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-S-D946-TJ-09*

Time Frame: *Nov 10, 2009*

LOCALITY

State *Virginia*

General Locality *50 NM East of Assateague Island, VA*

2009

CHIEF OF PARTY

CDR Shepard M. Smith
National Oceanic and Atmospheric Administration

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A. EQUIPMENT

The methods and systems described in this report are used to meet Complete and Object detection coverage requirements and are in accordance with the National Ocean Service Standing Instructions for Hydrographic Surveys (May 2006), the Hydrographic Surveys Specifications and Deliverables Manual (April 2009), Hydrographic Survey Directives, and the Field Procedures Manual for Hydrographic Surveying (April 2009).

The Survey Vessels

The platforms used for data collection were the *NOAA Ship Thomas Jefferson,* (Figure A-1) and *Hydrographic Survey Launches 3101 and 3102* (Figure A-1). *THOMAS JEFFERSON* acquired multibeam echosounder (MBES) data, Side Scan Sonar (SSS) imagery and sound velocity profile (SVP) data. The vessel is equipped with a DT Marine Products tow winch (Model 307EHLWR) for side scan deployment, and a DT Marine Oceanographic winch with approximately 1500m of galvanized steel cable for CTD and bottom sample deployment, and a Brooke Ocean Technology MVP 100 for Moving Vessel Profiler (MVP). Launches *3101* and *3102* acquire multibeam echosounder (MBES) data, vertical beam echosounder (VBES) data (*3101*), Side Scan Sonar (SSS) imagery and sound velocity profile (SVP) data. Table A-1 presents the vessel characteristics for all platforms.

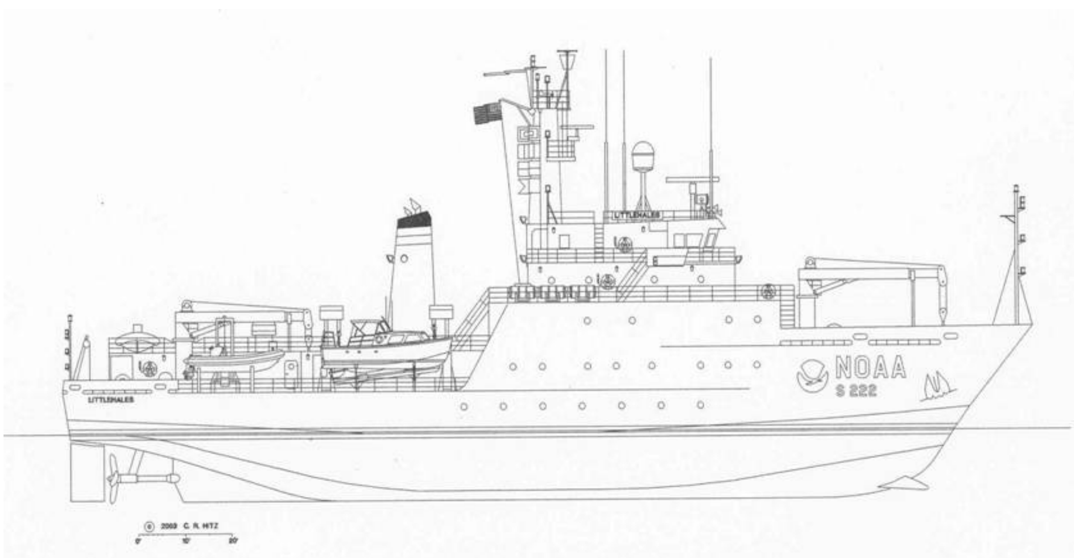


Figure A-1. The NOAA Ship *Thomas Jefferson*

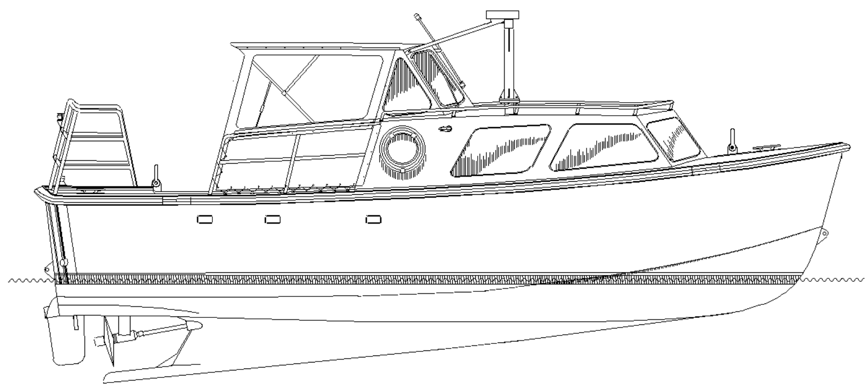


Figure A-2. Hydrographic Survey Launch *3101/3102*

Vessel Name	LOA (Ft)	Beam (Ft)	Draft (Ft)	Survey Speed	Date of last Vessel Survey	Date of last Dynamic Draft Measurement
NOAA Ship Thomas Jefferson	208’	45’	14.0’	5-10 kts	3/10/2005	4/4/2009
HSL 3101	31’	10’8”	5’2”	4-12 kts	8/19/2005	4/19/2009
HSL 3102	31’	10’8”	5’2”	4-12 kts	8/25/2005	4/27/2009

Table A-1. Survey Vessel Characteristics

Data Acquisition Systems

A complete listing of the data acquisition systems used for Project OPR-S-D946-TJ-09 are listed in Appendix A of this report.

A.1 ODOM Echotrac DF3200 MK II Vertical Beam Echosounder

The Echotrac DF3200 MKII is a dual-frequency digital recording echosounder system with an analog paper recorder. The high frequency setting may range from 100-1000 kHz. The low frequency setting may range from 12-50 kHz. It is hull-mounted on the *THOMAS JEFFERSON* and can be installed on Launch *3101*.

The high frequency transducer on *THOMAS JEFFERSON* operates at 200 kHz. The high frequency pulse forms a circular beam with a main-lobe beam footprint of 7.5° at the -6dB point. The low-frequency transducer operates at 24 kHz with a rectangular main-lobe beam footprint of 27° (along-track direction) by 47° (across-track direction) at the -6 dB point. Soundings are acquired in meters on both frequencies, with the high frequency selected for all sounding data.

On *THOMAS JEFFERSON*, the transducer is installed in an acoustically transparent fiberglass blister on the port side, adjacent to the KONGSBERG EM1002 multibeam transducer. On Launch 3101, the transducer is mounted on the port side on the same retractable arm that can accommodate the Reson 8125. The installation of the Odom on Launch 3101 allows simultaneous acquisition of Klein 5000 side scan with general survey-grade bathymetry when the ODOM is operated in high frequency only mode.

For the purposes of calculating total propagated error (TPU), the ODOM Echotrac MK II is assumed to be a single-frequency multibeam transducer with one beam. The maximum across-track and along-track beam angles are assumed to be identical at a value of 7.5°. The sonar is assumed to have a pulse length of 0.1 ms at 100 kHz and a ping rate of 20 Hz. As the primary bathymetry source for *THOMAS JEFFERSON* is almost exclusively the Reson 7125, the vertical-beam echosounder data for *THOMAS JEFFERSON* is archived in raw format when acquired.

The ODOM Echotrac is inappropriate for sole use in situations requiring full bottom or object detection bathymetry coverage. However, combined with side scan sonar acquisition, the ODOM Echotrac can be used to meet NOAA specifications for full bottom coverage and object detection.

Owing to its wide beamwidth, vessel pitch and roll calculations are not applied to ODOM Echotrac data. During typical acquisition conditions, the high-frequency beamwidth is sufficiently wide to receive a primary-lobe hit at nadir regardless of vessel attitude. This breaks down, however, when the vessel pitches more than 3° or rolls more than 5°. Care is taken to avoid using the ODOM as the primary source of bathymetry in situations where the pitch or roll would cause attitude artifacts or side-lobe hits.

The ODOM Echotrac MKII on *THOMAS JEFFERSON* is used primarily to provide a depth input to the Brooke Ocean MVP System. The Hypack software package is used to acquire ODOM VBES data.

Notable Odom echotrac equipment changes:

DN259-3101: VB latency test, new values added to hvf.

A.2 RESON SeaBat 7125 Multibeam Echosounder

The RESON SeaBat 7125 system is a single-frequency, digital recording multibeam echosounder with a central frequency of 400 kHz. The RESON 7125 system aboard *THOMAS JEFFERSON* is installed in a steel housing assembly with hydrodynamic shape mounted to a pylon extending from the starboard hull of the ship (Figure A-3).

Figure A-3. 7125 Housing on *Thomas Jefferson*

The RESON 7125 system aboard Launch *3102* is installed in a RESON Seabat 7125 mounting bracket deployed on a retractable arm from the hull. (Figure A-4).

Figure A-4. 7125 Housing on Launch *3102*

The RESON 7125 forms 512 beams in the receive array, each of which has a 0.5° across-track resolution and 1° along-track resolution. The RESON 7125 has a maximum ping rate of 48 Hz and is capable of bottom detection in depths from 1-200 m.

The best expected performance of the RESON 7125, as installed on THOMAS JEFFERSON and Launch 3102, is to the IHO Special Order standard. Actual performance will vary according to sea state, swell, tide zoning error, and sound velocity spatial and temporal distribution, and is typically to the IHO Order 1 standard.

The RESON 7125 performs active beam steering to correct for sound velocity at the transducer head using an Applied Microsystems LTD Sound Velocity and Temperature Smart Sensor. This sensor will be discussed in more detail in the Sound Velocity Equipment Section.

The user selectable range scale on the Reson 7125 was adjusted appropriately depending upon the survey depth.

Notable Reson7125 equipment changes:

DN256-3102: MB struck submerged piling, system was patch tested, DN257, SAT.

DN265-3102:Swapped loaned Reson CPU#4408009 with corrected 3102 unit #61203.

DN292-3102: Removed towed gear, update hvf with static draft.

A.3 RESON SeaBat 8125 Multibeam Echosounder

The RESON SeaBat 8125 multibeam echosounder is a single-frequency, digital-recording multibeam echosounder with an operating frequency of 455 kHz. The RESON 8125 transducer consists of a flat transmitter array and solid cylindrical receiver array deployed on a retractable arm from the hull of Survey Launch 3101.

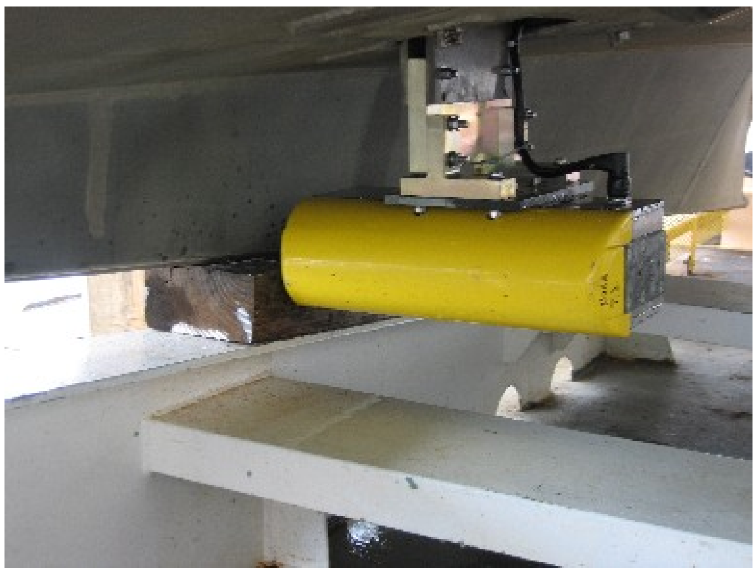


Figure A-5. 8125 Housing on Launch *3101*

The RESON 8125 forms 240 beams each of which has a 0.5° across-track beam footprint for a maximum total swath width of 120°. Each beam has an along-track resolution of 1°. The ping rate is nominally 20-40 Hz, but may vary according to user specification. The RESON 8125 sonar is capable of bottom detection in depths from 3-120m. Aboard Survey Launch 3101 the RESON 8125 is used in depths from 4-40m.

The RESON 8125 performs active beam steering to correct for sound velocity at the transducer head using an ODOM Hydrographic Systems Digibar Pro sea surface sound velocity sensor. This sensor will be discussed in more detail in the Sound Velocity Equipment section.

For the purposes of calculating total propagated error, the RESON 8125 is assumed to have an operational frequency of 455 kHz, a pulse length of 0.15ms, and a typical ping rate of 40Hz. The RESON 8125 meets NOAA specifications for object detection in shallow water.

The best expected performance of the RESON 8125, as installed on Survey Launch 3101, is to the IHO Special Order standard. Actual performance will vary according to sea state, swell, tide zoning error, and sound velocity spatial and temporal distribution, and is typically to the IHO Order 1 standard.

The user selectable range scale on the Reson 8125 was adjusted appropriately depending upon the survey depth.

Notable Reson8125 equipment changes:

DN266-3101: Reinstalled sonar. New patch test, updated in Hvf.

DN300-3101: Reson processor not responsive to mouse control, corrosion on CPU card.

DN302-3100: Reons processor cleaned and responding to mouse control.

A.4 Kongsberg EM 1002 Multibeam Echosounder

The Kongsberg EM1002 system is a single-frequency, digital recording multibeam echosounder with an operating frequency of about 95 kHz. The EM1002 aboard *THOMAS JEFFERSON* was installed in August 2001 in Jacksonville, FL, while the ship was still under the purview of the U.S. Navy.

The Kongsberg EM1002 transducer consists of a curved transmitter array and flat receiver array encased in an acoustically transparent fiberglass blister that is rigidly fixed to the hull of *THOMAS JEFFERSON* at the keel near frame 20. The KONGSBERG EM1002 forms 111 beams each of which has a 2° across-track beam footprint for a maximum total swath width of 150°. Each beam has an along-track beam resolution of 1.5°. The ping rate is nominally 10 Hz, but may vary depending on water depth, swath width, or user specification. For any given survey area optimal line spacing is determined for the system. A maximum width is set in the acquisition software (using the equidistant setting). The resulting swath is usually less than the maximum of 75 degrees. This compressed swath increases the ping frequency and therefore the data density. The KONGSBERG EM1002 is capable of bottom detection in depths from 5-1000m. Aboard the *THOMAS JEFFERSON* the KONGSBERG EM1002 is used in depths from 15m-1000m. The Windows-based Kongsberg Seafloor Information System (SIS) software package is used to acquire EM1002 data.

Active beam steering is performed to correct for sound velocity at the transducer head using an Applied Microsystems Smart SV&T sea surface sound velocity sensor. This sensor will be discussed in more detail in the Sound Velocity Equipment section. In addition, the curved face of the transducer array is designed to mechanically steer acoustic energy. An outer beam roll calibration coefficient is determined before starting acquisition for a project. This value is entered into the acquisition software and cannot be post processed.

The Kongsberg EM1002 does not meet NOAA specifications for object detection in shallow water (<20m). EM1002 data must be acquired with either side-scan sonar or high-resolution multibeam echosounder data (e.g. RESON 7125) to meet NOAA object detection specifications in shallow water.

For the purposes of calculating total propagated error, the KONGSBERG EM1002 is assumed to have an operational frequency of 95 kHz, pulse length of 0.2ms and a typical ping rate of between 1-8 Hz.

The best expected performance of the KONGSBERG EM1002, as installed on THOMAS JEFFERSON in 15m of water with an isopycnal water column and sound velocity of 1500 ms-1, is to the IHO Order 1 standard. Actual performance will vary according to sea state, water depth, swell, tide zoning error, and sound velocity spatial and temporal distribution.

A.5 KLEIN 5000 High-speed Side Scan Sonar

The KLEIN 5000 high-resolution side-scan sonar (SSS) system is a beam-forming acoustic imagery device with an operating frequency of 455 kHz and vertical beam angle of 40°. The KLEIN 5000 system consists of a KLEIN 5500 towfish, a Transceiver/Processing Unit (TPU), and a computer for user interface. Stern-towed units also include a tow cable telemetry assembly. There are two configurations for data acquisition using the KLEIN 5000 system: stern-towed and hull-mounted. S-222 uses exclusively towed SSS, HSL 3101 is hull mount configuration, HSL 3102 is typically hull mounted but can be converted to towed is required.

The KLEIN 5000 system is distinct from other commercially-available side scan sonars in that it forms 5 simultaneous, dynamically-focused receiver beams per transducer face. This improves along-track resolution to approximately 30cm at the 100m range scale, even when acquiring data at up to 10 knots. Across-track resolution is typically 7.5cm at the 100m range scale. The achievable 30cm resolution meets the NOAA Hydrographic Surveys Specifications and Deliverables Manual (HSSDM) for object detection. Klein SONARPRO is used to acquire KLEIN 5000 side scan sonar data.

Digital data from the Klein 5000 TPU were sent directly to the Klein 5000 computer for display and logging by Klein **SonarPro** software. Raw digital side scan data from the Klein 5000 were collected in (SDF) and maintained full resolution, with no conversion or down sampling techniques applied. These files were archived to the raw data storage drives at the end of each line for initial processing and quality control review

Towfish positioning was provided by **CARIS HIPS** using cable out values recorded in the Sonar Pro SDF files. This program uses Payout and Towfish Depth, Figure A-6, 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 **SonarPro** from the cable payout meter, the towfish pressure depth (sent via a serial interface from the Klein 4000 computer to **SonarPro**), 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.

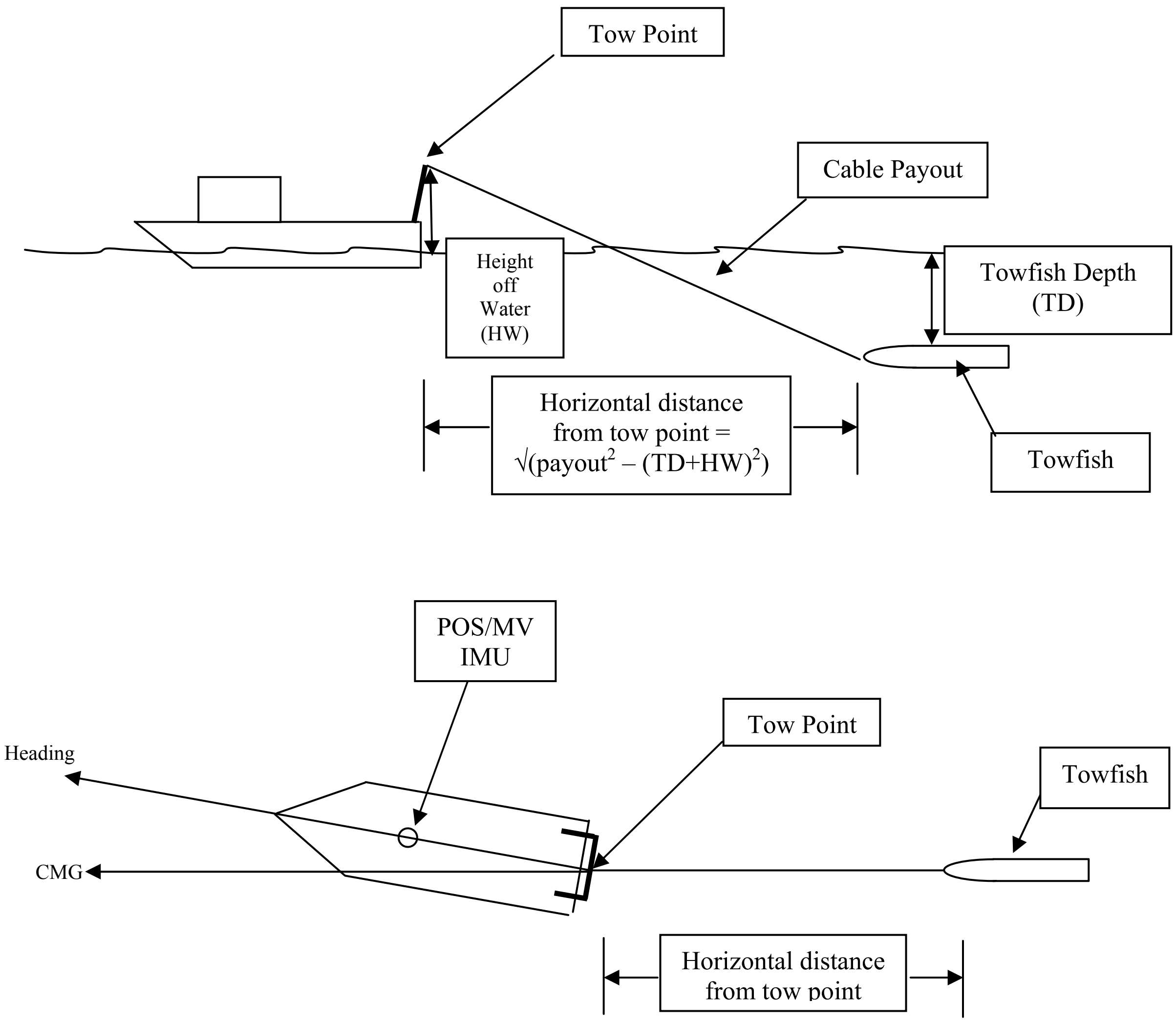


Figure A-6. Side Scan Towfish Position Calculations

The ship's and 3102'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 in acquisition in order to maintain acceptable towfish altitudes and sonar record quality. Changes to the amount of cable out were automatically saved to the **SonarPro** SDF.

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 vessel wake, even in shallower near shore waters at slower survey speeds. The use of the K-wing reduced the amount of cable payout, which in turn 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.

Side scan data file names were changed automatically every 15 minutes and manually at the completion of a survey line.

Notable SSS equipment changes:

DN 255-3102: Installed Tow configuration. Swapped Klein lightweight from S222 s/n 280 with 3102's heavy weight s/n 136. Updated tow point offset in hvf.

DN 255-3102 & S222: SSS cert updated values in Hvfs.

DN292-3102: Removed towed gear, switch back to hull mount SSS.

DN299-3102: Port transducer signal loss, possible ship collision while placing in cradle.

Hull-Mounted Configuration
Aboard both survey launches, the towfish can be mounted to an aluminum sled using omega brackets.

The hull-mounted configuration is normally used in depths of twenty meters or less, per the HSSDM. Aboard Launch 3101, sidescan may be collected concurrently with ODOM

Echotrac MkII vertical beam bathymetry. Aboard Launch 3102, sidescan may be collected concurrently with Reson 7125 or 8101 MBES data.

Tow Configuration
Aboard 3102 survey launch, the towfish is towed behind the launch by a hydraulic A-frame winch. Cable counter keeps counts of the cable length and automatic reads into the computer via serial port to update for layback by Sonarpro.

The tow configuration is normally used in any depth range with corresponding range scale, as per the HSSDM. The towfish height above bottom flies at 8-10% of water depth, as per the HSSDM. Aboard Launch 3102, sidescan may be collected concurrently with Reson 7125 or 8101 MBES data.

A.6 Manual Sounding Equipment

Diver Least Depth Gauge
The diver least depth gauge is a hand-held device that uses pressure to determine depth of water over a discrete point (e.g. mast of a shipwreck). A raw sounding obtained during a dive is corrected with verified tides and a sound velocity profile acquired in the vicinity of the object. The sound velocity profile is acquired from THOMAS JEFFERSON or one of the launches. Calibration was accomplished on the diver least depth gauge during the 2007-2008 winter inport period.

Lead Lines
Lead lines are composed of brass or bronze wire that is encased in dark red cotton tiller rope and marked at predetermined intervals. Lead lines are used to perform confidence checks against acoustic echosounders. Leadlines aboard THOMAS JEFFERSON and Survey Launches 3101 and 3102 are marked in decimeters. An alternative method of determining manual depths is to use a steel engineering tape with a lead attached.

A.7 Positioning and Orientation Equipment

Applanix POS/MV

A basic requirement of multibeam hydrography is accurate ship's position and attitude data during data acquisition. THOMAS JEFFERSON uses inertial positioning and orientation sensors and U.S. Coast Guard Differential GPS (DGPS) for a highly accurate blended position and orientation solution.

THOMAS JEFFERSON, Survey Launch 3101, and Survey Launch 3102 are each equipped with Trimble DSM212L DGPS receivers. The DSM212L includes a 12-channel GPS receiver capable of receiving external RTCM correctors from a shore-based reference station. The system outputs position information once each second. Best expected position accuracy with the DSM212L system is less than one meter with 5 or more space vehicle vectors in the solution. This system is very accurate in the long term (>5 min) but subject to short period noise.

Inertial position calculations on *THOMAS JEFFERSON*, *Survey Launch 3101, and Survey Launch 3102* are provided by an Applanix POS/MV Model 320 v.4. The POS/MV 320 system includes dual GPS antennas, an inertial measurement unit (IMU), and data processor (PCS). The IMU measures linear and angular accelerations corresponding to the major motions of the vessel (heave, pitch, roll, yaw) and inputs this data to the PCS, where it is combined with a GPS position determined by carrier-phase differential measurements to give the final position solution. The POS/MV position solution is not sensitive to short period noise, but its accuracy may decay rapidly over time.

The blended DGPS and inertial position/orientation solution has typical values of 0.02° true roll and pitch accuracy, 0.02° heading accuracy, 2m position accuracy, and 0.03 ms-1 velocity accuracy. These parameters are monitored in real time during acquisition using the POS/MV user interface software. These values meet the position accuracy standard for an IHO Order 1 survey.

All acquisition platforms are equipped with Precise Timing, a multibeam sonar acquisition configuration which synchronizes all data to the same time. The timing message is generated by the POS/MV which is received by both the acquisition computer and the Reson TPU. At the time of data acquisition, the POS/MV-generated time stamp is applied to the data instead of the system clock. Precise Timing reduces the variable effects of time latency and creates a single, measurable latency. This is determined via a patch test.

All platforms utilize True Heave (a long-period recording of vessel heave used to detect longer period sea swells that may not be detected during short-period heave calculations) for a post processed heave solution.

Notable Positioning and Orientation Equipment changes:

NONE

A.8 Sound Velocity Profiles

A Brooke Ocean Technology Moving Vessel Profiler (MVP) with an Applied Microsystems Smart Sound Velocity and Pressure (SV&P) sensors or a Seabird Electronics SBE-19 CTD were used to collect sound speed profile (SSP) data from Thomas Jefferson. Seabird Electronics SBE-19 CTD+ units were used to collect sound speed profile (SSP) data from Launches 3101 and 3102. 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 simultaneous casts taken with different Sound Velocity and Pressure sensors or with a Sound Velocity and Pressure sensor and a Seabird SBE-19 CTD.

Sound speed data and calibration records are included with the survey data in Section II of the Separates for each sheet's Descriptive Report.

Sea-Bird SBE19/19+ CTD Profilers

THOMAS JEFFERSON and Survey Launches 3101 and 3102 acquire water column sound velocity data using Sea-Bird Electronics SeaCat SBE19 and SBE19+ Conductivity-Temperature-Depth (CTD) profilers. Temperature is measured directly. Salinity is calculated from measured electrical conductivity. Depth is calculated from strain gauge pressure.

THOMAS JEFFERSON is equipped with a SeaCat SBE19 CTD profiler with strain gauge pressure sensor. The SBE19 is capable of CTD profiling at depths from 0-3400m. Post calibration drift is expected to be 0.02 °C yr^{-1}, 0.012S m^{-1} yr^{-1}, and 4.5 psia yr^{-1} for temperature, conductivity, and pressure, respectively. The SBE19 is deployed using the DT Marine Oceanographic winch for ship based acquisition.

Survey Launch 3101 and Survey Launch 3102 are each equipped with a SeaCat SBE19+ CTD profiler with strain gauge pressure sensor. The SBE19+ has a specified post-calibration temperature accuracy of 0.0005S m^{-1}, and strain-gauge pressure accuracy of 0.35 psia. Post calibration drift is expected to be 0.002 °C yr^{-1}, 0.004S m^{-1} yr^{-1}, and 0.168 psia yr^{-1} for temperature, conductivity, and pressure, respectively. The SBE19+ is capable of CTD profiling at depths from 0-350m. The SBE19+ is deployed by hand from Survey Launch 3101 and 3102.

All CTD instruments were returned to the manufacturer for calibration during the 2008-2009 winter in port period. Calibration documents are contained in Separates II of the Descriptive Report accompanying this report.

Sea Surface Sound Velocimeters

Unlike CTD profilers, sea surface sound velocimeters (SSVS) calculate sound velocity in water using two-way travel time. The typical SSVS consists of a transducer and a reflector at a known distance from the transducer. A pulse of known frequency is emitted, reflects at the reflector surface, and returns to the transducer. The two-way travel time is measured, and sound velocity derived from the two-way travel time. SSVS are required for multibeam systems that perform active beam steering at the transducer head. The Reson 7125 and Reson 8125 systems both require SSVS data.

The AML Smart SV&T Probe is a real-time time-of-flight sound velocimeter and thermistor sensor. The manufacturer specified sound velocity accuracy is 0.05 ms-1 and temperature accuracy is 0.05 °C. Empirical observations of drift show a sound velocity drift of approximately 0.5 ms-1 yr-1and temperature drift of approximately 0.05 °C yr-1.

Aboard *THOMAS JEFFERSON*, the AML Smart SV&T probe is mounted in an insulated sea chest in the sonar void. Sea surface temperature and sound velocity values are output in real time to the SIMRAD EM1002 and Reson 7125 systems at a rate of 10 Hz. Data are sent in real time to the Kongsberg EM1002 transducer.

The AML Smart SV&T Probe was returned to the manufacturer and calibrated during the 2008-2009 winter in-port period.

ODOM Hydrographic Systems Digibar Pro

The Digibar Pro is a real-time time-of-flight sea surface sound velocimeter. The manufacturer specified sound velocity accuracy is 0.3 ms-1. Aboard Survey Launch 3101, the Digibar Pro is mounted to an aluminum sled aft of the RESON 8125 transducer. Sea surface temperature and sound velocity values are output to the RESON 8125 system at a rate of 10 Hz. Data are sent in real time to the RESON 8125 processor unit.

Aboard Survey Launch 3102, the Digibar Pro is mounted in the RESON Seabat 7125 housing. Sea surface temperature and sound velocity values are output to the RESON 7125 system at a rate of 10 Hz. Data are sent in real time to the RESON 7125 processor unit.

The units were returned to the manufacturer and calibrated during the 2008-2009 in port period.

Notable digibar equipment changes:

DN257-3102: Swapped Digibar SN 98032 internals with SN98129 internals.

Brooke Ocean Technology Moving Vessel Profiler 100

The Moving Vessel Profiler (MVP) (figure A-7) is a self-contained profiling system capable of sampling water column profiles to 100m depth. MVP-100 was mounted to the port stern quarter. Configuration parameters, offsets, and installation diagrams are included in Appendix A. The MVP consists of a computer-controlled high speed hydraulic winch, a cable metering, over-boarding and docking system, a conductor cable and a streamlined free fall fish (FFF) housing an Applied Microsystems “time of flight” SV&P Smart Sensor (see SV&P below) . The system as configured aboard the *THOMAS JEFFERSON* collects vertical profiles of sound velocity data while the ship is underway at survey speed. The unit is located on the fantail and controlled remotely from the ship’s acquisition room. The MVP is capable of importing its data directly into the Kongsberg SIMRAD EM 1002 multi-beam echosounder (MBES) at the time of acquisition. When using MVP casts in conjunction with the RESON 7125 MBES, sound velocity data is processed using Velocwin software, then applied in CARIS HIPS during post processing.

Figure A-7. MVP 100 on S-222

Notable equipment changes:

DN257-S222: Swapped sensor A010657 SN 4988 with A009547 SN 5340, MVP still unresponsive

DN265-S222: Swapped sensor A009547 SN 5340 with A010657 SN 4988, reterminated cable at sensor.

DN280-S222: MVP broke, slip ring failure.

AML – Sound Velocity & Pressure Smart Sensor (SV&P)

The SV&P Smart Sensor is the main instrument housed on the MVP free fall fish; it is designed to directly measure sound velocity and pressure in water. Its small size, extremely fast response time and high sampling rate make the sensor ideal for fast profiles or tow speeds. The sensor has internal calibration coefficients and outputs real-time data to allow a "plug and play" environment. The stainless steel, right-angle end cap instrument operates as a stand alone unit with a fixed 19200 baud rate, RS-485 communications interface. Maximum depth is 1000 meters.

The Applied Microsystems Smart SV&P Sensor was calibrated by the manufacturer during the 2008-2009 winter import.

A.6. Bottom Samplers

Two types of bottom samplers are used aboard THOMAS JEFFERSON for analyzing bottom sediments.

The Khalisco Mud Snapper model 214WA100 (figure A-6) may be deployed by one person by handand is best used for shallow water samples acquired on the survey launches. (Figure A-8)

The Ponar Wildco model # 1728 sampler is used with the DT Marine Oceanographic winch for Ship based bottom sample acquisition. (Figure A-9)

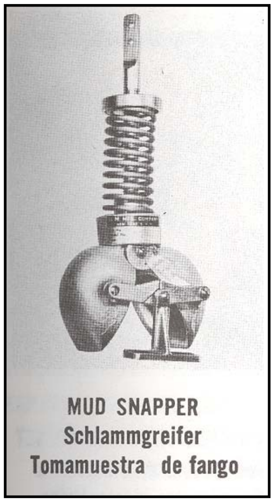


Figure A-8. Khalisco Mud Snapper

Figure A-9. Ponar Grab Sampler

A.10 Software Systems

Acquisition Software

Multibeam data were acquired using **Hypack 2009** software running on a acquisition computers with the Windows XP operating system. Hypack is used to control real-time navigation, data time tagging and data logging. Klein 5000 side scan sonar data were acquired using Klein's **SonarPro** sonar software running on acquisition computers with the Windows XP operating system. Moving Vessel Profiler data were acquired using **Brooke Ocean Technology MVP** software running on a computer with the Windows XP operating system.

Data Processing: Post-acquisition multibeam processing was performed on board the Thomas Jefferson using processing computers with Windows XP operating systems, which run **CARIS HIPS** software. Side scan sonar data were reviewed for targets, side scan mosaics and contact generation in **CARIS HIPS** software; Side-scan contacts were correlated with multibeam data in NOAA's **Pydro** software. CTD and MVP data were processed using NOAA **Velocwin** software.

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 Appendix A of this report.

Notable Sonarpro software changes:

DN255: Select get tow fish position from ship's navi.

Hypack 2009
Hypack is used for vessel navigation during sidescan and multibeam acquisition, and acquisition of vertical-beam echosounder data. Survey lines, vessel position with respect to lines, and various navigation parameters are displayed on a screen both at the acquisition station and on a repeater screen for the helmsman or coxswain. Hypack is also used to acquire detached positions on all platforms.

Notable Hypack software changes:

DN280: New Hypack keys for S222/3101/3102

DN290-S222: New Hypack 2009a

DN298-3101/3102: New Hypack 2009a

Hysweep
Hysweep is a module for Hypack used to acquire RESON 7125 and 8125 multibeam data.

Operational, on both launches it was decided to process just the nadir beam saved in the HSX file as EC1 in hysweep as single beam. The cost benefit of treating bathymetry as "single" beam outweighed the hours of processing and cleaning full swath bathymetry when acquiring SSS concurrent. However, because 3101 SSS and 8125 are the same frequency, the 8125 was tuned to get optimal SSS trace and cleanest bathymetry bottom trace.

Notable Hysweep software changes:

DN290-S222: New Hysweep key.

DN298-3101/3102: New Hysweep key

Kongsberg Simrad SIS

Kongsberg Seafloor Information System (SIS) is a Windows-based acquisition software package providing real time coverage, sensor control and monitoring for the EM 1002 multibeam echosounder. All EM1002 MBES data are collected onboard THOMAS JEFFERSON using SIS.

BOT MVP Controller

The MVP controller software allows the MVP system to operate automatically using a variety of deployment parameters. Data can be viewed in real-time and can be sent directly to a compatible multibeam echosounder's processor. The MVP software provides graphical display (strip charts) of sensor data in real time as well as saving all pertinent data to files on a cast by cast basis.

Data Collection and Processing Software

CARIS HIPS AND SIPS

CARIS HIPS (Hydrographic Information Processing System) is used for all initial processing of multibeam and vertical beam echosounder bathymetry data, including tide, sound velocity, and vessel offset correction and data cleaning. CARIS HIPS uses statistical modeling to create Bathymetry with Associated Statistical Error (BASE) surfaces in one of three ways: swath-angle weighted grids, uncertainty-weighted grids, and Combined Uncertainty and Bathymetry Estimator (CUBE) algorithm grids. Creation of grids as bathymetric products is discussed in section D of this report.

CARIS SIPS (Side-scan Information Processing System) is used for all processing of side-scan sonar imagery, including cable layback correction, slant range correction, contact selection, towpoint entry, and mosaic generation.

HSTP PYDRO

HSTP PYDRO is a program for the classification of side-scan sonar and multibeam bathymetry contacts and for the creation of preliminary smooth sheets. Multibeam contacts (designated soundings), side-scan sonar contacts, and detached position contacts are analyzed, grouped, and assigned S-57 classifications. High resolution BASE surface data is entered into the program and excessed to survey scale. The final product is a Preliminary Smooth Sheet file (PSS), which is delivered to the Atlantic Hydrographic Branch as part of the final submission package.

Pydro Versions 7.3 and later have functionality for TCARI installed. TCARI is described in detail in section D.3. The TCARI file for the area is received from NOS and loaded into Pydro along with the predicted, observed, or verified tide files for the corresponding stations. The use of TCARI is specified in the Project Instructions.

Pydro is also used for chart comparisons, generation of chartlets, generation of Danger to Navigation reports, generation of appendices to the Descriptive Report, compilation of survey statistics, and generation of standard NOAA forms such as the Descriptive Report cover sheet.

HSTP VELOCWIN

HSTP Velocwin is a program for the processing of sound velocity casts. This program uses Sea-Bird Electronics SeaSoft software to convert hexadecimal SeaCat data into ASCII conductivity-temperature-depth data, and then converts the ASCII data into a depth-binned sound velocity file. Velocwin software is also used to process Moving Vessel Profiler (MVP) sound velocity data into a CARIS compatible format. Velocwin allows for batch processing of the numerous .calc files generated by the MVP during multibeam echosounder acquisition. The resulting .svp files are applied in CARIS HIPS during post-processing to correct for sound velocity variation within the water column. These sound velocity files are applied to the data in CARIS HIPS. Velocwin is also used to check the accuracy of sound velocity casts and to archive sound velocity information for the National Oceanographic Data Center.

MAPINFO Professional 9.0

MapInfo Professional is the Geographic Information System (GIS) software package used aboard THOMAS JEFFERSON. MapInfo is used for sheet management, line planning, final data analysis, and creating end-user plots.

A.8. Acquisition Procedures

Acquisition Types

All platforms acquire hydrographic data according to the Letter Instructions for each survey. The Letter Instructions for a given survey will specify the acquisition method desired. The Letter Instructions will occasionally state the desired coverage and give the field unit discretion as to the best method to achieve that coverage.

The following survey types are used during field operations by THOMAS JEFFERSON in the 2008 Field Season:

- Set Line Spacing
- Complete MBES Coverage
- 100% SSS + Complete MBES
- Object Detection SSS Coverage
- Object Detection MBES Coverage

These coverage types are described in detail in the Aril 2009 Hydrographic Survey Specifications and Deliverables.

Line plans are designed by the field unit according to the coverage type specified in the Letter Instructions. Occasionally the Letter Instructions will give discretion regarding which coverage type to use to the field unit. Line planning and coverage type will be discussed in detail in the Descriptive Report for each survey.

Crosslines are acquired as an additional confidence check to the performance of echosounder data. Crosslines are used to check sonar confidence and to provide a meaningful comparison between nadir beams and outer beams of a multibeam mainscheme acquisition line. Crosslines are compared to the product navigation surface in CARIS HIPS. The results of the crossline QC test are submitted in Separates V of the Descriptive Report for each survey.

Acquisition speeds are monitored and limited to maintain density as required in Specs and Deliverables.

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 Hypack/Hysweep, POSPAC and SonarPro 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 begins on *Thomas Jefferson*. This includes 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
- Generation of preliminary side scan coverage mosaics

On a daily basis BASE surfaces are generated to ensure adequate data density, identify areas of high standard deviation and note any obvious problems with correctors. The following grids are created and used for crossline analysis, tide zone boundary comparisons, and day to day data comparisons.

- Main scheme, item, and holiday fill survey lines
- Crosslines

Results of this analysis are reviewed to determine adequacy of data and sounding correctors. Additional processing in preparation of data deliverables includes the following steps:

- Generation of side scan Contact Files and Contact Plot
- Subset 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 below.

B.1. Bathymetry

Raw bathymetry data, (Sonar Pro .sdf, Simrad .all, Hypack .raw and .hsx) are converted into CARIS HDCS data format upon completion of daily acquisition. Conversion parameters vary for each data format, and are stored in the LogFile of each HDCS processed line folder. After data conversion, water level, sound velocity, attitude, and navigation data are applied as described in section C. Bathymetry lines are then merged. Following merge, Total Propagated Uncertainty (TPU) is calculated for each sounding. For a more detailed explanation of TPU calculation of multibeam and vertical beam echosounder data, refer to Section 4.2.3.6 of the 2009 NOAA Field Procedures Manual.

Depending on acquisition type, MBES bathymetry may be processed using either an uncertainty-weighted navigation surface or a CUBE surface. Uncertainty-weighted BASE surfaces and CUBE surfaces are described in detail in the 2009 NOS Field Procedures Manual and the CARIS HIPS/SIPS Users Manual.

When the primary source of bathymetry for a survey area is a combination of VBES and MBES, a collection of finalized uncertainty-weighted mean bathymetric surfaces is generated as the product of the survey. CUBE is not permitted for this type of survey. When the primary source of bathymetry for this type of survey is set line spacing MBES data (also known as “skunk striped”), CUBE shall be used. The use of CUBE in this situation is required to guarantee proper nodal propagation distances as described in section 5.1.1.3, Gridded Data Specifications, of the 2009 Hydrographic Survey Specifications and Deliverables. The data is examined and cleaned as necessary. Blunders are rejected and lines with major systematic errors are removed from the grid. Systematic errors are identified and documented by the office processor. The product surface is generated at standard resolution for Complete MBES even though bathymetry data may be sparse.

When Complete or OD MB is the primary source of bathymetry, data are processed using CUBE grids. The use of CUBE is mandatory to ensure compliance with the specification described in the paragraph above. After computation of TPU, multibeam lines are either used to create a new BASE Surface or are added to an existing BASE Surface. The resulting layers are analyzed by the data processor to identify blunders, systematic errors, and to identify significant bottom features. Blunders are rejected by the data processor in CARIS Subset Editor (multi-line spatial view) or CARIS Swath Editor (single-line time-series view). Caris Database 2.3 has been folded into the processing work flow to support the quality control assessments. By analyzing the specific child layers of the CUBE surface, systematic errors are identified and documented by the data processor. Least depths of navigationally significant features are flagged as “designated soundings,” which both identifies the object as a navigationally significant object for import in to Pydro and forces the depth of the grid to match the least depth of the feature. Hypothesis selection (available in CARIS) is not allowed per specifications and is not used aboard *THOMAS JEFFERSON*.

After data editing is complete, grids are finalized in CARIS Hips. The final resolution of the product surfaces depends on whether Complete or OD MBES is specified in the letter instructions.

B.2. Error Modeling in CARIS Hips

CARIS computes TPU based on both the static and dynamic measurements of the vessel. These values are based on the offsets tables found in Appendix B. As well, CARIS uses survey-specific information including a tidal zoning error estimate and speed of sound measurement errors. Offset values are entered into the CARIS *.hvf file. During processing, the tidal zoning and speed of sound measurement errors are applied. Tidal zoning values are provided with the Letter Instructions in a separate tidal information document. Instrument-specific values are obtained from either the CARIS TPU resource website or per HSD guidance (e.g. Hydrographic Surveys Technical Directive 2007-2). TPU Parameters for each survey are listed in the Descriptive Report.

B.3. Bathymetry Analysis and Feature Classification

Following data cleaning in CARIS HIPS and SIPS, uncertainty-weighted or CUBE bathymetry grids and CARIS contacts are inserted into a PYDRO Preliminary Smooth Sheet (PSS). Side Scan Sonar (SSS), Multi Beam Echo Sounding (MBES) and Vertical Beam Echo Sounding (VBES) data are imported into PYDRO using the “Insert CARIS Line Features” tool. DP and GP features are inserted using the “Generic Data Parser” tool. Images of contacts exported from CARIS are displayed in the Image Notebook Editor in PYDRO. Contacts are arranged by day and line and can be selected in the data “Tree” window. Information concerning a specific contact is reviewed in the Editor Notebook Window in PYDRO. This information includes contact positions, AWOIS item positions, surrounding depths, contact cross references, and charting recommendations.

Contacts are classified according to type of contact (e.g. MBES, SSS, DP, etc), confidence, and proximity to other contacts. Although this will vary from survey to survey, the following general rules apply for classification of contacts:

- MBES contacts will be classified as primary contacts over SSS, DP, and GP contacts;
- If there are two or more MBES contacts for the same feature, the MBES contact of least depth is classified as the primary contact;
- If there is no bathymetry contact for a feature, then the SSS position will be classified as primary contact over DP and GP contacts;
- If there are two or more SSS contacts for the same feature, then the SSS contact that best represents the feature is classified as the primary contact;
- If there are no bathymetry or imagery contacts, then the DP contact that best represents the feature is classified as the primary contact.

Multiple representations of one distinct feature (e.g. contacts from two or more SSS lines on a known wreck) may be grouped. For a group of features, one representation is selected as the primary contact, and all others are selected as secondary contacts with respect to the primary contact.

Significant features are defined by the Hydrographic Survey Specifications and Deliverables as an object rising more than 1m above the seafloor in water depth of 0-20m, and an object rising 10% of depth above the seafloor in water depths greater than 20m. Either echosounder least depth or side-scan sonar acoustic shadow height may be used to determine height of an object off the water bottom. The following types of features are always significant contacts: wrecks, obstructions, pipelines, and piers and wharves.

Contacts appearing significant are further investigated with a MBES system capable of meeting NOAA object detection specifications. If there is no known least depth of good confidence on a significant feature, then the feature will be flagged as "Investigate." Features with such a tag must be further developed, in order of preference, with multibeam echosounder, diver least depth gauge, or vertical beam echosounder.

Any items that are to be addressed in the Item Investigation section of the Descriptive Report are flagged as "Chart". Examples of Chart items include position of new or repositioned Aids to Navigation, permanent man-made features which do not pose a danger to surface navigation, or dynamic sedimentary bedforms which have not been previously noted on the chart. Items which have the "Chart" flag set could also be further designated for inclusion in the Danger to Navigation Report by choosing the "DTON" flag. Dangers to Navigation are submitted to the Commanding Officer for review prior to submission to the Marine Charting Division (MCD).

After a feature is fully classified, primary features are flagged as "Resolved." If a primary feature is flagged "Resolved," then the secondary features correlated to that primary feature are automatically flagged "Resolved" and are given the same full classification as the primary feature.

B.4. Imagery

Side scan sonar data are converted from *.sdf (Sonarpro raw format) to CARIS HDCS. Processing side scan data includes examining and editing fish height, vessel heading (gyro), and vessel navigation records. When side scan sonar is towed, fish navigation is recalculated using CARIS SIPS. Tow point offsets (C-frame and cable out), fish depth, fish attitude, and water depth are used to calculate horizontal layback.

After fish navigation is recalculated, side scan imagery data are slant-range corrected to 0.1m with beam pattern correction. The slant-range corrected side scan imagery data are closely examined for any targets. Targets-of-interest are evaluated as potential contacts based upon apparent shadow length and appearance, particularly targets which do not appear to be natural in origin. Contacts are selected and saved to a contact file for each line of SSS data. Contact selection includes measuring apparent height, selecting contact position, and creating a contact snapshot (*.tif) image.

Side scan sonar coverage is determined by using mosaics generated in CARIS SIPS and imported into MapInfo. If any deficiencies in the side scan sonar data are found, a holiday line file is created from the mosaics, and additional lines of SSS are acquired, in order to meet the requirements set forth in the Hydrographic Survey Letter Instructions.

B.5. Survey Deliverables and Ancillary Product Generation

The ship's final bathymetric deliverables to the Atlantic Hydrographic Branch are a collection of BASE surfaces, the Pydro PSS (including S-57 feature classifications), the Descriptive Report, side scan sonar mosaics (when applicable), and two sun-illuminated digital terrain models of the multibeam bathymetry. The resolution of surfaces varies according to acquisition type specified in the Letter Instructions.

Side scan sonar line files are reviewed in CARIS SIPS to identify contacts which may be significant enough for further investigation. Side scan sonar data are used to create high-resolution mosaics of the seafloor which are used to demonstrate coverage and analyze general bottom type. When permitted by Letter Instructions, these mosaics are used to determine where to acquire full multibeam coverage and developments.

The Pydro Preliminary Smooth Sheet (PSS) contains a set of soundings, features, and other data which best represent the survey area at survey scale. Along with the Descriptive Report, the PSS is the ship's record of the survey, from which the final survey product is created at the Atlantic Hydrographic Branch. A Microsoft Access database file (.mdb) containing all S-57 feature attributions is exported from Pydro.

C. Corrections to Echo Soundings

C.1. Sound Velocity

Sound speed data acquired by the sea surface sound velocity sensors on *THOMAS JEFFERSON* and *Survey Launch 3101/3102* are neither recorded nor used for post-processing of echosounder data. The sea surface sound velocity sensors will not be discussed further in this section.

CTD Profiles

Sound velocity profiles for the *THOMAS JEFFERSON* and for Launches *3101* and *3102* are processed using the program HSTP Velocwin which generates sound velocity profiles for CARIS HIPS. Sound velocity correctors are applied to MBES and VBES soundings in CARIS HIPS during post processing only

The speed of sound through water is determined by a minimum of one cast daily for VBES acquisition and one cast every three to four hours of MBES acquisition, in accordance with the Standing Letter Instructions and NOS Specifications and Deliverables for Hydrographic Surveys. Casts are conducted more frequently when changing survey areas, or when environmental conditions such as changes in weather, tide, or current would warrant additional sound velocity profiles.

The sound velocity casts are extended in HSTP Velocwin and applied to all bathymetric data in CARIS HIPS during post processing.

Brooke Ocean MVP

The SV data acquired by the MVP is transmitted to a raw SV file folder, where the hydrographer conducts a basic check of the data for correct day number, sound velocity data, and file format/integrity. The SV cast may also be graphically viewed and compared with other casts using the associated feature in the MVP controller software.

Like CTD casts, MVP casts are processed and/or extended for use in CARIS HIPS using HSTP Velocwin.

C.2. Water Level Correctors

Soundings are initially reduced to Mean Lower-Low Water (MLLW) using preliminary (observed) water level data. Data may be obtained from the primary tide gauge through the Center for Operational Oceanographic Products and Services (CO-OPS) web site or TideBot automated water level observation delivery program. Observed water level files are converted to CARIS tide files (.tid) and/or text files and applied to all sounding data using either discrete tide zoning in CARIS HIPS or the TCARI module in Pydro, as provided by CO-OPS. The type of water level correction used in a survey is specified in the Letter Instructions.

When discrete tide zoning is the type of final water level correction specified in the Smooth Tide Note, THOMAS JEFFERSON personnel use verified water levels and final tide zoning provided by CO-OPS for hydrographic product generation.

C.2.1 TCARI

TCARI grid files may be submitted to THOMAS JEFFERSON as part of the Project Instruction package. A grid is computed using the shoreline, a limiting boundary, and the positions of two or more water level gages. Harmonic constants, residual water levels, and gage weights are interpolated for each grid point, using the data from the water level gages as control points. Water level corrections are applied in Pydro using the TCARI tools found in Pydro 7.xx and beyond. When using TCARI for datum reduction, water level corrections are not applied to echosounder data in CARIS. Following water level correction, data is merged and processed as described in Section B.

C.3. Multibeam Calibration Procedures

Heave, pitch, roll, yaw, and navigation latency biases for each vessel are corrected during a multibeam bias calibration test (patch test). MBES vessel offsets, dynamic draft correctors, and system bias values are contained in HIPS Vessel Files (HVFs). These offsets and biases are applied to the sounding data during processing in CARIS HIPS. A Patch Test or verification of certain biases is also performed at the start of each project before acquiring MBES data in the new survey area. The HVFs and patch test data are included with the processed data accompanying this report. Results of the Patch Test for each vessel can be found in Appendix C of this report.

C.4. Vessel Offsets and Dynamic Draft Correctors

A partial re-survey of *THOMAS JEFFERSON* vessel offsets was conducted on 10 March 2005 by NGS personnel, and no changes in offsets have occurred since then. The procedure and results of the 2005 re-survey may be found in the 2009 Hydrographic Systems Readiness Report.

Preliminary static draft measurements are made at the beginning of each leg. Static draft for *THOMAS JEFFERSON* is measured using a sight tube located in lower survey stores. Additional static draft measurements will be made as needed with changing conditions, such as short or long term shifts in ship ballast/loading.

Vessel offset measurements were made on *Launch 3101* on August 19, 2005 by NGS personnel. The offset measurement for the new ODOM Echotrac MkII VBES was derived by applying measured X, Y, and Z differences between the Reson 8125 mounted position and the Odom mounted position. Static draft measurements for Launch 3101 are determined using a sight tube and made from a reference point with respect to the IMU. These measurements are made at the beginning and end of each working day while the vessel is dead in the water.

Vessel offset measurements were made on *Launch 3102* on August 25, 2005 by NGS personnel and a slight modification to the POS M/V antennae vertical (Z) offset was applied in 2007 after upgrading to v.4 antennae. Static draft measurements for Launch 3102 are determined using a sight tube and made from a reference point with respect to the IMU. These measurements are made at the beginning and end of each working day while the vessel is dead in the water.

Dynamic Draft

The Echosounder method was used to determine the dynamic draft for all platforms for the 2009 field season. The Echosounder method is described in the FPM section 1.4.2.1. and is adapted from an older practice where successive lines were run over a flat bottom at different speeds. A standard operating procedure (SOP) for the Echosounder method is found in Appendix I of the FPM.

All multibeam data were processed using standard procedures in CARIS HIPS. Dynamic draft was computed for each RPM level. The speed at each RPM was calculated by querying the speed of the lines run at that RPM. Three different regions on the line were sampled for depth soundings; the regions were at 1/4, 1/2, and 3/4 along the line. The sampled regions were queried by line for depth soundings. Depth soundings collected at similar RPMs were combined and the median depth sounding found. This sounding was used in the calculation of the vessel draft. To determine the change in vessel draft at each speed the difference between the median depth sounding at that speed and the median depth sounding at drift speed was found. See Appendix C for tabulated results. Results of the Dynamic Draft Test for each vessel can be found in Appendix C of this report.

D. APPROVAL SHEET

This Data Acquisition and Processing Report for project OPR-D946-TJ-09, North Atlantic Ocean, VA is respectfully submitted.

As Chief of Party, I have ensured that standard field surveying and processing procedures were adhered to during these projects in accordance with the Hydrographic Surveys Specifications and Deliverables (4/2009), Hydrographic Survey Technical Directive HTD 2009-02, and the Field Procedures Manual for Hydrographic Surveying (4/2009,).

I acknowledge that all of the information contained in this report is complete and accurate to the best of my knowledge.

This DAPR applies to survey F00585 which was completed in 2009 for Project D946.

Approved and Forwarded:

Mark Blankenship
2009.12.11
11:38:52 -05'00'

LT Mark A. Blankenship, NOAA
Field Operations Officer

Digitally signed by Shepard Smith
Date: 2009.12.11 12:30:47 -05'00'

CDR Shepard M. Smith, NOAA
Commanding Officer

Appendix A

Acquisiton Computer Software

	Date of application	TJ	3101	3102
Hypack/Hysweep	October-09	v2009a	v2009a	v2009a
Sonarpro	April-09	v11.2	v9.3	v11.2
Velowin	April-09	v8.95	v8.95	v8.95
Applanix	April-09	v4.0.2.0	v4.3.4.0	v4.0.2.0
TSIP Talker	April-09	v2.00	v2.00	v2.00
MVP	May-09	v2.31	n/a	n/a
SIS	July-07	v3.4.3		

Processing Computers Software

	Date of application	Versions
CARIS Hips snd Sips	March-09	SP2, hotfix 8
CARIS Bathy Database	August-09	2.3, hotfix 5
Windows Professional	January-08	SP3
Microsoft Office 2007	July-09	current
Mapinfo	March-08	9.5
Fledermaus	February-08	6.5
Caris Bathy DataBase	July-09	2.3
Adobe	unknown	7
Pydro	August-09	9.6v 2698

Hydrographic Hardware Inventory

Field Unit: Thomas Jefferson (S-222)

SONAR AND SOUNDING EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	CD000104551
Reson	7P Processor	50357	AMC-A010729
	Lower Control Unit	61206	None
	Lower Control Unit	1512013	None
	Projector	1908188	None
	Reciever, EM7200-1	808042	CD0000825373
Kongsberg	EM 1002	Processor: 227	CD0001474854
		Transducer: 227	AMC-A010656
Klein	5500 high speed high resolution side scan sonar towfish	280	CD0000825295
	Top Side Processor Unit	135	CD0000656528
Odom	Echotrac MKII	9656	

POSITIONING & ATTITUDE EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	**CD Number**
Trimble	DSM212L	n/a	CD0000658032
Trimble	DSM212L	0220227516	CD0000832703
Applanix	POS/ MV	PCS - 2321	CD0001472952
Applanix	POS M/V	IMU - 356	None

SOUND SPEED MEASUREMENT EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	**CD Number**
Seabird	SBE 19 SVP	285	CD0001776086
Applied Micro Systems	Smart SV+T SSVS	4823	None
Brooke Ocean Technology LTD	Sensor 1	187-1	None
	MVP PU	10332	CD0200825374
	"Fish 1"	10535	None
	"Fish 2"	10936	None
	MVP Computer	0127560	None
	Sensor 2	166-5	None
	Deck Unit	10332	None

TIDES & LEVELING EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	**CD Number**
Lietz / Sokkisha	B1 Automatic Level	7423	None
Carl Zeiss	Ni 2 Level	20606	None

Hydrographic Hardware Inventory

Field Unit: Launch 3102

Effective Date: June 16,2009

Updated Through:

SONAR AND SOUNDING EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	**CD Number**
Reson	7P Processor	61203	CD0001601003
	LCU: RMA 501264	50872	N/A
	Projector	1908188	N/A
	Reciever, EM7200-1	2208050	N/A
	8101 TPU	13976	CD0000832761
	8101 Power Supply	N/A	AMC-A004311
Klein	5500 SS Fish		CD0001776003
	Klein TPU	136	CD0000825297

POSITIONING & ATTITUDE EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	**CD Number**
Trimble	DSM212L	0220168291	CD0000819685
Applanix	POS/MV	1000 3370	CD0000156714
		IMU - 146	CD0001284522

SOUND SPEED MEASUREMENT EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	**CD Number**
Seabird	SBE 19 Plus SVP	4487	CD0001776088
Odom	DIGIBAR-Pro Profiling Sound Velocimeter	Top side unit Display: 98130	CD000825299

Hydrographic Hardware Inventory

Field Unit: Launch 3101

Effective Date: June 18, 2009

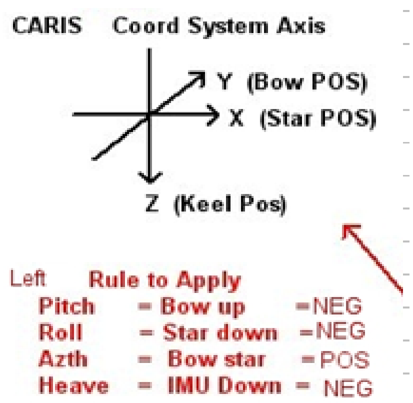
Updated Through:

Manufacturer	Model	Serial Number	CD Number
SONAR AND SOUNDING EQUIPMENT			
Reson	SeaBat 8125 TPU	31381	CD0000825283
	SeaBat 8125 X-Ducer	Transducer: 2007011	N/A
Klein	5500 ss towfish	eeb spare unnumbered	N/A
	Top Side Processor Unit	166	AMC-A014614
Odom	Echotrac MKII	TR5345	CD0000656532
POSITIONING & ATTITUDE EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	**CD Number**
Trimble	DSM212L	0220243252	CD0000819685
Applanix	POS M/V	2207	CD000825575
		IMU - 352	none
SOUND SPEED MEASUREMENT EQUIPMENT			
Manufacturer	**Model**	**Serial Number**	**CD Number**
Seabird	SBE 19 Plus SVP	4486	CD0001776087
Odom	DIGIBAR-Pro Profiling Sound Velocimeter	Top side unit Display: 98351	CD0001044543
		Probe: 98130	N/A

Appendix B

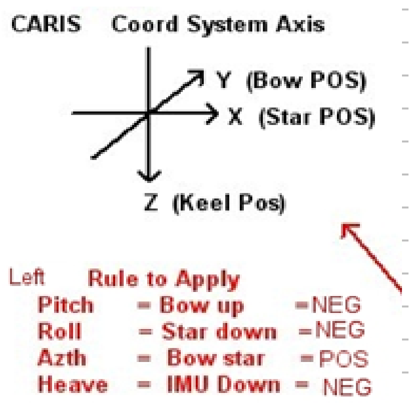
S222 CARIS Offsets 2009

ITEM	DESCRIPTION	X_AXIS	Y_AXIS	Z_AXIS
1	Optical Reference unit	0	-0.844	-0.116
2	POS/MV IMU	0.000	0.000	0.000
3	Port POS/MV Aero Antenna 1 Phase Center	1.560	-10.282	-22.320
4	Stbd POS/MV Aero Antenna 2 Phase Center	3.563	-10.166	-22.336
5	EM 1002 transducer	2.384	-0.560	5.153
6	200 khz transducer	0.494	-1.902	4.980
7	24 khz transducer	2.213	-2429.000	4.663
8	SSS block NGS Aug extension	6.374	-42.553	-4.797
9	Waterline	n/a	n/a	0.570
10	7125 STD transducer	8.499	-2.364	5.064



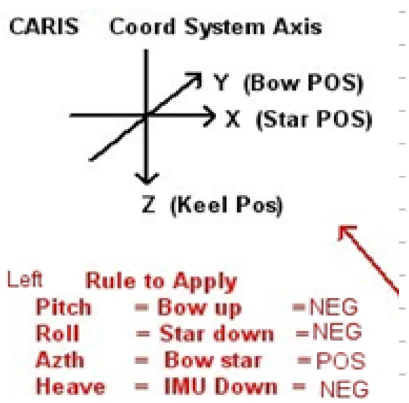
3102 CARIS Offsets 2009

ITEM	DESCRIPTION	X_AXIS	Y_AXIS	Z_AXIS
1	POS/MV IMU	0.000	0.000	0.000
2	Port POS/MV Aero Antenna 1 Phase Center	-0.794	-0.962	-3.743
3	Stbd POS/MV Aero Antenna 2 Phase Center	0.691	-0.955	-3.761
4	Reson 8101	-0.577	-0.036	0.543
5	Klein 5000	0.485	0.008	0.847
6	Waterline	N/A	N/A	-0.220



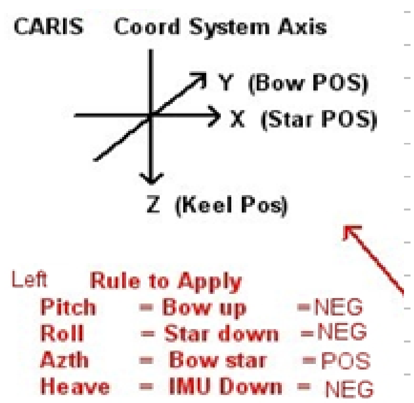
3102 CARIS Offsets 2009

ITEM	DESCRIPTION	X_AXIS	Y_AXIS	Z_AXIS
1	POS/MV IMU	0.000	0.000	0.000
2	Port POS/MV Aero Antenna 1 Phase Center	-0.794	-0.962	-3.743
3	Stbd POS/MV Aero Antenna 2 Phase Center	0.691	-0.955	-3.761
4	Reson 7125	-0.577	-0.036	0.533
5	Klein 5000	0.485	0.008	0.847
6	Waterline	N/A	N/A	-0.220



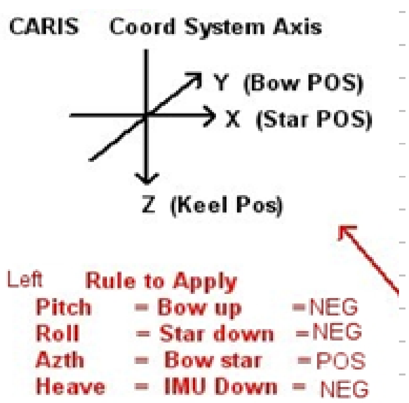
3102 CARIS Offsets 2009

ITEM	DESCRIPTION	X_AXIS	Y_AXIS	Z_AXIS
1	POS/MV IMU	0.000	0.000	0.000
2	Port POS/MV Aero Antenna 1 Phase Center	-0.794	-0.962	-3.743
3	Stbd POS/MV Aero Antenna 2 Phase Center	0.691	-0.955	-3.761
4	Reson 7125	-0.577	-0.036	0.543
5	Klein 5000	0.485	0.008	0.847
6	Waterline	N/A	N/A	-0.220



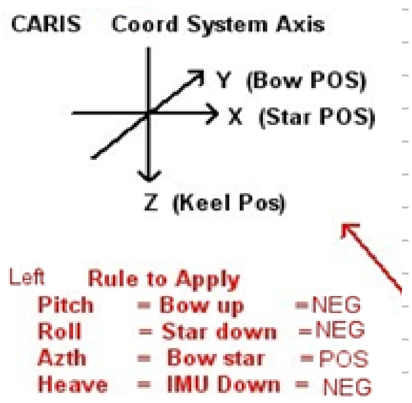
3102 CARIS Offsets 2009

ITEM	DESCRIPTION	X_AXIS	Y_AXIS	Z_AXIS
1	POS/MV IMU	0.000	0.000	0.000
2	Port POS/MV Aero Antenna 1 Phase Center	-0.794	-0.962	-3.743
3	Stbd POS/MV Aero Antenna 2 Phase Center	0.691	-0.955	-3.761
4	Reson 7125	-0.577	-0.036	0.533
5	Klein 5000	0.485	0.008	0.847
6	Waterline	N/A	N/A	-0.220



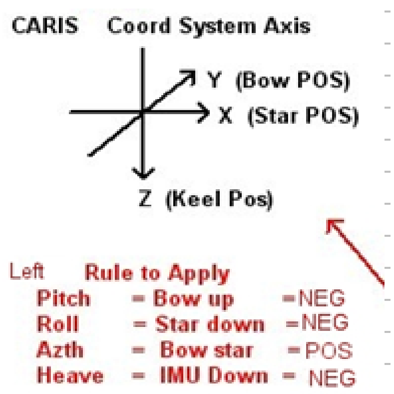
3102 CARIS Offsets 2009

ITEM	DESCRIPTION	X_AXIS	Y_AXIS	Z_AXIS
1	POS/MV IMU	0.000	0.000	0.000
2	Port POS/MV Aero Antenna 1 Phase Center	-0.794	-0.962	-3.743
3	Stbd POS/MV Aero Antenna 2 Phase Center	0.691	-0.955	-3.761
4	Reson 8101	-0.577	-0.036	0.543
5	Klein 5000	0.485	0.008	0.847
6	Waterline	N/A	N/A	-0.220



3101 CARIS Offsets 2009

ITEM	DESCRIPTION	X_AXIS	Y_AXIS	Z_AXIS
1	POS/MV IMU	0.000	0.000	0.000
2	Port POS/MV Aero Antenna 1 Phase Center	-0.711	-0.866	-3.789
3	Stbd POS/MV Aero Antenna 2 Phase Center	-0.717	0.631	-3.800
4	Reson 8125	-0.379	-0.116	0.600
5	Klein 5000	-0.500	-0.040	-0.660
6	Waterline	N/A	N/A	-0.220
7	Odom MK II	-0.379	0.076	0.611



Appendix C

Multibeam Echosounder Calibration

Field Unit: NOAA Ship Thomas Jefferson S222
Date of Test: 02 June 2009
Calibrating Hydrographer(s): AHB

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: RESON 7125 STBD
System Location:
Sonar Serial Number:
Processing Unit Serial Number:
Date of Most Recent EED / Factory Checkout:

VESSEL INFORMATION

Sonar Mounting Configuration: Hull-mounted
Date of Current Vessel Offset Measurement / Verification:

Date of Most Recent Positioning System Calibration:

TEST INFORMATION

Test Date(s) / DN(s): 02 June 2009
System Operator(s): CST Wright, ST Glomb
Wind / Seas / Sky: Calm
Locality: Chesapeake Bay
Sub-Locality: Entrance Chesapeake Bay
Bottom Type: sand, brk Sh
Approximate Average Water Depth: 15 m

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
001_0005	180	4.9 - 6.8 kts
001_0035	180	4.4 - 6.4 kts
001_0055	000	10.2 kts
001_2309	180	10.7 kts
001_2342	000	5.6 kts
002_0157	180	8.4 kts
003_0118	180	8.2 kts

TEST RESULTS

Navigation Timing Error: Precise Timing = 0.17 Entered value -0.17 in hvf
Pitch Timing Error: 0
Roll Timing Error: 0
Pitch Bias: -1.9
Roll Bias: 0
Heading Bias: -0.6
Resulting CARIS HIPS HVF File Name: TJ_S222_RESON7125_STBD_AHB

NARRATIVE

Briefly and succinctly summarize the MBES Certification Test, focusing on those aspects of the test. Particular attention shall be paid to interpretation of test results, with discussion on residual biases in roll, pitch, heading, and navigation timing e

Multibeam Echosounder Calibration

Field Unit: NOAA Ship Thomas Jefferson S222
Date of Test: 02 June 2009
Calibrating Hydrographer(s): AHB

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: RESON 7125 STBD
System Location:
Sonar Serial Number:
Processing Unit Serial Number:
Date of Most Recent EED / Factory Checkout:

VESSEL INFORMATION

Sonar Mounting Configuration: Hull-mounted
Date of Current Vessel Offset Measurement / Verification:

Date of Most Recent Positioning System Calibration:

TEST INFORMATION

Test Date(s) / DN(s): 02 June 2009
System Operator(s): CST Wright, ST Glomb
Wind / Seas / Sky: Calm
Locality: Chesapeake Bay
Sub-Locality: Entrance Chesapeake Bay
Bottom Type: sand, brk Sh
Approximate Average Water Depth: 15 m

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
001_0005	180	4.9 - 6.8 kts
001_0035	180	4.4 - 6.4 kts
001_0055	000	10.2 kts
001_2309	180	10.7 kts
001_2342	000	5.6 kts
002_0157	180	8.4 kts
003_0118	180	8.2 kts

TEST RESULTS

Navigation Timing Error: Precise Timing = 0.00 Entered value -0.00 in hvf
Pitch Timing Error: 0
Roll Timing Error: 0
Pitch Bias: -1.3
Roll Bias: 0.00
Heading Bias: -0.00
Resulting CARIS HIPS HVF File Name: TJ_S222_RESON7125_STBD_RAW

NARRATIVE

Briefly and succinctly summarize the MBES Certification Test, focusing on those aspects of the test. Particular attention shall be paid to interpretation of test results, with discussion on residual biases in roll, pitch, heading, and navigation timing e

Multibeam Echosounder Calibration

Field Unit: NOAA Ship Thomas Jefferson S222

Date of Test: 02 June 2009

Calibrating Hydrographer(s): AHB

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: RESON 7125 STBD

System Location:

Sonar Serial Number:

Processing Unit Serial Number:

Date of Most Recent EED / Factory Checkout:

VESSEL INFORMATION

Sonar Mounting Configuration: Hull-mounted

Date of Current Vessel Offset Measurement / Verification:

Date of Most Recent Positioning System Calibration:

TEST INFORMATION

Test Date(s) / DN(s): 02 June 2009

System Operator(s): CST Wright, ST Glomb

Wind / Seas / Sky: Calm

Locality: Chesapeake Bay

Sub-Locality: Entrance Chesapeake Bay

Bottom Type: sand, brk Sh

Approximate Average Water Depth: 15 m

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
001_0005	180	4.9 - 6.8 kts
001_0035	180	4.4 - 6.4 kts
001_0055	000	10.2 kts
001_2309	180	10.7 kts
001_2342	000	5.6 kts
002_0157	180	8.4 kts
003_0118	180	8.2 kts

TEST RESULTS

Navigation Timing Error: Precise Timing = 0.00 Entered value -0.00 in hvf

Pitch Timing Error: 0

Roll Timing Error: 0

Pitch Bias: -1.9

Roll Bias: 0.44

Heading Bias: -0.46

Resulting CARIS HIPS HVF File Name: TJ_S222_RESON7125_STBD_CST

NARRATIVE

Briefly and succinctly summarize the MBES Certification Test, focusing on those aspects of the test. Particular attention shall be paid to interpretation of test results, with discussion on residual biases in roll, pitch, heading, and navigation timing e

Multibeam Echosounder Calibration *Thomas Jefferson* S222

Date of Test: April 5th, 2009, DN 095, Calibrating Hydrographer(s): SST Wood, CST Wright, ST Glomb.

MULTIBEAM SYSTEM INFORMATION

Sonar Serial Number: Processing Unit Serial Number: Processor: 222: System Location: Sonar Void, Survey Multibeam Echosounder System: Reson 7125

VESSEL INFORMATION

Sonar Mounting Configuration: Permanent Hull Mount, **Description of Positioning System:** POS/MV version 4 w/ Precise Timing, **Date of Most Recent Positioning System Calibration: 3/29/2007**

TEST INFORMATION

Locality: Approaches to Chesapeake Bay, **Sub-Locality:** 6 Km SE of Chesapeake Light, **Bottom Type:** sandy, **Approximate Average Water Depth:** 20 meters, **System Operator(s):** SST Wood, AST Van Hoy, AST Forrest.

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
001_1459	East	7 kts
001_1512	West	
001_1523	West	9 kts
001_1533	East	10 kts
004_1545	East	9 kts
003_1554	West	9 kts
003_1709	East	5.5 kts

TEST RESULTS
Navigation Time Error: 0.00 sec, Pitch bias: -2.480 deg, Roll bias: -0.00, Yaw Bias -1.05
NARRATIVE
Note on outer beam angle setting: Initially, the average of the roll bias values for the patch test was about 0.3 degrees. Later survey data over deeper water showed a slight roll artifact. Removing the roll bias (setting it to zero) corrected this value. It appears that the artifact was not noticeable in the shallow water.

THOMAS JEFFERSON (S222)
Dynamic Draft Determination 2009

SST Douglas Wood, CST Daniel Wright, Lt Jasper Schaer

Background:

The Echosounder method was used to determine the dynamic draft for NOAA Ship *Thomas Jefferson* (S222) for the 2009 field season. The Echosounder method is described in the FPM section 1.4.2.1. and is adapted from a traditional practice whereby successive lines were run over a flat bottom at different speeds and the change in measured depth is recorded. A standard operating procedure (SOP) for the Echosounder method is found in Appendix I of the FPM.

Location, Date, and Personnel:

Data were acquired on the 5th of April, 2009 (Julian day 095) by ASTs VanHoy and Forrest. The location of the test was approximately 1.5 Km southeast of the Chesapeake Bay light, see figure A.

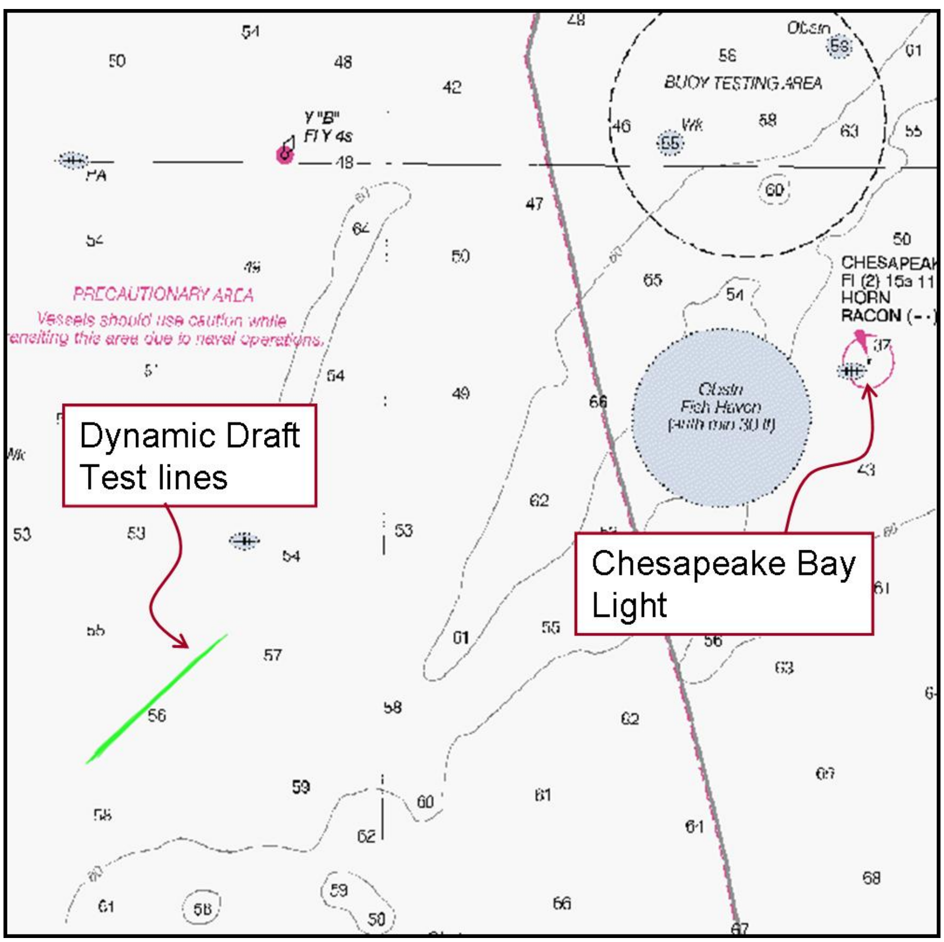


Figure A: location of dynamic draft test working grounds.

Process:

A total of 10 300-meter lines were run in opposite directions for each of 5 different RPMs on the ship's main engine. The relative engine RPMs, speed and directions are listed on table A below. The average ship speed for each engine speed is listed in table B.

Line	***RPM***	***Speed (m/s)***	***Speed (kts)***	***Heading***
003_1654	360	2.88	5.61	46
003_1709	360	2.90	5.64	227
003_1725	450	3.45	6.71	47
003_1737	450	3.60	7.01	227
003_1750	560	4.44	8.63	47
003_1836	560	4.27	8.29	227
003_1847	650	4.99	9.71	48
003_1859	650	4.96	9.64	228
003_1916	750	5.62	10.93	227
003_1926	750	5.61	10.90	48

Table A: characteristics of each line run.

RPM	***speed (m/s)***	***Speed (Knots)***
ME 360	2.89	5.63
ME 450	3.53	6.86
ME 560	4.35	8.46
ME 650	4.98	9.67
ME 750	5.62	10.92

Table B: average ship speed for each engine speed.

All multibeam data were processed using standard procedures in Caris HIPS and SIPS 6.1. Dynamic draft was computed for each RPM level. The speed at each RPM was calculated by averaging the queried speeds of the lines run at that RPM. Three different regions on the line were sampled for depth soundings; the regions were at 250, 500, and 750 meters along the line from northeast to southwest. The sampled regions were queried by line for depth soundings. Depth soundings collected at the same RPM were combined and the median depth found. This depth was used in the calculation of the vessel draft. To determine the change in vessel draft at each speed the difference between the median depth at that speed and the median depth at the lowest speed was determined. Table C (below) shows the change in draft and the speed at each RPM as calculated by CST Wright. Chart A is a graphical representation of the same. These values were entered into the ship HVF configuration file.

Engine RPM	Speed (m/s)	Speed (kts)	relative draft (m)
ME 360	2.89	5.62	0
ME 450	3.53	6.86	-0.02
ME 560	4.35	8.46	-0.07
ME 650	4.98	9.68	-0.13
ME 750	5.62	10.92	-0.12

Table C: relative draft at different speeds.

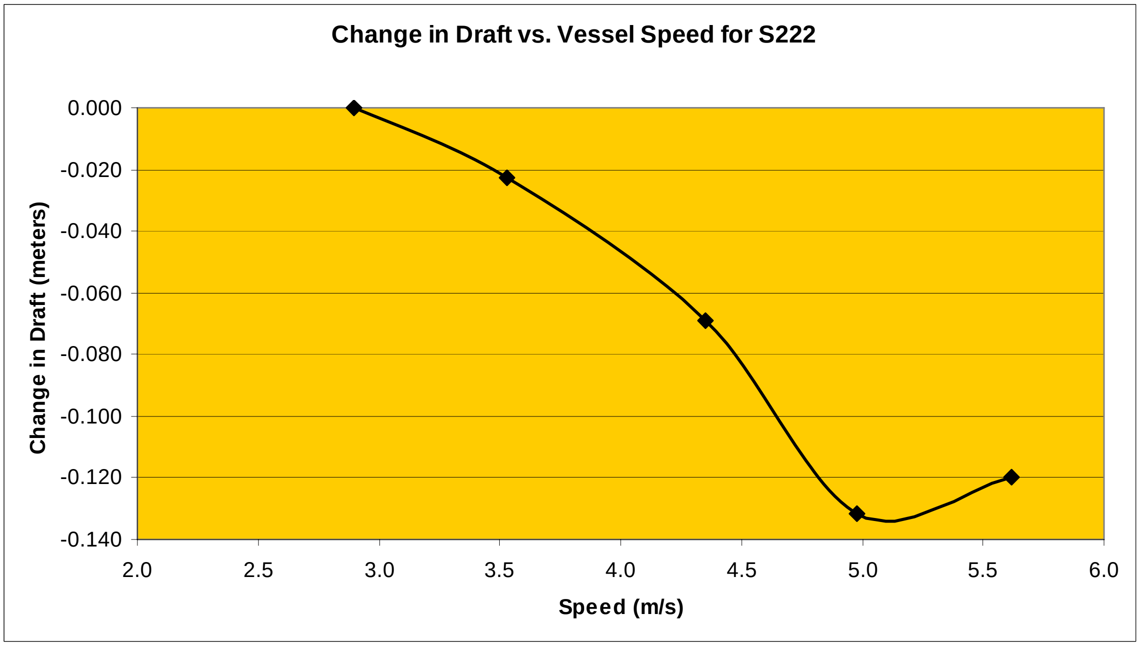


Chart: A: draft relative to vessel speed.

Equipment:

TSS POS/MV version 4 + Precise Timing s/n: 2321
Aero Antenna DSM 212L DGPS receiver
Reson 7125 MBES

Limitations:

- Procedure deviates from FPM in that change in draft was calculated using various RPM lines minus 360 RPM line median draft, not various RPM drafts minus median depth of reference area.
- Procedure deviates from FPM in that speed of vessel calculated from average of lines in each azimuth at same RPM, not speed of vessel in each reference area.

THOMAS JEFFERSON Launch 3101
Dynamic Draft Determination 2009

Background:

The Echosounder method was used to determine the dynamic draft of NOAA Launch 3101 for the 2009 field season. The Echosounder method is described in the FPM section 1.4.2.1. and is adapted from an older practice where successive lines were run over a flat bottom at different speeds. A standard operating procedure (SOP) for the Echosounder method is found in Appendix I of the FPM.

Location, Date, and Personnel:

Data was acquired on 19 April 2009 (Julian day 109). Personnel on board during acquisition included Ensign Wartick, ST Glomb and AB Teele. The location was Northeast of Hatchet Reef in Eastern long Island Sound.

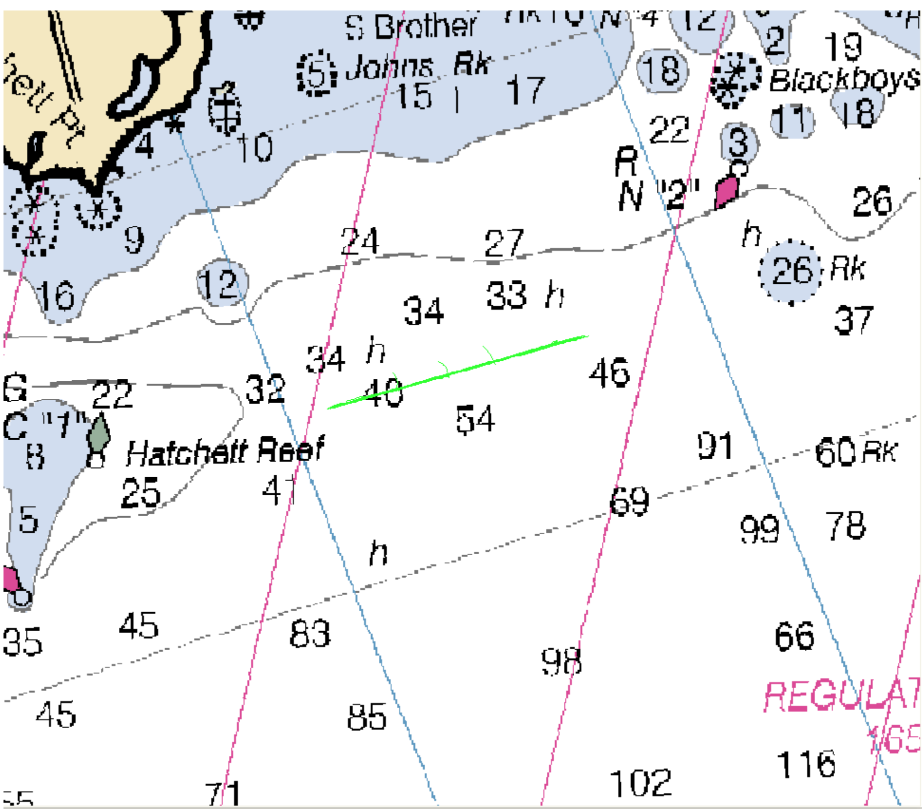


Figure A: 3101 dynamic draft acquisition site

Process:

A total of 14 1000-meter lines were used. Lines 301_1848, 302_1852 and 303_1845 were drift lines over the reference areas, and used only in center data computations.

All multibeam data was processed using standard procedures in Caris HIPS and SIPS 6.1. Dynamic draft was computed for each RPM level. The speed at each RPM was calculated by querying the speed of the lines run at that RPM. Three different regions on the line were sampled for depth soundings; the regions were at 1/4, 1/2, and 3/4 along the line. The sampled regions were queried by line for depth soundings. Depth soundings collected at similar RPMs were combined and the median depth sounding found. This sounding was used in the calculation of the vessel draft. To determine the change in vessel draft at each speed the difference between the median depth sounding at that speed and the median depth sounding at drift speed was found. Table A (below) shows the change in draft and the speed at each RPM as calculated by the Root Mean Square RMS). Chart A is a graphical representation of the same.

RPM	Speed (m/s)	Change in draft (m)
600	2.312	0.000
800	2.961	0.003
1000	3.510	0.010
1200	3.984	0.006
1400	4.341	-0.032
1600	4.698	-0.021
1800	5.212	-0.016

Table A

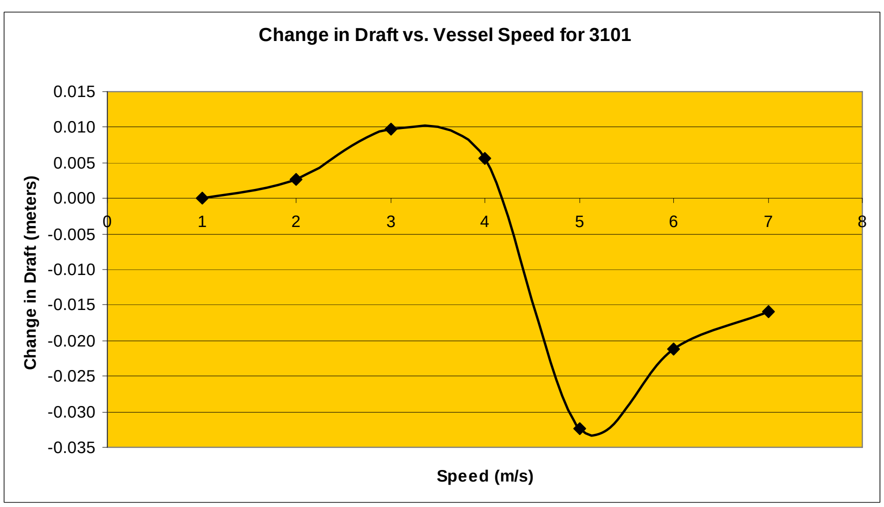


Chart: A.

Equipment:

TSS POS/MV version 4 + Precise Timing
Aero Antenna DSM 212L DGPS receiver
Reson 8125 MBES

Limitations:

- The variation in RPM for each line appears to be in order to compensate for changes in speed, contrary to FPM guidelines of maintaining constant RPM for each azimuth.

- Procedure deviates from FPM in that change in draft was calculated using various RPM lines minus drift line median draft, not various RPM drafts minus median depth of reference area.

Thomas Jefferson 3102
DYNAMIC DRAFT REPORT

Date of Survey	27-Apr-09	**DN**	117
Personnel	SST Lewit AB Newton AB Salazar	**Location**	Boston Harbor MA

Description

3102 is a 31ft launch equipped with Reson 7125 Multibeam and Hull mounted SSS. The Launch also has an Omega Arm attached on the stern for towed side scan operations. This new setup (launch 3101 does not not have one) may change dynamic draft results.

At the time of survey 3102 did not have a door cover for the Multibeam leaving the unit exposed and decreasing the aerodynamics of the launch. It was noted that there was a lot of turbulence in the well at higher speeds.

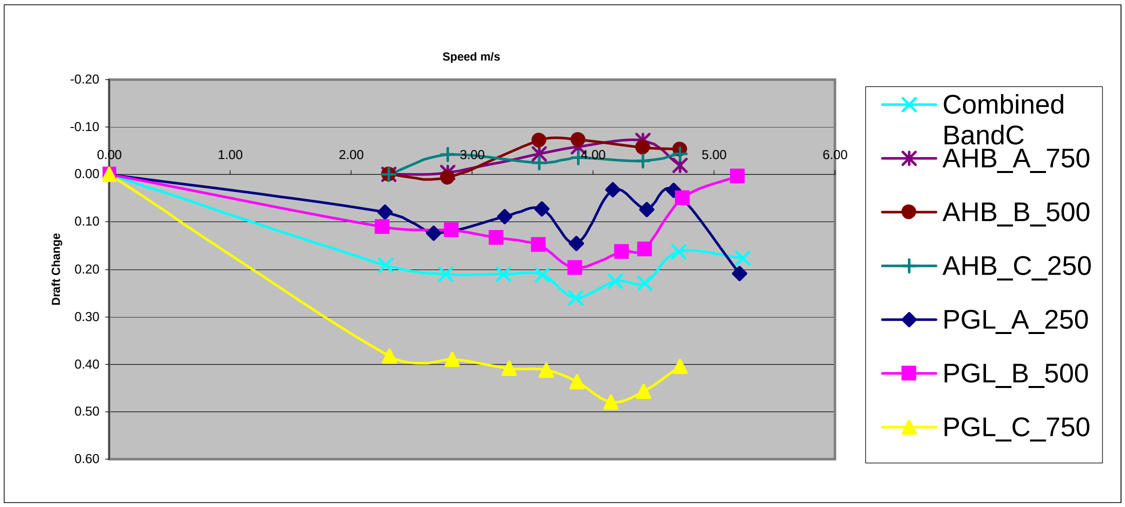
Results

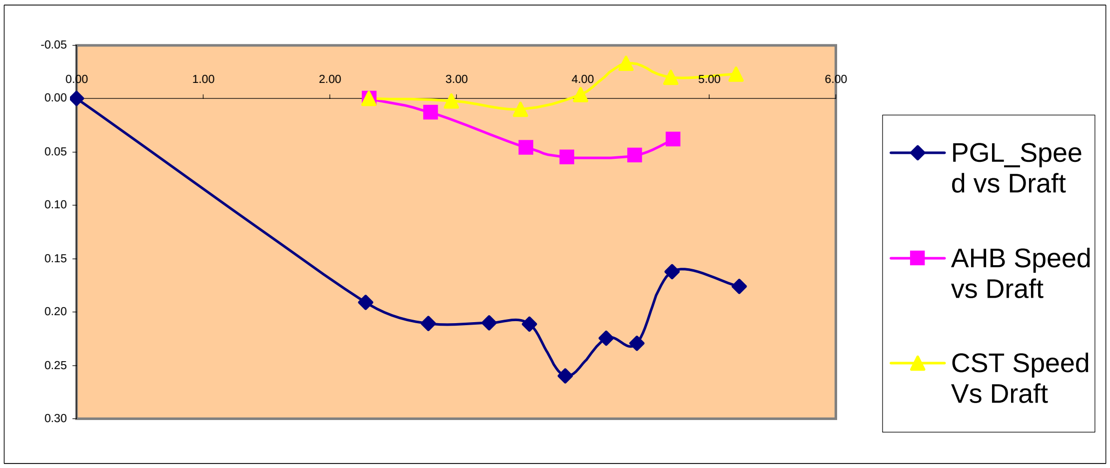
With the exception of PGL results all other assessments did not use an at rest value. The northern median at 750 was not considered in the final average because the values were far beyond expected values. This could be a result of true heave values not getting the proper steady up time as it was in the vicinity of a dock and no wake zone.

HVF Dynamic Draft entries are highlighted in Blue

FPM Format Final Results

RPM	AVG Speed	Median A 250	Median B 500	Median C 750	STD DEV abc	STD DEV BC	AVG Draft ABC	AVG DRAFT AB
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
600	2.29	0.08	0.11	0.38	0.17	0.02	0.19	0.09
750	2.78	0.12	0.12	0.39	0.16	0.00	0.21	0.12
900	3.26	0.09	0.13	0.41	0.17	0.03	0.21	0.11
1050	3.58	0.07	0.15	0.41	0.18	0.05	0.21	0.11
1200	3.86	0.15	0.20	0.44	0.16	0.04	0.26	0.17
1350	4.18	0.03	0.16	0.48	0.23	0.09	0.22	0.10
1500	4.43	0.07	0.16	0.46	0.20	0.06	0.23	0.12
1650	4.71	0.03	0.05	0.40	0.21	0.01	0.16	0.04
1800	5.24	0.21	0.00	0.32	0.16	0.15	0.18	0.11





Preliminary Calculations PGL

250 A	avg Speed (m/s)	median offset at 250	Change in draft (m)	Std Dev
3.00	0.00	13.40	0.00	
3.00	2.28	13.32	0.08	
3.00	2.68	13.28	0.12	
3.00	3.27	13.31	0.09	
3.00	3.58	13.33	0.07	
3.00	3.86	13.26	0.15	
3.00	4.17	13.37	0.03	
3.00	4.45	13.33	0.07	
3.00	4.67	13.37	0.03	
3.00	5.21	13.20	0.21	

500 B	avg Speed (m/s)	median offset at 500	Change in draft (m)	Std Dev
2.00	0.00	13.31	0.00	
2.00	2.26	13.20	0.11	
2.00	2.83	13.19	0.12	
2.00	3.20	13.18	0.13	
2.00	3.55	13.16	0.15	
2.00	3.85	13.11	0.20	
2.00	4.24	13.15	0.16	
2.00	4.43	13.15	0.16	
2.00	4.74	13.26	0.05	
2.00	5.20	13.31	0.00	

750 C	avg Speed (m/s)	median offset at 750	Change in draft (m)	Std Dev
1.00	0.00	14.01	0.00	
1.00	2.32	13.63	0.38	
1.00	2.84	13.62	0.39	
1.00	3.31	13.60	0.41	
1.00	3.61	13.59	0.41	
1.00	3.87	13.57	0.44	
1.00	4.15	13.53	0.48	
1.00	4.42	13.55	0.46	
1.00	4.72	13.60	0.40	
1.00	5.30	13.69	0.32	

AHB FINAL Stats

RPM	Speed (m/s)	median offsets at 250	median offset at 500	median offset at 750	Change in draft	Std Dev
ME 600	2.31	0.00	0.00	0.00	0.00	0.00
ME 700	2.80	-0.04	0.01	0.00	0.01	0.03
ME 900	3.55	-0.02	-0.07	-0.04	0.05	0.02
ME 1000	3.88	-0.04	-0.07	-0.06	0.06	0.02
ME 1200	4.41	-0.03	-0.06	-0.07	0.05	0.02
ME 1300	4.72	-0.04	-0.05	-0.02	0.04	0.02

Multibeam Echosounder Calibration

Field Unit: Thomas Jefferson 3102

Date of Test: 14 September 2009 DN257

Calibrating Hydrographer(s): LT Schaer, CST Wright

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: Reson 7125 Multibeam

System Location:

Sonar Serial Number:Proj=TC2160 SN1908188 Receiver= EM7200 SN 220 8050

Processing Unit Serial Number: 61203

Date of Most Recent EED / Factory Checkout: 3/9/2009

VESSEL INFORMATION

Sonar Mounting Configuration: Port Hull Mount Swing ARM

Date of Current Vessel Offset Measurement / Verification: 11 June 2009

Description of Positioning System: POS/MV version 4 w/ Precise Timing

Date of Most Recent Positioning System Calibration: 01/01/2007

TEST INFORMATION

Test Date(s) / DN(s): Dn 257

System Operator(s): SST Wood

Wind / Seas / Sky: Calm <1

Locality: Sandy Hook, NJ

Sub-Locality:

Bottom Type: Mud

Approximate Average Water Depth:

DATA ACQUISITION INFORMATION

Line	Heading	Speed (m/s)
108_1254	307	2.95
110_1259	157	3.79
111_1301	311	2.86
111_1304	128	3.89
111_1306	308	3.83
111_1317	128	4.27
112_1320	307	3.46
113_1322	308	3.49

TEST RESULTS

Precise Timing Error: Observed Value=0.00 Entered swath Value= -0.00

Pitch Bias: 0.87

Roll Bias: -0.80

Heading Bias: Inconclusive

Resulting CARIS HIPS HVF File Name:

NARRATIVE

* For 7125 HVF entry, the precise timing value will be entered in the swath section with opposite sign. The observed value will be from the calibration procedure, the enterd sign will be the opposite sign. Apply in post processing for all entrys

Multibeam Echosounder Calibration

Field Unit: Thomas Jefferson 3102
Date of Test: 14 Junel 2009 DN165
Calibrating Hydrographer(s): CST Wright, SST Lewit

MULTIBEAM SYSTEM INFORMATION
Multibeam Echosounder System: Reson 7125 Multibeam
System Location:
Sonar Serial Number:Proj=TC2160 SN1908188 Receiver= EM7200 SN 2208050
Processing Unit Serial Number: 61203
Date of Most Recent EED / Factory Checkout: 3/9/2009

VESSEL INFORMATION
Sonar Mounting Configuration: Port Hull Mount Swing ARM
Date of Current Vessel Offset Measurement / Verification: 11 June 2009
Description of Positioning System: POS/MV version 4 w/ Precise Timing
Date of Most Recent Positioning System Calibration: 01/01/2007

TEST INFORMATION		
Test Date(s) / DN(s): Dn 165		
System Operator(s): SST Lewit		
Wind / Seas / Sky: Calm <1		
Locality: Approaches Chesapeake		
Sub-Locality:		
Bottom Type: Sand		
Sound Velocity Profile	Patch_3102_Master.svp	
Tides	TCARI	
Approximate Average Water Depth:		

DATA ACQUISITION INFORMATION

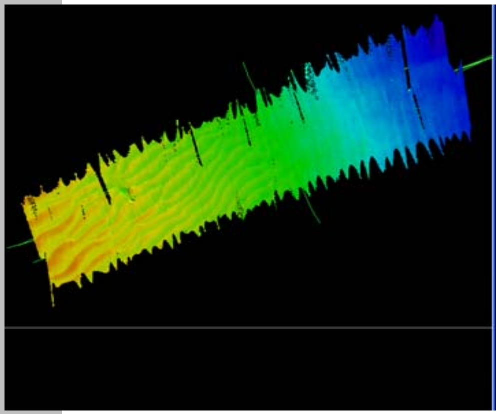
Line Number	Heading	Speed
139_1439	67	3.71
139_1447	247	3.66
139_1455	67	4.37
139_1501	247	4.72
140_1512	248	3.60
140_1516	67	3.68
141_1508	66	3.73
141_1519	246	3.87
143_1525	336	3.56

TEST RESULTS

	Entered swath Value
Precise Timing Error:	0
Pitch Bias:	-2.05
Roll Bias:	-1.24
Heading Bias:	-0.125
Resulting CARIS HIPS HVF File Name:	

NARRATIVE

* For 7125 HVF entry, the precise timing value will be entered in the swath section with opposite sign. The observed value will be from the calibration procedure, the entered sign will be the opposite sign. Apply in post processing for all entry. Image at right shows no artifacts.



Multibeam Echosounder Calibration

Field Unit: Thomas Jefferson 3102
Date of Test: 14 June 2009 DN165
Calibrating Hydrographer(s): CST Wright

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: Reson 7125 Multibeam
System Location:
Sonar Serial Number:Proj=TC2160 SN1908188 Receiver= EM7200 SN 220 8050
Processing Unit Serial Number: 61203
Date of Most Recent EED / Factory Checkout: 3/9/2009

VESSEL INFORMATION

Sonar Mounting Configuration: Port Hull Mount Swing ARM
Date of Current Vessel Offset Measurement / Verification: 11 June 2009
Description of Positioning System: POS/MV version 4 w/ Precise Timing
Date of Most Recent Positioning System Calibration: 01/01/2007

TEST INFORMATION

Test Date(s) / DN(s): Dn 165
System Operator(s): SST Lewit
Wind / Seas / Sky: Calm <1
Locality: Approaches Chesapeake
Sub-Locality:
Bottom Type: Sand
Approximate Average Water Depth:

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
139_1439	67	3.71
139_1447	247	3.66
139_1455	67	4.37
139_1501	247	4.72
140_1512	248	3.60
140_1516	67	3.68
141_1508	66	3.73
141_1519	246	3.87
143_1525	336	3.56

TEST RESULTS

Precise Timing Error: Observed Value=0.00 Entered swath Value= -0.00
Pitch Bias: -3.4
Roll Bias: -1.26
Heading Bias: 0
Resulting CARIS HIPS HVF File Name:

NARRATIVE

* For 7125 HVF entry, the precise timing value will be entered in the swath section with opposite sign. The observed value will be from the calibration procedure, the enterd sign will be the opposite sign. Apply in post processing for all entrys

Multibeam Echosounder Calibration

Field Unit: Thomas Jefferson 3102
Date of Test: 14 Junel 2009 DN165
Calibrating Hydrographer(s): SST Lewit

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: Reson 7125 Multibeam
System Location:
Sonar Serial Number:Proj=TC2160 SN1908188 Receiver= EM7200 SN 2208050
Processing Unit Serial Number: 61203
Date of Most Recent EED / Factory Checkout: 3/9/2009

VESSEL INFORMATION

Sonar Mounting Configuration: Port Hull Mount Swing ARM
Date of Current Vessel Offset Measurement / Verification: 11 June 2009
Description of Positioning System: POS/MV version 4 w/ Precise Timing
Date of Most Recent Positioning System Calibration: 01/01/2007

TEST INFORMATION

Test Date(s) / DN(s): Dn 165
System Operator(s): SST Lewit
Wind / Seas / Sky: Calm <1
Locality: Approaches Chesapeake
Sub-Locality:
Bottom Type: Sand

Sound Velocity Profile	**Patch_3102_Master.svp**
Tides	**TCARI**

Approximate Average Water Depth:

DATA ACQUISITION INFORMATION

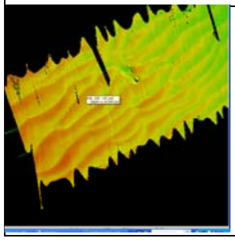
Line Number	Heading	Speed
139_1439	67	3.71
139_1447	247	3.66
139_1455	67	4.37
139_1501	247	4.72
140_1512	248	3.60
140_1516	67	3.68
141_1508	66	3.73
141_1519	246	3.87
143_1525	336	3.56

TEST RESULTS

	Observed Values	Entered swath Value
Precise Timing Error:	0.0, 0.0, 0.0, 0.0	0.0
Pitch Bias:	-0.56, 3.1, 2.5, -1.0, -4.2, -4.0	-0.69
Roll Bias:	-1.2 -1.2, -1.2, -1.23, -1.22	-1.21
Heading Bias:	-0.3, -0.2	-.25
Resulting CARIS HIPS HVF File Name:		

NARRATIVE

* For 7125 HVF entry, the precise timing value will be entered in the swath section with opposite sign. The observed value will be from the calibration procedure, the entered sign will be the opposite sign. Apply in post processing for all entry's. Picture at right shows no artifacts from HVF entrys.



Multibeam Echosounder Calibration

Field Unit: Thomas Jefferson 3101

Date of Test: 24 September 2009 DN267

Calibrating Hydrographer(s): CST Wright

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: Reson 8125 Multibeam

System Location:

Sonar Serial Number:Proj=2007011

Processing Unit Serial Number: 31381

Date of Most Recent EED / Factory Checkout: 2/9/2008

VESSEL INFORMATION

Sonar Mounting Configuration: Port Hull Mount Swing ARM

Date of Current Vessel Offset Measurement / Verification: 11 June 2009

Description of Positioning System: POS/MV version 4 w/ Precise Timing

Date of Most Recent Positioning System Calibration: 01/01/2007

TEST INFORMATION

Test Date(s) / DN(s): Dn 267

System Operator(s): AST Van Hoy

Wind / Seas / Sky: Calm <1

Locality: Point Judith

Sub-Locality:

Bottom Type: Mud

Approximate Average Water Depth:

DATA ACQUISITION INFORMATION

Line	Heading	Speed (m/s)
011_1418	165	3.01
011_1423	343	2.91
011_1428	164	4.47
011_1432	344	4.43
015_1439	164	3.06
015_1444	345	4.49
016_1447	163	3.03
016_1451	343	4.48

TEST RESULTS

Precise Timing Error: Observed Value=0.00 Entered swath Value= -0.00

Pitch Bias: Inconclusive-retained previous value 3.010

Roll Bias: -1.25

Heading Bias: Inconclusive-retained previous value -1.960

Resulting CARIS HIPS HVF File Name: TJ_3101_Reson8125_MB_CST.hvf

NARRATIVE

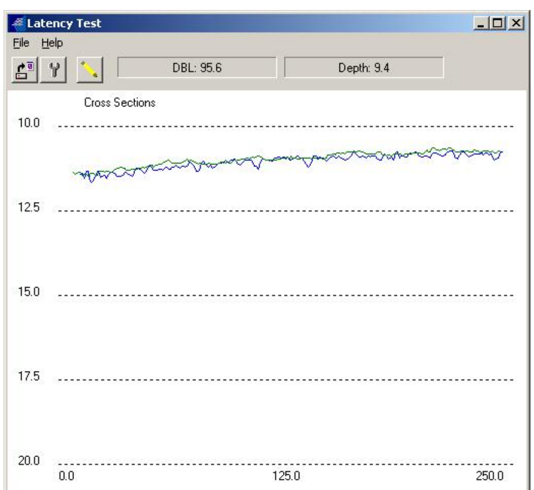
* For 8125 HVF entry, the precise timing value will be entered in the swath section with opposite sign. The observed value will be from the calibration procedure, the enterd sign will be the opposite sign. Apply in post processing for all entrys

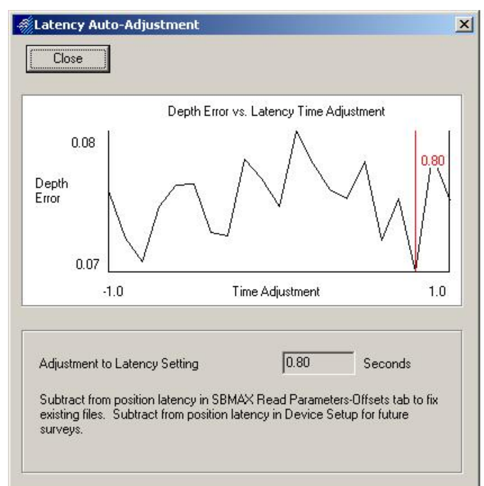
VB latency test

DN 259 on project B310

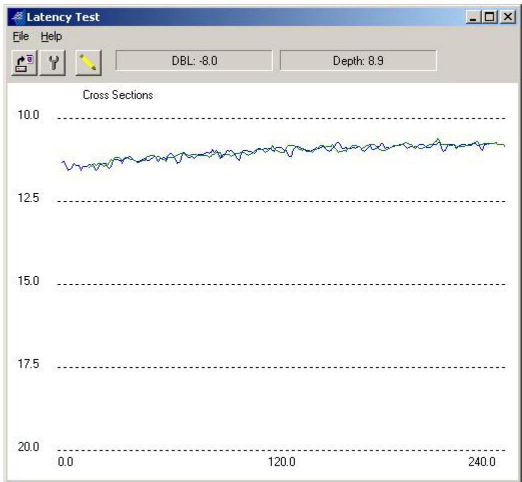
Results: used hypack latency program to get test results.

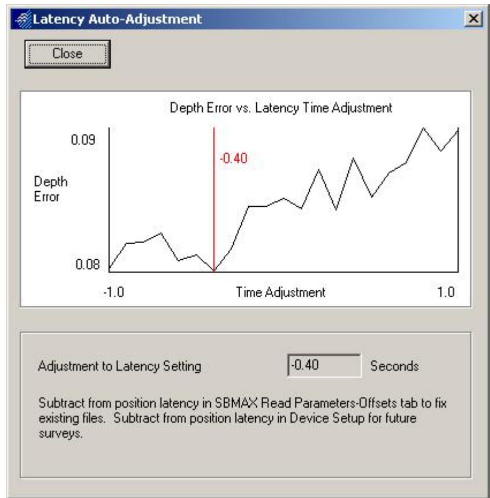
1516	Latency test 5 knots Az 45
1519	Latency test 9 knots Az 225
1521	Latency test 5 knots Az 45
1525	Latency test 9 knots Az 45





1516 vs 1525

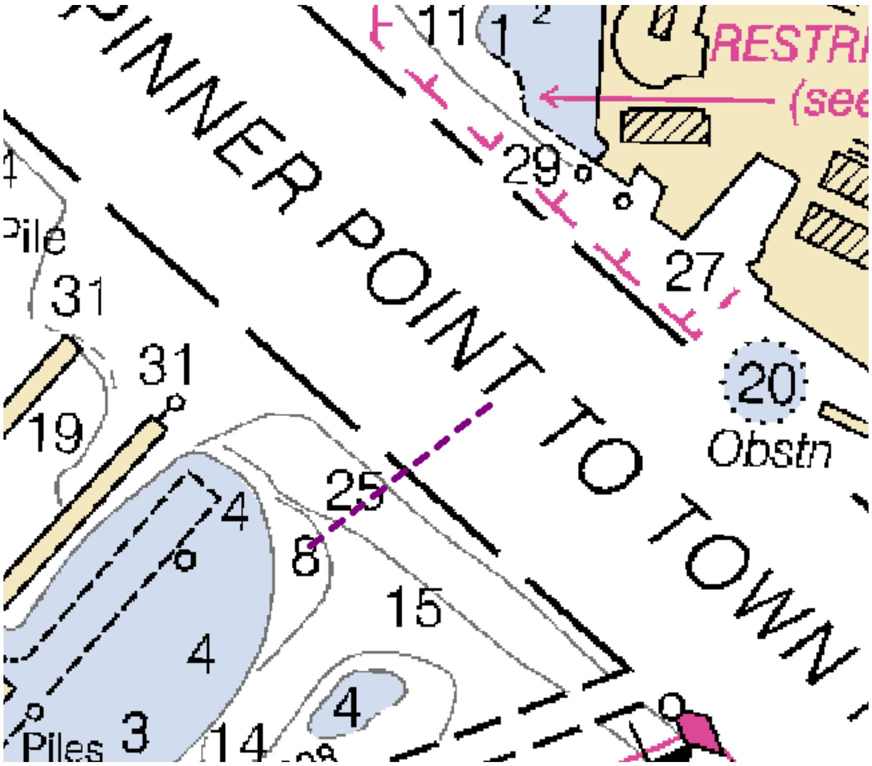

Latency Test
File Help
DBL: -8.0
Depth: 8.9
Cross Sections
10.0
12.5
15.0
17.5
20.0
0.0
120.0
240.0


Latency Auto-Adjustment
Close
Depth Error vs. Latency Time Adjustment
0.09
-0.40
Depth Error
0.08
-1.0
Time Adjustment
1.0
Adjustment to Latency Setting
-0.40
Seconds
Subtract from position latency in SBMAX Read Parameters-Offsets tab to fix existing files. Subtract from position latency in Device Setup for future surveys.

1521 vs 1525

VBES Latency Test 3101
June 30, 2009
LT Jasper Schaer

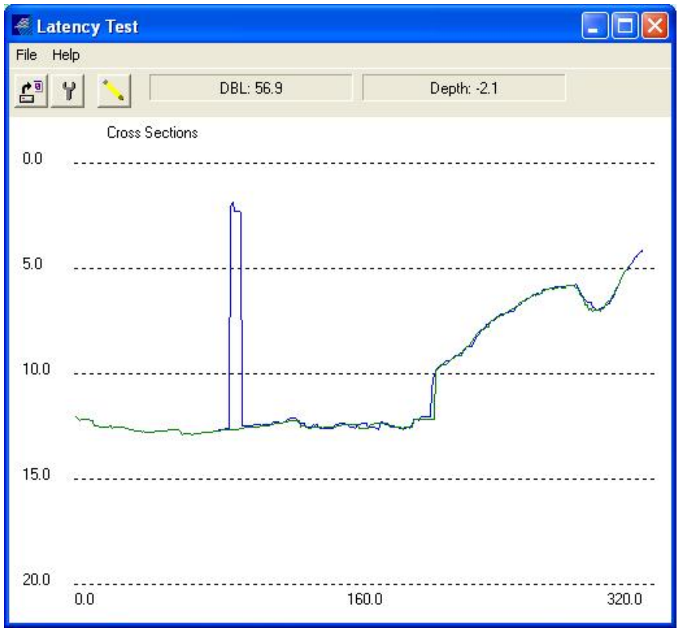
Plan: Acquired 2 pairs of lines, one set 5 kts and another set at 10kts, across a slope with ODOM SBES system.



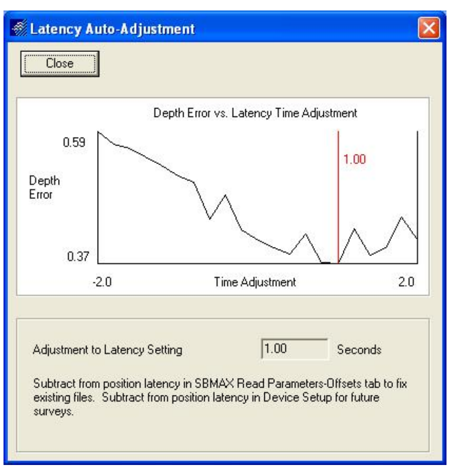
Results:

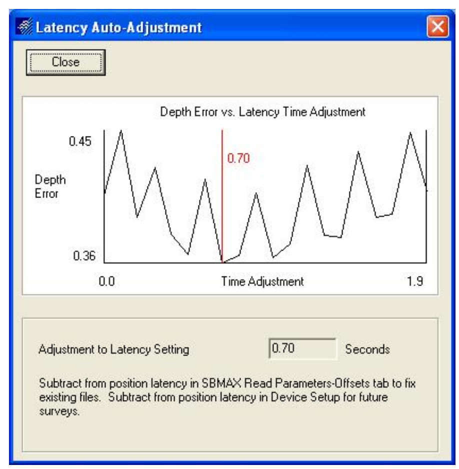
SW	001_1739	930RPMS	6 kts
NE	001_1741	930RPMS	6 kts
SW	001_1745	1800RPMS	10 kts
NE	001_1747	1800RPMS	10 kts

Used Hypack's latency utility tool to arrive at the results:

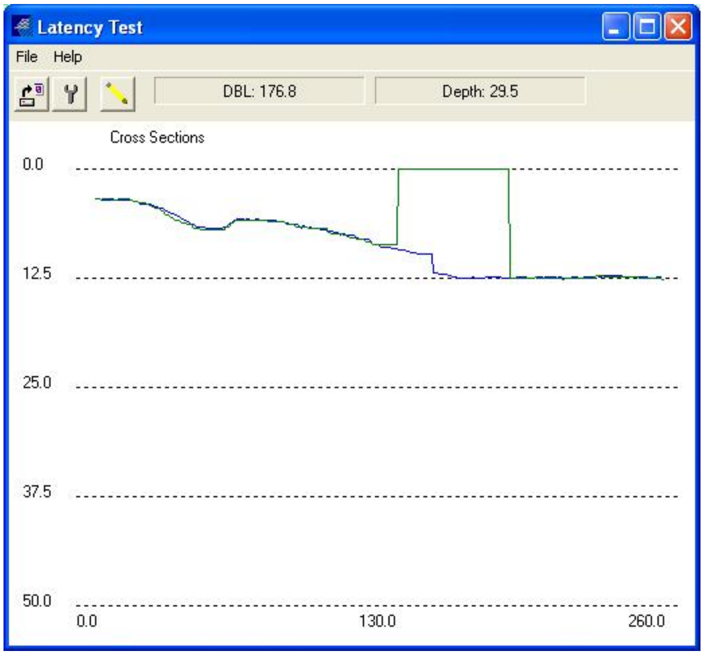


001_1739 and 001_1745

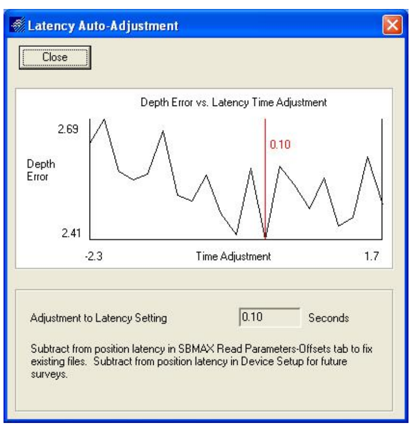


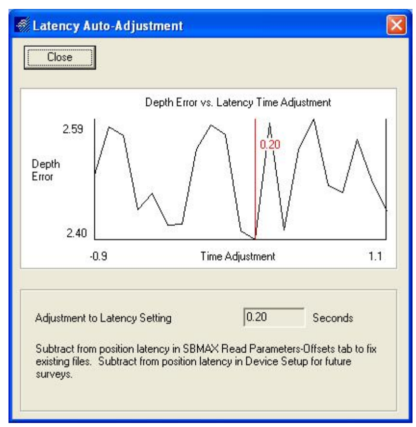


001_1739 and 001_1745



001_1741and 001_1747





001_1741and 001_1747

Average timing latency value of 0.15 secs