Delaware</u> General Locality: <u>Atlantic Ocean</u> Locality: <u>25 NMI ESE of Cape Henlopen (H11554); 30 NMI SE of Cape Henlopen (H11555)</u> Scale: <u>1:20,000</u> Date of Survey: <u>1 June 2006 – 9 Sept 2006</u> Instructions Dated: <u>1 February 2006</u> Project No. <u>OPR-D302-KR-06</u> Vessel: <u>M/V Atlantic Surveyor, D582365</u> Chief of Party: <u>Jason M. Infantino, Gary R. Davis & Paul L. Donaldson</u>	
Surveyed by: <u>Brian Biggert, Curtis Clement, Gary Davis, Paul Donaldson, Sean Halpin, Karen Hart, Chuck Holloway, Erick Huchzermeyer, Jason Infantino, Meme Lobecker, Matt Meyer, Rick Nadeau, Evan Robertson, Jeremy Shambaugh, Deb Smith, and Ryan Thomas.</u> Soundings taken by <u>(echosounder)</u> hand lead, pole: <u>MULTIBEAM RESON SEABAT 8101</u> Graphic record scaled by: _____ Graphic record checked by: _____ Protracted by: _____ Automated plot by: _____ Verification by: _____ Soundings in fathoms, feet, <u>(meters)</u> at MLW, <u>(MLLW)</u>	
REMARKS: Contract # <u>DG133C-05-CQ-1088</u> Contractor: <u>Science Applications International Corp., 221 Third Street; Newport, RI 02840</u> Times: <u>All times are recorded in UTC.</u> Purpose: <u>To provide NOAA with modern, accurate hydrographic survey data for the purpose of updating the relevant nautical charts of the assigned areas: Sheet A (H11554) and Sheet B (H11555) in Mid-Atlantic Corridor, Coast of Delaware.</u>	

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A. VERTICAL CONTROL

For H11554 and H11555, the NOAA tide station in Lewes, DE (8557380) was the source for verified water level heights for the Mid-Atlantic Corridor, Coast of Delaware surveys. All preliminary and verified tides obtained for the 2006 survey season were downloaded from the National Oceanic and Atmospheric Administration (NOAA) Tides and Currents website (<http://tidesandcurrents.noaa.gov/>). All tide data are annotated with Coordinated Universal Time (UTC).

Final water level files for each tide zone were created from downloaded verified tide data using the **SABER Create Water Level Files** tool. Water level files contained water level heights that were algebraically subtracted from depths to correct the sounding for tides and water levels. These water level files were applied to the multibeam data using the **SABER Apply Tides** program.

When it was necessary to apply updated tide correctors such as verified water levels to the GSF files, the program removed the previous tide corrector and applied the new corrector. Each time a processing routine was run on the GSF multibeam data file, a history record was appended to the end of the GSF file. For quality assurance, the **Check Tides** program was run on all GSF files to confirm that the appropriate water level corrector had been applied to the GSF file.

For all sheets, the primary means for analyzing the adequacy of zoning was observing zone boundary crossings in the navigated swath editor, SAIC's **Multi View Editor (MVE)**. In addition, sun illuminated coverage plots were examined on screen for adequacy of zoning. Grid depth color change intervals were set to draw out any significant, unnatural changes in depth across zone boundaries due to water level correction errors, unusual currents, storm surges, etc. Cross line comparisons were used to analyze zoning for the influence of wind and weather.

H11554 and H11555 surveys were entirely within the water level zones for Lewes, DE (8557380). Analysis of the H11554 and H11555 multibeam data in the **SABER Multi-View Editor** and in depth grids revealed minimal depth jumps across the junction of the zones. A spreadsheet analysis of the correctors for each zone (summarized in Table A-1) also confirmed the adequacy of zoning correctors based on Lewes, DE (8557380). Observed verified water levels from 31 May 2006 through 09 September 2006 for station Lewes, DE (8557380) were entered in the spreadsheet. Correctors were computed at 6-minute intervals for each zone. Differences were computed zone to zone. As a result, the NOAA-provided preliminary zone boundaries and zoning parameters for Lewes, DE (8557380) were accepted as final and applied to all multibeam data for H11554 and H11555. Therefore, the NOAA zoning parameters were used to develop the water level correctors for soundings on sheets H11554 and H11555. The zoning parameters applied on sheets H11554 and H11555 are presented in Table A-2.

Table A-1. Summary of Verified Tide Corrector Differences at Zone Boundaries for Lewes, DE (8557380)

Zones	26-26A	26A-45	26A-24	45-47	24-47
Maximum	0.089	0.053	0.745	0.734	0.089
Minimum	-0.010	-0.006	-0.082	-0.075	-0.010
Average	0.037	0.022	0.000	0.015	0.037
Standard Deviation	0.023	0.014	0.021	0.022	0.023

Table A-2. Water Level Zoning Parameters Applied on Sheets H11554 and H11555

Zone	Time Corrector (minutes)	Range Ratio	Reference Station
SA24	-78	0.86	8557380
SA26	-72	0.91	8557380
SA26A	-72	0.86	8557380

B. HORIZONTAL CONTROL

The survey data for sheets H11554 and H11555 were collected in horizontal datum NAD-83, using geodetic coordinates, while data display and products used the UTM Zone 18 projection. The following equipment was used for positioning on the *M/V Atlantic Surveyor*:

- TSS POS/MV, Serial Number 314
- Trimble 4000 DS GPS Receiver, Serial Number 3504A09516

All antenna and transducer offsets were measured relative to the Position Orientation System/Marine Vessel (POS/MV) Inertial Measurement Unit (IMU). Offsets from the Reson 8101 transducer were then computed from these measurements. The POS/MV offsets Reference to Vessel are the same as the Reference to Reson 8101 transducer so that the vessel positions in the GSF multibeam files are the position of the transducer. Therefore, vessel offsets to the Trimble GPS antenna and to the A-Frame Tow Block are entered in the ISS-2000 as offsets from the Reson 8101 transducer. Tow Block Z is entered as height above the water for use in computing the tow fish layback. During the remobilization of the *M/V Atlantic Surveyor* in 2006, all antenna and transducer offsets were re-measured. The 2006 results are depicted in Table B-1 and Figure B-1.

Table B-1. 2006 *M/V Atlantic Surveyor* Antenna and Transducer Offsets (measurements in meters with 68% CI measurement errors)

Sensor	Offset in ISS-2000		Offset in POS/MV	
Multibeam Reson 8101 Transducer Hull Mount (Ref to vessel lever arm)			X	-0.34 ±0.05
			Y	-0.12 ±0.05
			Z	+1.64 ±0.05
Reference to Heave (Ref to IMU lever arm)			X	0.00
			Y	0.00
			Z	0.00
POS/MV GPS Master Antenna (Ref to primary GPS lever arm)			X	4.24 ±0.05
			Y	-0.66 ±0.05
			Z	-6.37 ±0.05
Reference to Vessel			X	-0.34 ±0.05
			Y	-0.12 ±0.05
			Z	+1.64 ±0.05
Trimble GPS Antenna	X	+4.59 ±0.05		
	Y	+0.46 ±0.05		
	Z	-8.02 ±0.05		
A-Frame Tow Block (Z = Height above the Water)	X	-19.56 ±0.15		
	Y	+0.52 ±0.15		
	Z	-4.87 ±0.15		

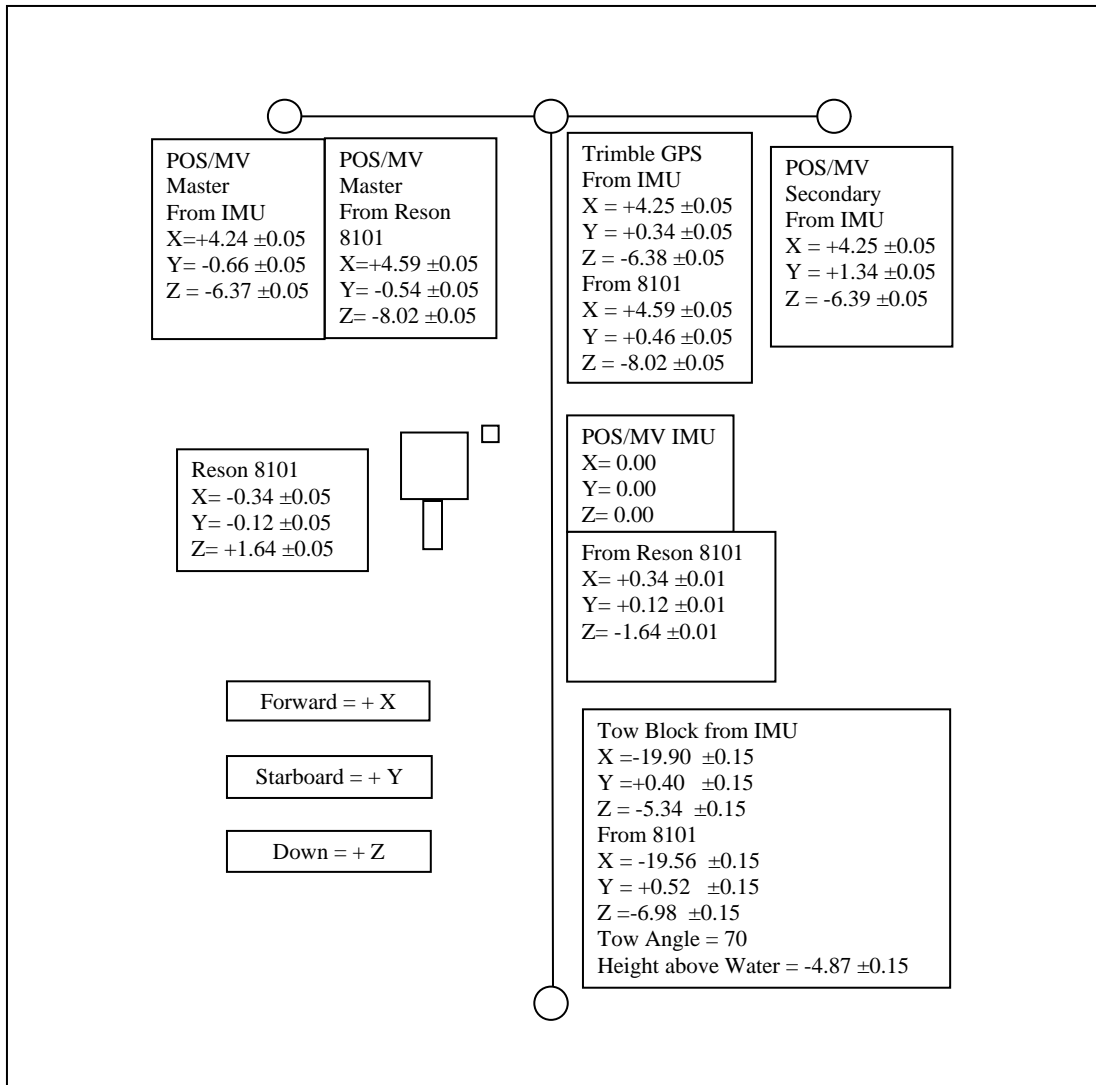


Figure B-1. 2006 Configuration and Offsets of the *M/V Atlantic Surveyor* Sensors (measurements in meters with 68% CI measurement errors)

Daily position confidence checks were made by comparing the DGPS position from the POS/MV with the Trimble DGPS position. A real-time monitor automatically issued an alarm when the two DGPS positions differed by more than 10 meters horizontally. Positioning confidence checks were well within an inverse distance of 5 meters.

Differential correctors used for H11554 and H11555 online data were from the U.S. Coast Guard Stations at Moriches, NY, Reedy Point, DE, Annapolis, MD and Sandy Hook, NJ. The differential receiver was set to only receive data from these four corrector stations; however the POS/MV reported that it used additional stations during online data collection. Station 294 (Kodiak, AK) and erroneous station identification codes were reportedly used by the POS/MV for a total of 16 seconds of online data collection. SAIC believes that the POS/MV incorrectly reported the station identification it was using for correctors and was indeed using one of the four assigned stations. This behavior has been previously observed in the POS/MV system.

Table B-2. Positional Difference between vessel positions determined by the POS/MV and the Trimble 4000 on the *M/V Atlantic Surveyor*

Julian Day	Sheet ID	Time of Day (UTC)	Positional Difference (m)
152	A	0950	1.27
153	A	0424	1.41
154	A	1403	1.50
156	A	1505	1.31
157	A	0203	1.69
159	A	1056	0.80
160	A	0219	0.61
162	A	1540	0.82
163	A	0220	2.10
164	A	0157	0.82
165	A	0147	0.86
166	A	1604	0.76
167	A	0403	2.00
168	A	1302	3.37
169	A	0229	0.91
170	A	0302	1.50
171	A	2220	2.13
172	A	0830	1.34
173	A	0611	0.62
174	A	1549	1.35
174	B	2301	3.40
175	B	0608	0.80
176	B	0618	2.10
177	B	0605	1.34

Julian Day	Sheet ID	Time of Day (UTC)	Positional Difference (m)
189	B	1644	1.44
190	B	0207	1.30
191	B	0220	1.49
192	B	0155	0.88
193	B	0153	1.54
194	B	0000	1.50
195	B	1602	1.36
196	B	0357	3.38
197	B	0210	2.03
198	B	0214	3.00
199	B	0215	1.31
200	B	0405	1.24
201	B	0001	1.01
205	B	1802	1.51
206	B	0215	0.50
207	B	0237	1.50
208	B	0200	0.53
211	B	1426	0.84
212	B	0210	1.20
213	B	0230	1.50
214	B	0230	1.00
215	A/B	0300	1.00
251	L/A/B	1134	1.34
252	L/A/B	1958	0.67

C. APPROVAL SHEET

27 July 2007

LETTER OF APPROVAL

REGISTRY NUMBERS: H11554 and H11555

This Horizontal and Vertical Control Report for project OPR-D302-KR-06, Mid-Atlantic Corridor, Coast of Delaware Project is respectfully submitted.

Field operations and data processing contributing to the accomplishment of this survey, H11554 and H11555 were conducted under my supervision and that of lead hydrographers Gary R. Davis and Paul L. Donaldson with frequent personal checks of progress and adequacy. This report has been closely reviewed and is considered complete and adequate as per the Statement of Work.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

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27 July 2007