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

Data Acquisition & Processing Report

Type of Survey *Multibeam and Side Scan Sonar*

Project No. *OPR-C303-KR-05*

Time Frame: *9 July 2005 – 21 November 2005*

LOCALITY

State *New Jersey*

General Locality *Atlantic Ocean*

2005

CHIEF OF PARTY

Gary R. Davis
Science Applications International Corporation

LIBRARY & ARCHIVES

DATE______________________________

NOAA FORM 77-28 (11-72)

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

REGISTRY NO.

H11455
H11456
H11495

HYDROGRAPHIC TITLE SHEET

INSTRUCTIONS – When the Hydrographic Sheet is forwarded to the office, it should be accompanied by this form filled in as completely as possible.

FIELD NO.

State: New Jersey

General Locality: Atlantic Ocean

Sublocality: Holgate to Beach Haven Crest, Beach Haven Crest to Barnegat Inlet, and Barnegat Inlet to Chadwick Beach

Scale: 1:20,000 Date of Survey: 9 July 2005–21 November 2005

Instructions Dated: 10 March 2005 and 20 July 2005 Project No. OPR-C303-KR-05

Vessel: *M/V Atlantic Surveyor*, D582365

Chief of Party: Gary R. Davis

Surveyed by: Kendra Arbesman, Brian Biggert, Curtis Clement, Gary Davis, Matt Farley, Nick Frede, Sean Halpin, Karen Hart, Chuck Holloway, Jason Infantino, Mike Kelly, Elizabeth Lobecker, Peter Martin, Matt Meyer, Rick Nadeau, Gary Parker, Gary Paquette, Evan Robertson, Jeremy Shaumbaugh, Deb Smith, Nicole Stanger, and Ryan Thomas

Soundings taken by **echo sounder**, hand lead, pole: MULTIBEAM RESON SEABAT 8101

Graphic record scaled by

Graphic record checked by Automated plot HP1055CM

Verification by

Soundings in fathoms, **feet,** meters at MLW, **MLLW**

REMARKS: **Contract**: DG133C-03-CQ-0014
Contractor: Science Applications International Corp., 221 Third Street; Newport, RI 02840 USA
Times: All times are recorded in UTC
Purpose: To provide NOAA with modern, accurate hydrographic survey data for the purpose of updating the relevant nautical charts of the assigned areas: Sheets H (H11455), J (H11456), and K (H11495) in Mid-Atlantic Corridor, Coast of New Jersey.

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ACRONYMS

Acronym	Definition
CMG	**C**ourse **M**ade **G**ood
CTD	**C**onductivity, **T**emperature, **D**epth profiler
DAT	**D**igital **A**udio **T**ape
DGPS	**D**ifferential **G**lobal **P**ositioning **S**ystem
DPC	**D**ata **P**rocessing **C**enter
DR	**D**escriptive **R**eport
GPS	**G**lobal **P**ositioning **S**ystem
GSF	**G**eneric **S**ensor **F**ormat
IMU	**I**nertial **M**easurement **U**nit
ISO	**I**nternational **O**rganization for **S**tandardization
ISS-2000	**I**ntegrated **S**urvey **S**oftware 2000
ISSC	**I**ntegrated **S**urvey **S**ystem **C**omputer
JD	**J**ulian **D**ay
KW	**K**ilo**w**att
MVE	**M**ulti-**V**iew **E**ditor
MVP	**M**oving **V**essel **P**rofiler
NAS	**N**etwork **A**ttached **S**torage
NMEA	**N**ational **M**arine **E**lectronics **A**ssociation
NOAA	**N**ational **O**ceanic and **A**tmospheric **A**dministration
PFM	**P**ure **F**ile **M**agic
POS/MV	**P**osition **O**rientation **S**ystem/**M**arine **V**essels
SABER	**S**urvey **A**nalysis and area **B**ased **E**dito**R**
SAIC	**S**cience **A**pplications **I**nternational **C**orporation
SAT	**S**ea **A**cceptance **T**ests, or **S**wath **A**lignment **T**ool
SDF	**S**onar **D**ata **F**ormat
SSP	**S**ound **S**peed **P**rofile
SV&P	**S**ound **V**elocity and **P**ressure Sensor
TPU	**T**ransceiver **P**rocessing **U**nit
UPS	**U**ninterruptible **P**ower **S**upply
XTF	e**X**tended **T**riton **F**ormat

A. EQUIPMENT

Data Acquisition: Central to Science Applications International Corporation's (SAIC) survey system is the ISSC (Integrated Survey System Computer). The ISSC consists of a high-end dual processor computer with the Windows 2000 operating system, which runs SAIC's **ISS-2000** software. This software provides survey planning and control in addition to data acquisition and logging for multibeam and navigation data. Klein 3000 side scan sonar data were acquired using Klein's **SonarPro** sonar software running on a high-end dual processor computer with the Windows 2000 operating system.

Data Processing: Post-acquisition multibeam processing was performed both on board and in the Newport, RI, office using a high-end dual processor computer with the Linux operating system, which runs SAIC's **SABER** (Survey Analysis and Area Based Editor) software. Side scan sonar data were reviewed for targets and quality in Triton-Elics' **Isis** sonar software both on board and in the Newport, Rhode Island, office. Subsequently, side scan mosaics were created, and correlation between side-scan contacts and multibeam data were established in **SABER**.

THE SURVEY VESSEL

The platform used for data collection was the *M/V Atlantic Surveyor* (Figure A-1). The vessel is equipped with an autopilot, echo sounder, Differential Global Positioning System (DGPS), radars, and two 40 KW diesel generators. Accommodations for twelve surveyors are available within three cabins. Table A-1 presents the vessel characteristics for the *M/V Atlantic Surveyor*.

Figure A-1. The *M/V Atlantic Surveyor*

Table A-1. Survey Vessel Characteristics, *M/V Atlantic Surveyor*

Vessel Name	LOA (Ft)	Beam (Ft)	Draft (Ft)	Max Speed	Gross Tonnage	Power (Hp)	Registration Number
M/V Atlantic Surveyor	110’	26’	9.0’	14 knots	Displacement 68.0 Net Tons Deck Load 65.0 Long Tons	900	D582365

Three 20-foot International Organization for Standardization (ISO) containers and a generator were secured on the aft deck. The first ISO van was used as the real-time, survey data collection office, the second van was used for the data processing office, and the third van was used for spares storage, maintenance, and repairs. The generator provided dedicated power to the survey containers and associated survey equipment.

The Position Orientation System/Marine Vessels (POS/MV) Inertial Measurement Unit (IMU) was mounted below the main deck of the vessel, 0.39 meters port of centerline and 0.34 meters forward and 1.64 meters above the RESON 8101 transducer. The multibeam sounder transducer was mounted on the hull 0.51 meters port of the keel. A Brook Ocean Technologies Moving Vessel Profiler 30 (MVP-30) was mounted to the starboard stern quarter. Configuration parameters, offsets, and installation diagrams are included in Section C of this report.

SINGLEBEAM SYSTEMS AND OPERATIONS

SAIC did not utilize singlebeam sonar on this survey for verification of the recorded nadir beam depth from the multibeam system. Periodic leadline comparisons were made during port calls (approximately every 5-6 survey days) in lieu of a singlebeam sonar comparison in accordance with the Statement of Work Attachment #6. Leadline results are included with the survey data in Section I of the Separates of each sheet’s Descriptive Report (DR).

MULTIBEAM SYSTEMS AND OPERATIONS

The real-time multibeam acquisition system used for the Mid-Atlantic Corridor, Coast of New Jersey surveys includes one of each of the following unless further specified:

- Windows 2000 workstation (ISSC) for data acquisition, system control, survey planning, survey operations, and real-time quality control
- Reson 8101 multibeam transducer
- Reson 81P sonar processor
- POS M/V 320 Position and Orientation System with a Trimble Probeacon Differential Receiver
- Trimble 4000 GPS Receiver with a Leica MX-41R Differential Receiver
- MVP 30 Moving Vessel Profiler with interchangeable Applied Microsystem Smart Sound Velocity and Pressure Sensors and a Notebook computer to interface with the ISSC and the deck control unit
- Notebook computer for maintaining daily navigation and operation logs

- One Seabird Model SBE 19-01 Conductivity, Temperature, Depth (CTD) profiler
- Uninterrupted power supplies (UPS) for protection of the entire system

The user selectable range scale on the Reson 8101 was adjusted appropriately depending upon the survey depth.

SIDE SCAN SONAR SYSTEMS AND OPERATIONS

The side scan system used for surveys H11455, H11456, and H11495 includes one of each of the following:

- Klein 3000 digital side scan sonar towfish with a Klein K1 k-wing depressor
- Klein 3000 Windows 2000 computer for data collection and logging of 3000 sonar data with Klein **SonarPro** software
- Klein 3000 Transceiver Processing Unit (TPU)
- McArtney sheave with cable payout indicator
- Sea Mac winch with remote controller
- Uninterrupted power supplies (UPS) for protection of the computer system

The backup side scan system maintained aboard includes:

- Klein 3000 digital side scan sonar towfish with a Klein K1 k-wing depressor
- Klein 3000 Windows 2000 computer for data collection and logging of 3000 sonar data with Klein **SonarPro** software
- Klein 3000 Transceiver Processing Unit (TPU)

The Klein 3000 is a conventional dual frequency side scan towfish. At a range scale of 50 meters, the ping rate of 15 pings/second is set by the transceiver, which allowed for a maximum survey speed of 9 knots. This maximum survey speed, based on the Klein 3000 range scale, ensured a minimum of three pings per meter in the along-track distance allowing for the detection of objects that measure 1.0 x 1.0 meters horizontally and 1.0 meter vertically (from shadow length measurements). Side scan operations were conducted in water depths ranging from 12 to 82 feet. During the survey operations on all sheets, a range scale of 50-meters was consistently used.

During survey operations, digital data from the Klein 3000 TPU were sent directly to the Klein 3000 computer for display and logging by Klein **SonarPro** software. Raw digital side scan data from the Klein 3000 were collected in Klein's proprietary Sonar Data Format (SDF). These files were periodically archived to the data processing computer for initial processing and quality control review. The SDF format files were converted to eXtended Triton Format (XTF) prior to processing and review. At the end of each survey day (i.e. Julian Day, JD) the raw SDF and XTF side scan data files were backed up on digital tapes which were shipped to the Data Processing Center in Newport, RI once the survey vessel reached port.

Towfish positioning was provided by **ISS-2000** through a program module called "rtcatnry." This program was configured to use a Payout and Towfish Depth, Figure A-2, to compute towfish positions. The Payout and Depth method computed the position of the tow point using the offsets of the tow point from the POS/MV IMU and the vessel heading. The tow fish position was calculated from the position of the tow point using the cable out value received by **ISS-2000** from the cable payout meter, the towfish pressure depth (sent via a serial interface from the Klein 3000 computer to the **ISS-2000**), and the Course Made Good (CMG) of the vessel. This method assumes that the cable is in a straight line therefore no catenary algorithm was used.

The ship's north and east velocity vectors are filtered to calculate the ship's CMG. The CMG is used to determine the azimuth from the tow block to the side scan towfish. The position for the side scan towfish was computed based on the vessel's heading, the reference position (POS/MV IMU), the measured offsets (X, Y, and Z) to the tow point, height of the tow point above the water, Course Made Good and the amount of cable out. This calculated towfish position was sent to the sonar data collection system in the form of a GGA (NMEA-183, National Marine Electronics Association, Global Positioning System Fix Data String) message where it was merged with the sonar data file. Cable adjustments were made using a remote winch controller inside the real time survey van in order to maintain acceptable towfish altitudes and sonar record quality. Changes to the amount of cable out were automatically saved to the **ISS-2000** message file and a payout file.

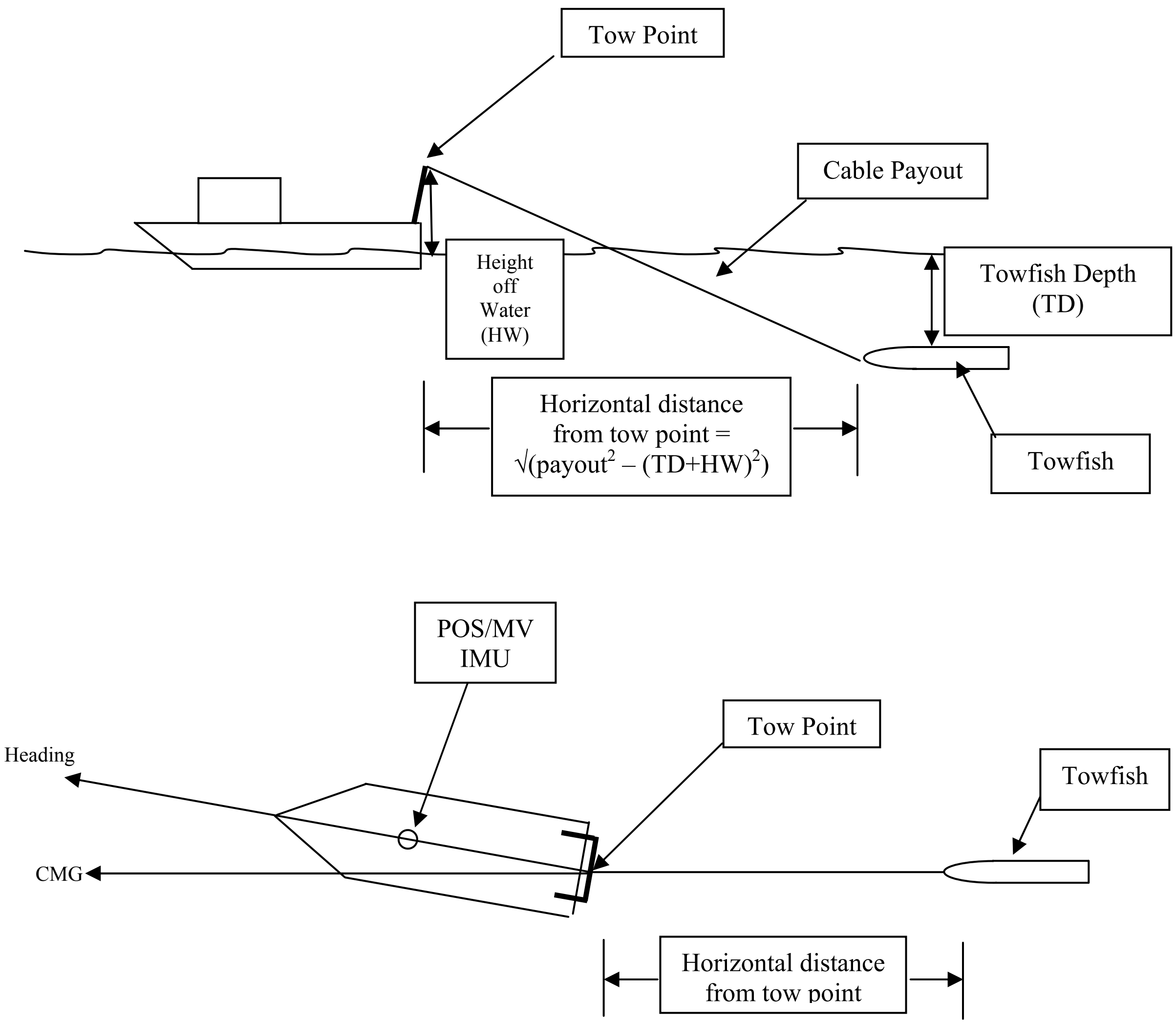

Figure A-2. Geometry of Side Scan Towfish Position Calculations Using the Payout and Depth Method.

Towfish altitude was maintained between 8% and 20% of the range (4m-10m), when conditions permit. For equipment and personnel safety as well as safe vessel maneuverability, data may have been collected at towfish altitudes outside the 8% to 20% of the range over shoal areas and in the vicinity of charted obstructions or wrecks. In some regions of the survey area, the presence of a significant density layer required that the altitude of the towfish be maintained outside the 8% to 20 % of the range to avoid refraction in the sonar data that would mask small targets in the outer sonar swath range. When the towfish altitude was either greater than 20% or less than 8%, periodic confidence checks on linear features (e.g. trawl scars) or geological features (e.g. sand waves or sediment boundaries) were made to verify the quality of the sonar data. Confidence checks ensured the ability to detect one-meter high objects across the full sonar record range.

Another feature that affected the towfish altitude was the use of a K-wing depressor. The K-wing depressor was attached directly to the towfish and served to keep it below the propeller, even at slower survey speeds of 6 knots. It also decreased the amount of cable out, which reduced the positioning error of the towfish. Another benefit to less cable out was the increased maneuverability of the ship in shallow water. Less cable out reduced the need to recover cable prior to turning for the next survey line, permitted tighter turns and increased survey efficiency. The K-wing was not used in the shallower areas because the reduced cable out resulted in acoustic interference with the multibeam system.

Side scan data file names were changed automatically every hour and manually at the completion of a survey line.

SOUND SPEED PROFILES

A Brooke Ocean Technology Moving Vessel Profiler (MVP) with an Applied Microsystems Smart Sound Velocity and Pressure sensors or a Seabird Electronics SBE-19 CTD were used to collect sound speed profile (SSP) data. SSP data were obtained at intervals frequent enough to reduce sound speed errors. The frequency of casts was based on observed sound speed changes from previously collected profiles and time elapsed since the last cast. Multiple casts were 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 the sound speed profiles change, cast frequency and location are modified accordingly. Confidence checks of the sound speed profile casts were conducted weekly by comparing two consecutive casts taken with different Sound Velocity and Pressure sensors or with a Sound Velocity and Pressure sensor and a Seabird SBE-19 CTD.

Serial numbers and calibration dates are listed below. Sound speed data and calibration records are included with the survey data in Section III of the Separates for each sheet's Descriptive Report.

Applied Microsystems Ltd., Smart SV & Pressure, Serial Number 4404
Calibration Dates: 24 February 2005
No post survey calibration as sensor was damaged during survey operations and is being repaired. If the repair is successful calibration dates will be noted in the H11456 and H11495 Descriptive Reports.

Applied Microsystems Ltd., Smart SV & Pressure, Serial Number 4523
Calibration Dates: 10 March 2005 and 24 March 2006

Applied Microsystems Ltd., Smart SV & Pressure, Serial Number 4880
Calibration Dates: 11 March 2005, 06 October 2005 and 01 March 2006

Seabird Electronics, Inc., CTD, Serial Number 2710
Calibration Dates: 25 February 2005 and 15 March 2006

DATA ACQUISITION AND PROCESSING SOFTWARE

Data acquisition was carried out using the SAIC **ISS-2000** software on a Windows 2000 operating system to control real-time navigation, data time tagging and data logging. Table A-2 provides a complete list of all **ISS-2000** version 3.9.1 software modules for the Windows 2000 platform.

Survey planning, data processing and analysis were carried out using the SAIC **SABER** software on LINUX operating system. Table A-3 provides a complete list of all **Survey Planning** and **SABER** version 3.1.13 software modules that were initially used both on the survey vessel and in the office for processing and analyzing data. In December 2005, SABER was upgraded to version 3.2.14 in the office only. Table A-4 provides a list of **Survey Planning** and **SABER** version 3.2.14 updated software modules. In January 2006, **SABER** was upgraded to version 3.2.15 in the office only. Table A-5 provides a list of **SABER** version 3.2.15 updated software modules. Table A-6 lists the **SABER** software patches that were installed in March 2006 in the office version only.

SonarPro version 8.0, running on a Windows 2000 platform was used for side scan data acquisition.

Isis version 6.06, running on Windows 2000 and XP platforms was used for side scan data quality review, and contact identification.

Position data were recorded from both the POS/MV system and the Trimble 7400. Data from the POS/MV were used as the primary navigation and were merged with multibeam data. Daily vessel positioning confidence checks were done by comparing data recorded from the POS/MV to data recorded from the Trimble DGPS (see Vertical and Horizontal Control Report – SAIC Doc 05-TR-013).

Table A-2. ISS-2000 for Windows Product Version: -v ISS-2000_3.9.1

checkkey.dll Built at Version -vLIBCHKKEY_1.14	magynav.exe Built at Version -vMAGYNAV_2.3
utility.dll Built at Version -vUTILITY_2.11.3	makeindx.exe Built at Version -vMAKEINDX_2.5
bancomm.dll Built at Version -vBANCOMM_2.2.1	mergserv.exe Built at Version -vMERGE_SERVE_2.3
proj.dll Built at Version -vPROJ_2.5	mbimagery.exe Built at Version -vMBIMAGERY_2.1.4
nad.dll Built at Version -vPROJ_2.5	mbmgr.exe Built at Version -vMBMGR_2.7
snpgeo.dll Built at Version –vSNPGEO_2.3	mru6.exe Built at Version -vMRU6_2.2
dbms.dll Built at Version -vDBMS_2.12	msgmgr.exe Built at Version -vMSGMGR_2.8.1
nmea0183.dll Built at Version –vNMEA0183_2.2	mvp30.exe Built at Version -vMVP30_2.1
snpgprim.dll Built at Version -vSNPGPRIM_2.9	mvpout.exe Built at Version -vMVPOUT_2.4
gsf.dll Built at Version -vGSF_2.03.5	navisounddtc.exe Built at Version -vNAVISOUNDDTC_1.5
dbdb.dll Built at Version -vDBDB_2.3	nmea_apb.exe Built at Version -vNMEA_APB_2.3
hmps.dll Built at Version -vHMPS_LIB_2.12	ntimesrv.exe Built at Version -vNTIMESRV_2.2
sensors.dll Built at Version -vSENSORS_2.16	payout.exe Built at Version -vPAYOUT_2.4
filters.dll Built at Version -vFILTERS_2.2	phoenix.exe Built at Version -vPHOENIX_2.2
grid_io.dll Built at Version -vGRID_IO_3.13	phxovl.exe Built at Version -vPHOENIX_OVL_2.3
nutil.dll Built at Version -vNUTIL_2.1	pmv_3.exe Built at Version -vPMV3_2.12

plotw.dll Built at Version –vPLOTWID_2.4	ptti.exe Built at Version -vPTTI_2.2
dspgraph.dll Built at Version -vDSPGRAPH_2.6	resondtc.exe Built at Version -vRESONDTC_2.7.3
hpgraph.dll Built at Version –vHPGRAPH_2.4	rtcatnry.exe Built at Version -vRTCATNRY_2.5
snpdraw.dll Built at Version –vSNPDRAW_2.20	rtkf.exe Built at Version -vRTKF_2.8
pthreads.dll Built at Version –vPTHREAD_2.3	rtkflite.exe Built at Version -vRTKFLITE_2.4
childwatch.dll Built at Version -vLBLNAV_2.1	rttide.exe Built at Version -vRTTIDE_2.11
svputil.dll Built at Version –vSVPUTIL_2.12	sbdtc.exe Built at Version -vSBDTC_1.1
smemcom.dll Built at Version -vSMEMCOM_2.8.1	serialb.exe Built at Version -vSERIALB_2.4
xutils.dll Built at Version -vXUTILS_2.7	sirpm.exe Built at Version -vSIRPM_2.6
htmlwid.dll Built at Version –vHTMLWID_2.4.1	srvfile.exe Built at Version -vHPRCAL_2.2
sputil.dll Built at Version -vSPUTIL_2.16	stateb.exe Built at Version -vSTATEB_2.4
set_serial_ex.dll Built at Version -vSET_SERIAL_EX_1.1	svpmon.exe Built at Version -vSVPMON_2.13
datamrge.dll Built at Version -vDATAMRGE_2.3	swathplt.exe Built at Version –vSWATHPLT_2.6.1
mb_corr.dll Built at Version -vMB_CORR_1.8	synctime.exe Built at Version –vSYNCTIME_2.6
mberr.dll Built at Version -vMBERR_2.3	syscon.exe Built at Version -vSYSCON_2.11
ctable.dll Built at Version -vCTABLE_2.3	taim.exe Built at Version -vTAIM_2.3.1
dbx.dll Built at Version -vDBX_2.2	telrx.exe Built at Version -vTELWNT_2.1
sim_util.dll Built at Version -vSIM_UTIL_2.0	teltx.exe Built at Version -vTELWNT_2.1
spmgr.exe Built at Version -vSPMGR_2.14.1	timechk.exe Built at Version -vTIMECHK_2.5
sysadmin.exe Built at Version -vSYSADMIN_2.2.1	tkpt2.exe Built at Version -vTRACKPT2_2.3
4rinex.exe Built at Version –vFORRINEX_1.0	tprobet.exe Built at Version -vTPROBET_2.2
ap9.exe Built at Version -vAP9_2.1	tss335b.exe Built at Version -vTSS335B_2.4
autoarch.exe Built at Version –vAUTO_ARCHIVE_2.8	utcmsg.exe Built at Version -vUTCMSG_1.1
bc635_detect.exe Built at Version -vBC635_DETECT_1.1	waterfal.exe Built at Version –vWATERFAL_2.5.1
bc635evt.exe Built at Version -vBC635EVT_2.2	whnav.exe Built at Version -vWHNAV_2.2
beacons.exe Built at Version -vBEACONS_2.6	xdp.exe Built at Version -vXDP_2.0.3
cdrvtime.exe Built at Version -vCDRVTIME_1.1	xpdctl.exe Built at Version -vXPDCTL_2.0.3
comtst.exe Built at Version -vCOMTST_2.2	xgpsmon.exe Built at Version –vXGPSMON_2.7
cov_mon.exe Built at Version -vCOV_MON_2.11	xnavmgr.exe Built at Version -vXNAVMGR_2.13
dpt_dtc.exe Built at Version -vNMEA_DPT_2.2	z12.exe Built at Version -vZ12_2.7
dtc_disp.exe Built at Version -vDTC_DISP_2.7	datamgr.exe Built at Version -vDATAMGR_2.8
echodtc.exe Built at Version -vECHO_DTC_2.4	datasumm.exe Built at Version -vDATASUMM_2.13
envmgr.exe Built at Version –vENVMGR_2.9.2	imprtdxf.exe Built at Version -vIMPRTDXF_2.11
em_out.exe Built at Version -vEM_OUT_2.5	tkproj.exe Built at Version -vTKPROJ_2.10
em_rcv.exe Built at Version -vEM_RCV_2.8	echo_raw.exe Built at Version -vECHO_RAW_1.0
exammb.exe Built at Version -vEXAMMB_2.11.2	iem3000.exe Built at Version -vIEM3000_2.5.1
file_mgr.exe Built at Version -vFILE_MGR_2.6	inavisound.exe Built at Version -vINAVISOUND_1.0
fishbath.exe Built at Version -vFISH_BATHY_2.6	inmeaapb.exe Built at Version -vINMEA_APB_2.0
focus.exe Built at Version -vFOCUS_2.2	inmeagps.exe Built at Version -vINMEAGPS_2.1
helmmgr.exe Built at Version -vHELMMGR_1.1	irpm.exe Built at Version -vIRPM_2.0
hpr309.exe Built at Version -vHPR309_2.2	iss2000_sim_scripts.exe Built at Version -vISS2000_SIM_SCRIPTS_2.0
hpr410.exe Built at Version -vHPR410_2.3	navsim.exe Built at Version -vNAVSIM_2.1
hprcal.exe Built at Version -vHPRCAL_2.2	pmv_3sim.exe Built at Version -vPMV3SIM_2.6
innovatum.exe Built at Version –vINNOVATUM_2.2	replay_svy.exe Built at Version -vREPLAY_SVY_1.0
kflogfsh.exe Built at Version -vKFLOGFSH_2.4	replay_xtf.exe Built at Version -vREPLAY_XTF_1.0
kflogshp.exe Built at Version -vKFLOGSHP_2.7.1	resonsim.exe Built at Version -vRESONSIM_1.0
Klein595.exe Built at Version -vKLEIN595_2.1	sbsim.exe Built at Version -vSBSIM_1.0

kpdisplay.exe Built at Version -vKP_2.2	supfiles.exe Built at Version - vISS2000_SUPPORT_2.15
kvh.exe Built at Version -vKVH_2.1	

Table A-3. Survey Planning and SABER for Linux Machines, Product Version: - vSABER_3.2.13

libabe_merge.so Built at Version - vABE_MERGE_LIB_1.2	gsf_strip_imagery Built at Version - vGSF_STRIP_IMAGERY_1.0
libabe_shoals.so Built at Version - vABE_SHOALS_LIB_1.3	gsfedit Built at Version -vGSFEDIT_1.1
libabe_utility.so Built at Version - vABE_UTILITY_LIB_1.5	gsfhist2txt Built at Version -vGSFHIST2TXT_1.4
libabe_target.so Built at Version - vABE_TARGET_LIB_1.7	gsfsplit Built at Version -vGSFSPLIT_1.0
libabe_pfm.so Built at Version - vABE_PFM_LIB_4.41.1	gsfupdat Built at Version -vGSFUPDATE_1.7
libabe_misp.so Built at Version - vABE_MISP_LIB_1.1	gsf_fix_heave Built at Version - vGSF_FIX_HEAVE_1.0
libabe_byteswap.so Built at Version - vABE_BYTESWAP_LIB_1.0	gsfnavfix Built at Version -vGSFNAVFIX_1.0
libabe_mosaic.so Built at Version - vABE_MOSAIC_LIB_1.0	gxy2pfl Built at Version -vGXY2PFL_1.1
libabe_unisips.so Built at Version - vABE_UNISIPS_LIB_1.0	hmscorrs Built at Version -vHMSCORRS_1.4
libabe_charts.so Built at Version - vABE_CHARTS_LIB_1.0	hmsreport Built at Version -vHMSREPORT_1.5
libabe_profedit.so Built at Version - vABE_PROFEDIT_LIB_1.1	i_elacmk2 Built at Version –vI_ELAC_1.5
libutility.so Built at Version -vUTILITY_2.11.3	i_sb2112 Built at Version -vI_SB2112_1.1
libproj.so Built at Version -vPROJ_2.5	imprtdxf Built at Version -vIMPRTDXF_2.11
libsnpgeo.so Built at Version -vSNPGEO_2.3	ing_cmap Built at Version -vING_CMAP_1.1
Libdatamrge.so Built at Version -vDATAMRGE_2.3	ingseabm Built at Version -vING_SEABM_1.2
libdbdb.so Built at Version -vDBDB_2.3	ingsimrad Built at Version -vINGSIMRAD_2.8
libdbms.so Built at Version -vDBMS_2.12	isis2ctv Built at Version –vISIS2CTV_2.2
libctable.so Built at Version -vCTABLE_2.3	isissubprof Built at Version -vISISSUBPROF_1.4
libfilters.so Built at Version -vFILTERS_2.2	magyprof Built at Version -vMAGYPROF_1.1
libgrid_io.so Built at Version -vGRID_IO_3.13	makeextents Built at Version –vMAKEEXTENTS_1.2
libgsf.so Built at Version -vGSF_2.03.5	makekps Built at Version -vMAKEKPS_1.2
libhmps.so Built at Version -vHMPS_LIB_2.12	makellprof Built at Version -vMAKELLPROF_1.3
libnutil.so Built at Version -vNUTIL_2.1	makeminmaxz Built at Version - vMAKEMINMAXZ_1.3
libsensors.so Built at Version -vSENSORS_2.16	maketrk Built at Version -vMAKETRK_1.3
Libsnpgprim.so Built at Version -vSNPGPRIM_2.9	mbfilt Built at Version -vMBFILT_1.8
libsvputil.so Built at Version –vSVPUTIL_2.12	mbimagery Built at Version -vMBIMAGERY_2.1.4
libxutils.so Built at Version -vXUTILS_2.7	merge_dig Built at Version -vMERGE_DIG_1.0
Libdspgraph.so Built at Version -vDSPGRAPH_2.6	saber_miles Built at Version -vSABER_MILES_1.0
libhpgraph.so Built at Version –vHPGRAPH_2.4	mkgmtprof Built at Version -vMKGMTPROF_1.1
libhtmlwid.so Built at Version –vHTMLWID_2.4.1	moundgrd Built at Version -vMOUNDGRD_1.1
libmberr.so Built at Version -vMBERR_2.3	msgread Built at Version -vMSGREAD_1.10
libplotw.so Built at Version –vPLOTWID_2.4	mstnav Built at Version -vMSTNAV_1.2
libsmemcom.so Built at Version -vSMEMCOM_2.8.1	navup Built at Version -vNAVUP_1.9
libsnpdraw.so Built at Version –vSNPDRAW_2.20	pcss2targ Built at Version -vPCSS2TARG_1.2

libsputil.so Built at Version -vSPUTIL_2.16	pfm2covgrd Built at Version -vPFM2COVGRD_1.3
libchkkey.so Built at Version -vLIBCHKKEY_1.15	pipe2dxf Built at Version -vPIPE2DXF_1.1
libgeotiff.so Built at Version -vGEOTIFFLIB_1.0	platf2trk Built at Version -vPLATF2TRK_1.1
libmbhat.so Built at Version -vMBHAT_LIB_1.1	plibextents Built at Version -vPLIBEXTENTS_1.1
libmb_corr.so Built at Version -vMB_CORR_1.8	posgapchk Built at Version -vPOSGAPCHK_1.2
libnmeamsgs.so Built at Version -vNMEAMSGS_1.7	posrplcnt Built at Version -vPOSRPLCNT_1.3
libnut.so Built at Version -vHTMLUTIL_1.2	postest Built at Version -vPOSTEST_1.1
libsnpchart.so Built at Version -vSNPCHART_1.2	profedit Built at Version -vPROFEDIT_1.6
libtiff.so Built at Version -vTIFFLIB_1.0	proflbls Built at Version -vPROFLBLS_1.1
libxgraph.so Built at Version –vXGRAPH_1.2	rangeflt Built at Version -vRANGEFLT_1.2
libxerces-c.a Built at Version -vLIB_XERCES_1.0	rawread Built at Version -vRAWREAD_1.2
libabe_xml_tgt.so Built at Version -vLIBABE_XML_TGT_1.2	recon Built at Version -vRECON_1.8
libMbHat.so Built at Version -vMBHAT_2.33	redocat Built at Version -vREDOCAT_1.1
accutest Built at Version -vACCUTEST_1.6	refrmtrk Built at Version -vREFRMTRK_1.2
anx_crossings Built at Version -vANX_CROSSINGS_1.3	regchkgsf Built at Version -vREGCHKGSF_1.2
appcors Built at Version -vAPPCORS_2.4	remote Built at Version -vREMOTE_2.1
applysqt Built at Version -vAPPLYSQT_1.2	resetflg Built at Version -vRESETFLG_1.3
autoarch Built at Version -vAUTO_ARCHIVE_2.8	resonflt Built at Version -vRESONFLT_1.2
bathyprof Built at Version -vBATHYPROF_1.1	reversit Built at Version -vREVERSIT_1.1
beamhist Built at Version -vBEAMHIST_1.1	saber_sat Built at Version -vSABER_SAT_1.5
cablerun Built at Version -vCABLERUN_1.2	sel2hist Built at Version -vSEL2HIST_1.1
calc_slope_aspect Built at Version -vCALC_SLOPE_ASPECT_1.0	sel_sound Built at Version -vSEL_SOUND_1.19
cell_to_pcx Built at Version -vCELL_TO_PCX_1.14	selslope Built at Version -vSELSLOPE_1.3
check_features Built at Version -vCHECK_FEATURES_1.3	send_telegram Built at Version -vSEND_TELEGRAM_1.0
check_tides Built at Version -vCHECK_TIDES_1.1	set_sound Built at Version -vSETSOUND_1.6
checksqt Built at Version -vCHECKSQT_1.2	shaded_relief Built at Version -vSHADED_RELIEF_1.0
chkgsf Built at Version -vCHKGSF_1.3	slopevol Built at Version -vSLOPEVOL_1.1
chkkfp Built at Version -vCHKKFP_1.1	smooth_layer Built at Version -vSMOOTH_LAYER_1.0
chnlvol Built at Version -vCHNLVOL_1.1	smoothpfl Built at Version -vSMOOTHPFL_1.1
class1_layer Built at Version -vCLASS1_LAYER_1.1	snipit Built at Version -vSNIPIT_1.2
combine_layers Built at Version –vCOMBINE_LAYERS_1.2	spmgr Built at Version -vSPMGR_2.14.1
contact_dxf Built at Version –vCONTACT_DXF_1.3	srv_rpt Built at Version -vSRV_RPT_1.4
contour_layer Built at Version -vCONTOUR_LAYER_1.7	sscodes Built at Version -vSSCODES_1.1
conv_dxf Built at Version -vCONV_DXF_1.2	summdata Built at Version -vSUMMDATA_1.7
count_soundings Built at Version -vCOUNT_SOUNDINGS_1.0	svpmon Built at Version –vSVPMON_2.13
cov2grass Built at Version -vCOV2GRASS_1.0	target_dxf Built at Version -vTARGET_DXF_1.3
cpwindprj Built at Version -vCPWINDPRJ_1.1	tid2hmps Built at Version -vTID2HMPS_1.12
crs2mtif Built at Version -vCRS2MTIF_1.1	tingrid Built at Version -vTINGRID_1.3
datasumm Built at Version -vDATASUMM_2.13	trk2gxy Built at Version -vTRK2GXY_1.1
decitrk Built at Version -vDECITRK_1.4	tkproj Built at Version -vTKPROJ_2.10
designgrd Built at Version -vDESIGNGRD_1.3	update_contact Built at Version -vUPDATECONT_1.4
diff_layer Built at Version -vDIFF_LAYER_1.3	write_hist Built at Version –vWRITE_HIST_1.7
dbextrct Built at Version –vDBEXTRACT_1.2	xtf_io Built at Version -vXTF_IO_1.20
dump_gsf Built at Version -vDUMP_GSF_1.1	xtf2gsf Built at Version -vXTF2GSF_1.5
dxf2mask Built at Version -vDXF2MASK_1.1	makeindx Built at Version -vMAKEINDX_2.5

editgrid Built at Version -vEDITGRID_1.3	exammb Built at Version -vEXAMMB_2.11.2
edit_pfm Built at Version -vEDIT_PFM_1.0	SPMGR_HELP Built at Version -vSPMGR_2.14.1
errors Built at Version -vERRORS_1.0	SA_HELP Built at Version -vSA_HELP_1.5
errors_gui Built at Version –vERRORS_GUI_1.1	check_disk_dialog Built at Version -vCHECK_DISK_DIALOG_1.0
examgyro Built at Version -vEXAMGYRO_1.2	mbhat_tcl Built at Version -vMBHAT_2.33
saber_exclude Built at Version -vSABER_EXCLUDE_1.0	key_dialog Built at Version -vKEY_DIALOG_1.0
exprtgrd Built at Version -vEXPRTGRD_1.9	runkeymem Built at Version -vRUNKEYMEM_1.5
exprtsnd Built at Version -vEXPRTSND_1.6	install_saber Built at Version -vINSTALL_SABER_1.10
exrtprof Built at Version -vEXRTPROF_1.5	install_spmgr Built at Version -vINSTALL_SPMGR_1.1
exrtprof_mag Built at Version -vEXRTPROF_MAG_1.1	pfm_tasks Built at Version -vPFM_TASKS_1.5
extractHeave Built at Version –vEXTRACT_HEAVE_1.0	saber_apply_tides Built at Version -vSABER_APPLY_TIDES_1.4
featcorr Built at Version –vFEATURE_CORRELATOR_1.8	saber_build_target Built at Version -vSABER_BUILD_TARGET_1.2
feature_gsf Built at Version -vFEATUREGSF_1.4	saber_gridview Built at Version -vSABER_GRIDVIEW_1.2
filldbs Built at Version -vFILLDBS_1.2	saber_gsf_class Built at Version -vSABER_GSF_CLASS_1.0
find_crossings Built at Version -vFIND_CROSSINGS_1.2	mve Built at Version -vMVE_4.12
getkps Built at Version -vGETKPS_1.2	saber_pfm2cov Built at Version -vSABER_PFM2COV_1.0
getllprof Built at Version –vGETLLPROF_1.2	saber_pfm2rdp Built at Version -vSABER_PFM2RDP_1.1
getdiffs Built at Version –vGETDIFFS_1.1	saber_pfm2vrml Built at Version -vSABER_PFM2VRML_1.0
getextents Built at Version -vGETEXTENTS_1.3	saber_pfm_beamstats Built at Version -vSABER_PFM_BEAMSTATS_1.1
get_features Built at Version -vGET_FEATURES_1.5	saber_pfm_deconflict Built at Version -vSABER_PFM_DECONFLICT_1.0
getjunc Built at Version -vGETJUNC_1.6	saber_pfm_misp Built at Version -vSABER_PFM_MISP_1.0
getprof Built at Version -vGETPROF_1.8	saber_pfm_extract Built at Version -vSABER_PFM_EXTRACT_1.1
gridgsf Built at Version -vGRIDGSF_1.13	saber_pfm_loader Built at Version -vSABER_PFM_LOADER_1.7
Nav_edit Built at Version -vNAV_EDIT_1.6	saber_pfm_modscale Built at Version -vSABER_PFM_MODSCALE_1.0
gsf2xyz Built at Version -vGSF2XYZ_1.4	saber_pfm_recompute Built at Version -vSABER_PFM_RECOMPUTE_1.2
gsf2txt Built at Version -vGSF2TXT_1.4	saber_pfm_residual Built at Version -vSABER_PFM_RESIDUAL_1.0
gsf_find_squat Built at Version -vGSF_FIND_SQUAT_1.0	saber_pfm_unload Built at Version -vSABER_PFM_UNLOAD_1.2
gsfbeamex Built at Version -vGSFBEAMEX_1.2	shoals_wave_view Built at Version -vABE_SHOALS_WAVE_VIEW_1.0
gsfcat Built at Version -vGSFCAT_1.0	

Table A-4. Survey Planning and SABER for Linux Machines, Product Version: -vSABER_3.2.14, Software Modules Updated from SABER Version 3.2.13

libgsf.so Built at Version -vGSF_2.04	gridgsf Built at Version -vGRIDGSF_1.13.1
appcors Built at Version -vAPPCORS_2.5	mbhat_tcl Built at Version -vMBHAT_2.33.1
exprtgrd Built at Version -vEXPRTGRD_1.10	

Table A-5. Survey Planning and SABER for Linux Machines, Product Version: -vSABER_3.2.15, Software Modules Updated from SABER Version 3.2.14

exammb Built at Version -vEXAMMB_2.11.3	

Table A-6. Software Patches for Survey Planning and SABER for Linux Machines, Product Version: -vSABER_3.2.15

featcorr Built at Version – vFEATURE_CORRELATOR_1.9	

B. QUALITY CONTROL

A systematic approach to tracking data has been developed to maintain data quality and integrity. Several forms and checklists identify and track the flow of data as it is collected and processed. These forms are presented in the Separates section included with the data for each survey.

During data collection, the watch standers continuously monitor the systems, checking for errors and alarms. Thresholds set in the **ISS-2000** system alert the watch stander by displaying alarm messages when error thresholds or tolerances are exceeded. These alarms, displayed as they occur, are reviewed and acknowledged on a case-by-case basis. Alarm conditions that may compromise survey data quality are corrected and then noted in both the navigation log and the message files. Warning messages such as the temporary loss of differential GPS, excessive cross track error, or vessel speed approaching the maximum allowable survey speed are addressed by the watch stander and automatically recorded into a message file. Approximately every 1-2 hours the real-time watch standers complete checklists to ensure critical system settings and data collection are valid.

Following data collection, initial processing began on the vessel. This included the first level of quality assurance:

- Initial swath editing of multibeam data flagging invalid pings and beams
- Second review and editing of multibeam data. Open beam angles where appropriate to identify obstructions outside the cut-off angle
- Identify items for investigation with additional multibeam coverage
- Turning unacceptable data “offline”
- Turning additional data “online”

- Identification and flagging of obstructions and wrecks
- Track plots
- Preliminary sounding grids
- Cross line checks
- Conversion of the side scan SDF format data to XTF format.
- Generation of preliminary side scan coverage mosaics

During port calls a complete backup of all raw and processed multibeam data and side scan data was sent to the Newport Data Processing Center. Analysis of the data at the Newport facility includes the following steps:

- Generation of multibeam and side scan track line plots
- Generation of side scan Contact Files and Contact Plot
- Swath editing and review of multibeam data
- Calculation and application of verified tide correctors to multibeam data
- Application of delayed heave
- Coverage plots of multibeam data
- Cross line analysis of multibeam data
- Comparison with prior surveys
- Generation of shoal biased selected soundings at the scale of the survey
- Generation of contour plots of multibeam data
- Comparison with existing charts
- Quality control reviews of side scan data and contacts
- Final Coverage mosaic plots of side scan sonar data
- Correlation of side scan contacts with multibeam data
- Final quality control of all delivered data products

Processing and quality control procedures for multibeam and side scan data acquisition are described in detail in the following pages.

MULTIBEAM DATA PROCESSING

The multibeam data is initially edited on-board the vessel using SAIC's **Multi-View Editor** (**MVE**) program. This tool is a geo-referenced editor, which can project each beam in its true geographic position and depth in both plan and profile views. At the end of each survey line, all data files are closed and new files opened for data logging. The closed files were then auto-archived to the processing center where track lines were generated and the multibeam data file was reviewed to flag erroneous data such as noise, flyers, fish, etc. At the end of each survey day, both the raw and processed data were backed up onto 4mm tapes. These tapes were shipped to the Data Processing Center in Newport, RI at each port call.

Once the data were in Newport, and extracted to the Network Attached Storage (NAS) unit for the Data Processing Center (DPC), the initial step in processing was to create track lines from the multibeam data. Once created, the tracks were reviewed to confirm that no navigational errors existed and that the tracks extended to the outermost boundaries of the survey area. When these criteria were met a second round of manual editing was performed, if not previously completed on the vessel. Throughout the second review special emphasis was placed on verifying features (i.e. potential hazards to navigation) and erroneous data flagged as invalid by the initial reviewer. The second review ensured that at least two different people examined every multibeam file for both quality and features. Following the second review, the lead hydrographer addressed any remaining unresolved issues including defining additional data required to resolve such issues. Upon the completion of multibeam reviews, verified water levels and delayed heave were applied to the multibeam data. If necessary, corrections to the draft were also made at this time.

Following the application of verified water levels and heave, multibeam binned-depth grids were generated for each survey sheet. If any anomalies were found in the sounding bins, the edited multibeam files were re-examined and re-edited to resolve them. When all multibeam files were determined to be satisfactory, the data were binned to the standard 5-meter cell size, populating the bin with the shoalest sounding in that bin while maintaining its true position and depth. The following three binned grids were created:

- Main scheme, item, and holiday fill survey lines
- Cross lines using only near nadir (+/- 5° from nadir)
- All Survey lines (main, cross, item, and holiday)

The main scheme grid and cross line grid were used for cross line analysis. The all grid was compared to previous surveys.

Selected soundings were generated on the 5-meter binned minimum layer using the **sel_sound** sounding selection program. The **sel_sound** program begins by selecting the shoalest sounding in the grid. All adjacent soundings that fall within a specified search radius of the shoalest sounding were flagged as unselected. The program then selected the next shoalest sounding outside the search radius of the previously selected sounding and identified adjacent soundings inside the search radius. This process was repeated until all soundings in the bin layer have been evaluated. Two files of fully attributed sounding data were generated by this process, one of all selected soundings and one of all unselected soundings. The search radius was determined based on the chart scale, height of the sounding characters on the chart, and the required distance between soundings on the chart. The **set_sound** program was run to flag all selected soundings in the Generic Sensor Format (GSF) multibeam data. After these programs have been run on all the data, the selected sounding, navigation aid, bottom sample, and multibeam feature files were combined to produce the smooth sheet in **AutoCAD** and **MicroStation**.

NOTE: Throughout this report wherever software is mentioned, it is inferred that the most current version of the software available was used. A complete list of all software versions and dates is provided in Section A of this report.

Multibeam Coverage Analysis

The Mid-Atlantic Corridor, Coast of New Jersey survey operations were conducted at a line spacing optimized to achieve 200% side scan sonar coverage. Multibeam coverage was not required to be 100%. Main scheme lines were run at 40-meter line spacing while running the side scan at 50-meter range scale.

SIDE SCAN SONAR DATA PROCESSING

In real-time, the Klein 3000 digital side scan data were recorded in SDF format on the hard disk of the Klein's **SonarPro** acquisition system. After changing the file name at the end of each line, the closed side scan files were auto-archived to the on-board processing computer. On-board the survey vessel, the SDF format files were converted to XTF format prior to processing and review. Initial processing included generation of towfish track plots and generation of initial mosaics for coverage verification and quality control.

All original and processed side scan data files were backed up onto 4mm tapes in tar format for transfer to the Data Processing Center.

Once in Newport, initial processing included re-navigating the towfish to apply more accurate towfish positions using the **SABER navup** routine. This routine replaced the towfish position recorded in the original side scan XTF file with the towfish position recorded in the real-time catenary data file recorded by **ISS-2000**. It also computed a unique position and heading for each ping record. Each record in the catenary file includes:

- Time
- Fish position
- Cable out
- Layback
- Fish velocity
- Fish heading
- Fish depth
- Tow angle
- Cable tension

During examination of side scan sonar data, a side scan review log was generated. This review log contains information about each file, including the line begin and line end times, survey line name, corresponding multibeam and side scan file names, line azimuth, data gap information, and notes pertaining to hazards of navigation (i.e. contacts), and other points of interest (e.g. large schools of fish that may partially obstruct data). Other pertinent information regarding the interpretation of the imagery was also logged in the spreadsheet. The contents of the processing log spreadsheet were later merged with the annotation file.

Side Scan Quality Review

A processor conducted a quality review of each side scan file using Triton **Isis** to replay the data. During this review the processor assessed the quality of the data and defined holidays in the data where the quality was insufficient to determine the presence of contacts. The times of these data holidays were entered into the side scan review log. Data holidays were generally characterized by:

- Surface noise (vessel wakes, sea clutter, and/or waves)
- Towfish motion (yaw and heave)
- Electrical noise
- Acoustic noise
- Large, dense schools of fish
- Density layers (refraction)
- Turbidity clouds

Side Scan Coverage Analysis

A time window file listing the times of all valid online side scan data was created along with separate side scan file lists for first and second 100% coverage mosaic. The time window file and file lists were then used to create towfish track lines and mosaics in **SABER.** The mosaics were viewed using tools in **SABER** to verify swath coverage and to plan further survey lines to fill in any data gaps.

Side Scan Contact Analysis

During side scan review, sonar contacts were selected and measured using the **Isis** Target utility. Significant side scan contacts were chosen based on size and height or a unique sonar signature. In general, contacts with a height greater than or equal to 50 centimeters were selected. Where the survey passed through fish havens, unusually large or abnormally high (equal or greater than 1 m) contacts were selected. Contacts with a unique sonar signature (e.g. size, shape, and reflectivity) were typically selected regardless of height. Contact information was saved in a ".CON" file, which included a snapshot of the image and the following information regarding the acquisition of the target data:

- Year and JD
- Time
- Position
- Fish altitude
- Slant range to contact (Note: port = negative #, starboard = positive #)
- Contact length, width, and height (based on shadow length, fish altitude, and slant range)

Wreck and large objects were positioned at their highest point. Similarly, contacts for debris fields were positioned at the highest object in the debris field. Additional contacts were made on other man-made objects such as exposed cables, pipelines, and sewer outfalls. Additional information regarding objects not included as contacts but still noted in the side scan review log include descriptions of other man-made objects such as bottom fishing gear and non-significant objects.

After a second review of the side scan files was complete, the contact files were converted into a side scan contact (CTV) file using an SAIC proprietary program called **isis2ctv**. The resulting CTV is a text file that documents all of the contact attributes contained in the individual contact files. In addition a postscript image file is made of each individual contact sonar image. In **SABER**, the CTV file was directly loaded and viewed as a separate data layer. Once in the **SABER** system, side scan contacts were correlated to multibeam data by overlaying them on the gridded depth layer. By comparing multibeam bathymetry with the side scan contact data, permanent features were selected for the smooth sheet. Positions and depths of these features were determined directly from the multibeam data in SAIC's **MVE** swath editor by flagging the shoalest depth as a feature. A multibeam feature file (CNT) was created using the **SABER get_features** routine which extracted flagged features from the GSF multibeam data. The final correlation process updated the CNT file with the type of feature (obstruction, wreck, etc.) and the CTV file with the feature-to-contact correlation.

Side Scan Annotations

During survey operations, a side scan operation log was created in real-time by the watch standers. Once all processing of the side scan data was complete, and all data holidays, contacts, confidence checks etc. were identified, a side scan annotation file was generated from the side scan log. The annotation file, consisting of operator notes (weather, confidence checks, contacts), real time system messages, (line begin, line end, cable out), and all processing notes (data holidays, contacts), was then merged into the final XTF data record using the **xtf_io** program.

C. CORRECTIONS TO ECHO SOUNDINGS

VESSEL CONFIGURATION PARAMETERS

The *M/V Atlantic Surveyor* sensor configuration is depicted in Figure C-1 and the vessel offsets are tabulated in Table C-1. All measurements are in meters. For the surveys, the Reson 8101 transducer was hull-mounted. The reference point for the entire system is located at the POS/MV IMU.

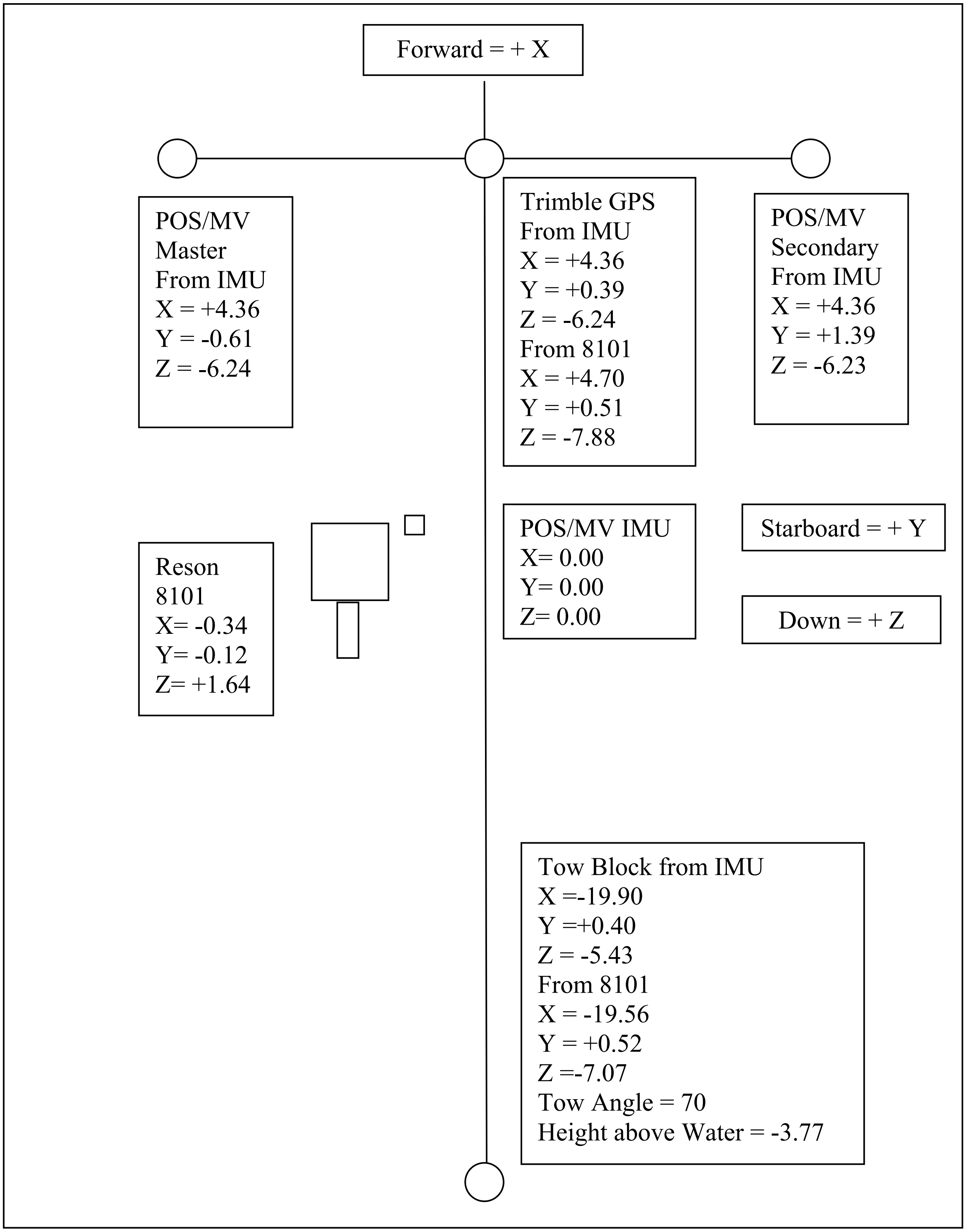

Figure C-1. Configuration of *M/V Atlantic Surveyor* during Survey Operations (Measurements in meters)

Table C-1. *M/V Atlantic Surveyor* Antenna and Transducer Locations (measurements in meters)

Sensor	Offset in ISS-2000		Offset in POS/MV	
Multibeam Reson 8101 Transducer Hull Mount			X	-0.34
			Y	-0.12
			Z	+1.64
Reference to Heave (POS/MV IMU)			X	0.00
			Y	0.00
			Z	0.00
POS/MV GPS Master Antenna			X	4.36
			Y	-0.61
			Z	-6.24
Trimble GPS Antenna	X	+4.70		
	Y	+0.51		
	Z	-7.88		
A-Frame Tow Block (Z = Height above the Water)	X	-19.56		
	Y	+0.52		
	Z	-3.77		

The SAIC Integrated Survey System (ISS-2000) and the POS/MV utilize a coordinate system where “z” is considered to be positive down, “x” is considered to be positive forward, and “y” is considered to be positive athwart ships to starboard. Sensor offsets are entered into either the POS/MV or ISS-2000 and all sensors connected to ISS-2000 have their coordinate system transformed to match the one used by ISS-2000.

STATIC AND DYNAMIC DRAFT MEASUREMENTS

Static Draft

Figure C-2 shows the draft calculations for the *M/V Atlantic Surveyor*. Depth of the transducer’s acoustic center below the deck (3.30 meters) was determined from measurements made while the boat was hauled in May 2004. By subtracting the measured distance from the main deck to the waterline on both sides of the vessel, and averaging the two values, the transducer distance below the water surface (static draft) was determined.

Static draft measurements were taken on each side of the vessel at each port call, both after arrival and before departure, in order to prorate the daily draft for fuel and water consumption. The draft value was then recorded in the real-time Navigation Log. If the static draft value changed from the previously noted value, the new value was entered into the **ISS-2000** system. The observed and prorated static draft for each survey is included with the survey data in Section I of the Separates of each Sheet’s Descriptive Report.

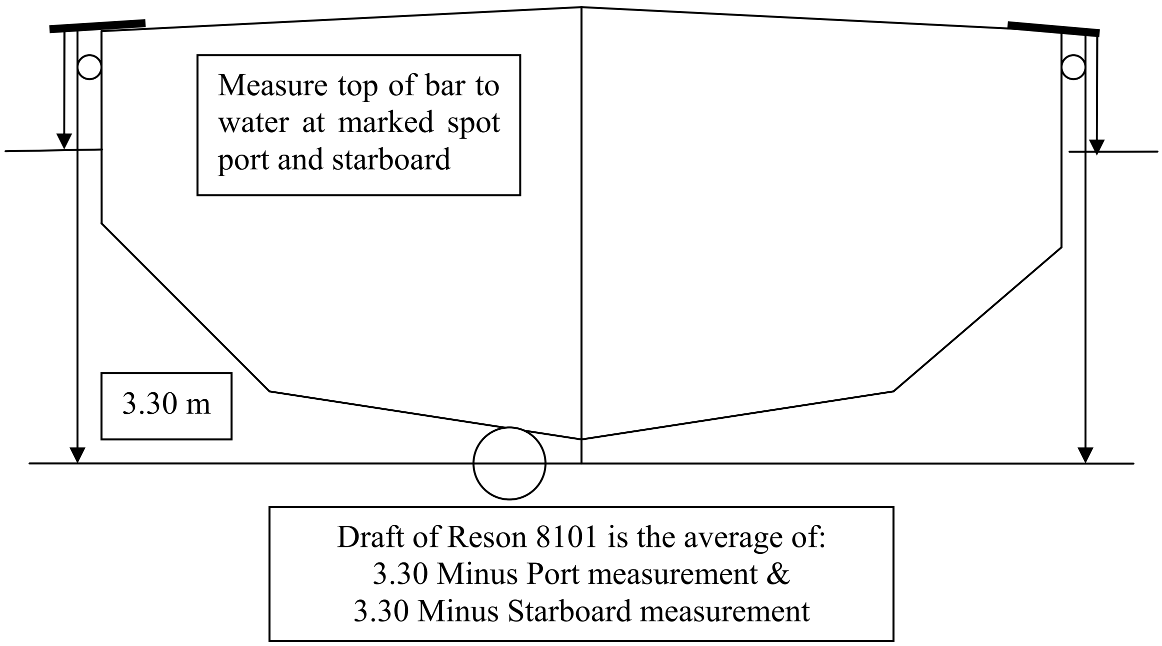

Figure C-2. *M/V Atlantic Surveyor* Draft Determination

Settlement and Squat

Settlement and squat correctors were determined during the initial Sea Acceptance Test for the *M/V Atlantic Surveyor* in June 2004. The correctors were determined by establishing a multibeam soundings reference by bringing the *M/V Atlantic Surveyor* to "all stop" and drifting with the wind and current. The vessel drifted nearly dead astern making it possible to record a normal swath of soundings (file asmba04162.d01). A survey line was created that crossed the reference swath at a selected spot and was run twice at each of the shaft rpm settings. A Pure File Magic (PFM) grid was made from these files. In the **MVE** editor, an area of the PFM near nadir was selected for display. The reference file and the two files for the desired shaft rpm were also displayed and depth differences and offsets were measured in several places. Correctors resulting from the average of these measurements are shown in Table C-2. This procedure is valid because the IMU and the multibeam transducer are mounted almost directly in line vertically.

Table C-2. *M/V Atlantic Surveyor* Settlement and Squat Determination

Shaft RPM	Depth Corrector	Depth	Approximate Speed, Knots	Files	
0	0.00	22.04	0	asmba04162.d01	
140	0.00	22.04	4	asmba04162.d02	asmba04162.d03
180	-0.01	22.05	5	asmba04162.d04	asmba04162.d05
220	0.00	22.04	6	asmba04162.d06	asmba04162.d07
255	0.00	22.03	7	asmba04162.d08	asmba04162.d09
300	0.04	22.00	8	asmba04162.d10	asmba04162.d11
340	0.10	21.93	9	asmba04162.d12	asmba04162.d13
390	0.13	21.91	10	asmba04162.d14	asmba04162.d15

SPEED OF SOUND

A Moving Vessel Profiler (MVP), constructed by Brooke Ocean Technology Ltd., with an Applied Microsystems Ltd. Smart Sound Velocity and Pressure (SV&P) sensor, was used to determine sound speed profiles for corrections to multibeam sonar soundings. During repairs of the MVP or upon failure of the instrument, a Seabird CTD is used to obtain sound speed profiles.

Weekly confidence checks were obtained using consecutive casts with two different SV&P sensors or with a Seabird CTD. After downloading the SSP casts, graphs and tabulated lists were used to compare the two casts for discrepancies.

During multibeam acquisition, SSP casts were copied to **ISS-2000** where the profiles were reviewed for quality and compared to the preceding cast. After review the cast was "applied" to the system. Once applied, **ISS-2000** used the cast for speed and ray tracing corrections to the multibeam sounding data. If sounding depths exceeded the cast depth, the **ISS-2000** used the deepest sound speed value of the cast to extend the profile to the maximum depth.

Factors considered in determining how often a SSP cast was needed include: shape and proximity of the coastline, sources and proximity of freshwater, seasonal changes, wind, sea state, cloud cover, and changes from the previous profile. Casts were taken at the beginning of each survey leg, approximately one-hour intervals thereafter, and upon moving to a different survey area.

Quality control tools in **ISS-2000**, including real-time displays of color-coded coverage and a multibeam swath editor, were used to monitor how the sound speed affected the multibeam data. Severe effects due to improper sound speed profile could clearly be seen when viewing multibeam data in an along-track direction. Proper sound speed application and effects were also analyzed throughout the survey by using SAIC's **Analyze Crossings** software.

A table including all SSP casts, date, location, and maximum depth is located in Section III of the Separates of each sheet's DR.

<u>MULTIBEAM ACCURACY</u>

In the vicinity of the alignment site, a small survey was run with swaths from several main scheme lines and a cross line covering a wreck. This survey in addition to selected soundings over a color-by-depth grid is shown in Figure C-3. Cross line comparisons based on predicted tides and preliminary zoning are presented in Table C-3. Comparisons of crossing data from this small survey show that 99% of comparisons are within 20 centimeters and 100% are within 40 centimeters.

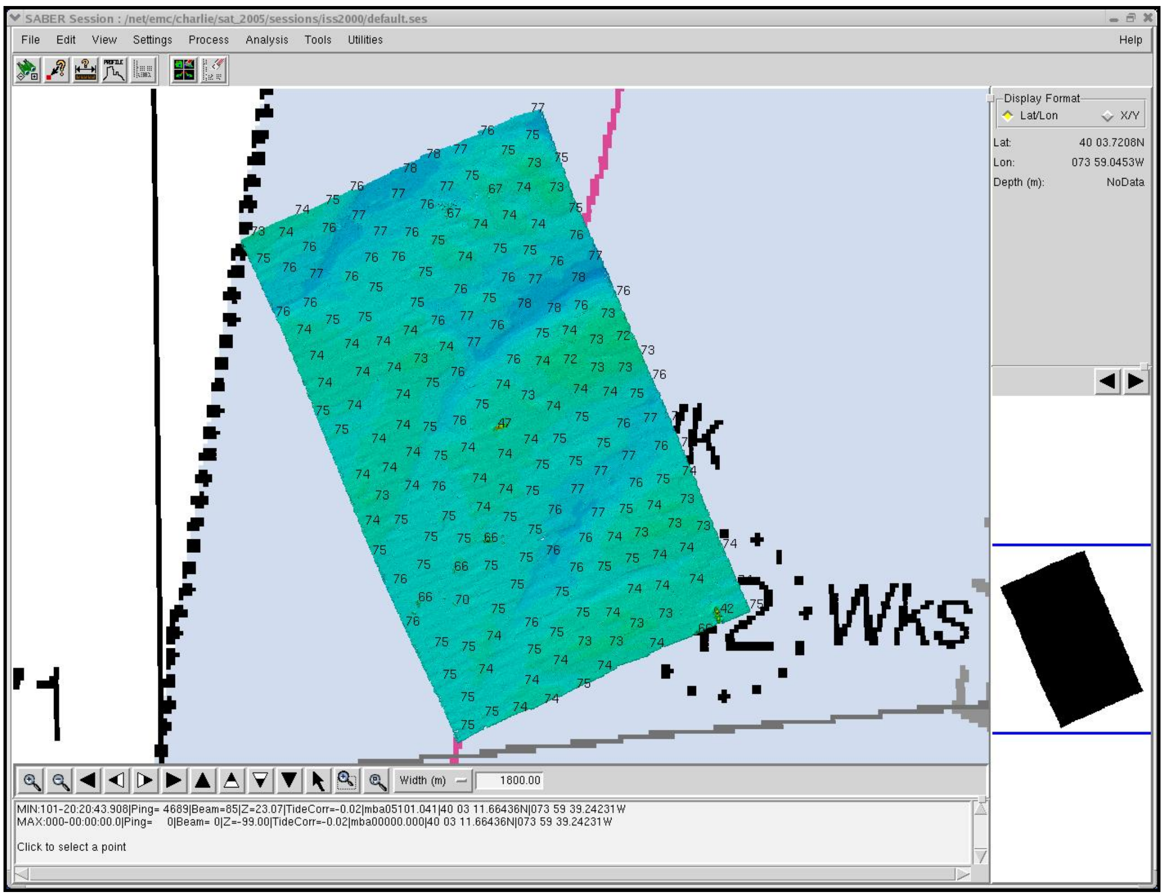

Figure C-3. Survey Grid, Selected Soundings and Chart 12323

Table C-3. Junction Analysis of Cross versus Main Scheme

Depth Difference Range (cm)	All		Positive		Negative		Zero
	Count	Percent	Count	Percent	Count	Percent	Count
0-5	2684	43.37	1573	33.05	803	71.63	308
5-10	2250	79.73	1956	74.15	294	97.86	
10-15	1048	96.67	1024	95.67	24	100.00	
15-20	169	99.40	169	99.22	0	100.00	
20-25	35	99.97	35	99.86	0	100.00	
25-30	1	99.98	1	99.98	0	100.00	
30-35	0	99.98	0	100.00	1	100.00	
35-40	1	100.00	1	100.00	0	100.00	

MULTIBEAM CALIBRATIONS

Timing Test

A ping-timing test was completed on 8 July 2005 to verify that no time latencies were occurring in the **ISS-2000.** To perform this test, the user logs ping times from an IRIG-B timing card triggered from the Reson 81P ping trigger. A standard multibeam file is logged simultaneously. While logging, the ping rate is slowly increased from 1 ping/sec to 14.9 pings/sec. The times in each file were compared and the results are plotted in Figure C-4. The difference in like time tags was less than 3 milliseconds. Timing tests of **ISS-2000** were successfully completed prior to any other calibration tests.

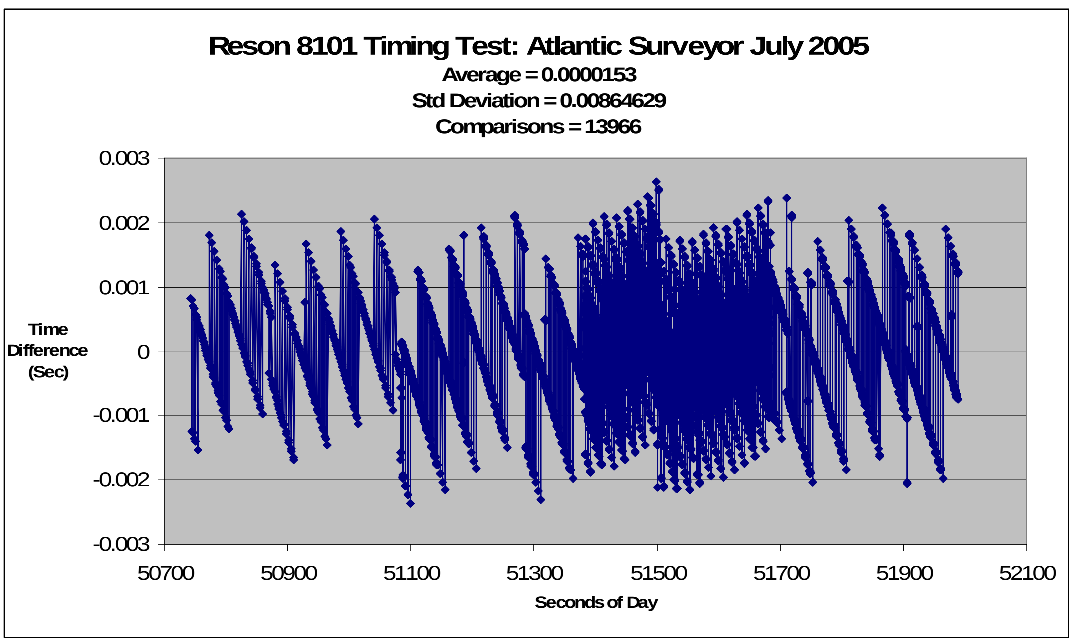

Figure C-4. Timing Test Results

Multibeam Bias Calibration

Multibeam alignment calibration was performed on 9 July 2005 (JD190) prior to commencing survey operations. The alignment was performed over a 47 foot wreck in 73 feet of water charted in 40° 03.3925'N 073° 59.5541'W (NAD83). The wreck is located in a fish haven approximately 6 kilometers southeast of Manasquan Inlet and was used in 2004 for alignment. The calibration resulted in bias values shown in Table C-4. Before running bias calibration lines, all instrument offsets were entered into **ISS-2000** and all bias values were set to zero. Bias determinations were made using the **SABER Swath Alignment Tool** (SAT) program.

Table C-4. Alignment Biases Calculated Using Swath Alignment Tools

Component	Multibeam files (pairs)		Bias
Pitch	asmba05190.d07	asmba05190.d11	+2.20°
Roll	asmba05190.d07	asmba05190.d11	+0.59°
Gyro	asmba05190.d08	asmba05190.d09	+2.10°

Pitch Alignment (9 July 2004)

Two sets of lines were collected for pitch bias calculation. All lines were run along the same survey transect in order that separate comparisons could be made. Several samples were viewed for each set of comparison lines in order to determine an accurate measurement of the pitch bias. Figure C-5 and Figure C-6 are images of the SAT tool depicting data collected with the +2.20 pitch bias entered in the **ISS-2000** system; therefore the indicated bias is zero.

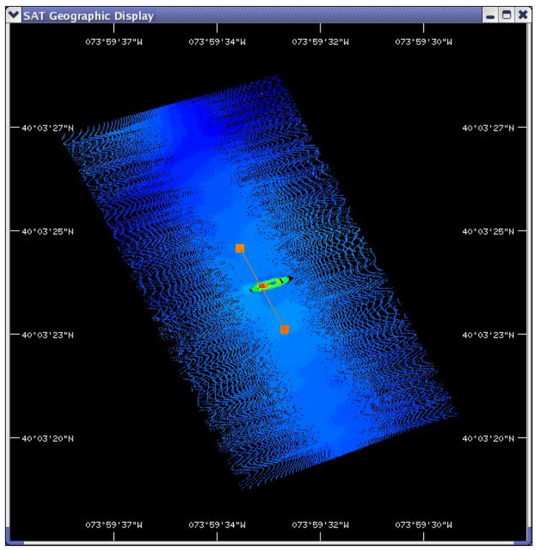

Figure C-5. SAT Tool, Plan View Depicting +2.20 Pitch Bias

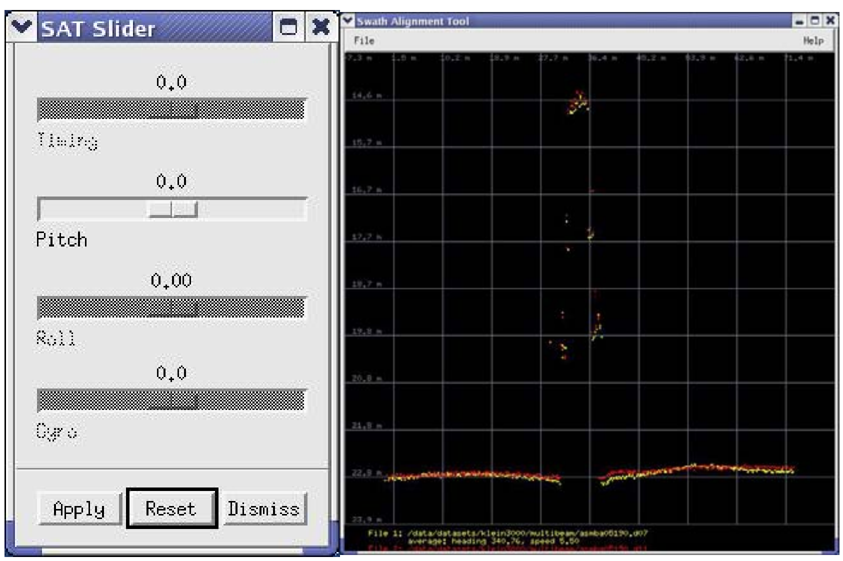

Figure C-6. SAT Tool, Depth vs. Distance Plot Depicting +2.20 Pitch Bias

Roll Alignment (9 July 2005)

Two sets of lines were collected for roll bias calculation. All lines were run along the same survey transect in order that separate comparisons could be made. Several samples were viewed for each set of comparison lines in order to determine an accurate measurement of the roll bias. Figure C-7 and Figure C-8 are images of the **SAT** tool depicting data collected with the +0.59 roll bias entered in the **ISS-2000** system; therefore the indicated bias is zero.

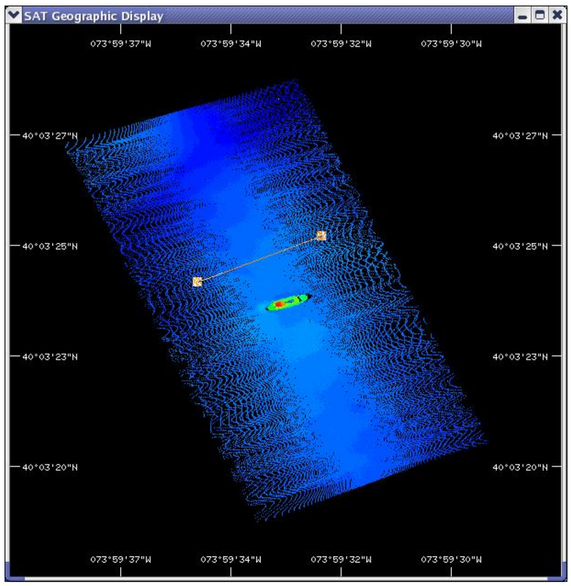

Figure C-7. SAT Tool, Plan View Depicting +0.59 Roll Bias

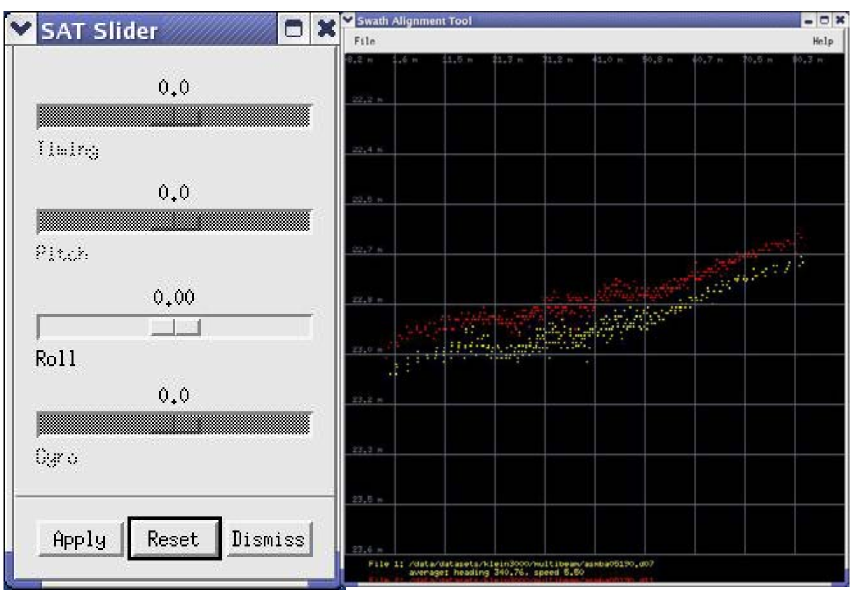

Figure C-8. SAT Tool, Depth vs. Distance Depicting +0.59 Roll Bias

Heading Alignment (9 July 2005)

Two sets of lines were collected for heading bias calculation. Lines were run on either side of a charted wreck in opposite directions in order that separate comparisons could be made. Several samples were viewed for each set of comparison lines in order to determine an accurate measurement of the heading bias. Figure C-9 and Figure C-10 are images of the **SAT** tool depicting data collected with the +2.10 heading bias entered in the **ISS-2000** system; therefore the indicated bias is zero.

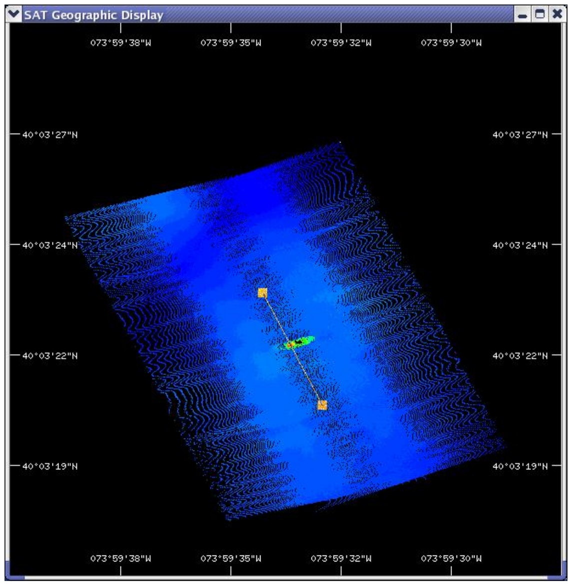

Figure C-9. SAT Tool, Plan View Depicting +2.10 Heading Bias

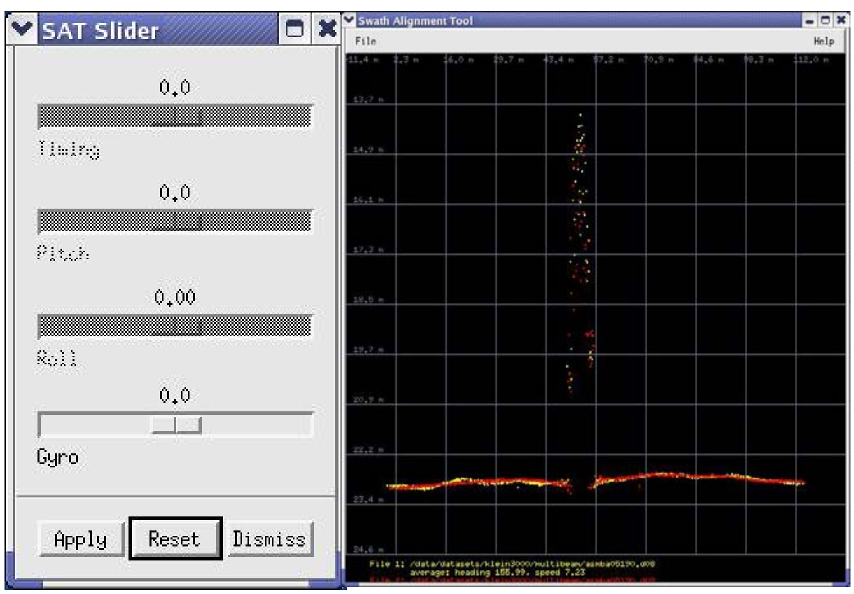

Figure C-10. SAT Tool, Depth vs. Distance Depicting +2.10 Heading Bias

Another patch test was conducted on 25 September 2005 (JD268), following a shut down of survey operations and a long vessel transit. This patch test verified the original biases as summarized in Table C-5.

Table C-5. Alignment Biases Verified on 25 September 2005

Component	Multibeam files (pairs)		Bias
Pitch	asmba05268.d01	asmba05268.d02	+2.20°
Roll	asmba05268.d01	asmba05268.d02	+0.59°
Gyro	asmba05268.d03	asmba05268.d04	+2.10°

TIDES AND WATER LEVELS

NOAA tide station in Atlantic City (8534720), NJ was the source of final verified water level heights for the Mid-Atlantic Corridor, Coast of New Jersey surveys. Preliminary and verified tide data for this station were downloaded from the NOAA CO-OPS web page (http://co-ops.nos.noaa.gov). All tide data in meters were annotated with Coordinated Universal Time (UTC).

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

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

After confirmation that verified water levels were applied to all multibeam data, grids were created and analyzed using various color change intervals. The color intervals provided a means to check for significant, unnatural changes in depth across zone boundaries due to water level correction errors, unusual currents, storm surges, etc.

The primary means for analyzing the adequacy of zoning was observing zone boundary crossings in the navigated swath editor, SAIC's **MVE**. In addition, cross line analysis using SAIC's **Analyze Crossings** software was used to identify possible depth discrepancies resulting from the applied water level corrector. Discrepancies were further analyzed to determine if they were the result of incorrect zoning parameters or weather (wind) conditions between the tide station and the survey area. The NOAA provided preliminary zone boundaries and zoning parameters are presented in Table C-6.

Table C-6. Preliminary Tide Zone Parameters

Zone	Time Corrector (mins)	Range Ratio	Reference Station
SA13	-36	0.87	8531680
SA14	-36	0.91	8531680
SA15	-36	0.91	8531680
SA16	-30	0.88	8531680
SA17	0	1.01	8534720
SA18	+12	0.97	8534720
SA21	0	0.97	8534720
SA22	-12	0.97	8534720

Final Tide Note

H11455 survey was entirely within the water level zones for Atlantic City, NJ (8534720). Analysis of the H11455 multibeam data in the SABER Multi-View Editor and in depth grids revealed minimal depth jumps across the junction of the zones. A spreadsheet analysis of the correctors for each zone (summarized in Table C-7) also confirmed the adequacy of zoning correctors based on Atlantic City, NJ (8534720). Observed verified water levels from 01 August 2005 through 30 November 2005 for station Atlantic City, NJ (8534720) were entered in the spreadsheet. Correctors were computed at 6-minute intervals for each zone. Differences were computed zone to zone. As a result, the NOAA provided preliminary zone boundaries and zoning parameters for Atlantic City (8534720) were accepted as final and applied to all multibeam data for H11455.

Table C-7. Summary of Verified Tide Correctors at Zone Boundaries for Atlantic City (8534720)

Zones	17-18	16-17	15-16	14-15	13-14
Maximum	0.173	0.005	0.019	0.177	0.104
Minimum	-0.226	-0.021	-0.083	-0.154	-0.024
Average	-0.031	-0.008	-0.031	-0.008	0.039
Standard Deviation	0.018	0.048	0.018	0.030	0.075

Analysis of the H11456 multibeam data in the SABER Multi-View Editor and in depth grids revealed significant depth jumps across the junction of zones based on Atlantic City, NJ (8534720) and the zones based on Sandy Hook, NJ (8531680).

The Draft Statement of Work for OPR-C303-KR-06 provided new NOAA zoning correctors for zones SA13, SA14, SA15, and SA16 with correctors based on Atlantic City, NJ (8534720) instead of Sandy Hook (8531680) as shown in Table C-8 below.

Table C-8. Preliminary Tide Zone Parameters Compared to Parameters from Draft Statement of Work for OPR-C303-KR-06 for Atlantic City (8534720)

Zone	Time Corrector (minutes)	Range Ratio	Reference Station
SA13	-12	1.02	8534720
	-36	0.87	8531680
SA14	-6	1.07	8534720
	-36	0.91	8531680
SA15	0	1.06	8534720
	-36	0.91	8531680
SA16	0	1.02	8534720
	-30	0.88	8531680

A spreadsheet was constructed to compare the two sets of NOAA preliminary zoning parameters. The results are summarized in Table C-9. Verified water levels from 01 August 2005 through 30 November 2005 for stations at Sandy Hook, NJ (8531680) and Atlantic City, NJ (8534720) were entered in the spreadsheet. Correctors were computed at 6-minute intervals for each zone. Differences (Table C-9) were computed for each zone on Atlantic City, NJ (8534720) compared to the same zones computed on Sandy Hook, NJ (8531680). In addition the differences between zones 17 computed on Atlantic City, NJ (8534720) and 16 computed on Sandy Hook, NJ (8531680) are shown.

Table C-9. Comparison of Water Level Correctors with Zoning Parameters for Stations 8534720 and 8531680

Zone	16	15	14	13	17-16
Maximum	0.527	0.645	0.610	0.531	0.531
Minimum	-0.639	-0.561	-0.609	-0.633	-0.633
Average	0.005	-0.036	0.108	0.014	0.014
Standard Deviation	0.083	0.088	0.106	0.125	0.108

This verified the significant difference in verified water level correctors at the zone boundaries depending on the stage of the tide and environmental factors (wind, rain). As a result of this analysis the water level zoning correctors based entirely on Atlantic City, NJ (8534720) were applied to all multibeam data for H11456 and H11495.

APPROVAL SHEET

30 March 2006

LETTER OF APPROVAL

REGISTRY NUMBERS H11455, H11456 and H11495

This Data Acquisition and Processing Report for Mid-Atlantic Corridor, Coast of New Jersey Project is respectfully submitted.

Field operations and data processing contributing to the accomplishment of these surveys, H11455, H11456 and H1495, were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report has been closely reviewed and is considered complete and adequate as per the Statement of Work.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Gary R. Davis
Hydrographer
Science Applications International Corporation
Thursday, 30 March 2006