H12093

NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY

DESCRIPTIVE REPORT

Type of Survey ***Multibeam and Sidescan Sonar***

Field No. ***Q***

Registry No. ***H12093***

LOCALITY

STATE ***VIRGINIA***

GENERAL LOCALITY ***ATLANTIC OCEAN***

SUBLOCALITY ***12 NM ESE OF CHINCOTEAGUE INLET***

2010

CHIEF OF PARTY

CHARLES F. HOLLOWAY

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

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DATE

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY No
HYDROGRAPHIC TITLE SHEET	**H12093**

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	Virginia
General Locality	Atlantic Ocean
Sub Locality	12 NM East South East of Chincoteague Inlet
Scale	1:20,000
Date of Survey	22 September 2010 – 19 November 2010
Instructions Dated	01 December 2008 and 18 June 2009
Project No.	OPR-D302-SA-09
Vessel	*M/V Atlantic Surveyor* D582365
Chief of Party	Charles F. Holloway
Surveyed by	Alex Bernier, Jediah Bishop, Daniel Burgo, Gary Davis, Paul Donaldson, Chuck Holloway, Colette LeBeau, Rick Nadeau, Katie Offerman, Evan Robertson, Eva Rosendale, Andrew Seaman, Deb Smith, Bridget Williams
Soundings by echosounder	Multibeam RESON SeaBat 7125 SV and Multibeam RESON SeaBat 8101 ER
Verification by	***Atlantic Hydrographic Branch Personnel***
Soundings in	Meters
Soundings at	MLLW

REMARKS:		
	Contract:	DG133C-08-CQ-0003
	Contractor:	Science Applications International Corporation 221 Third Street, Newport, RI 02840 USA
	Subcontractor:	N/A
	Times:	All times are recorded in UTC
	UTM Zone:	Zone 18 North
	Purpose:	To provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area: Sheet Q (H12093) in Mid–Atlantic Corridor, Coast of Virginia.

Science Applications International Corporation (SAIC) warrants only that the survey data acquired by SAIC and delivered to NOAA under Contract DG-133C-08-CQ-0003 reflects the state of the sea floor in existence on the day and at the time the survey was conducted.

Red, Bold, Italic comments made during office processing

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Revisions and Rednotes were generated during office processing. The processing branch concurs with all information and recommendations in the DR unless otherwise noted. Page numbering may be interrupted or non-sequential. All pertinent records for this survey, including the Descriptive Report, are archived at the National Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

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Descriptive Report to Accompany
Hydrographic Survey H12093
Scale 1:20,000, Surveyed 2010
M/V Atlantic Surveyor
Science Applications International Corporation (SAIC)
Charles F. Holloway, Lead Hydrographer

PROJECT
Project Number: OPR-D302-SA-09
Dates of Instructions: 01 December 2008 and 18 June 2009 **Task Order#:** T002

Dates of Supplemental Instructions: 21 May 2009, 10 July 2009, 23 September 2009, 23 February 2010, and 15 September 2010
Sheet Letter: Q
Registry Number: H12093
Purpose: To provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area.

A. AREA SURVEYED

The area surveyed was a section of the Atlantic Ocean off of Virginia, 12 NM East South East of Chincoteague Inlet (Figure A-1). H12093 was surveyed in accordance with the Project Instructions, OPR-D302-SA-09 (including D302KR2009_Rev); provided in Separates III, and the April 2009 "*NOS Hydrographic Surveys Specifications and Deliverables"*. The line kilometers, bottom samples, item investigations, and other survey statistics are listed in Table A-1. The survey was conducted with set line spacing with multibeam sonar and towed sidescan sonar from 22 September 2010 to 19 November 2010 (Table A-2). H12093 was surveyed with 200% side scan coverage with resulting multibeam coverage. The CUBE depth range encountered in H12093 was from 11.49 meters (37 feet, 0.270 meter uncertainty) to 33.54 meters (110 feet, 0.287 meter uncertainty).

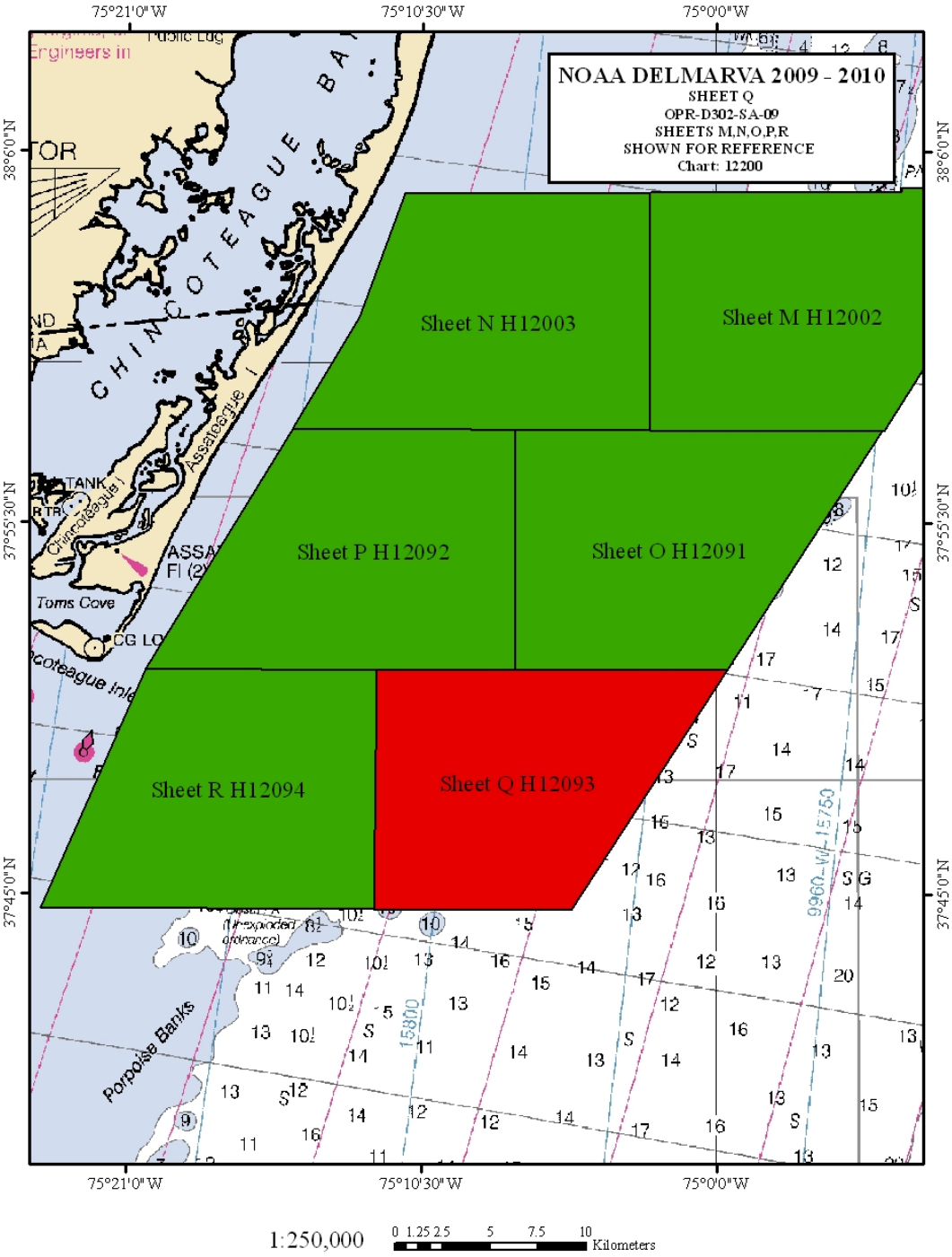

Figure A-1. H12093 Survey Bounds

Table A-1. Hydrographic Survey Statistics

***M/V Atlantic Surveyor*, Sheet Q H12093**	**Value**
LNM Single beam only sounding lines (main scheme only)	N/A
LNM Multibeam only sounding lines (main scheme only)	N/A
LNM Lidar sounding lines (main scheme only)	N/A
LNM Sidescan sonar only lines (main scheme only)	N/A
LNM Main scheme lines (multibeam and sidescan)	1533.8
LNM Crosslines from multibeam	63.2
LNM Lidar crosslines	N/A
LNM development lines non main scheme	0.9
LNM shoreline/nearshore investigations	N/A
Number of Bottom Samples	49
Number of items investigated that required additional time/effort in the field beyond the above operations not developed by sonar	0
Total number of square nautical miles	53.13

Table A-2. Dates of Multibeam Data Acquisition in Calendar and Julian Days

Calendar Date	Julian Day
22 September 2010	265
23 September 2010	266
24 September 2010	267
25 September 2010	268
10 October 2010	283
11 October 2010	284
12 October 2010	285
13 October 2010	286
14 October 2010	287
17 October 2010	290
18 October 2010	291
19 October 2010	292

Calendar Date	Julian Day
20 October 2010	293
21 October 2010	294
23 October 2010	296
24 October 2010	297
25 October 2010	298
30 October 2010	303
31 October 2010	304
01 November 2010	305
02 November 2010	306
03 November 2010	307
18 November 2010	322
19 November 2010	323

B. DATA ACQUISITION AND PROCESSING

B.1 EQUIPMENT

A detailed description of the systems used to acquire and process these data has been included in the separate Data Acquisition and Processing Report (DAPR) for OPR-D302-SA-09, delivered with Descriptive Report H12091 on 01 October 2010. The information in Table B-1 below summarizes the systems listed in the DAPR. During transit to port on 04 November 2010 (JD308) the RESON 7125 was struck by an unknown submerged object. The *M/V Atlantic Surveyor* was then hauled into dry dock for inspection of the vessel and equipment, removal of the damaged equipment, and the installation of new survey equipment and measurement of offsets. A RESON 8101 was then installed by diver on the *M/V Atlantic Surveyor* on 14 November 2010. Please refer to Appendix V "Data Acquisition and Processing Supplemental Data" for a detailed description regarding new measurement offsets and the testing operations that took place on 15 November 2010. There were no other deviations from the equipment configuration described in the DAPR submitted 01 October 2010.

Table B-1. Major Systems by Manufacturer and Model Number

System	Manufacturer / Model Number	Subsystem
Multibeam Sonar	RESON SeaBat 7125 SV	7P Sonar Processor
	RESON SeaBat 8101 ER	81 P Sonar Processor
Sidescan Sonar	Klein 3000 Towfish	K-1 K-Wing Depressor, Transceiver/Processing Unit
Vessel Attitude System	Applanix POS/MV Inertial Navigation System	
Positioning Systems	Applanix POS/MV 320	
	Trimble 7400 GPS Receiver	
	Trimble Probeacon Differential Beacon Receiver	
Sound Speed Systems	Brooke Ocean Technology Ltd., Moving Vessel Profiler-30	Applied Microsystems Ltd. Smart SV and Pressure Sensor
	Sea-Bird Electronics, Inc. SBE 19 CTD Profiler	

B.1.1 Survey Vessel

The platform for multibeam sonar, sidescan sonar, and sound speed data collection was the *M/V Atlantic Surveyor*. Three 20-foot ISO containers were secured on the aft deck. One was used as the real-time data acquisition office, the second as a data processing office, and the third for spares storage, maintenance, and repairs.

The Position Orientation System/Marine Vessels (POS/MV) Inertial Measurement Unit (IMU) was mounted below the main deck of the vessel, port of the keel. The RESON 7125 transducer and associated sound velocity sensor were hull-mounted port of the vessel's keel in close proximity to the POS/MV's IMU. After the removal of the

damaged RESON 7125 transducer, the RESON 8101 transducer was hull-mounted to the same mounting plate, which had been used for the RESON 7125, when installed for survey operations, 18 November 2010 to 19 November 2010. Please refer to Appendix V "Data Acquisition and Processing Supplemental Data" for a detailed description regarding new measurement offsets and the testing operations that took place on 15 November 2010.

A Brook Ocean Technologies Moving Vessel Profiler 30 (MVP-30) was mounted to the starboard stern quarter. The Klein 3000 sidescan sonar was towed along the centerline axis from an A-frame mounted on the stern of the vessel. Table B-2 is a list of vessel characteristics for the *M/V Atlantic Surveyor*.

Table B-2. Survey Vessel Characteristics *M/V Atlantic Surveyor*

Vessel Name	LOA	Beam	Draft	Max Speed	Gross Tonnage	Power (Hp)	Registration Number
M/V Atlantic Surveyor	110'	26'	9'	14 knots	Displacement 68.0 Net Tons Deck Load 65.0 Long Tons	900	D582365

Bottom characteristics were determined from bottom samples taken using a WILDCO Petite Ponar grab. The location for acquiring bottom samples was determined at a set distance of 2000-meters; samples were evenly distributed throughout the H12093 survey area, in accordance with Section 7.1 of the *NOS Hydrographic Surveys Specifications and Deliverables* April 2009. Samples of the seabed were obtained, characterized, and photographed. Specific details pertaining to each sample were saved through SAIC's Integrated Survey System (**ISS-2000**) software; information logged was position, depth, and sample characteristics. Bottom characteristic results are further detailed in Section D.2.4 and Appendix V.

B.1.2 Major Systems

SAIC used their **ISS-2000** software on a Windows XP platform to acquire these survey data. Survey planning and data analysis were conducted using SAIC's **SABER** software on Red Hat Enterprise 5 Linux platforms. Klein 3000 sidescan data were collected on a Windows XP platform using Klein's **SonarPro** software. The Klein 3000 sidescan sonar data were collected in eXtended Triton Format (XTF) and maintained at full resolution (16 bit), with no conversion or down sampling techniques applied. Triton **Isis** was used to review all sidescan data. Subsequent processing and the generation of coverage mosaics were done using **SABER** on a Linux platform.

B.2 QUALITY CONTROL

SAIC completes various quality control checks throughout survey operations. In addition to the Data Acquisition and Processing Report delivered 01 October 2010, Figure B-1 also describes the processing flow SAIC utilizes.

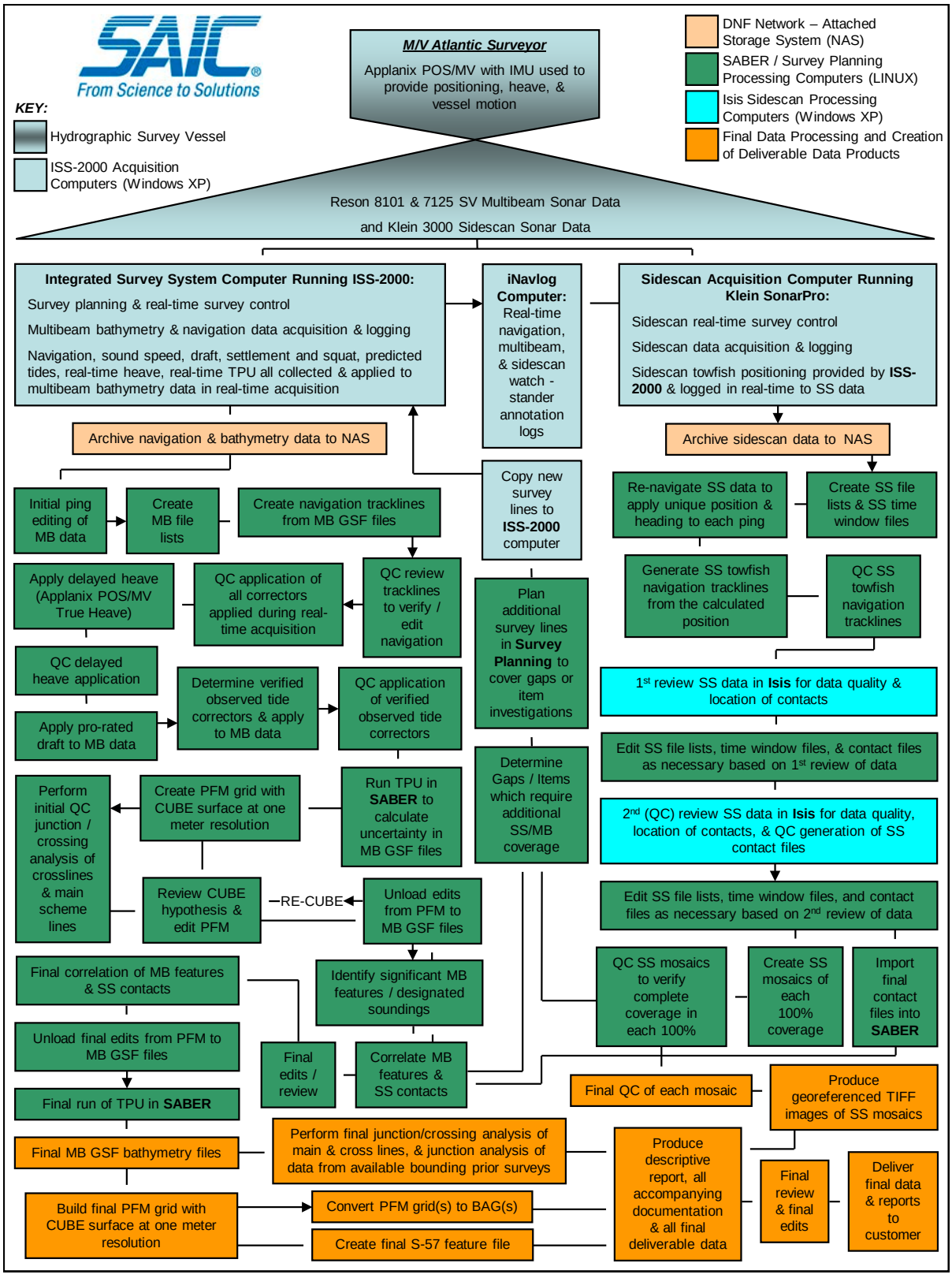

Figure B-1. SAIC Processing Flow Diagram

There were approximately 63.2 linear nautical miles of crosslines and 1532.4 linear nautical miles of main scheme lines surveyed on H12093. This resulted in crossline mileage that represented approximately 4.1 percent of the main scheme mileage which meets Section 5.1.4.3 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009, requirement to achieve at least four percent for a multibeam survey. Crosslines were oriented at 123°/303° and were predominately spaced 1000 meters apart, while most of the main scheme lines were oriented at 33°/213° and were spaced 65 meters apart. Comparison between crosslines and main scheme data is discussed in Section B.2.3. During main scheme operations, the sidescan sonar range scale of 75 meters provided a consistent 150-meter imagery swath.

As noted previously the CUBE depth range encountered was from 11.49 meters (37 feet, 0.270 meters uncertainty) to 33.54 meters (110 feet, 0.280 meters uncertainty). Based on the depth range encountered in H12093, the CUBE surface was generated at one-meter grid node resolution as defined in Section 5.1.2.1 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009. For significant features with a least depth of less than or equal to 23 meters, CUBE surfaces were generated at half-meter grid node resolution as defined in Section 5.1.2.1 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009.

A Brooke Ocean Technology Moving Vessel Profiler (MVP) with an Applied Microsystems SV&P Smart Sensor or a Seabird Electronics SBE-19 CTD was used to collect sound speed profile (SSP) data. SSP data were obtained at frequent intervals as defined in Section 5.1.3.3 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009. Cast frequency was enough to reduce sound speed errors and varied based on several criteria:

- Observed sound speed changes from previously collected profiles
- Surface sound speed differences between the SSP sensor collocated with the RESON 7125 sonar head and the current profile obtained from the MVP-30
- The amount of time elapsed since the last cast

Multiple casts were initially taken along a survey line to identify the rate and location of sound speed changes. Subsequent casts were made based on the observed trend of sound speed changes. As changes in the SSP data occurred, cast frequency and location were modified accordingly. A total of 471 profiles were applied to online data for H12093. Since SAIC continuously logs both multibeam and sidescan sonar data; the designation of "online data" refers to data which is used for sidescan coverage and bathymetry used for generating the CUBE surface. For information regarding the start and end of online data, please reference the "H12093_Sidescan_Review_Log" and "Watchstander_Logs" located in Separates I.

Confidence checks of the sound speed profile casts were conducted periodically (6 to 13 survey days) by comparing at least two consecutive casts taken with different SV&P Smart Sensors or with a SV&P Smart Sensor and a Seabird SBE-19 CTD. Seven

confidence checks were conducted during H12093, the results can be found in Separates II within file "H12093_Atlantic_Surveyor_Comparison_Cast_Log".

The "H12093_Atlantic_Surveyor_Sound_Speed_Profile_Log", a spreadsheet located in Separates II, is a cumulative spreadsheet detailing each cast associated with H12093. This log is separated by the purpose of the applied cast; with individual tabs for: "Used_for_MB" (online Multibeam), "Used_for_Comparison_Cast", "Used_for_Lead_Line", and "Used_for_Closing_Casts". Additionally in a separate folder within Separates II, Caris_SSP, there are four sound speed profile files (.svp). These four files contain concatenated SSP data that has been formatted for use in Caris. The Caris SSP files match the sound speed profile log, such that files are designated based on the purpose of the cast. For example, casts identified in the sound speed profile log on the "Used_for_MB" tab will appear in the file named "H12093_Used_for_MB.svp". Sound speed files are delivered with the H12093 delivery in the "H12093_SSP_Data" folder. The sound speed files are broken out into individual folders which correspond to the purpose of that applied cast; for example the folder named "Used_for_MB" has sound speed files that were applied to online multibeam data.

Static draft measurements were taken on each side of the vessel at each port call, both prior to departure and upon arrival. These observed static draft measurements were used to compute and apply a prorated daily static draft during each survey leg to account for small changes in draft as a result of fuel and water consumption. Static draft measurements are presented in "H12093_Daily_Drafts" located in Separates I. A dynamic draft look-up table was constructed from settlement and squat measurements determined during the pre-survey Sea Acceptance Trials, detailed in the DAPR for this Project delivered 01 October 2010. The dynamic draft look-up table was used in conjunction with recorded input from shaft RPM (revolutions per minute) counters to calculate and apply a dynamic draft during data collection.

Horizontal positioning of the multibeam transducer by the POS/MV was verified by frequent comparison checks against an independent Trimble DGPS system. During survey data acquisition, the **ISS-2000** real-time system provided a continuous view of the positioning comparison between the POS/MV and the Trimble DGPS. An alarm was triggered within **ISS-2000** if the comparisons were not within an acceptable range. Positioning confidence data for H12093 are presented in "H12093_Daily_Positioning_Confidence_Checks" located in Separates I.

All multibeam files have delayed heave, identified as True Heave files (.thv) from the POS/MV, applied during post processing. There were a few instances where delayed heave was not applied, due to short time gaps in POS/MV True Heave file. When delayed heave was not available the real-time heave was used. All cases where delayed heave were not applied were investigated and the loss of delayed heave application had minimal or no effect to the data. Delayed heave files are included with the H12093 delivery, under folder "H12093_Delayed_Heave_Files".

Multibeam confidence checks were conducted during port calls (approximately every 10-12 survey days) by performing lead line measurements. Lead line measurements were taken on both port and starboard sides of the vessel in line with the multibeam transducer. Depth measurements obtained with the lead line were compared with collocated depth measurements obtained by the multibeam sonar. A complete listing of all lead line measurements can be found in "H12093_Altantic_Surveyor_Leadline_Comparison" located in Separates I. Of the nine lead lines performed, there was a mean difference of less than 0.048 meters, with an average standard deviation of the sets of less than 0.023 meters. Multibeam files used for confidence checks are located in a sub-folder within the multibeam data folder named "Used_for_Leadline".

As discussed in the DAPR sidescan data are collected and maintained in the eXtended Triton Format (XTF), preserved at full resolution. Towfish navigation is recomputed using the **SABER Navup** routine. The **Navup** routine populates the sensor X and sensor Y fields within the XTF files with the final sidescan position contained within the catenary data files recorded by **ISS-2000**.

Sidescan sonar confidence checks were performed at least once per day, as specified in Section 6.3.1 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009. Sidescan data reviewers verified that distinct bottom features or objects were visible to the outer edges of the sonar record. Confidence checks are included in the "H12093_Sidescan_Review_Log" located in Separates I.

B.2.1 Survey Systems Uncertainty Model

The Total Propagated Uncertainty (TPU) model that SAIC has adopted has its genesis at the Naval Oceanographic Office (NAVOCEANO), and is based on the work by Rob Hare and others ("Error Budget Analysis for NAVOCEANO Hydrographic Survey Systems, Task 2 FY 01", 2001, *HSRC FY01 Task 2 Final Report*). The terminology Total Propagated Error (TPE) has been replaced by Total Propagated Uncertainty (TPU). This was adopted by the International Hydrographic Organization in Special Publication No. 44, "*IHO Standards for Hydrographic Surveys, 5th Edition, February 2008"*. The fidelity of any uncertainty model is coupled to the applicability of the equations that are used to estimate each of the components that contribute to the overall uncertainty that is inherent in each sounding. SAIC's approach to quantifying the TPU is to decompose the cumulative uncertainty for each sounding into its individual components and then further decompose those into the horizontal and vertical components. The model then combines the horizontal and vertical uncertainty components to yield an estimate of the system uncertainty as a whole. This cumulative system uncertainty is the Total Propagated Uncertainty. By using this approach, SAIC can easily incorporate future uncertainty information provided by sensor manufacturers into the model. This also allows SAIC to continuously improve the fidelity of the model as our understanding of the sensors increases or as more sophisticated sensors are added to a system.

The data needed to drive the uncertainty model were captured as parameters taken from the Error Parameter File (EPF), which is created during survey system installation and

integration. Some of the required parameters are also obtained from values recorded in the GSF files during data acquisition and processing. While the input units vary, all uncertainty values that contribute to the cumulative TPU estimate are eventually converted to meters by **SABER's Errors** program. The cumulative TPU estimates are recorded as the Horizontal Uncertainty and Vertical Uncertainty at the 95% confidence level in the GSF file. These uncertainty estimates are then used to estimate the accuracy of each individual sounding's position and depth during both data acquisition and data processing. A more detailed discussion on the development of the EPF and application of the TPU was provided in the DAPR for OPR-D302-SA-09 delivered on 01 October 2010.

B.2.2 CUBE Uncertainty Analysis

The vertical and horizontal uncertainty values that were estimated by the TPU model for individual multibeam soundings varied little across the dataset, tending to be most affected by beam angle. During application of horizontal and vertical uncertainties to the GSF files, individual beams where either the horizontal or vertical uncertainty exceeded the maximum allowable IHO S-44, 5th edition, Order 1a specifications were flagged as invalid and therefore were not used in the CUBE depth calculations. As a result, all individual soundings used in development of the final CUBE depth surface had modeled vertical and horizontal uncertainty values at or below the allowable IHO S-44, Order 1a uncertainty. The allowable Order 1a vertical uncertainty is dependent on depth and varied from approximately ±0.522 to ±0.663 meters. The allowable Order 1a horizontal uncertainty is also depth dependent and defined as 5 meters + 5% of the depth. The CUBE depth is populated as either the node's best hypothesis or the depth of a feature or designated sounding set by the Hydrographer, which overrides the chosen hypothesis.

During the creation of the CUBE surface, two separate vertical uncertainty surfaces are also calculated by the **SABER** software, CUBE Standard Deviation and Average Total Propagated Uncertainty (Average TPU). The CUBE Standard Deviation is a measure of the general agreement between all of the soundings that contributed to the best hypothesis for the node, and is reported at the 95% Confidence Level. The Average TPU is the average of the vertical uncertainty component for each sounding that contributed to the best hypothesis for the node. A third vertical uncertainty surface is generated from the larger of these two uncertainties at each node and is referred to as the Final Uncertainty.

After creation of the initial one-meter PFM CUBE surface, the **SABER Check PFM Uncertainty** function was used to highlight all of the cases where computed final node vertical uncertainty exceeded IHO Order 1a. The final one-meter PFM CUBE surface had 91 individual CUBE nodes with Final Uncertainties that exceeded IHO Order 1a. As previously mentioned, all individual soundings used in the final CUBE depth surface had vertical and horizontal uncertainty values which were at or below the IHO Order 1a allowable limits. A review of the areas with Final Uncertainties exceeding IHO Order 1a revealed that the high vertical uncertainties surrounded features, such as wrecks and obstructions, and steeper slopes where there tended to be much greater variability in the soundings that contributed to a particular node.

The **SABER Check PFM Uncertainty** function was also run on each of the three half-meter feature PFM CUBE surfaces. Results are listed below.

- Features Area 1 (features 1 and 4) had 5 individual CUBE nodes which exceeded IHO Order 1a.
- Features Area 2 (features 9 and 13) had 492 individual CUBE nodes which exceeded IHO Order 1a.
- Features Area 3 (features 6 and 8) had 3 individual CUBE nodes which exceeded IHO Order 1a.

A complete listing of the Feature Area locations is provided in Table B-10 of Section B.4.

The **SABER Frequency Distribution** tool was also used to review vertical uncertainties within the one-meter and three half-meter resolution BAGs. This tool creates statistical data about the distribution of values within a selected surface. To examine the vertical uncertainty, the routine was run on the Final Uncertainty layer of each PFM. The results from the routine show that more than 99.99% of all grid nodes in the one-meter PFM contained vertical uncertainties of 0.50 meters or less. When performed on the three half-meter feature PFMs, at least 98.69% of all grid nodes contained vertical uncertainties of 0.50 meters or less.

B.2.3 Junction and Crossing Analysis

Three types of repeatability analyses were performed on H12093 multibeam data; junction analysis of gridded crossings data, junction analysis with adjacent completed sheets, and beam by beam crossing analysis.

B.2.3.1 Junction Analysis

During data acquisition comparison of main scheme to crossline near nadir data was done daily to ensure that no systematic errors were introduced and to identify potential problems with the survey system. After the application of all correctors and completion of final processing, separate one-meter CUBE PFM grids were built; One grid from the full valid swath (±60° cutoff, 120° swath) of all main scheme multibeam data and one from the class 1 (±5° cutoff, 10° swath) crossline data. Reference the "H12093_Multibeam_Processing_Log", spreadsheet located in Separates I, for delineation between main scheme and crossline data. Comparisons of all crossing data in H12093 showed that 94.98% of comparisons were within 25 centimeters and 99.81% of comparisons were within 35 centimeters (Table B-3).

Junction analysis was performed by subtracting the H12093 crossline grid from the H12093 main scheme grid. Therefore, negative values indicate that H12093 main scheme data are shoaler than H12093 crossline data. The main scheme data were shoaler than the crossline data in 56.12% of junctions and the main scheme data were deeper than crossline data in 40.85% of the junctions across the entire survey area. The six

comparisons larger than 50 centimeters are accounted for by normal small DGPS position variability around wrecks, obstructions and steep slopes.

Table B-3. Junction Analysis, Main scheme Lines vs. Near Nadir Crosslines, H12093

Depth Difference Range (cm)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Percent
0 - 5	186545	32.12	83520	14.38	85403	14.70	17622	3.03
> 5 - 10	139805	56.18	64316	25.45	75489	27.70		
> 10 - 15	108030	74.78	41703	32.63	66327	39.12		
> 15 - 20	70641	86.94	25064	36.95	45577	46.96		
> 20 - 25	46665	94.98	14113	39.38	32552	52.57		
> 25 - 30	21665	98.71	6647	40.52	15018	55.15		
> 30 - 35	6389	99.81	1760	40.82	4629	55.95		
> 35 - 40	1019	99.98	129	40.85	890	56.10		
> 40 - 45	79	100.00	4	40.85	75	56.12		
> 45 - 50	12	100.00	0	40.85	12	56.12		
> 50	6	100.00	0	40.85	6	56.12		
Totals	580856	100.00%	237256	40.85%	325978	56.12%	17622	3.03%
Reference Grid: h12093_1m_main_28jan2011_pfm_h12093_1m_cross_class1_28jan2011_pfm.dif								

The **SABER Frequency Distribution** tool was used to analyze the H12093 main scheme multibeam data compared to the H12093 crossline near nadir ±5 degree multibeam data (Figure B-2). The **Frequency Distribution** was run on the same difference grid used to generate the data in Table B-3. The results from the **Frequency Distribution** tool match those of the Junction analysis, reported in Table B-3.

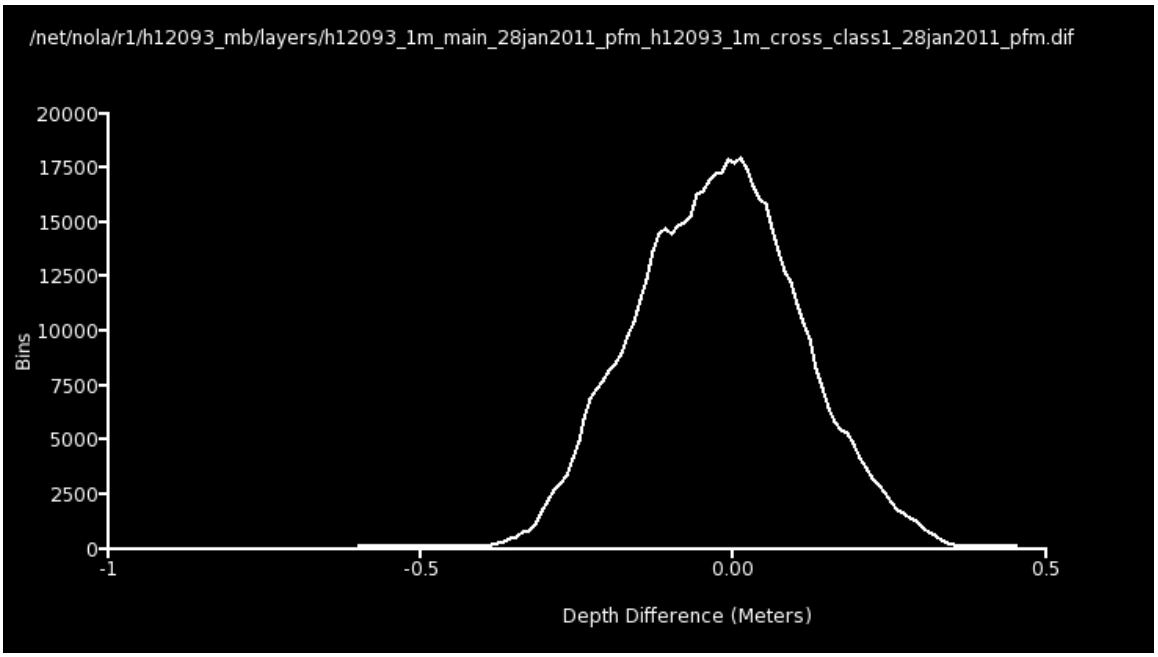

Figure B-2. Frequency Distribution Plot of Depth Differences for H12093 Main Scheme Lines vs. H12093 Crosslines

Two echosounders, RESON 7125 and RESON 8101, were used for acquisition of H12093. The RESON 7125 was used for acquisition 22 September 2010 through 04 November 2010 and the RESON 8101 acquired data from 18 November 2010 to 19 November 2010. A junction analysis was performed on the common area for data collected with the RESON 7125 and RESON 8101. Analysis was performed by building a one-meter PFM with RESON 7125 data and a one-meter PFM of RESON 8101 data. This analysis showed that 96.83% of the comparisons were within 25 centimeters and 99.67% were within 35 centimeters (Table B-4).

The junction analysis was performed by subtracting the RESON 8101 data from the RESON 7125 data. Therefore negative values indicate that RESON 7125 depth data were shoaler than RESON 8101 depth data. Throughout the common area, RESON 7125 CUBE depths were shoaler than RESON 8101 59.04% of the time and were deeper than RESON 8101 38.00% of the time.

Table B-4. Junction Analysis, H12093 RESON 7125 vs. H12093 RESON 8101

Depth Difference Range (cm)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Percent
0 - 5	178809	34.73	77193	14.99	86401	16.78	15215	2.96
> 5 - 10	151488	64.16	69649	28.52	81839	32.68		

Depth Difference Range (cm)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Percent
> 10 - 15	98315	83.26	33544	35.04	64771	45.26		
> 15 - 20	46961	92.38	11292	37.23	35669	52.19		
> 20 - 25	22932	96.83	3150	37.84	19782	56.03		
> 25 - 30	10470	98.87	661	37.97	9809	57.94		
> 30 - 35	4159	99.67	114	37.99	4045	58.72		
> 35 - 40	1294	99.92	26	38.00	1268	58.97		
> 40 - 45	300	99.98	6	38.00	294	59.03		
> 45 - 50	62	99.99	3	38.00	59	59.04		
> 50 - 60	26	100.00	0	38.00	26	59.04		
> 60	1	100.00	0	38.00	1	59.04		
Totals	514817	100.00%	195638	38.00%	303964	59.04%	15215	2.96%
Reference Grid: h12093_1m_all_7125_31jan2011_pfm_h12093_1m_all_8101_31jan2011_pfm.dif								

Sheet-to-sheet junction analyses were only performed between adjacent sheets for which data collection was completed, with all edits and final correctors applied to the data. Survey sheets with finalized data for junction analysis are listed in Table B-5. Refer to Figure B-3 for the general locality of each sheet.

Table B-5. Surveys for Junction to H12093

Registry No.	Scale	Year of Acquisition	Field Party	Date Delivered to AHB	Location of Junction
H12091	1:20,000	2009 - 2010	SAIC	01 October 2010	North
H12092	1:20,000	2010	SAIC	17 December 2010	North
H12094	1:20,000	2010	SAIC	21 January 2010	West

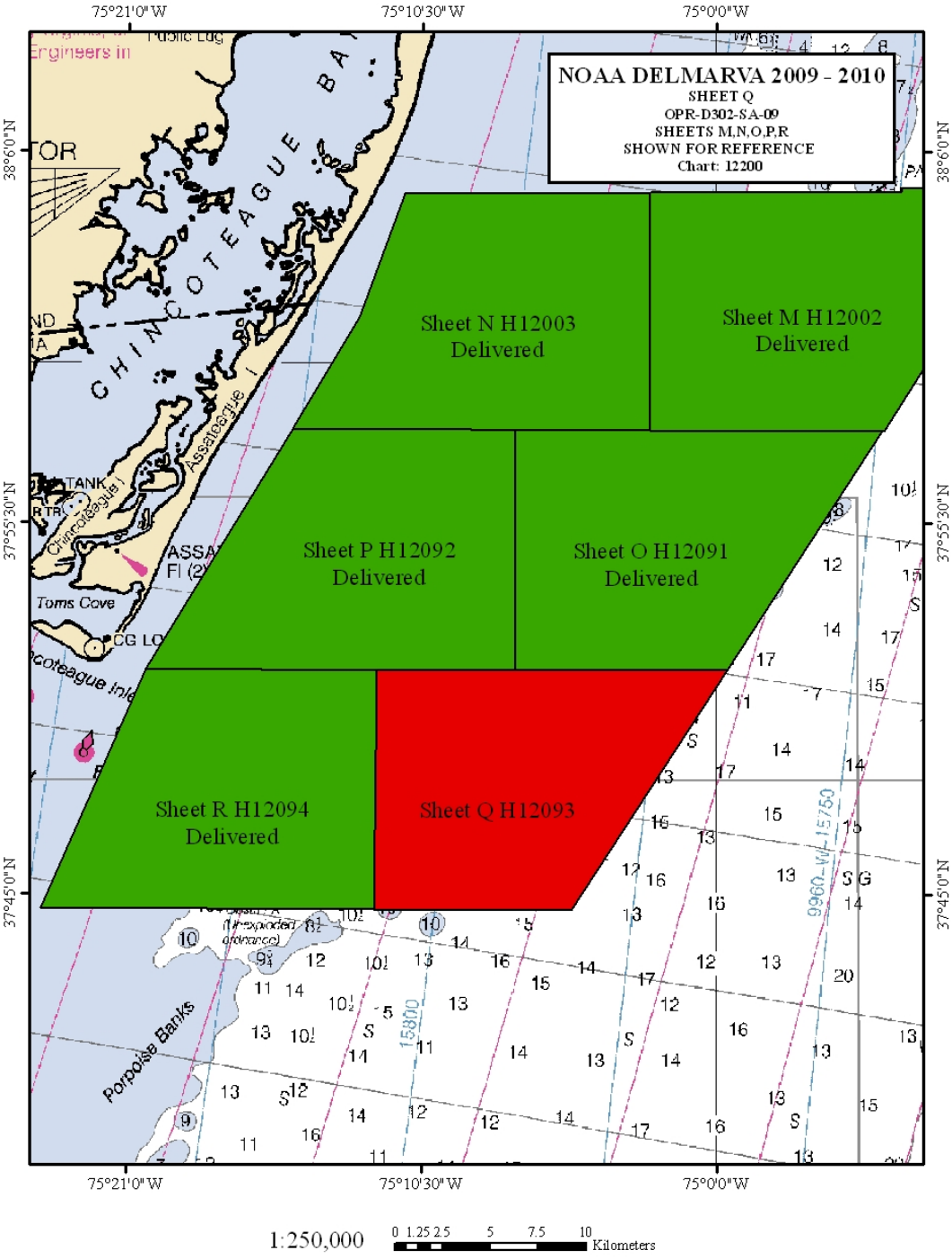

Figure B-3. General Locality and Status of Sheets in Reference to H12093

Table B-6 depicts the junction analysis between H12093 and H12091 (Sheet O) of Project OPR-D302-SA-09, surveyed between 19 September 2009 and 23 June 2010.

Junction analysis was conducted on the common area between these two sheets; which falls along the north-east area of H12093. Analysis was performed on the H12093 final one-meter PFM CUBE surface, with all data included, and the H12091 final one-meter PFM CUBE surface, with all data included. This analysis showed that 96.31% of the comparisons were within 35 centimeters and 99.09% were within 50 centimeters.

Junction analysis was performed by subtracting the H12091 data from the H12093 data. Therefore negative values indicate that H12093, depth data, were shoaler than H12091, depth data. Throughout the common area, H12093 CUBE depths were shoaler than H12091 52.89% of the time and were deeper than H12091 44.46% of the time.

Table B-6. Junction Analysis, H12093 vs. H12091

Depth Difference Range (cm)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Percent
0 - 5	226247	28.72	106902	13.57	98496	12.50	20849	2.65
> 5 - 10	183488	52.01	87237	24.64	96251	24.72		
> 10 - 15	141375	69.95	63182	32.66	78193	34.64		
> 15 - 20	94816	81.99	37650	37.44	57166	41.90		
> 20 - 25	58234	89.38	18549	39.79	39685	46.94		
> 25 - 30	34252	93.72	11421	41.24	22831	49.83		
> 30 - 35	20366	96.31	7881	42.24	12485	51.42		
> 35 - 40	11967	97.83	5111	42.89	6856	52.29		
> 40 - 45	6066	98.60	3617	43.35	2449	52.60		
> 45 - 50	3835	99.09	2631	43.69	1204	52.75		
> 50 - 60	4355	99.64	3384	44.12	971	52.88		
> 60 - 70	1735	99.86	1593	44.32	142	52.89		
> 70 - 80	655	99.94	650	44.40	5	52.89		
> 80 - 90	243	99.97	243	44.43	0	52.89		
> 90 - 100	107	99.99	107	44.44	0	52.89		
> 100 - 110	93	100.00	93	44.46	0	52.89		
> 110	19	100.00	19	44.46	0	52.89		
Totals	787853	100.00%	350270	44.46%	416734	52.89%	20849	2.65%
Reference Grid: h12093_1m_all_27January2011_pfm_h12091_1m_all_18aug2010_pfm.dif								

Table B-7 depicts the junction analysis between H12093 and H12092 (Sheet P) that was surveyed between 22 June 2010 and 17 October 2010. Junction analysis was conducted across the common area, the north-west edge of H12093. Analysis was performed on the H12093 final one-meter PFM CUBE surface, with all data included, and the H12092

final one-meter PFM CUBE surface, with all data included. This analysis showed that 95.80% of the depth comparisons were within 20 centimeters and 99.10% were within 25 centimeters.

Junction analysis was performed by subtracting the H12092 data from the H12093 data. Therefore negative values indicate that H12093 was deeper than H12092. Throughout the common area, H12093 was shoaler than H12092 35.20% of the time and it was deeper than H12092 60.60% of the time.

Table B-7. Junction Analysis, H12093 vs. H12092

Depth Difference Range (cm)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Percent
0 – 5	176391	41.37	88509	20.76	69948	16.40	17934	4.21
> 5 – 10	113749	68.04	74721	38.28	39028	25.56		
> 10 – 15	76670	86.02	51685	50.40	24985	31.42		
> 15 – 20	41693	95.80	31288	57.74	10405	33.86		
> 20 – 25	14048	99.10	10096	60.11	3952	34.78		
> 25 – 30	2981	99.80	1615	60.49	1366	35.10		
> 30 – 35	711	99.96	380	60.57	331	35.18		
> 35 – 40	133	99.99	78	60.59	55	35.19		
> 40 – 45	20	100.00	9	60.60	11	35.20		
> 45 – 50	9	100.00	5	60.60	4	35.20		
> 50	1	100.00	1	60.60	0	35.20		
Totals	426406	100.00%	258387	60.60%	150085	35.20%	17934	4.21%
Reference Grid: h12093_1m_all_27January2011_pfm_H12092_1m_MLLW_pfm.dif								

Table B-8 depicts the junction analysis between H12093 and H12094 (Sheet R) that was surveyed between 19 August 2010 and 17 October 2010. Junction analysis was conducted across the common area, the western edge of H12093. Analysis was performed on the H12093 final one-meter PFM CUBE surface, with all data included, and the H12094 final one-meter PFM CUBE surface, with all data included. This analysis showed that 96.08% of the depth comparisons were within 25 centimeters and 99.71% were within 35 centimeters.

Junction analysis was performed by subtracting the H12094 data from the H12093 data. Therefore negative values indicate that H12093 was deeper than H12094. Throughout the common area, H12093 was shoaler than H12094 23.30% of the time and it was deeper than H12094 73.36% of the time.

Table B-8. Junction Analysis, H12093 vs. H12094

Depth Difference Range (cm)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Percent
0 – 5	268976	33.91	148463	18.72	94009	11.85	26504	3.34
> 5 – 10	199082	59.00	145487	37.06	53595	18.61		
> 10 – 15	157782	78.89	132642	53.78	25140	21.78		
> 15 – 20	92324	90.53	83281	64.27	9043	22.92		
> 20 – 25	44038	96.08	41326	69.48	2712	23.26		
> 25 – 30	20342	98.65	20075	72.01	267	23.29		
> 30 – 35	8435	99.71	8355	73.07	80	23.30		
> 35 – 40	1780	99.94	1773	73.29	7	23.30		
> 40 – 45	424	99.99	424	73.34	0	23.30		
> 45 – 50	85	100.00	85	73.36	0	23.30		
> 50	6	100.00	6	73.36	0	23.30		
Totals	793274	100.00%	581917	73.36%	184853	23.30%	26504	3.34%
Reference Grid: h12093_1m_all_27January2011_pfm_h12094_1m_mb_all_04Jan2011_pfm.dif								

B.2.3.2 Crossing Analysis

Twenty-five selected crossings were randomly selected across relatively flat bottom for beam by beam comparison based on spatial and temporal distribution across the H12093 survey area (Figure B-4). Figure B-4 depicts the H12093 Statement of Work boundary (in blue) and the 25 crossings.

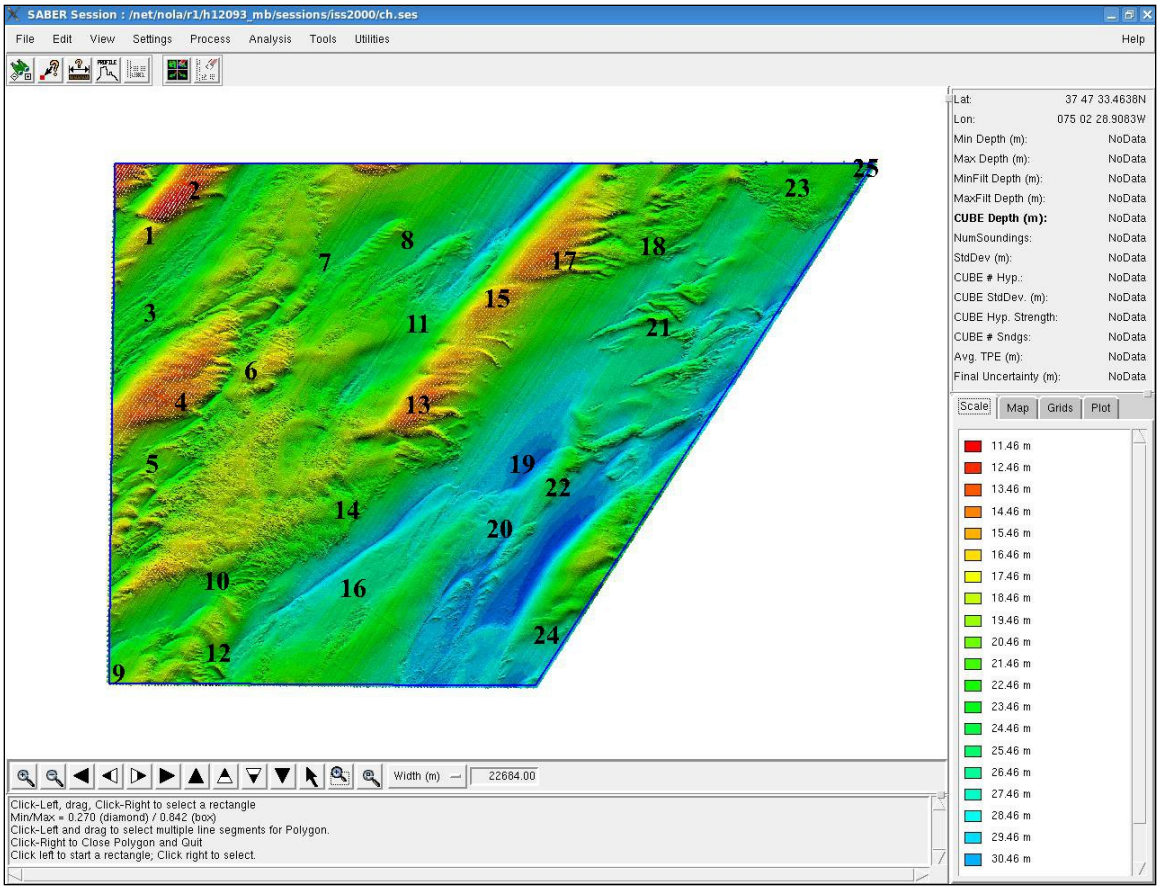

Figure B-4. Location of 25 Crossings used for Crossing Analysis and the Statement of Work Boundary (in blue)

B.2.4 Multibeam Coverage Analysis

These survey operations were conducted at a consistent 65-meter line spacing optimized to achieve 200% sidescan sonar coverage at the 75-meter range scale setting. Based on the 60° beam angle used as the cutoff for acceptable multibeam data, the effective swath width for the multibeam coverage was approximately 3.5 times the water depth. Though full bottom coverage multibeam was not required, in depths greater than approximately 21.5 meters there was sufficient outer beam overlap to provide 100% multibeam bottom coverage.

A one-meter node PFM CUBE surface was used to assess and document survey coverage. The **SABER Gapchecker** routine flagged multibeam data gaps exceeding the allowable limit of three contiguous nodes as specified in Section 5.1.2.3 and 5.1.2.2 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009. In addition, the entire surface was visually scanned for holidays at various points during the data processing effort. Additional survey lines were run to fill any holidays that were detected while the survey operations were still underway. A final review of the coverage shows a

few small areas with four or more contiguous nodes without data located in the outer beams of the multibeam swath. They were attributed to noise from bubble sweep along the hull and resulted in a reduced swath width of the multibeam data. In all cases there was 200% sidescan coverage of the areas with no contacts detected. The final CUBE surface had valid depths in more than 99.99% of the nodes.

There were four significant multibeam features within the depth range (0-23 meters) for which the specification requires a half-meter resolution grid for object detection coverage (features 1, 6, 8, and 9). There were two other features that were recommended for charting (features 4 and 13) that have depths deeper than 23 meters. Three half-meter CUBE PFM grids were created to cover all six of the significant multibeam features that were recommended for charting (features 1, 4, 6, 8, 9, and 13). Each CUBE PFM grid was analyzed for coverage. One gap was found in the H12093_features_area_1_50cm_MLLW grid where the U.S. Coast Guard maintained buoy (feature 18) was removed from the multibeam file. Data within the three half-meter resolution CUBE PFM grids remains in the one-meter CUBE PFM grid.

All grids were examined for the number of soundings contributing to the chosen CUBE hypotheses for each node by running **SABER's Frequency Distribution** tool on the CUBE number of soundings layer. The CUBE number of soundings layer reports the number of soundings that were used to compute the best hypothesis. Analysis of the H12093 final one-meter PFM grid revealed that 99.88% of all nodes contained five or more soundings; satisfying the requirements for complete multibeam coverage as specified in Section 5.1.2.1 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009. A complete analysis based on the Frequency Distribution routine is provided in Table B-9 for the one-meter PFM grid.

Table B-9. Frequency Distribution of the one-meter H12093 CUBE Number of Soundings Layer

CUBE No. of Soundings contributing to Grid Node	Binned Grid Node Count	Cumulative Percent	Percentile
401-500	3	100.00%	0.00%
301-400	580	100.00%	0.00%
201-300	15332	100.00%	0.01%
101 - 200	449758	99.99%	0.26%
11 - 100	176644884	99.74%	99.67%
10	129487	0.33%	99.75%
9	57768	0.25%	99.78%
8	46410	0.22%	99.81%
7	46863	0.19%	99.83%
6	46423	0.17%	99.86%
5	44747	0.14%	99.88%
4	46251	0.12%	99.91%
3	47552	0.09%	99.94%
2	55431	0.06%	99.97%
1	58909	0.03%	100.00%

Analysis of the six feature's half-meter PFM grids indicated that more than 95.16% of the individual nodes contained five or more soundings as listed below.

- Area surrounding feature 1 had 95.68%
- Area surrounding feature 4 had 97.54%
- Area surrounding feature 6 had 96.64%
- Area surrounding feature 8 had 95.16%
- Area surrounding feature 9 had 99.73%
- Area surrounding feature 13 had 98.05%

B.2.5 Sidescan Coverage Analysis

The Project Instructions required 200% sidescan coverage for all depths. The 200% sidescan coverage was verified by generating two separate 100% coverage mosaics at one-meter resolution as specified in Section 8.3.1 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009. The first and second 100% coverage mosaics were reviewed using tools in **SABER** to verify data quality and swath coverage. The first and second 100% coverage mosaics are determined to be complete and sufficient to meet the Project Instructions, for 200% sidescan sonar coverage. Each 100% coverage mosaic is delivered as a geo-referenced image (image file (.tif) and a corresponding world file (.tfw).

B.3 CORRECTIONS TO ECHO SOUNDINGS

Please refer to the DAPR for a description of all corrections applied to echo soundings. A RESON 8101 was installed on the *M/V Atlantic Surveyor* on 14 November 2010, which was after the DAPR had been delivered. Please refer to Appendix V "Data Acquisition and Processing Supplemental Data" for a detailed description regarding new measurement offsets and the testing operations that took place on 15 November 2010. There were no other deviations from the equipment configuration described in the DAPR submitted 01 October 2010. Please note that the delivered Generic Sensor Format (GSF) multibeam files are in version 3.01 GSF. This version of GSF is compatible with Caris version 6.1.2.8 using the HotFix initially delivered to the Atlantic Hydrographic Branch on 18 December 2009. The Caris version 6.1.2.8 HotFix has also been included with this delivery. Caris version 7.0 is compatible with this new version of GSF with HotFix 5.

B.4 DATA PROCESSING

Please refer to the DAPR for a description of all data processing steps performed. There were no deviations from the processes described therein.

While H12093 was required in the Statement of Work to meet the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009; SAIC has received approval to begin delivering some products to meet specifications detailed differently in the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2010. The changes that have been made that specifically meet the April 2010 Specifications include:

- Filename convention of the BAG files
    - Survey registry number_units of resolution_vertical datum_BAG file number of total number (Ex., H12093_1m_MLLW_1of8.bag)
- Reports and Naming Convention
    - Main Body of the DR (Sections A through D) (Ex. H12093_DRBody.doc)
    - Entire Report Cover Sheet, Title Sheet, Sections A through E, and Appendices (Ex. H12093_DR.pdf)

Other changes include:

- Updating the NOAA Hydrographic Title Sheet form 77-28
    - New Format/Layout
- Delivery of six supplemental nonstandard BAG files based on a request by AHB
    - CUBE Number of Hypotheses
    - CUBE Standard Deviation
    - CUBE Hypothesis Strength
    - CUBE Number of Soundings
    - Average TPU
    - Standard Deviation
- Evaluation of crossline and main scheme coverage to verify that 95% of the depth values differences are within the maximum allowable Total Vertical Uncertainty.

B.4.1 Bathymetry Data Processing

Seven BAGs at one-meter grid resolution are submitted for the entire H12093 area. The BAGs were exported from the CUBE Depth Surface and the Final Uncertainty surface within the CUBE PFM grid. The CUBE Depth Surface and the Final Uncertainty surfaces are defined in the CUBE Uncertainty Analysis (Section B.2.2). The resulting BAG files were limited to 300 MB in size, based on a request by AHB, and therefore multiple BAGs are produced from a single CUBE PFM grid. The BAG file named H12093_1m_MLLW_1of7.bag is the southernmost one-meter BAG while the BAG file named H12093_1m_MLLW_7of7.bag is the northernmost one-meter BAG. A summary of the final one-meter BAG files (converted from the one-meter CUBE PFM grid) and the three half-meter BAG files (converted from half-meter CUBE PFM grids) is provided in Table B-10. The depth range and uncertainty range for each delivered BAG is detailed in Table B-11.

Table B-10. Summary of H12093 BAG Files

BAG File Name	Comments
H12093_1m_MLLW_1of7.bag	Southern most 1.0-meter BAG
H12093_1m_MLLW_2of7.bag	
H12093_1m_MLLW_3of7.bag	
H12093_1m_MLLW_4of7.bag	
H12093_1m_MLLW_5of7.bag	

BAG File Name	Comments
H12093_1m_MLLW_6of7.bag	
H12093_1m_MLLW_7of7.bag	Northern most 1.0-meter BAG
H12093_features_area_1_50cm_MLLW_1of3.bag	Features 1 and 4; 0.5 meter BAG
H12093_features_area_2_50cm_MLLW_2of3.bag	Feature 9 and 13; 0.5-meter BAG
H12093_features_area_3_50cm_MLLW_3of3.bag	Feature 6 and 8; 0.5-meter BAG

Table B-11. Summary of H12093 BAG Depth and Uncertainty Values

BAG File Name	Depth Range (meters)	Uncertainty Range (meters)
H12093_1m_MLLW_1of7.bag	18.440 – 32.410	0.270 – 0. 694
H12093_1m_MLLW_2of7.bag	14.360 – 33.540	0.270 – 0.803
H12093_1m_MLLW_3of7.bag	17.310 – 33.470	0.270 – 0.625
H12093_1m_MLLW_4of7.bag	13.230 – 32.670	0.270 – 0.572
H12093_1m_MLLW_5of7.bag	13.640 – 31.290	0.270 – 0.842
H12093_1m_MLLW_6of7.bag	14.140 – 31.240	0.270 – 0.641
H12093_1m_MLLW_7of7.bag	11.490 – 32.300	0.270 – 0. 659
H12093_features_area_1_50cm_MLLW_1of3.bag	21.610 – 25.140	0.270 – 0.834
H12093_features_area_2_50cm_MLLW_2of3.bag	14.360 – 27.250	0.270 – 1.384
H12093_features_area_3_50cm_MLLW_3of3.bag	19.830 – 22.850	0.270 – 1.116

As requested by NOAA's AHB, six additional non-standard BAG files corresponding to each of the standard BAG files listed in Table B-10 were generated. These additional BAG files were generated through the same processes that were used for the standard BAG files. **SABER** generated BAG files are to BAG version 1.0, which only allows for two layers to be defined within the BAG, a Depth layer and an Uncertainty layer. Therefore, each non-standard BAG files were created with a CUBE Depth layer, populating the Depth layer of the BAG and each of the following child layers populating the Uncertainty layer of the BAG:

- CUBE Number of Hypotheses
- CUBE Standard Deviation
- CUBE Hypothesis Strength
- CUBE Number of Soundings
- Average TPU
- Standard Deviation

The CUBE Number of Hypotheses BAG contains the number of hypotheses for each node. CUBE Hypothesis Strength estimates how strongly supported a hypothesis depth estimate is. It is calculated as the ratio of the number of samples in the 'best' hypothesis and the number of samples in the next 'best' hypothesis. This ratio is subtracted from an arbitrary limit of 5, and the hypothesis strength is interpreted as the closer this value is to zero; the stronger the hypothesis. When a resulting value is less than zero the hypothesis strength is reported as zero. The CUBE Number of Soundings BAG derives the number of soundings that were used in the chosen CUBE hypothesis. CUBE Standard Deviation

is the CUBE algorithm's calculated depth uncertainty for the node, reported at the 95% Confidence Level. The Average TPU BAG is created from a second uncertainty value calculated in **SABER**, and is not part of the CUBE algorithm. It is computed by taking the average of the vertical component of the TPU for each sounding that contributed to the best hypothesis for the node. It provides an alternative means for describing the likely depth uncertainty for nodes that are thinly populated with data, a condition that may result in poor performance of CUBE's estimated depth uncertainty. Finally, the Standard Deviation BAG contains the standard deviation of the valid soundings within each bin.

Please note when reviewing these additional, nonstandard, BAGs the filename designates the layer which populates the Uncertainty layer of the BAG. Please also note that when displayed, the two layers of the BAG remain named Depth and Uncertainty. These nonstandard BAGs are provided for review purposes only and are not intended to be used as archival products.

B.4.2 Sidescan Data Processing

Sidescan contact information is delivered in several ways. The spreadsheet named "H12093_Sidescan_Contacts_List", located in Appendix II, notes all sidescan contacts that were identified within H12093. Contacts for which an **Isis** contact file was created are delivered in Separates V (*_n.CON files). The **Isis** contact files (*_n.CON) can be viewed with **Isis Target**. The contact positions stored in these files are the last click positions as chosen by the hydrographer to represent the position with the least depth, not the position that is calculated by **Isis**. SAIC's **isis2ctv** program, which is part of SAIC's processing pipeline, creates the *_n.CON file and overwrites the **Isis** calculated position field within the *_n.CON file with the last click position. Sidescan contacts that have been correlated to a multibeam feature are included in the Feature Correlator Sheets found in Appendix II. Sidescan Sonar Contacts are also delivered as an S-57 file. Additionally all contact image files (.tif) are delivered in Separates V.

C. VERTICAL AND HORIZONTAL CONTROL

Please refer to the Horizontal and Vertical Control Report, for detailed descriptions of the procedures and systems used to attain hydrographic positioning. This report is concurrently delivered with this Descriptive Report; specifics pertaining to H12093 are discussed below.

C.1 VERTICAL CONTROL

The vertical datum for H12093 is Mean Lower-Low Water (MLLW). NOAA tide station 8651370 Duck, NC (latitude 36° 11'N, longitude 075° 44.8'W) was the source of all verified water level heights for determining correctors to soundings. All data for H12093 were contained within one tide zone, SA46A; which was provided from NOAA.

The primary means for analyzing the adequacy of zoning was by entering the observed verified water level correctors at 6-minute intervals from 22 September 2010 to 19 November 2010 from adjacent zones into a spreadsheet. As the H12093 data were all contained within the one tide zone, crossing zone boundaries was not an issue within the data. Adequacy of zoning was determined by analyzing data within the navigated swath editor, SAIC's **Multi View Editor (MVE)**, for differences between overlapping swath data as well as crossline versus main scheme data. In addition sun illuminated coverage grids were viewed within **SABER** and examined for any vertical offsets which may be a result of tidal zoning impacts. As a result of these analyses SAIC did not revise the delivered tide zone for H12093. The water level zoning parameters provided by NOS, Table C-1, were adequate for application of the observed verified water levels, and they were accepted as final and applied to all H12093 multibeam data.

Table C-1. Water Level Zoning Parameters Applied on Sheet H12093

Zone	Time Corrector (minutes)	Range Ratio	Reference Station
SA46A	00:00	1.08	8651370

No final tide note was provided by NOAA Center for Operational Oceanographic Products and Services (CO-OPS). SAIC is not required to have a final tide note from CO-OPS. SAIC has provided a final tide note in Appendix IV.

C.2 HORIZONTAL CONTROL

The survey data for sheet H12093 were collected in horizontal datum North American Datum of 1983 (NAD-83), using geodetic coordinates, while data display and products used the UTM Zone 18, North projection. The following equipment was used for positioning on the *M/V Atlantic Surveyor*:

- POS/MV Model 320 Version 4, Serial Number 2575 with a Trimble Probeacon Differential Receiver (primary sensor)
- Trimble 7400 Rsi GPS Receiver with a Trimble Probeacon Differential Receiver (secondary sensor)

Differential correctors used for online data were from the U.S. Coast Guard Stations at Driver, VA, Annapolis, MD, Reedy Point, DE, and New Bern, NC. The differential receivers were programmed to only receive differential corrector data from these four stations.

Daily position confidence checks were conducted using an independent Trimble DGPS system. A real-time **ISS-2000** survey monitor also raised an alarm to alert the survey watchstander if the position differences exceeded the maximum allowable distance. All positioning confidence checks were within the 10 meter limit specified in Section 5.1.4.2 of the *NOS Hydrographic Surveys Specifications and Deliverables*, April 2009. A

summary report is located in Separates I, H12093_Daily_Positioning_Confidence_Checks".

D. RESULTS AND RECOMMENDATIONS

D.1 CHART COMPARISON

For chart comparisons, survey data are compared to the largest scale chart that encompasses the entire area. In the case of H12093, the survey area is fully covered by one Raster Chart (BSB) and one Electronic Navigational Chart (ENC). Details of each chart are listed below.

Chart 12210	**Chincoteague Inlet to Great Machipongo Inlet**	
	Scale	1:80,000
	Edition and Date	38th, 05/01/2008
	Notice to Mariners corrected through	38.133, 01/22/2011

ENC US4VA70M	**Chincoteague Inlet to Great Machipongo Inlet**	
	Scale	1:80,000
	Edition and Issue Date	10th, 12/03/2010
	Update and Date	0, 12/03/2010

The chart comparisons were conducted using SAIC's **SABER** software to view the BSB raster charts with overlain layers of H12093 data such as the CUBE gridded surface, selected soundings, contacts, and features. For ENC comparisons, a combination of Jeppesen's **dKart Inspector** and SevenCs **SeeMyDENC** were used in conjunction with **SABER**. Results from the comparisons are described below. Charting recommendations for depths follow guidance in Section 5 of the *NOS Hydrographic Surveys Specifications and Deliverables* April 2009, where depths and uncertainties are to be reported in meters with a precision of at least centimeters. Rounding for depths reported in meters was performed by standard arithmetic rounding (round half up). Charted BSB depth units are reported in feet and are rounded using NOAA cartographic rounding (0.75 round up).

H12093 data meets data accuracy standards and bottom coverage requirements and therefore is adequate to supersede common areas and soundings of all affected charts.

D.1.1 Chart 12210 Chincoteague Inlet to Great Machipongo Inlet (1:80,000)

Chart 12210 encompasses all of H12093.

The depths collected during this survey were found to agree quite well with the charted depths covered by H12093. The charted depths generally varied within ± 3 feet from the depths observed. The following large differences between the charted depths and survey depths were noted during the chart comparison.

The charted 66-foot sounding in 37° 50’ 57.46”N 075° 04’ 50.56”W was not found. CUBE depths in this area were 71 to 94 feet.

The charted 66-foot sounding in 37° 50’ 58.68”N 075° 00’ 38.79”W was not found. CUBE depths in this area were 76 to 80 feet.

The charted 60-foot and 90-foot depth curves across the survey area were found to generally be within 200 to 400 meters of their charted position. Slight changes were noted around the isolated 60-foot depth curves centered around 37° 46’ 58.18”N 075° 10’ 37.72”W where there was some minor migration of shoals causing some of the isolated depth curves to combine and others to become isolated. The 90-foot isolated depth curve charted in 37° 46’ 48.40”N 075° 05’ 47.24”W no longer exists.

The charted 93-foot sounding and the portion of the 90-foot depth curve extending to the west in 37° 50’ 42.79”N 075° 06’ 25.89”W was not found. CUBE depths in this area were 81 to 86 feet.

Feature #5 is a 82-foot (25.108 meters, 0.280 meter uncertainty) obstruction in 37° 50’ 00.00”N 075° 11’ 00.78”W and is associated with the dangerous wreck charted in 37° 49’ 59.95”N 075° 10’ 57.14”W (AWOIS 2433).

Recommendations:

- Remove the charted dangerous wreck in 37° 49’ 59.95”N 075° 10’ 57.14”W.
- Feature #5 is not significant and therefore no charting recommendations are being made.

Feature #9 is a 47-foot (14.363 meters, 0.270 meter uncertainty) wreck and is charted in 37° 45’ 45.84”N 075° 11’ 47.45”W as a 44-foot dangerous wreck labeled Wk (AWOIS 2424).

Recommendations:

- Remove the charted 44-foot dangerous wreck and label in 37° 45’ 45.84”N 075° 11’ 47.45”W.
- Chart a 47-foot dangerous wreck in 37° 45’ 45.88”N 075° 11’ 49.78”W and label Wk.

Feature #18 is an aid to navigation and is charted in 37° 50’ 37.45”N 075° 12’ 05.57”W labeled R “8” Fl R 2.5s GONG.

Recommendations:

- Retain as charted.

There was one currently charted item that was not found during the H12093 survey. It is presented in Table D-1. This item was covered by an AWOIS area and, since nothing was observed within the AWOIS search radius, is recommended for removal from the chart.

Table D-1. Charted Item Not Found, Recommended for Removal from Chart 12210

Latitude, North (NAD83)	Longitude, West (NAD83)	Search Method	Description of Item
37° 48’ 53.68”	075° 03’ 39.55”	200% Sidescan and resulting Multibeam	Dangerous Wreck labeled “PA”, AWOIS 2420

Features not previously discussed that were found in H12093 and are recommended for charting are reported in Table D-2. All information regarding these features is available in the Multibeam Features List found in Appendix II.

Table D-2. Additional Features to be Considered for Charting

Feature Number	Latitude, North (NAD83)	Longitude, West (NAD83)	Chart Depth (Feet)	Depth (Meters)	Description
1	37° 50’ 38.19”	075° 12’ 02.89”	71	21.612	Obstruction
4	37° 48’ 46.33”	075° 11’ 55.95”	79	24.102	Obstruction
6	37° 49’ 25.93”	075° 10’ 42.40”	67	20.587	Obstruction
8	37° 49’ 26.96”	075° 08’ 31.05”	71	21.784	Obstruction
13	37° 46’ 20.64”	075° 07’ 31.89”	86	26.146	Obstruction

Since Chart 12210 (1:80,000) fully encompassed the H12093 survey area, chart comparisons were only reported with reference to that chart. However, other charts exist which have common areas with Chart 12210 and the survey area. All chart recommendations should be applied to the common areas of additional charts where applicable. The additional charts which have common area are listed below:

Chart 12211 Fenwick Island to Chincoteague Inlet

Scale	1:80,000
Edition and Date	43rd, 10/01/2007
Notice to Mariners corrected through	43.166, 01/22/2011

Chart 12200 Cape May to Cape Hatteras

Scale	1:419,706
Edition and Date	49th, 06/01/2007
Notice to Mariners corrected through	49.179, 01/22/2011

Chart 13003 Cape Sable to Cape Hatteras

Scale	1:1,200,000
Edition and Date	50th, 05/01/2010
Notice to Mariners corrected through	50.53, 01/22/2011

There were no discrepancies between the charts and therefore no additional charting recommendations for these charts are provided.

D.1.2 ENC US4VA70M Chincoteague Inlet to Great Machipongo Inlet (1:80,000)

The depths collected during this survey were found to agree quite well with the charted depths covered by H12093. The charted depths generally varied within ± 1 meter from the observed depths. The following large differences between the charted depths and survey depths were noted during the chart comparison.

The charted 20.1-meter sounding in 37° 50’ 57.82”N 075° 04’ 50.46”W was not found. CUBE depths in this area were 22.8 to 28.6 meters.

The charted 20.1-meter sounding in 37° 50’ 58.93”N 075° 00’ 38.16”W was not found. CUBE depths in this area were 23 to 24.3 meters.

The charted 19.8-meter sounding in 37° 51’ 13.32”N 075° 02’ 33.39”W was not found. CUBE depths in this area were 23 to 24.1 meters.

The charted 18.2-meter and 27.4-meter depth curves across the survey area were found to generally be within 200 to 400 meters of their charted position. Slight changes were noted in the area of the isolated 18.2-meter depth curves centered around 37° 46’ 58.18”N 075° 10’ 37.72”W where there was some minor migration of shoals causing some of the isolated depth curves to combine and others to become isolated. The 27.4-meter isolated depth curve charted in 37° 46’ 48.40”N 075° 05’ 47.24”W no longer exists.

The charted 28.3-meter sounding in 37° 50’ 42.97”N 075° 06’ 25.04”W and the portion of the 27.4-meter depth curve surrounding it were not found. CUBE depths in this area were 24.8 to 26.7 meters.

The charted 26.2-meter sounding in 37° 49’ 56.66”N 075° 00’ 56.82”W and the portion of the 27.4-meter depth curve surrounding it were not found. CUBE depths in this area were 28.4 to 29.3 meters.

Feature #5 is a 25.108-meter (82.375 feet, 0.280 meter uncertainty) obstruction and is associated with the dangerous wreck charted in 37° 49’ 59.55”N 075° 10’ 57.23”W (AWOIS 2433).

Recommendations:

- Remove the charted dangerous wreck in 37° 49’ 59.55”N 075° 10’ 57.23”W.
- Feature #5 is not significant and therefore no charting recommendations are being made.

Feature #9 is a 14.363-meter (47.122 feet, 0.270 meter uncertainty) wreck and is charted in 37° 45’ 45.78”N 075° 11’ 47.13”W as a 13.4-meter dangerous wreck (AWOIS 2424).

Recommendations:

- Remove the charted 13.4-meter dangerous wreck and label in 37° 45’ 45.78”N 075° 11’ 47.13”W.
- Chart a 14.3-meter dangerous wreck in 37° 45’ 45.88”N 075° 11’ 49.78”W.

Feature #18 is an aid to navigation and is charted in 37° 50’ 37.45”N 075° 12’ 05.69”W labeled R “8” Fl R 2.5s GONG.

Recommendations:

- Retain as charted.

There was one currently charted item that was not found during the H12093 survey. It is presented in Table D-3. This item was covered by an AWOIS area and, since nothing was observed within the AWOIS search radius, is recommended for removal from the chart.

Table D-3. Charted Item Not Found on ENC US4VA70M Recommended for Removal from Chart

Latitude, North (NAD83)	Longitude, West (NAD83)	Search Method	Description of Item
37° 48’ 53.14”	075° 03’ 39.86”	200% Sidescan and resulting Multibeam	Dangerous Wreck, AWOIS 2420

Features not previously discussed that were found in H12093 and are recommended for charting are reported in Table D-4. All information regarding these features is available in the Multibeam Features List found in Appendix II.

Table D-4. Additional Features to be Considered for Charting on ENC US4VA70M

Feature Number	Latitude, North (NAD83)	Longitude, West (NAD83)	Chart Depth (Feet)	Depth (Meters)	Description
1	37° 50’ 38.19”	075° 12’ 02.89”	71	21.612	Obstruction
4	37° 48’ 46.33”	075° 11’ 55.95”	79	24.102	Obstruction
6	37° 49’ 25.93”	075° 10’ 42.40”	67	20.587	Obstruction
8	37° 49’ 26.96”	075° 08’ 31.05”	71	21.784	Obstruction
13	37° 46’ 20.64”	075° 07’ 31.89”	86	26.146	Obstruction

D.1.3 Automated Wreck and Obstruction Information Service (AWOIS) Item Investigations

As defined in the Project Instructions, there were a total of 18 AWOIS items assigned for Project OPR-D302-SA-09; three of which fell within the H12093 survey bounds. All

AWOIS items within H12093 were identified for full investigation. AWOIS item investigations were conducted with 200% sidescan sonar coverage with resulting multibeam coverage. In conjunction with the 200% sidescan sonar coverage, multibeam coverage is discussed individually for each AWOIS item. A listing of all full AWOIS items that fall within the bounds of H12093 is provided in Table D-5 and each is discussed below.

Table D-5. Complete AWOIS Listings Received from NOAA for H12093

AWOIS Number	Search Type	Chart 12210	ENC US4VA70M
2420	Full	X	X
2424	Full	X	X
2433	Full	X	X

* X denotes that the AWOIS item falls within the limits of the specified Chart or ENC

D.1.3.1 AWOIS 2420 (Full):

History: LNM50/78 – F/V sunk in approx. post Lat 37-48-54N, Long 75-03-42W. Charted as submitted dangerous wreck PA. H10044/82 – OPR-D103-MI-82; Item 51; 400% side scan sonar search, 1 mile radius, negative. Hydro. Recommends deleting wreck from chart. Evaluator does not concur and recommends retaining wreck as charted. 400% SSS coverage not achieved.

Survey Results: A search radius of 200 meters was covered with 200% sidescan and complete multibeam coverage around AWOIS 2420. No obstructions or wrecks were found within the covered area.

D.1.3.2 AWOIS 2424 (Full):

History: CL854/81-USPS; LD of 45FT. Obtained by diver depth gage in depths of 75FT. Loran-C position. Observed rates 9960-X=270503.1, 9960-y=41922.9 converted to GP using program RK321 and published 1981 ASF corrections LAT 37-45-47.2N, Long. 75-11-50.80W. Wreck is a popular dive and is locally known as the USS Bone. David A. Potter, JR. USPS member originator of letter. D-5 Indian River, Rd 2, Box 142 Millsboro, DE, 19966. Tel. 302-934-8463. LNM36/81-Publishes info. RE: Wreck above. NM36/81- Publishes infor. RE: wreck above. MAR—8/27/82; OPR-D103-MI-82; Item 142, Found by side scan sonar search H10044/82; Item 142; wreck found in 60FT. In pos Lat 37-45-46.93N, Long 75-11-50.86W. Found using Loran-C rates and SSS. LD at bow of 44FT (actual tides) by nylon line & dive float. Metal hull length not determined (visibility 10-15 & 5FT at bottom). Coral growth on hull prevented determining name. Hull oriented N-S with a scour of 70ft on its east side.

Survey Results: A radius of 200 meters was covered with 200% sidescan and complete multibeam coverage around AWOIS 2424. Feature 9 was found to fall within the search radius and is discussed above in the Chart Recommendations.

D.1.3.3 AWOIS 2433 (Full):

> **History**: LNM17/72-F/V, 61 ft. Long, white hull, sunk in 63ft. In approxoy [sic: approx] pos Lat. 37-50N, Long 75-11W. Charted as a dangerous sunken wreck. MAR—8/27/82; OPR-D-103-MI-82; main scheme hydro. Negative. H10044/82—OPR-D103-MI-82; Item 37; 100% side scan sonar search negative. Search radius not given in Descriptive Report. Hydro. Recommends charting wreck as PD. Evaluator recommends retaining as charted since insufficient SSS coverage achieved south of item. Also recommends additional wire drag and SSS work to verify of [sic or] disprove item.
>
> **Survey Results**: A radius of 200 meters was covered with 200% sidescan and complete multibeam coverage around AWOIS 2433. Feature 5 was found to fall within the search radius and is discussed above in the Chart Recommendations.

D.1.4 Designated Soundings

Designated soundings were set across this sheet to help better preserve the shallowest soundings relative to the computed depth surface. In some cases, designated soundings were used to preserve the least depth of small objects that were not significant enough to warrant a feature designation. Separate flags exist in the Generic Sensor Format (version 3.01) for designated soundings and features. All of the designated soundings in the final CUBE surface have also been flagged as designated soundings in the GSF files. There were nine designated soundings set in H12093. All depths flagged as features and designated soundings will override the CUBE best estimate of the depth in the final BAG files. All of the features and designated soundings that have been set for H12093 are listed within two spreadsheets "H12093_Multibeam_Features_List" and "H12093_Designated_Soundings_List" located in Appendix II. Both the designated soundings and features flags as defined within GSF are mapped to the same HDCS flag when ingested into CARIS (PD_DEPTH_DESIGNATED_MASK).

D.1.5 Danger to Navigation Reports

There were no Danger to Navigation Reports submitted for H12093

D.2 ADDITIONAL RESULTS

D.2.1 Shoreline Verification

Shoreline verification was not required for H12093.

D.2.2 Comparison with Prior Surveys

Comparison with prior surveys was not required under this task order.

D.2.3 Aids to Navigation

There was one U.S Coast Guard maintained charted buoy within the bounds of H12093.

The charted R "8" Fl R 2.5s GONG buoy was found (Feature 18) in 37° 50' 37.45"N 075° 12' 05.57"W (Figure D-1). During survey operations the buoy was found to have a flashing light and gong in accordance with its charted description. This agreed with the description of the Blackfish Bank Lighted Gong Buoy 8 in the United States Coast Guard Light List Volume II Atlantic Coast 2010.

This buoy was also addressed in the H12094 Descriptive Report, Project OPR-D302-SA-09 submitted 21 January 2011, as Feature 26, in 37° 50' 37.48N 075° 12' 05.58"W.

Figure D-1. Blackfish Bank Lighted Gong Buoy 8

D.2.4 Bottom Characteristics

In accordance with both the Project Instructions and *NOS Hydrographic Surveys Specifications and Deliverables* April 2009, bottom characteristics were obtained for H12093. Forty-nine samples were collected. Bottom characteristics are included within the H12093 Feature File, 3S412093.000, within the Seabed Area (SBDARE) object and attributed correctly to the International Hydrographic Organization (IHO) Special Publication 57, the IHO Transfer Standard for Digital Hydrographic Data (S-57) requirements. In addition to the data being maintained within the S-57 feature file, bottom characteristics are also represented within table Appendix V-1 and are followed by images of the bottom samples. Bottom characteristics obtained for H12093 are sufficient to be used to update the respective raster and vector charts.

D.2.5 S-57 Feature File

The final S-57 feature file for H12093, "3S412093.000, was made in accordance with the IHO S-57 standards and Section 8.2 of the *NOS Hydrographic Surveys Specifications and Deliverables* April 2009. SAIC generates the S-57 feature file through **SABER** using the SevenCs Kernel. The software was recently modified to preserve depths (attribute value of sounding (VALSOU)) to at least centimeter precision, and to millimeter precision where supported by the depths stored in the GSF files, as opposed to decimeter precision.

The S-57 feature file delivered for H12093 contains millimeter precision, although some supporting documents; such as the Feature Correlator Sheets retain centimeter precision. Following specifications, the S-57 feature file is in the WGS84 datum and is unprojected with all units in meters. All features addressed in H12093, including those features not recommended for charting, are retained within the S-57 feature file, with the exception of Feature 18. As specified in Section 8.2 of the *NOS Hydrographic Surveys Specifications and Deliverables* April 2009 navigational aids that are maintained by the U.S. Coast Guard are not submitted within this S-57 feature file. As discussed in Section D.2.3, Feature 18 is a U.S. Coast Guard maintained aid to navigation; and as such is not included in the final S-57 feature file. Please refer to Section D.2.3 and the "H12093_Multibeam_Features_List" for more information regarding Feature 18.

In addition to the Feature Correlator Sheets being delivered within Appendix II, they are also included under the pictorial representation (PICREP) attribute within the S-57 feature file, as requested by AHB. However, the manner in which SAIC generates the S-57 feature file at this time is restricted to maintaining the IHO S-57 standard. Currently SAIC can only attribute PICREP, when the object class is defined to have the PICREP attribute available. Therefore, for Sheet H12093 only wrecks have the Feature Correlator Sheet as a .TIF file, listed for PICREP.

"H12093_Multibeam_Features_List" provided within Appendix II lists all multibeam features flagged within the GSF records.

The feature file is subjected to ENC validation checks through Jeppesen's **dKart Inspector** and quality control through **dKart Inspector**, CARIS **Easy View**, and SevenCs **SeeMyDENC.**

D.2.6 Sidescan Sonar Contacts S-57 File

As requested from NOAA AHB in addition to the Sidescan Contact list, "H12093_Sidescan_Contacts_List" located in Appendix II, SAIC also generated a supplemental S-57 file to present the sidescan contacts. The supplemental S-57 file was generated through the same process used to create the H12093 S-57 final feature file. Note both of these S-57 files share the same name "3S412093.000". The supplemental sidescan S-57 feature file is located in the directory named "H12093_Side_Scan_Sonar_S-57_File_as_Cartographic_symbol", while the S-57 final feature file is located in the directory named "H12093_S-57_Feature_File".

Within the sidescan S-57 file, contacts are delivered by using an object from the Cartographic Object Classes, Cartographic Symbol ($CSYMB). The information field (INFORM) of each cartographic symbol details specifics regarding the contact; the contact name, sequential id, length, width, height, shadow length, range scale, slant range, altitude, and whether or not the contact was correlated to a feature. Contacts that were correlated list the multibeam feature number and least depth. Additionally under pictorial representation (PICREP) a tiff image for each contact is delivered. Sidescan contact images are delivered in two places, under Separates V and the Sidescan Sonar Contact S-57 file folder. Within Separates V images are named by the contact name and in the Sidescan Sonar Contact S-57 folder by the sequential id. Contacts correlated to a feature have a linked text file which corresponds to the INFORM field of the correlated feature as it appears in the H12093 S-57 feature file, 3S412093.000. The "H12093_Sidescan_Contacts_List" also provides the same information as is in this S-57 file. For spatial reference, the meta-objects provided in the S-57 final feature file are also in the sidescan contact S-57 file.

D.2.7 Additional Factors

The inshore, near coastal areas of the mid-Atlantic are relatively dynamic, and fine grained sediments (e.g., fine sands and silt) are routinely transported through normal coastal processes including alongshore and offshore seasonal sediment transport. In addition, periodic large storm events may be capable of re-suspending and transporting coarser-grained bottom sediments. Although there were small-scale seafloor changes over the course of this survey, based on comparisons with the charts, it appears that the major shoal features throughout this area have remained relatively stable. These larger shoal areas are comprised of coarser-grained sediments that are much less impacted by coastal sediment transport processes. However, in the event of an unusually large coastal storm or hurricane, the depths and extents of these relatively stable features may be greatly altered.

E. APPROVAL SHEET

25 February 2011

LETTER OF APPROVAL

REGISTRY NUMBER: H12093

This report and the accompanying digital data for Project OPR-D302-SA-09 DELMARVA, Virginia Project is respectfully submitted.

Field operations and data processing contributing to the accomplishment of this survey, H12093, were conducted under supervision of myself and other SAIC lead hydrographers with frequent personal checks of progress and adequacy. This report and accompanying deliverable data items have been closely reviewed and are considered complete and adequate as per the Statement of Work.

Reports previously submitted to NOAA for this Project include:

Report	Submission Date
Data Acquisition and Processing Report	01 October 2010
H12091 Descriptive Report	01 October 2010
H12092 Descriptive Report	17 December 2010
H12094 Descriptive Report	21 January 2011

Reports concurrently submitted to NOAA for this Project include:

Report	Submission Date
Horizontal and Vertical Control Report	25 February 2011

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Charles F. Holloway

Digitally signed by Charles F. Holloway
DN: cn=Charles F. Holloway, o=MSTD, ou=SAIC, email=hollowaycf@saic.com, c=US
Date: 2011.02.25 17:01:21 -05'00'

Charles F. Holloway
Lead Hydrographer
Science Applications International Corporation
25 February 2011

APPENDIX I

TIDES AND WATER LEVELS

APPENDIX IV. TIDES AND WATER LEVELS

The on-line times for acquisition of valid hydrographic data are presented in the Abstract of Times of Hydrography, H12093.

Project: OPR-D302-SA-09
Registry No.: H12093
Contractor Name: Science Applications International Corporation
Date: 19 November 2010
Sheet Letter: Q
Inclusive Dates: 22 September 2010 – 19 November 2010

Field work is complete.

Table Appendix IV-1. Abstract Times of Hydrography, H12093

Begin Date	Begin Julian Day	Begin Time	End Date	End Julian Day	End Time
09/22/2010	265	15:22:55	09/25/2010	268	01:01:11
10/10/2010	283	10:05:30	10/10/2010	283	11:01:02
10/10/2010	283	20:38:13	10/11/2010	284	09:56:43
10/11/2010	284	20:50:36	10/12/2010	285	12:44:16
10/12/2010	285	21:32:53	10/14/2010	287	10:19:35
10/17/2010	290	20:30:28	10/21/2010	294	03:28:13
10/23/2010	296	18:25:42	10/25/2010	298	04:05:37
10/30/2010	303	11:42:42	10/31/2010	304	01:44:55
10/31/2010	304	16:53:54	11/03/2010	307	21:35:54
11/18/2010	322	13:48:05	11/19/2010	323	07:13:35

Final Tide Note

Observed verified water levels were downloaded from the NOAA Tides and Currents web site for the station in Duck, NC (8651370). Water Level correctors were prepared for each zone using the **SABER/Tools/Create Water Level Files** software. **SABER/Apply Correctors/Tides** software applied these files to the multibeam data according to the zone containing the nadir beam of each ping.

The H12093 multibeam data fell entirely within the NOAA supplied tide zone SA46A. Analysis of multibeam data collected from all sheets of this Project using **SABER's Multi-View Editor** and bathymetry grids revealed minimal depth changes across the junction of the supplied zones based on the preliminary zoning parameters and data from the tide station in Duck, NC (8651370). A statistical analysis also confirmed the adequacy of zoning correctors based on Duck, NC (8651370), refer to the Horizontal and Vertical Control Report for Project OPR-D302-SA-09, Submitted with this DR, Section A.1 for details regarding final tides for the entire project. The water level zoning

correctors based entirely on Duck, NC (865-1370) were applied to all multibeam data for H12093.

No final tide note was provided by NOAA Center for Operational Oceanographic Products and Services (CO-OPS), this project is not required to have a final tide note from CO-OPS.

APPENDIX II

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCE

CORRESPONDENCE

-----Original Message-----
From: Evans, Rhodri E.
Sent: Thursday, May 21, 2009 11:27 AM
To: Donaldson, Paul L.; Davis, Gary R.; Quintal, Rebecca T.
Cc: Infantino, Jason; Simmons, Walter S.
Subject: RE: NOAA: Science Application Doc

For the record: in discussion with Mark Lathrop this morning he confirmed that we should work to the April 2009 HSSD. Rebecca is conducting the change detention on the HSSD versions. Thx, RE.

-----Original Message-----
From: Evans, Rhodri E.
Sent: Thursday, May 21, 2009 9:10 AM
To: Donaldson, Paul L.; Davis, Gary R.; Quintal, Rebecca T.
Subject: NOAA: Science Application Doc
Importance: High

FYI, the award of Task Order #1. Note the only discrepancy I see is that the award states April 2007 HSSD and the Project Instructions state April 2009 HSSD.

Note that the NOAA website now states: "The April 2009 edition includes new specifications and changes since the previous April 2008 version, including updates to Depth Sounding (Chapter 5) and Deliverables (Chapter 8). As there have been both minor and major edits throughout this new edition, it would be in the best interest to those that expect to acquire hydrographic survey data in accordance to NOS specifications, to use the current version."

See you at 10.

RE.

From: Evans, Rhodri E. [mailto:RHODRI.E.EVANS@saic.com]
Sent: Friday, July 10, 2009 11:32 AM
To: Davis, Gary R.; Donaldson, Paul L.; Quintal, Rebecca T.; Simmons, Walter S.
Subject: Fw: [Fwd: Re: [Fwd: RE: Tide Clarification]]

All, resolution on the tide station hot list issue. RE.

From: Jeffrey Ferguson <Jeffrey.Ferguson@noaa.gov>
To: Evans, Rhodri E.
Cc: Mark T Lathrop <Mark.T.Lathrop@noaa.gov>

Sent: Fri Jul 10 11:23:42 2009
Subject: [Fwd: Re: [Fwd: RE: Tide Clarification]]

Rod,

See below. Let me know if you have any other questions.

Jeff

-------- Original Message --------
Subject:
Re: [Fwd: RE: Tide Clarification]
Date: Fri, 10 Jul 2009 11:12:16 -0400
From: Carolyn Lindley Carolyn.Lindley@noaa.gov
Reply-To: Carolyn.Lindley@noaa.gov
Organization: National Ocean Service
To: Kyle.Ward Kyle.Ward@noaa.gov
CC: Jeffrey Ferguson <Jeffrey.Ferguson@noaa.gov>, William Sweet <William.Sweet@noaa.gov>
References: <4A57405A.2050208@noaa.gov> 4A5759CF.4010209@noaa.gov

Hi All,
Duck has been upgraded to priority processing on the HHL.

Thanks,Carolyn

Kyle.Ward wrote:

Jeff,
I spoke with Billy and Caroline and they confirmed only Duck is needed to control D302, as stated in the instructions from CO-OPS. Atlantic City, NJ (853-4720) and Lewes, DE (863-5750) were inadvertently added to the SOW. Caroline will have Duck added to the Hydro hot list.
Regards,
Kyle

Jeffrey Ferguson wrote:

As discussed...

Thanks,
Jeff

-------- Original Message --------
Subject: RE: Tide Clarification
Date: Thu, 09 Jul 2009 17:46:56 -0400

From: Evans, Rhodri E. <RHODRI.E.EVANS@saic.com
To: Davis, Gary R. <GARY.R.DAVIS@saic.com>, Mark.T.Lathrop >> <Mark.T.Lathrop@noaa.gov>, Jeffrey.Ferguson@noaa.gov>>
CC: Donaldson, Paul L. <PAUL.L.DONALDSON@saic.com>, Rebecca >> Quintal <REBECCA.T.QUINTAL@saic.com>, Walter Simmons >> <WALTER.S.SIMMONS@saic.com>>>
References: >> <4A3253243D8F5B4BB74B27E54334000D051CC164@0015-its-exmb04.us.saic.com>>> >> >> >>

Jeff,

I believe Mark is on leave as of this evening. Please see the attached email.

Thanks, RE.

From: Davis, Gary R.
Sent: Thu 7/9/2009 5:30 PM
To: Mark.T.Lathrop
Cc: Rhodri Evans; Donaldson, Paul L.; Rebecca Quintal; Walter Simmons
Subject: Tide Clarification

Mark,

In a recent response for tide zoning for our upcoming surveys off the DelMarVa coast you indicated that we should use the same zoning as last year's surveys. These zones were based on the tide station at Duck, NC (865-1370). We are currently planning to start survey operations on Sunday 12 July and request that the status of this station be changed to Priority Processing on the COOPS Hot List. The COOPS Hot List currently shows the status of this station as "Priority Processing removed, gauge will be used again in the summer of 2009. We have also noticed that the Project Instructions (OPR-D302-SA-09 Project Instructions.pdf) lists tide stations Atlantic City, NJ (853-4720) and Lewes, DE (863-5750) under the Tide Requirements. It does not mention the Duck, NC tide station. Are these stations required in addition to Duck, NC; or intended as backup tide stations in the event that Duck, NC fails? If so we request that they also be added to the COOPS Hot List.

Regards,
Gary R. Davis, ACSM Certified Hydrographer
Chief Hydrographer
SAIC Marine Science and Technology Division
221 Third Street
Building A
Newport, RI 02840
Tel (401)847-4210
Email: gary.r.davis@saic.com

-----Original Message-----
From: Mark.T.Lathrop [mailto:Mark.T.Lathrop@noaa.gov]
Sent: Wednesday, September 23, 2009 9:53 AM
To: Davis, Gary R.
Cc: Evans, Rhodri E.; Donaldson, Paul L.; Quintal, Rebecca T.; Simmons, Walter S.
Subject: Re: OPR_D302_SA-09 Task Order2 Mod 2

Gary,

Attached is the revised tide zoning for the expanded Delmarva survey.

Mark

Davis, Gary R. wrote:
> Mark,
>
> Thanks for the tide zones for the Georgia sheets A, B, C, D, and E.
> As mentioned in the Status report of 17 September we are planning to
> commence survey operations on these sheets in Late October. Please
> request that CO-OPS place tide station 8720030 (Fernandina Beach) on
> the hot list.
>
> As mentioned in Rod's last Status Report we have commenced survey
> operations on the Virginia O, P, Q, and R Sheets. Please forward ASAP
> additional tide zones based on station 8651370 (Duck, NC). The zones
> we have received do not cover the southwest area of Sheet P nor the
> west half of Sheet R.
>
> The Project Instructions for Sheets OPQR include 17 AWOIS items for
> full investigation and 1 for information only. Please forward the
> AWOIS information as soon as possible.
>
> Thanks
> Gary R. Davis, ACSM Certified Hydrographer Chief Hydrographer SAIC
> Marine Science and Technology Division
> 221 Third Street
> Building A
> Newport, RI 02840
> Tel (401)847-4210
> Email: gary.r.davis@saic.com

-----Original Message-----
From: Castle.E.Parker [mailto:Castle.E.Parker@noaa.gov]

Sent: Tuesday, February 23, 2010 2:44 PM
To: Mark.T.Lathrop; Quintal, Rebecca T.
Cc: Evans, Rhodri E.; Donaldson, Paul L.; Davis, Gary R.; Simmons, Walter S.
Subject: Re: Clarification on Object Detection Coverage

Good Day Everyone,
My comments will be in blue fonts:
Question 1: Yes to 1m resolution grid for the entire area and no to the second part. Object Detection 0.5m resolution grid for AWOIS MB investigations where 200% SS was not acquired and any MB developments that contains a feature. This refers to the output deliverables at 0.5m resolution. Object detection is really covered with the SS 200% for disprovals and detecting features; side scan is the object detection tool in this case, then developed with MB coverage for features that are considered significant or an AWOIS item if located. If the multibeam sonar is a high resolution sonar such a 0.5°x0.5° beam width it is considered object detection capable and considered appropriate for charted feature disproval without SSS coverage. We don't really need the AWOIS items covered with 200% SSS and then conducting object detection coverage over the same area with MB where the feature was not located within the SS records. This in essence is two object detect coverages. The disproval of a feature (AWOIS or charted feature) can occur with MB if a high res sonar unit, but that common area should have 200% SSS coverage and that would be the disproval source. Thus if SS doesn't reveal or contain contacts that represent the AWOIS item, then the AWOIS items does not need 0.5m resolution grid coverage over the entire AWOIS search radius. The 0.5m grid should only contain the MB developments for the feature located.

We don't need a 0.5m resolution grid for the entire area. The 0.5m resolution grid should contain only the feature developments.

Question 2: Yes.
Again, object detection grid resolution would not be applicable for a 200% SSS survey with skunk striped MB (bathy data). the object detection should source the SS.

Submit 1 grid for the entire area at 1m resolution. Submit a grid at 0.5m resolution for all MB developments where applicable.
Clear? If not, please respond.
Gene

Mark.T.Lathrop wrote:

Rebecca,

It makes sense to me to have a 1-meter BAG for the entire sheet including the AWOIS and a separate BAG for those AWOIS items < 23m. I am including Gene in my reply since AHB will be reviewing the data and I'm sure he'll want to weigh in on this.
Mark

Quintal, Rebecca T. wrote:

Mark,

We would like clarification on the requirement for Object Detection Coverage in the Project Instructions for OMNI TO#1 MARYLAND Sheets LMN, TO#2 DELMARVA Sheets OPQR, and TO#3 Georgia ABCDE. For all three projects the Coverage section of the Project Instructions state the following:

REQUIRED COVERAGE TYPES

/water depth range or area
required coverage type(s)/**

all depths 200% SSS with concurrent VBES or MB coverage

Area(s) where object detection is critical
Object Detection Coverage including AWOIS investigations

We have interpreted the "areas where object detection is critical" to only be the portions of assigned AWOIS investigation areas within our survey bounds since no other areas are specified.

Section *5.1.2.1 Object Detection Coverage *in the 2009 Specifications and Deliverables document states that "The following grid-resolution thresholds as a function of depth range; shall be used unless an exception is approved as described in Section 5.1.2."

* *

*Depth** Range** (m)	Resolution (m)*
0–23	0.5
20-40	1

* *

Question 1 – For water depths between 0-23 meters

Our intention is to deliver 1 meter resolution BAG files for the entire sheet to meet the Set Line Spacing Coverage requirement. For the Object Detection Coverage, we have assumed where the assigned AWOIS search radius falls within our SOW area, and the depths range from 0-23 meters, that a separate BAG will be delivered covering this area at 0.5 meter resolution. Please confirm if this is correct?

Question 2 – For water depths deeper than 23 meters

As our intention is to deliver 1 meter resolution BAG files for the entire sheet, we are assuming that these 1 meter BAGs will meet the Object Detection Coverage requirement for AWOIS areas (with assigned

search radii) that fall within our SOW area and the depths are deeper than 23 meters water depth. Therefore no additional deliverables are required. Please confirm this assumption?

-Rebecca

Rebecca T. Quintal | SAIC
Data Processing Manager | Marine Science and Technology Division
phone: 401.847.4210 | fax: 401.849.1585
mobile: 401.829.6242 | email: rebecca.t.quintal@saic.com

……

From: Gene Parker [mailto:Castle.E.Parker@noaa.gov]
Sent: Wednesday, September 15, 2010 2:26 PM
To: Quintal, Rebecca T.
Cc: Sarah Eggleston; Richard T Brennan; Mark T Lathrop
Subject: Re: S57 SSS Contact File

Good Afternoon,
I opened the files you submitted, reviewed, and determine that we can work with what you provided.!!! Yea! It appears normal as any other AHB feature file. I like the way that I can hover the mouse pointer over the Inform field and the whole string of attributes is visible. I can't capture the visible string, but trust me it's readable and will work FINE!
So, deliver as such and we'll take it from there.
Thanks for your additional effort for customized feature objects.

Regards,
Gene

Quintal, Rebecca T. wrote:

Gene and Sarah,

Please find attached a zip file that contains a .000 file and associated tif images and text files for a sample S-57 file with side scan sonar contacts represented in the $CSYMB object type. We have followed your lead and used a question mark ($SCODE QUESMRK1) as the symbol. I have attached a page from the IHO Publication S-52 Appendix2 which describes the symbol QUESMRK1 as well.

I know you are short on time, but if you can please have a look at this sample file to make sure it comes in to Caris as expected. I have also attached the excel file that describes these contacts (there are 6contacts) which are from Sheet H12096 which was delivered to AHB on August 20, 2010.

If all goes well we will deliver our next sheet with this $CSYMB object for the SSS S-57 file instead of the OFSPLF object. IF we run into a snag, then you will get one more delivery with this non-standard deliverable. Our next delivery is scheduled for September 29 (H12097) but amazingly this sheet has zero contacts (first time in my career).

The next delivery that has contacts is scheduled for October 1 (H12091).

Please let me know if you have any questions.

Thanks!
Rebecca

-----Original Message-----
From: Castle.E.Parker [mailto:Castle.E.Parker@noaa.gov]
Sent: Wednesday, June 23, 2010 11:22 AM
To: Quintal, Rebecca T.
Cc: Sarah Eggleston; Mark T Lathrop; Richard T Brennan
Subject: Re: S57 SSS Contact File

Hey and good day Rebecca,
I finally reviewed the files on the disk detailing grid child layers and S57 SS contact file.

I think the S57 SSS contact file will work fine. It's nice to have this in a GIS environment rather than CAD file. I feel that we should transition to the S57 format if you're willing. I think the S57 contact file complies or enables the spec to be met.

NOS HSSD 2010 version states the following: "The contact list should be created such that it can be *imported into a GIS for office verifier to analyze the distribution of contacts*. However, if the hydrographer creates any image file showing the distribution of contacts and/or other products to assist with processing and analysis of the data, they may be included with the survey deliverables."

Regarding the grid child layers, this will work as well, I think. AHB will just have to carry a cheat sheet with grid child layer interpretations based upon using the Depth layer to represent different attributes such as density, hypothesis count, etc. Even though it says depth, the layer represents something else. This will have to work based upon SAIC's processing system and procedures. I would suggest providing the "read Me" file with every survey.

So, for the surveys that SAIC is planning on submitting, I think we should transition to the S57 environment and start working through the issues, that is if they exist. The files as existing on the submitted disc for review would comply with the ability to import to a GIS. I wonder if you still plan on submitting a SS contact list or table and if so, we might

have to use in conjunction with the S57 SS contact file. I think that AHB would be able to backtrack the SS contact to appropriate line based upon the contact name.

I've passed the disc over to Sarah and she'll review, then bring another perspective to the table.

Rebecca, thanks for your effort with this endeavor and sorry for AHB's delayed response. Overall, good job and look forward to your response and revision within the survey deliverables. Please respond as necessary.

Regards,
Gene

Quintal, Rebecca T. wrote:

Hello Gene and Sarah,

Today you should receive a DVD from us with a variety of sample files.

We have sample BAGs that have a variety of CUBE child layers in them.

The CUBE child layers that are available in our PFM grids are:

CUBE Depth
CUBE Standard Deviation
CUBE Number of Hypotheses for each node
CUBE Hypothesis Strength (chosen hypothesis)
CUBE Number of Soundings contributing to the chosen hypothesis for each node
Average Propagated Error of soundings contributing to the node
Final Uncertainty (the larger of the Average Propagated Error and the CUBE Standard Deviation)

We have included these layers in various combinations in BAG files as listed below. It turns out that if you go through the GUI our software prevents us from populating the BAGs with nonstandard data (ex: number of hypotheses in the Depth layer), but if we export from PFM to BAG via command line we can do it. We have also included XYZ files of the layers as well. Does Caris have the capability to display PFM grids? I know there was talk of them supporting the format at one point but never heard what became of it. If Caris can display them, then we could certainly delivery our final PFM grid which has all of these as layers within the single grid.

We have also included two sample s-57 feature files with side scan contacts in them. We populated the contacts into the OFSPLF (Offshore platform) object. One file has only that object in it and the other has the meta objects as well (mcovr, mnsys, and mqual). These were produced with our existing capability. So we can certainly implement the $csymb object as well once it is implemented.

Please let me know if you have any questions on any of these sample files. Hopefully something in this mix will be beneficial.

Happy Friday!
Rebecca

Bag and XML files:
Cube_#Snds_depth_Cube_stdev_uncert
Depth = Cube number of soundings
Uncertainty= Cube Standard Deviation
Cube_depth_Avg_TPE_uncert
Depth = Cube Depth
Uncertainty = Average Total Propagated Error
Cube_depth_Cube_StdDev_uncert
Depth = Cube Depth
Uncertainty = Cube Standard Deviation
Cube_depth_Final_uncert
Depth = Cube Depth
Uncertainty = Final Uncertainty
Cube_hyp_depth_Cube_stdev_uncert
Depth = Cube number of hypothesis
Uncertainty = Cube Standard Deviation
Cube_HypStr_depth_Cube_stdev_uncert
Depth = Cube Hypothesis strength
Uncertainty = Cube Standard Deviation
XYZ Files:
Avg_tpe = Average Total Propagated Error
Cube_#hyp = Cube number of hypothesis
Cube_#sndgs = Cube number of soundings
Cube_depth = Cube depth
Cube_hyp_strth = Cube hypothesis strength
Cube_stdev = Cube Standard Deviation
Final_unct = Final Uncertainty

-----Original Message-----
From: Castle.E.Parker [mailto:Castle.E.Parker@noaa.gov]
Sent: Friday, April 02, 2010 11:54 AM
To: Quintal, Rebecca T.
Cc: Sarah Eggleston
Subject: Re: S57 SSS Contact File

Good morning Rebecca,

These are the issues that HSD has been dealing with for several years....related to S57 format and trying to fit an international standard to specific uses for a data file transfer format. AHB and PHB deal with this same issue for the H-Cell as well. The S57 format

Files we receive are not meant to be an ENC and fit the ENC standards, thus why we want to customized product spec and revising the S57 ENC standards to fit our needs. S57 format is only the deliverable format.

This is why AHB needs to understand the complications of our request...
to determine if SAIC can create an S57 feature and SS contact file within the constraints of SAIC's use of the 7 Seas kernel. AHB encounters many ENC standards which are violated within the HCell. The HCell and the deliverable S57 format files are not ENCs and not viewedin that light, so many ENC errors are acceptable.

Modifying the object catalog for Caris users is just editing an XML file. For SAIC the issues may not be possible.... we need to find out.

In the end, depending on your discussions with SAIC programmers, we may have to make exception.

Thanks for your effort and inquiry with these issues.

Gene

Quintal, Rebecca T. wrote:

Gene,

Thanks. A couple of questions/observations.

1. I don't see REMARK as an available attribute for the object $CSYMB (Cartographic Symbol). S-57 Appendix A IHO Object Catalogue page 230. Can SAIC modify the catalog to include REMARK? What I mean is, can SAIC modify the object catalog that is used in conjunction with the 7 Seas kernel? If for instance, the use of REMARK for $CSYMB is not possible, we can pick another attribute such as NINFOM and NTXTDS.

2. Do you still want RECDAT populated even though it has been prohibited for any object? Appendix B.1 Section 3.5.3 Prohibited attributes (page 8). Yes, unless the 7 Seas kernel won't allow inclusion of the attribute.

3. okay, I looked into the lowercase attributes a little (to be honest I had never used any non-standard objects or attributes before), so it appears that they can just be added onto an Object. So in your list I only see two (User ID and recomd). Correct. I wanted to spell it all out before I presented it to the programmers.

In the mean time we will produce a sample file with our currently supported attributes.

Thanks,

Rebecca

-----Original Message-----

From: Castle.E.Parker@noaa.gov [mailto:Castle.E.Parker@noaa.gov]
Sent: Thursday, April 01, 2010 4:01 PM

To: Quintal, Rebecca T.
Subject: S57 SSS Contact File

Rebecca,

Here's the list of SS contact attributes that AHB (me with Rick's consent) suggested for an S57 SSS contact file. Think about it and discuss with hydro co-workers and programmers. I appreciate your review and comments.

thanks,

Gene

1. SORIND: Source Indication (US,US,graph,H12345)
2. SORDAT: Source Date (last day of hydro) 20091131
3. RECDAT: Record Date (date of contact acquisition)
4. PICREP: SS contact image (image file name)
5. INFORM: Information field for corrected least depth of the correlating SWMB feature (This could be optional and open for discussion)
6. REMARK: contact remark: some sort of description of the SS contact i.e. debris, or Rk
7.User ID: SS Contact Number (unique identifier) list the contact number or could list the SS DN and line number, ping number, offset, and estimated height off the sea floor) some kind of identifying information to point to the bathy data.
    DN. Line Number, Ping Number, Offset, Est. Contact Height
    Ex: 056,128_1202,2261,-21,1.25m
8. recomd: charting recommendation (i.e. significant, insignificant, or chart 32-ft Obstn)
9. TXTDSC: text description of the correlating SWMB feature that Includes line number, ping number, and beam number
    (2009DN1021920_103-1175-96) Year 2009; DN 102; Line Start Time 1920; Line number 103; Ping 1175; Beam 96)

DATA ACQUISITION AND PROCESSING SUPPLEMENTAL DATA

Data collection for the Delmarva, Maryland, Project (OPR-D302-SA-09) was started on 19 September 2009 and completed 19 November 2010. The first sheet to be finalized for the project was H12091, delivered on 01 October 2010. The Data Acquisition and Processing Report (DAPR) for the project was delivered concurrently with H12091 and is complete for H12092 (delivered 17 December 2010) and H12094 (delivered on 21 January 2011). The data collection for H12093 began on 22 September 2010 and continued after the delivery of the DAPR until 19 November 2010.

On 04 November 2010 (JD308) the RESON 7125 struck an unknown submerged object during transit to port. The *M/V Atlantic Surveyor* was hauled into dry dock on 11 November 2010. The damaged RESON 7125 sonar equipment was removed and the vessel hull and sonar mount were inspected. The sonar hull mount bracket was verified that it was intact, and that a replacement sonar system could be securely mounted to the bracket. Also at that time offsets from the POS/MV IMU were verified. Installation of a RESON 8101 sonar system occurred on 14 November 2010.

The following sections provide supplemental data acquisition and data processing information about the systems used during the completion of the OPR-D302-SA-09 project (H12093 only), after the submission of the DAPR on 01 October 2010. Only changes from what was reported in the original DAPR are presented herein.

Corrections to Echo Soundings

Multibeam Calibrations

Prior to installation, a ping timing test on the RESON 8101 was conducted on 05 November 2010, to verify that no timing errors existed within the survey system. The RESON 8101 transducer was installed by a diver on the *M/V Atlantic Surveyor* on 14 November 2010, after the vessel had left the dry dock. A patch test was conducted on 15 November 2010 to determine bias values for roll, pitch, and heading. A small survey was run on 15 November 2010, to verify multibeam accuracies after the installation of the RESON 8101. The results of these tests are described in detail below.

Timing Test

A ping timing test was completed on 05 November 2010 for the RESON SeaBat 8101 to verify that no timing errors exist within the survey system. The fundamental tool is the event marking capability of the Symmetricom BC635PCI IRIG-B card. An event is characterized by a positive-going TTL pulse occurring on the event line of the IRIG-B connector on the back of the ISSC. The pulses of interest are the transmit trigger of the RESON 81-P and the 1PPS timing pulses from the POS/MV. These tests demonstrated that all GSF ping times matched the corresponding IRIG-B event times to within 2.5 milliseconds or less.

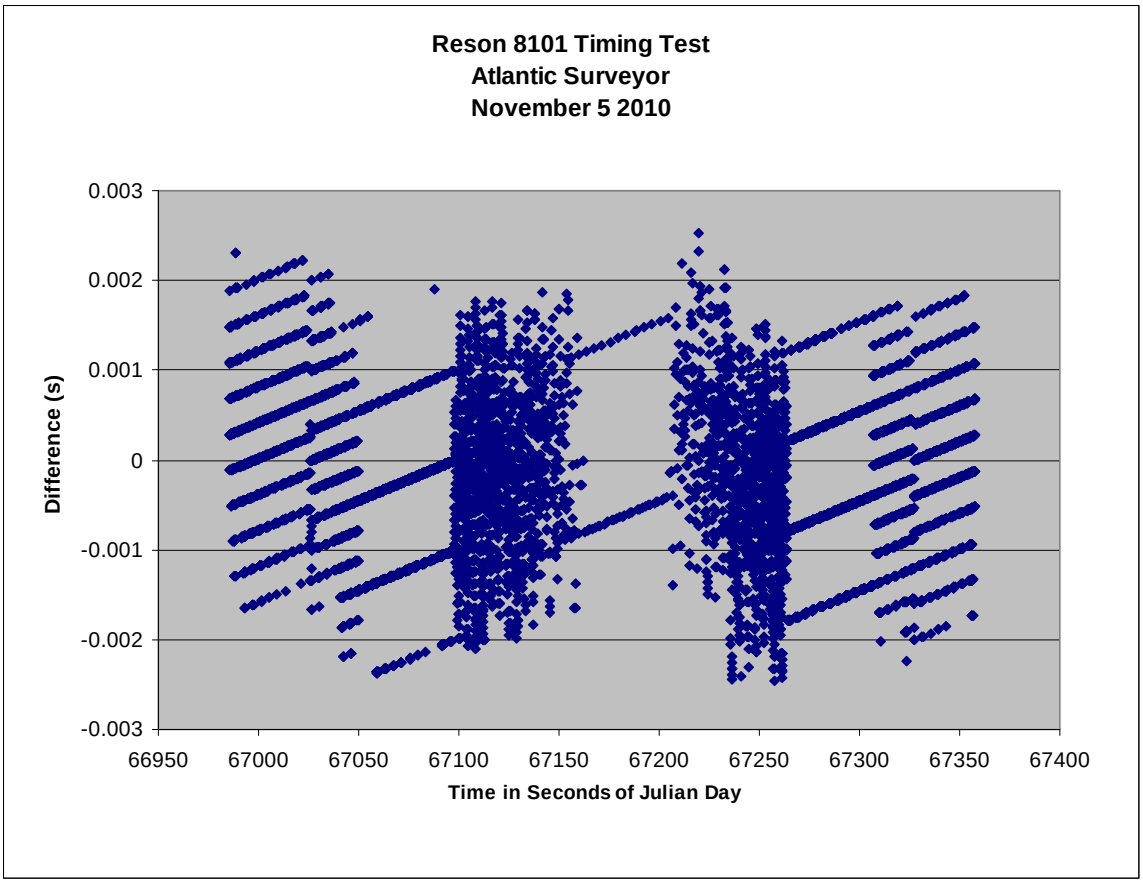

Figure Appendix V-1. November 2010 RESON 8101 Timing Test Results (time differences of ping trigger event vs. ping time tag from GSF)

Multibeam Bias Calibration

The RESON 8101 was installed on the *M/V Atlantic Surveyor* on 14 November 2010. Roll, pitch, and heading biases were determined on 15 November 2010 over a 47 foot wreck in the fish haven approximately six kilometers southeast of Manasquan Inlet. The wreck is charted in 40° 03.3925'N 073° 59.5541'W. Final biases are presented in Table Appendix V-2 and Figure Appendix V-2 through Figure Appendix V-7.

Table Appendix V-2. Multibeam Files Verifying Alignment Bias Calculated using the Swath Alignment Tool (SAT) - 15 November 2010 RESON 8101

Component	Multibeam Files		Result
Pitch	81mba10319.d24	81mba10319.d25	+0.69°
Roll	81mba10319.d24	81mba10319.d25	+0.661°
Heading	81mba10319.d22	81mba10319.d23	+1.4°

Two sets of lines were collected for pitch bias calculation. All lines were run along the same survey transect in order for separate comparisons to be made between lines run in

opposite directions. Several samples were viewed for each set of comparison lines in order to determine an accurate measurement of the pitch bias. Figure Appendix V-2 and Figure Appendix V-3 are images of the **SAT** tool depicting data collected with the +0.69° pitch bias entered in the **ISS-2000** system; therefore the indicated bias is zero.

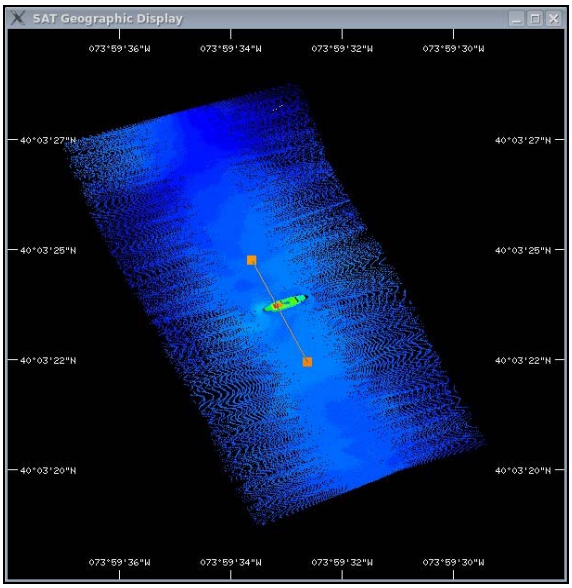

Figure Appendix V-2. SAT Tool, Plan View Depicting +0.69° Pitch Bias

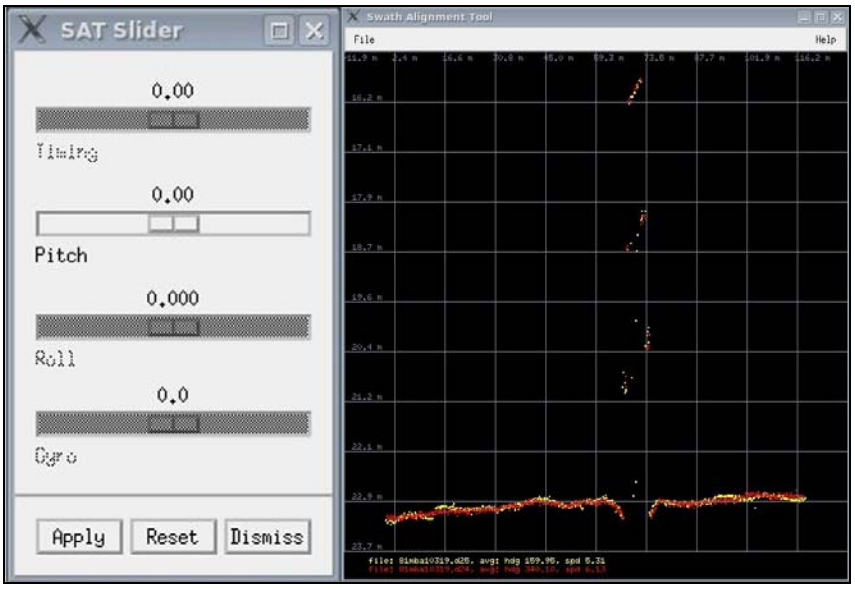

Figure Appendix V-3. SAT Tool, Depth vs. Distance Plot Depicting +0.69° Pitch Bias

Two sets of lines were collected for roll bias calculation. All lines were run along the same survey transect in order for separate comparisons to be made between lines run in opposite directions. Several samples were viewed for each set of comparison lines in

order to determine an accurate measurement of the roll bias. Figure Appendix V-4 and Figure Appendix V-5 are images of the **SAT** tool depicting data collected with the +0.661° roll bias entered in the **ISS-200** system; therefore the indicated bias is zero.

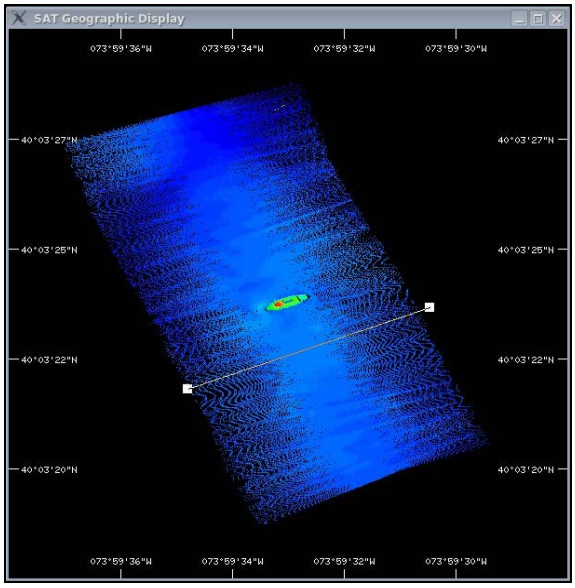

Figure Appendix V-4. SAT Tool, Plan View Depicting +0.661° Roll Bias

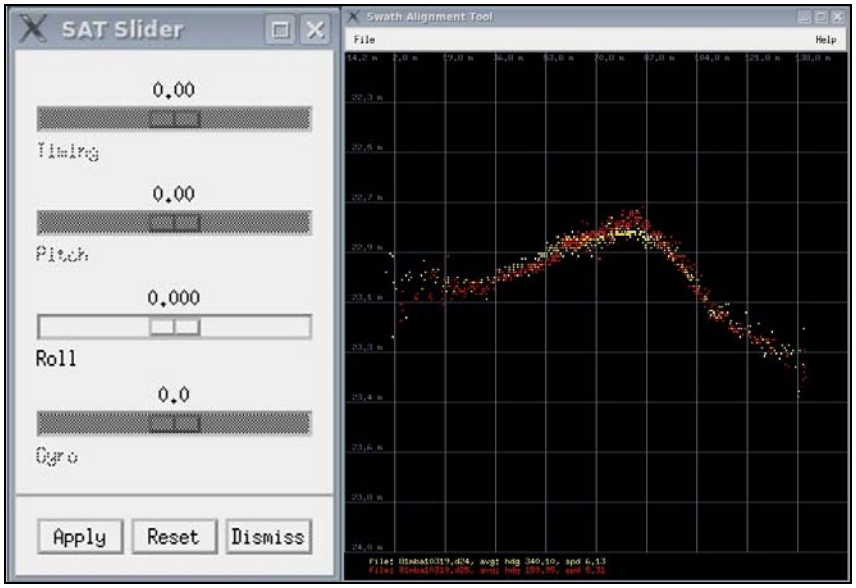

Figure Appendix V-5. SAT Tool, Depth vs. Distance Depicting +0.661° Roll Bias

Two sets of lines were collected for heading bias calculation. Lines were run on either side of the charted wreck in opposite directions in order for separate comparisons to be made. Several samples were viewed for each set of comparison lines in order to determine an accurate measurement of the heading bias. Figure Appendix V-6 and

Figure Appendix V-7 are images of the **SAT** tool depicting data collected with the +1.4° heading bias entered in the **ISS-2000** system; therefore the indicated bias is zero.

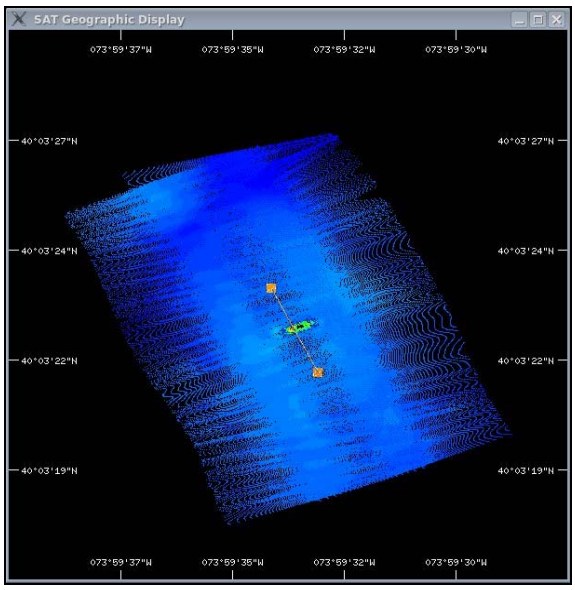

Figure Appendix V-6. SAT Tool, Plan View Depicting +1.4° Heading Bias

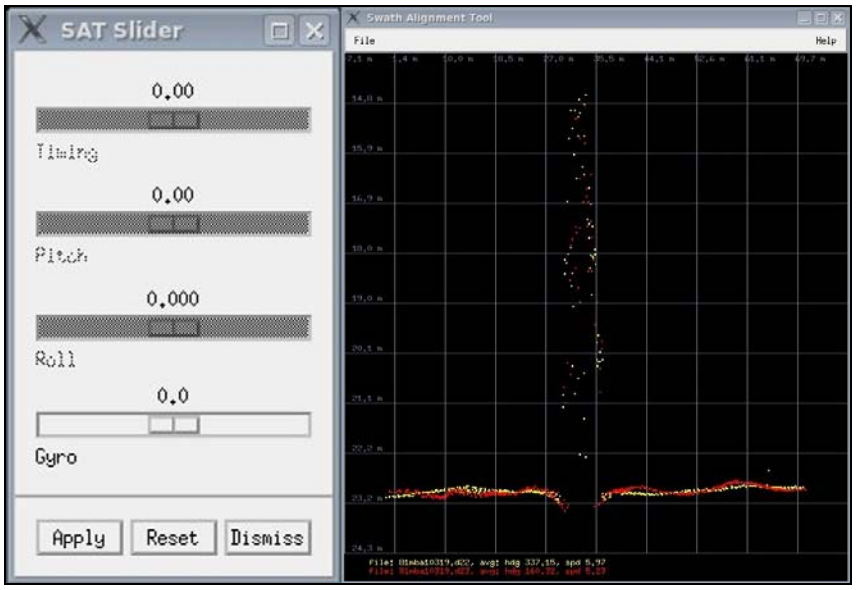

Figure Appendix V-7. SAT Tool, Depth vs. Distance Depicting +1.4° Heading Bias

Multibeam Accuracy

On 15 November 2010, a survey was run in the vicinity of the wreck alignment site to analyze multibeam accuracies after the installation of the RESON 8101. This survey consisted of nine main scheme lines and three crosslines centered on the wreck. All

depths were corrected for observed tides and zoning using the Atlantic City tide gage, 8534720. The class1 cutoff angle was set to 5° and the class2 cutoff angle was set to 60°. Standard multibeam data processing procedures were followed to clean the data, apply delayed heave, and calculate errors. One-meter minimum grids of main scheme lines, class1 crosslines, and all lines were created. A one-meter PFM CUBE of all the data was also generated and the **Gap Checker** and **Check Uncertainty** routines were run on the PFM CUBE Depth layer. The resulting minimum grid with selected soundings (in feet) is shown in Figure Appendix V-8. The PFM with CUBE depths and uncertainties are shown in Figure Appendix V-9 and Figure Appendix V-10, respectively.

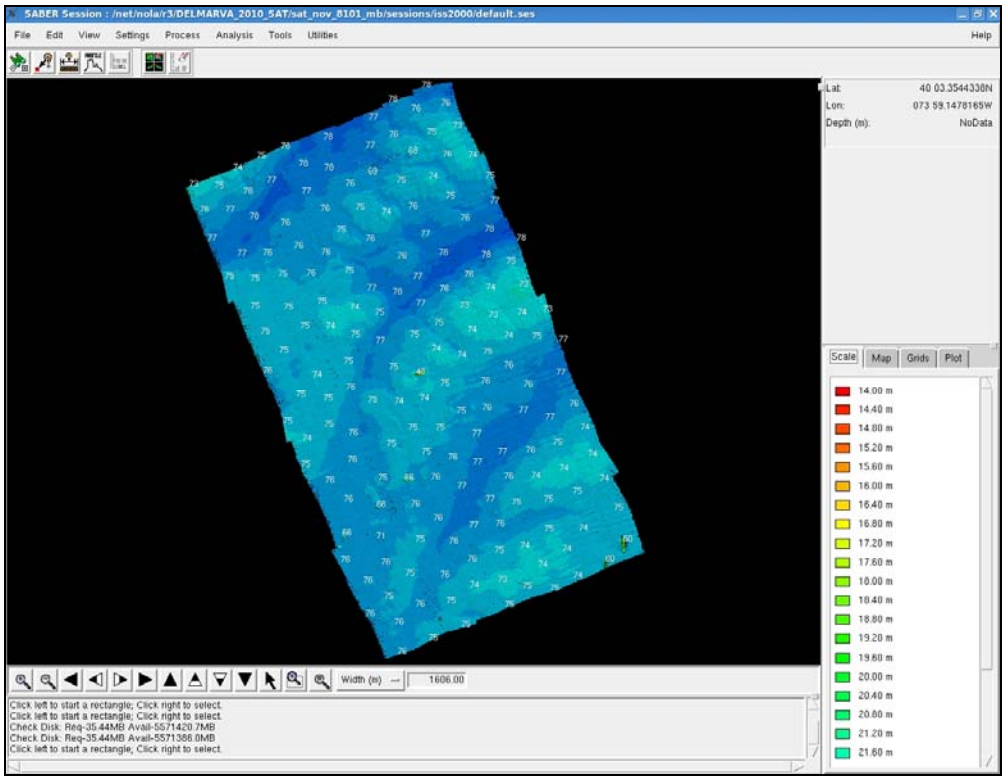

Figure Appendix V-8. 15 November 2010 Testing - RESON 8101 Verification Survey Minimum Depth Grid and Selected Soundings

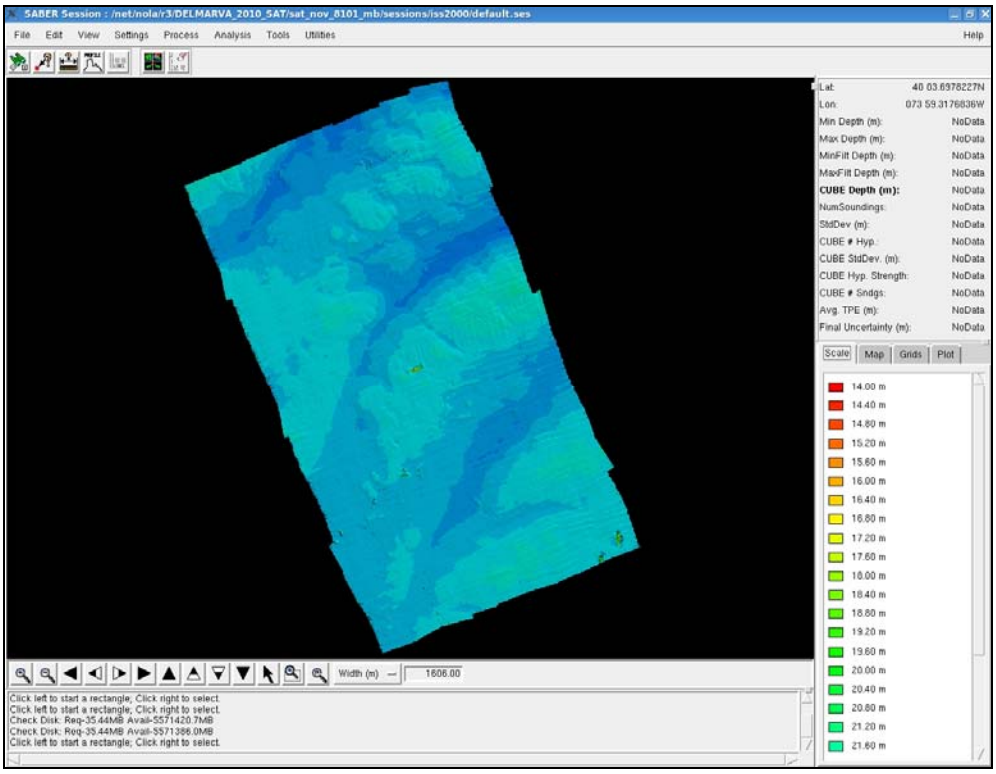

Figure Appendix V-9. 15 November 2010 Testing - RESON 8101 PFM CUBE Depth Layer

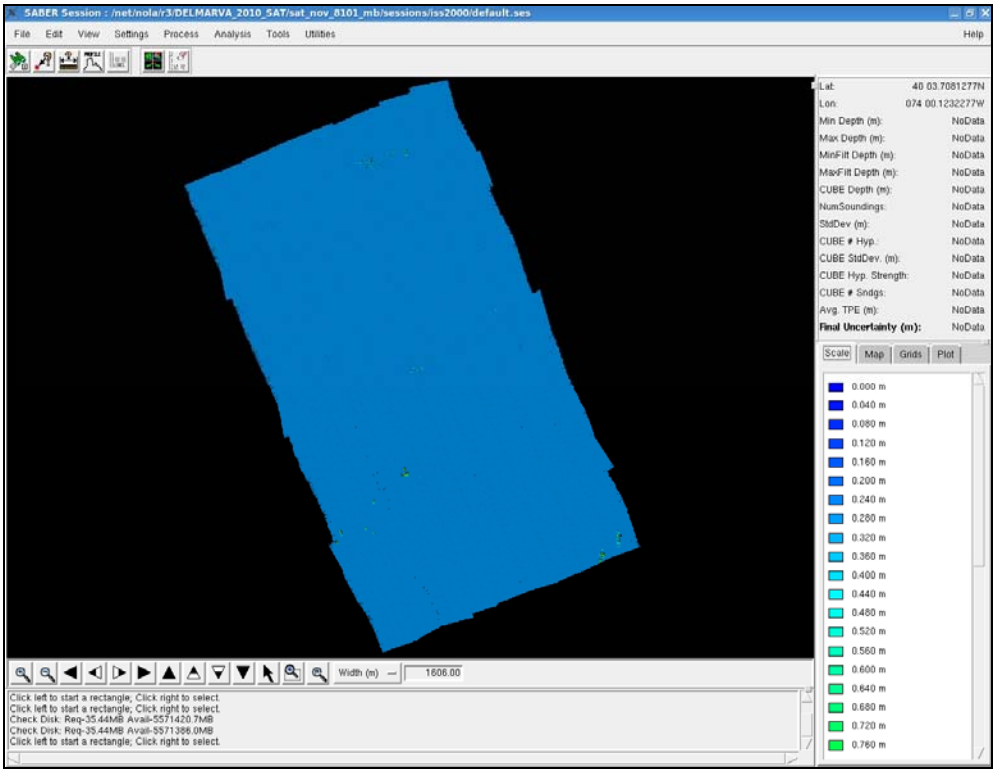

Figure Appendix V-10. 15 November 2010 Testing - RESON 8101 PFM Uncertainties Layer

A difference grid between the CUBE depth layer of the one-meter main scheme PFM and the class 1 crossline PFM was created. A statistical analysis of the depth differences using the **Frequency Distribution** tool in **SABER** was performed. The results of the statistical analysis showed that 99% of the depths agree to less than 0.20 meters, and 100% of the depths agree to less than 0.25 meters (Table Appendix V-3).

Table Appendix V-3. 15 November 2010 Testing - RESON 8101 Frequency Distribution of Depth Differences Between the Class One Crossline Minimum Grid and the Main Scheme Minimum Grid

Depth Difference (Meters)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Percent
0.00-0.05	4738	62.32	2602	34.22	1651	21.72	485	6.38
>0.05-0.10	2166	90.81	1795	57.83	371	26.59	-	-
>0.1-0.15	544	97.96	506	64.49	38	27.09	-	-
>0.15-0.20	149	99.92	145	66.39	4	27.15	-	-
>0.2-0.25	6	100.00	5	66.46	1	27.16	-	-
Total	7603	100%	5053	66.46%	2065	27.16%	485	6.38%
Reference Grid: tug_main_1m_pfm_tug_survey_cross_cl1_1m_pfm.dif								

A depth difference grid between the CUBE depth layer of the one-meter PFM from the 15 November 2010 survey (RESON 8101) and the 20 July 2010 survey (RESON 8101) was also created. A statistical analysis of the depth differences using the **Frequency Distribution** tool in **SABER** was also performed on this depth difference grid. The results of the statistical analysis showed that 98% of the depths agree to less than 0.25 meters, and 99% of the depths agree to less than 0.30 meters (Table Appendix V-4).

Table Appendix V-4. 15 November 2010 Testing - RESON 8101 Frequency Distribution of Depth Differences Between the 15 November 2010 All PFM CUBE Layer and the 20 July 2010 All PFM CUBE Layer

Depth Difference (Meters)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Percent
0.00-0.05	48936	8.74	40809	7.29	5270	0.94	2857	0.51
>0.05-0.10	129301	31.83	128608	30.26	693	1.06	-	-
>0.10-0.15	200393	67.62	200295	66.03	98	1.08	-	-
>0.15-0.20	138641	92.38	138606	90.78	35	1.09	-	-
>0.20-0.25	36927	98.97	36903	97.37	24	1.09	-	-
>0.25-0.30	4788	99.83	4775	98.22	13	1.10	-	-
>0.30-0.60	758	99.96	713	98.35	45	1.10	-	-
>0.60-1.00	67	99.97	50	98.36	17	1.11	-	-
>1.00-3.00	107	99.99	63	98.37	44	1.11	-	-
>3.00-6.50	39	100.00	23	98.37	16	1.12	-	-
Total	559957	100%	550845	98.37%	6255	1.12%	2857	0.51%
Reference Grid: tug_all_1m_8101_nov_pfm_tug_survey_all_8101_july_pfm.dif								

APPENDIX III SURVEY

FEATURES REPORT

No DTONs, Maritime Boundaries or Wrecks

H12093 AWOIS Items

Registry Number: H12093

State: Virginia

Locality: Atlantic Ocean

Sub-locality: 12 NM East South East of Chincoteague Inlet

Project Number: OPR-D302-SA-09

Survey Date: 22 September 2010 – 19 November 2010

Charts Affected

Number	Edition	Date	Scale (RNC)	RNC Correction(s)*
12211	43rd	10/01/2007	1:80,000 (12211_1)	[L]NTM: ?
12210	38th	05/01/2008	1:80,000 (12210_1)	USCG LNM: 2/14/2012 (3/20/2012) NGA NTM: None (3/31/2012)
12200	49th	06/01/2007	1:419,706 (12200_1)	[L]NTM: ?
13003	49th	04/01/2007	1:1,200,000 (13003_1)	[L]NTM: ?

* Correction(s) - *source: last correction applied (last correction reviewed--"cleared date")*

Features

No.	Name	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	AWOIS 2420 - Charted dangerous sunken Wreck, depth unknown	AWOIS	[no data]	[no data]	[no data]	---
1.2	AWOIS 2424 - USS BONE - Charted 44 foot dangerous sunken wreck	Wreck	14.36 m	37° 45' 45.9" N	075° 11' 49.8" W	2424
1.3	AWOIS 2433 - Charted dangerous sunken wreck, depth unknown	Wreck	25.11 m	37° 50' 00.0" N	075° 11' 00.8" W	2433

1.1) AWOIS #2420 - AWOIS 2420 - Charted dangerous sunken Wreck, depth unknown

No Primary Survey Feature for this AWOIS Item

Search Position: 37° 48' 54.5" N, 075° 03' 40.7" W
Historical Depth: [None]
Search Radius: 200
Search Technique: S2, MB
Technique Notes: [None]

History Notes:

History: LNM50/78 – F/V sunk in approx. post Lat 37-48-54N, Long 75-03-42W. Charted as submitted dangerous wreck PA. H10044/82 – OPR-D103-MI-82; Item 51; 400% side scan sonar search, 1 mile radius, negative. Hydro. Recommends deleting wreck from chart. Evaluator does not concur and recommends retaining wreck as charted. 400% SSS coverage not achieved.

Survey Summary

Charts Affected: 12210_1, 12211_1, 12200_1, 13003_1

Remarks:

A search radius of 200 meters was covered with 200% sidescan and complete multibeam coverage around AWOIS 2420. No obstructions or wrecks were found within the covered area.

Feature Correlation

Source	Feature	Range	Azimuth	Status
AWOIS_EXPORT	AWOIS # 2420	0.00	000.0	Primary

Hydrographer Recommendations

Charted item AWOIS 2420 not found. Remove from chart.

S-57 Data

[None]

Office Notes

SAR: Concur with field findings.

COMPILATION: Concur. No indication of wreck found during present survey. Delete charted dangerous sunken wreck, depth unknown and update area with present survey findings.

1.2) AWOIS 2424 - USS BONE - Charted 44 foot dangerous sunken wreck

Primary Feature for AWOIS Item #2424

Search Position:	37° 45' 47.4" N, 075° 11' 49.5" W
Historical Depth:	13.41 m
Search Radius:	200
Search Technique:	S2, MB
Technique Notes:	[None]

History Notes:

History: CL854/81-USPS; LD of 45FT. Obtained by diver depth gage in depths of 75FT. Loran-C position. Observed rates 9960-X=270503.1, 9960-y=41922.9 converted to GP using program RK321 and published 1981 ASF corrections LAT 37-45-47.2N, Long. 75-11-50.80W. Wreck is a popular dive and is locally known as the USS Bone. David A. Potter, JR. USPS member originator of letter. D-5 Indian River, Rd 2, Box 142 Millsboro, DE, 19966. Tel. 302-934-8463. LNM36/81-Publishes info. RE: Wreck above. NM36/81- Publishes infor. RE: wreck above. MAR—8/27/82; OPR-D103-MI-82; Item 142, Found by side scan sonar search H10044/82; Item 142; wreck found in 60FT. In pos Lat 37-45-46.93N, Long 75-11-50.86W. Found using Loran-C rates and SSS. LD at bow of 44FT (actual tides) by nylon line dive float. Metal hull length not determined (visibility 10-15 5FT at bottom). Coral growth on hull prevented determining name. Hull oriented N-S with a scour of 70ft on its east side.

Survey Summary

Survey Position:	37° 45' 45.9" N, 075° 11' 49.8" W
Least Depth:	14.36 m (= 47.12 ft = 7.854 fm = 7 fm 5.12 ft)
TPU (±1.96σ):	**THU (TPEh)** [None] ; **TVU (TPEv)** [None]
Timestamp:	2010-323.00:00:00.000 (11/19/2010)
Dataset:	H12093_AWOIS Items for PYDRO.000
FOID:	US 0000133842 00001(022600020AD20001)
Charts Affected:	12210_1, 12200_1, 13003_1

Remarks:

WRECKS/remrks: Item is a 47-foot (14.363 meters, 0.270 meter uncertainty) wreck and is charted in 37° 45’ 45.84”N 075° 11’ 47.45”W as a 44-foot dangerous wreck labeled Wk (AWOIS 2424).

Feature Correlation

Source	Feature	Range	Azimuth	Status
H12093_AWOIS Items for PYDRO.000	US 0000133842 00001	0.00	000.0	Primary
AWOIS_EXPORT	AWOIS # 2424	46.84	187.1	Secondary (grouped)

Hydrographer Recommendations

Update chart and AWOIS database

Cartographically-Rounded Depth (Affected Charts):

47ft (12210_1)

7 ¾fm (12200_1, 13003_1)

S-57 Data

Geo object 1:	Wreck (WRECKS)
Attributes:	CATWRK - 2:dangerous wreck
	CONVIS - 2:not visual conspicuous
	EXPSOU - 2:shoaler than range of depth of the surrounding depth area
	NINFOM - Add Wreck
	OBJNAM - USS BONE
	QUASOU - 6:least depth known
	SORDAT - 20101119
	SORIND - US,US,graph,H12093
	TECSOU - 2,3:found by side scan sonar,found by multi-beam
	VALSOU - 14.363 m
	WATLEV - 3:always under water/submerged

Office Notes

SAR: Confirmed. Update chart and AWOIS Database.

COMPILATION: Concur. Delete charted 44 foot dangerous sunken wreck. Add 47 foot dangerous sunken wreck in present survey location.

Feature Images

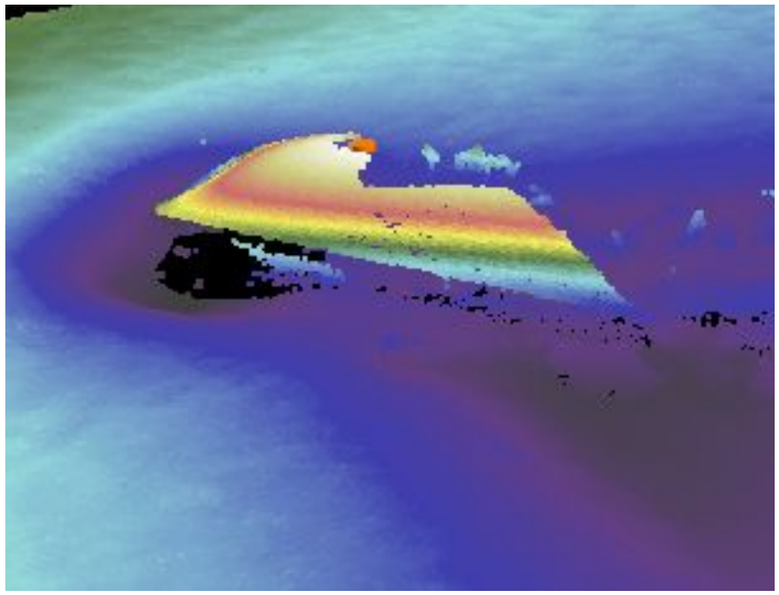

Figure 1.2.1

1.3) AWOIS 2433 - Charted dangerous sunken wreck, depth unknown

Primary Feature for AWOIS Item #2433

Search Position: 37° 50' 00.4" N, 075° 10' 58.7" W

Historical Depth: [None]

Search Radius: 200

Search Technique: S2, MB

Technique Notes: [None]

History Notes:

History: LNM17/72-F/V, 61 ft. Long, white hull, sunk in 63ft. In approxoy [sic: approx] pos Lat. 37-50N, Long 75-11W. Charted as a dangerous sunken wreck. MAR—8/27/82; OPR-D-103-MI-82; main scheme hydro. Negative. H10044/82—OPR-D103-MI-82; Item 37; 100% side scan sonar search negative. Search radius not given in Descriptive Report. Hydro. Recommends charting wreck as PD. Evaluator recommends retaining as charted since insufficient SSS coverage achieved south of item. Also recommends additional wire drag and SSS work to verify of [sic or] disprove item.

Survey Summary

Survey Position: 37° 50' 00.0" N, 075° 11' 00.8" W

Least Depth: 25.11 m (= 82.38 ft = 13.729 fm = 13 fm 4.38 ft)

TPU (±1.96σ): **THU (TPEh)** [None] ; **TVU (TPEv)** [None]

Timestamp: 2010-323.00:00:00.000 (11/19/2010)

Dataset: H12093_AWOIS Items for PYDRO.000

FOID: US 0000133845 00001(022600020AD50001)

Charts Affected: 12210_1, 12211_1, 12200_1, 13003_1

Remarks:

WRECKS/remrks: Item is an 82-foot (25.108 meters, 0.280 meter uncertainty) obstruction in 37° 50’ 00.00”N 075° 11’ 00.78”W and is associated with the dangerous wreck charted in 37° 49’ 59.95”N 075° 10’ 57.14”W (AWOIS 2433).

Feature Correlation

Source	Feature	Range	Azimuth	Status
H12093_AWOIS Items for PYDRO.000	US 0000133845 00001	0.00	000.0	Primary
AWOIS_EXPORT	AWOIS # 2433	52.91	254.9	Secondary (grouped)

Hydrographer Recommendations

Update chart and AWOIS database

Cartographically-Rounded Depth (Affected Charts):

82ft (12210_1, 12211_1)

13fm (12200_1, 13003_1)

S-57 Data

Geo object 1:	Wreck (WRECKS)
Attributes:	CATWRK - 3:distributed remains of wreck
	CONVIS - 2:not visual conspicuous
	EXPSOU - 1:within the range of depth of the surrounding depth area
	NINFOM - Add Wreck
	OBJNAM - UNKNOWN
	QUASOU - 6:least depth known
	SORDAT - 20101119
	SORIND - US,US,graph,H12093
	TECSOU - 2,3:found by side scan sonar,found by multi-beam
	VALSOU - 25.108 m
	WATLEV - 3:always under water/submerged

Office Notes

SAR: AWOIS confirmed. Wreck is largely deteriorated. Update location for submerged wreck, make non-dangerous, and update AWOIS database.

COMPILATION: Concur. Delete charted dangerous sunken wreck, depth unknown. Add non-dangerous 82 foot sunken wreck remains in present survey location.

Feature Images

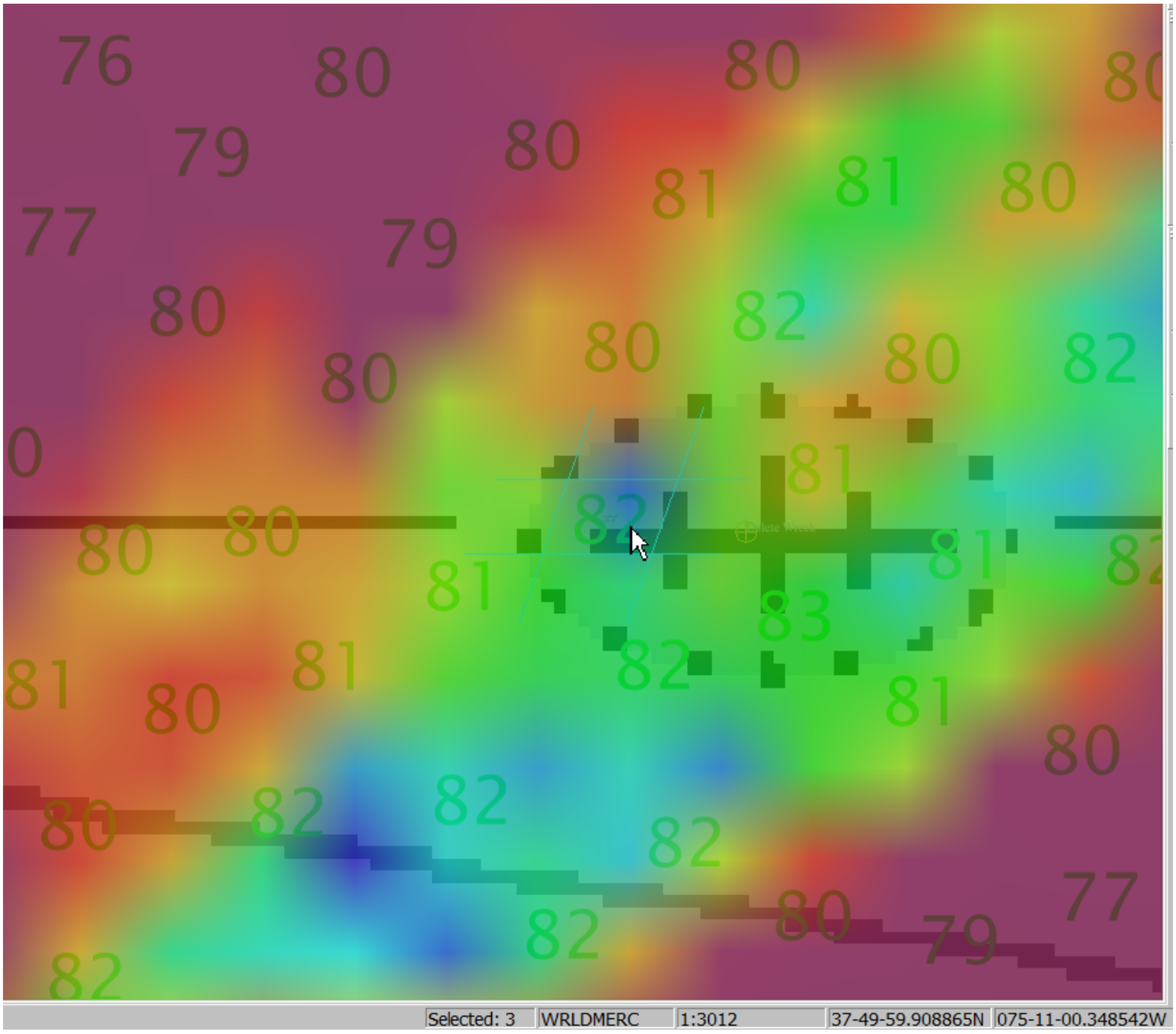

Figure 1.3.1

APPROVAL PAGE

H12093

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 NGDC for archive

- H12093_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12093_GeoImage.pdf

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 for: 

Digitally signed by Edward Owens
DN: cn=Edward Owens, o=NOAA, ou=AHB, email=Edward.Owens@noaa.gov, c=US
Date: 2012.07.31 10:28:07 -04'00'

LT Abigail Higgins
Chief, Atlantic Hydrographic Branch