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

DATA ACQUISITION AND PROCESSING REPORT

Type of Survey	**Hydrographic**
Project Nos.	**OPR-E346-BH, S-E906-BH, S-E603-BH & S-E913-BH**
Time Frame	**November 2001 - December 2004**

LOCALITY

State/Territory	**Maryland and Virginia**
General Locality	**Chesapeake Bay**

2004

CHIEF OF PARTY
LTJG Holly A. DeHart, NOAA

DATA ACQUISITION AND PROCESSING REPORT

NOAA S/V BAY HYDROGRAPHER

Chief of Party: Lieutenant (j.g.) Holly A. DeHart, NOAA

Effective Dates

November 2001 - December 2004

Applicable Surveys

OPR-E346-BH
H11196 – 1nm south of Piney Point
Upper Chesapeake Bay, Maryland
Hydrographic Letter Instructions dated March 26,1999

S-E906-BH
H11088 – Cove Point
Approaches to Cove Point, Maryland
Hydrographic Letter Instructions dated November 7, 2001

S-E603-BH
Homeland Security
Chesapeake Bay Route to Baltimore Harbor, Maryland & Virginia
Hydrographic Letter Instructions dated April 2, 2003

S-E913-BH
F00495 – Canton Piers & Sparrows Point
Baltimore Harbor, Maryland
Hydrographic Letter Instructions dated March 17, 2004

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A. EQUIPMENT

BAY HYDROGRAPHER was used for the acquisition and post-processing of all side scan-sonar (SSS) data, vertical-beam echosounder (VBES) data, shallow-water multibeam (SWMB) data, sound velocity profiles (SVP) and detached positions (DP's) unless otherwise noted in the Descriptive Report. BAY HYDROGRAPHER was used as the dive platform for all diver investigations conducted during these projects. No unusual vessel configurations or problems were encountered on these projects. Vessel configuration and offset measurements are included in Appendix III of this report.

Three different types of sonar systems (VBES, SWMB, and SSS) were utilized for these projects unless otherwise noted in the Descriptive Report. The methods and systems used to meet full-coverage requirements for the projects were determined by the Hydrographer and are in accordance with guidance provided in the Hydrographic Survey Letter Instructions and the Field Procedures Manual. Other considerations included system performance limitations, complexity of bathymetry, water depth, and ability of the vessel to safely navigate a particular area. Bathymetric data was acquired using either VBES or SWMB systems. Side scan sonar was utilized for imagery and object detection. These sonar systems are described individually in the following sections of this report.

SOUNDING EQUIPMENT

Vertical-Beam Echo Sounder (VBES)

BAY HYDROGRAPHER is equipped with a Knudsen Engineering Limited 320m Marine Echosounder. The Knudsen Echosounder is a dual frequency digital recording vertical-beam echo sounder with an analog paper record. Transducer frequencies utilized are 24 kHz and 100 kHz. Transmit pulse length is variable and was set to 0.05ms. Unless edited by the hydrographer, selected soundings were acquired in meters using high frequency. The low frequency tranducer was not operational prior to August 29, 2002. Both the inoperable low frequency transducer and the aging high frequency transducer were replaced during the vessel's July 2002 yard period. Vertical-beam echo sounder data were acquired in conjunction with SSS. In areas where 200% SSS revealed no point features requiring further investigation, VBES was determined adequate to define the natural depth contours of the area.

Shallow-Water Multibeam (SWMB)

BAY HYDROGRAPHER is equipped with Reson Seabat 8125 shallow water multibeam sonar. The system is installed on a retractable arm which deploys over the starboard side of the vessel. The Seabat 8125 is a 455 kHz system which measures relative water depths across a 120^o swath. The sonar utilizes 240 individual beams, each with a footprint of 1.0^o x 0.5^o. The sensor head is mounted vertically (0^0 mount) at a depth of 5.3ft below the water line. The SWBM system was used to develop significant contacts identified with SSS and to provide additional bathymetric data in critical areas such as along commercial pier faces and shipping terminals.

Multibeam operations were limited to speed-over-ground of 6.0 knots to ensure the required along-track coverage for object detection as stated in the NOS Specifications and Deliverables. Line spacing for item investigations was set at two times the water depth, while mainscheme SWMB sounding lines were generally run at three times the water depth. Coverage was determined in real-time using coverage tools in **ISIS** software. The Reson Seabat 8125 system also provides a low-resolution digital SSS record of the multibeam swath. This SSS imagery was used during processing of the multibeam depth data to aid in determining whether anomalous soundings are true features or noise.

Diver's Least-Depth Gauge (DLDG)

A MOD III Diver's Least-Depth Gauge (DLDG) was used to verify SWMB least depths over selected contacts. The DLDG (S/N 68334) was calibrated January 4, 2002, and again January 22, 2004. A copy of the calibration reports are included in Appendix IV. The DLDG measures pressure, and is combined with a CTD profile using VelocWin software in order to determine depth. These depths were processed in **CARIS HIPS** Single Beam Editor and compared to corresponding SWMB depths in **PYDRO**. The shoalest depth for the contact was then selected as the feature depth.

Lead Line

A leadline comparison to the Odom Echotrac VBES was performed March 17, 2004 (DN 077) at Sandy Point State Park, Annapolis, MD. BAY HYDROGRAPHER does not maintain traditional leadlines. In lieu of this equipment, a lead was attached to a metal measuring tape and measurements were corrected to account for the weight assembly. The bottom was very soft and, as expected, the 100khz Odom read 0.2m shoaler than the leadline. The vessel was port side to the bulkhead at the time of the comparison. Due to typical shoaling along bulkheads and the fact the VBES transducer is located on the vessel's starboard side, leadline readings were taken on the starboard side only. The water was calm, enabling the leadman to make multiple rapid readings and providing a steady fathometer reading. A copy of the leadline calibration report is included in Appendix IV of this report. Lead lines were not used to acquire depths over rocks and other features over the course of this survey.

IMAGING EQUIPMENT

Side Scan Sonar (SSS)

BAY HYDROGRAPHER is equipped with a Klein System 5500 (S/N 101) High-Speed, High Resolution Side Scan Sonar (HSHRSSS) System. This integrated system includes the Model 5250 HSHRSSS towfish and the T5100 Transceiver Processing Unit (TPU). The Klein 5250 operates at a frequency of 455 kHz and has a 40^0 vertical beam angle. The towfish contains transducers, sonar processing and control electronics, attitude and heading sensors, the down-link de-multiplexer (for control signals), and the uplink multiplexer (for sonar and auxiliary sensor data). The T5100 TPU contains electronics to demultiplex the sonar signal from the towfish and multiplex the control signals transmitted to the towfish via a coaxial tow cable. The T5100 also contains a network card for transmission of the sonar data to the **ISIS** acquisition computer.

The Klein System 5500 is unique in that each transducer simultaneously forms five dynamically focused beams per side (channel), allowing increased resolution along track (20-75 cm) and across track (7.5 cm). The Klein System 5500 multibeam tranducer technology also enables higher tow speeds of up to 10 knots.

The Klein towfish is deployed on an 80-150 foot armored cable via a SeaMac electric winch. The tow cable is fed from the winch drum to a stern mounted hydraulic A-frame and through a snatch block with a metered sheave. At the winch, the tow cable connects to a deck cable through a slip ring assembly mounted coaxially on the winch. Cable out is controlled remotely at the acquisition station (or locally at the winch) and is monitored using a DYNAPAR cable counter. This sensor computes cable out by the number of revolutions of the block’s sheave. The DYNAPAR cable counter provides a serial message to the **HYPACK** and **ISIS** acquisition computers. The cable-out value was checked prior to each SSS deployment and recalibrated if necessary.

Two hundred percent side scan-sonar coverage was completed for three of the four surveys for which this DAPR applies, H11196, H11088 and S-E603-BH (Homeland Security). Line spacing for SSS operations is determined as a function of the most suitable range scale. Typically when acquiring 200% SSS coverage, 40 meter line spacing is used while operating at a 50 m SSS range scale, 60 meter line spacing is used with a 75 m range scale, and 80 m line spacing is used with a 100 meter range scale. A sonar altitude of eight to twenty percent of the range scale was maintained during data acquisition whenever possible without endangering either vessel or equipment safety. The majority of SSS operations were conducted using either the 75-meter or 100-meter range scale. SSS altitude for towed operations was maintained by a combination of adjusting both the amount of deployed tow cable and vessel speed.

Imagery was monitored in real time using the side scan sonar waterfall display window in the **ISIS** acquisition software. Vessel speed was adjusted during SSS acquisition to insure that along-track coverage for object detection, as required by the NOS Specifications and Deliverables, was met. Confidence checks were performed by noting changes in linear bottom features extending to the outer edges of the digital side scan image and by verifying aids to navigation or other known features on the side scan record.

POSITIONING EQUIPMENT

Trimble DSM212L DGPS Receiver

Prior to March 27, 2003, BAY HYDROGRAPHER was equipped solely with a Trimble DSM212L to measure and calculate differential GPS (DGPS) position. The DSM212L is an integrated 12-channel GPS receiver and dual-channel differential beacon receiver. The beacon receiver can simultaneously monitor two U.S. Coast Guard (USCG) DGPS beacon stations. The Trimble DSM212L was configured in manual mode to allow reception of only one beacon station during data acquisition. Correctors for these projects were received from either the Annapolis, MD or Cape Henry, VA radiobeacons, depending upon proximity and beacon status.

The DSM212L was configured using Trimble **TSIPTalker** version 2.0 software. The configuration was checked if problems were encountered throughout the project period. Parameters included number of visible satellites (≥4 SV's), positional dilution of precision (PDOP < 8), maximum pseudo range corrector age (≤30 sec), and satellite elevation mask (≥8°).

Position quality was monitored in real time via the **HYPACK** data acquisition software. The primary positional quality monitored was HDOP. Where HDOP exceeded 4.0, the data were examined during post-processing, and if necessary, positions interpolated or rejected. The **HYPACK** nmea.dll or kinematic.dll was configured with a non-differential alarm in the acquisition window to alert the operator if the beacon signal was lost.

TSS POS/MV Position and Orientation System

All data acquired after March 27, 2003, utilized a TSS POS/MV Model 320, version 3, Position & Orientation System. The POS/MV is a GPS-aided inertial positioning system. The POS/MV, an aided strapdown inertial navigation system, provides a composite position solution derived from both an Inertial Measurement Unit (IMU) and dual-frequency GPS receivers. The IMU and GPS receivers are complementary sensors; data from one are used to filter and constrain errors from the other resulting in high position accuracy. Following installation of the POS/MV, the DSM212L was used only to provide RTCM correctors to the POS/MV, relying on the POS/MV to compute vessel position.

Position accuracy and quality were monitored in real time using the POS/MV Controller software, as well as the **HYPACK** data acquisition software, to ensure positioning accuracy requirements in the NOS Hydrographic Surveys Specifications and Deliverables were met. The POS/MV Controller software provides clear visual indications whenever accuracy thresholds are exceeded. The POS/MV user accuracy parameter for position was set to 2.0 meters.

HEADING AND ATTITUDE EQUIPMENT

Sperry SR 50 Gyrocompass

Prior to March 27, 2003, BAY HYDROGRAPHER utilized a Sperry SR 50 gyrocompass as the primary heading sensor for survey operations and vessel navigation. The Sperry SR 50 has a heading accuracy of +/- 0.5°. Heading data were output as a serial message from a synchronous repeater to the **HYPACK** and **ISIS** acquisition computers.

All data acquired subsequent to March 27, 2003 utilized the TSS POS/MV as the primary heading sensor for survey operations.

TSS DMS-05 Dynamic Motion Sensor

Prior to March 27, 2003, BAY HYDROGRAPHER utilized a TSS DMS-05 dynamic motion sensor to acquire heave, pitch and roll data. Heave correctors were collected during data acquisition and applied to VBES data in **CARIS HIPS**. Heave, pitch, and roll correctors were collected during data acquisition and applied to SWMB data in **CARIS HIPS**.

The DMS-05 measures instantaneous linear accelerations and angular rates which allow the sensor to derive vessel attitude with respect to the true vertical. Additionally, the DMS-05 uses velocity and heading input from external GPS and gyrocompass systems to maintain measurement accuracy. The system includes three linear accelerometers consisting of a proof mass and a detection and feedback network. Each accelerometer is used to measure movement along one of the three axes of the orthogonal array. These devices are insensitive to rotation in any plane. Heading information is used by the DMS-05 to provide yaw-axis reference for the array of linear accelerometers. Three vibrating Structure Gyroscopes are used to determine angular rates. Each of these devices measures any rotation about one of the three orthogonal axes. They are insensitive to linear movements in any direction. Data from the accelerometers are converted to roll and pitch information. At the same time, measurements from the angular rate sensors are integrated to determine the angle of turn in each plane of rotation. Rate sensor bias is determined and removed by a negative feedback loop comparing the attitude measurements from the linear accelerometers versus the angular rate sensors. Errors caused by centripetal acceleration during vessel turns are determined using both GPS velocity aiding signals and rate-of-turn information supplied by the angular rate sensors. Attitude data is corrected for the earth’s rotation using information from the external GPS and compass systems, and any remaining errors in bias are removed by the negative feedback loop. With all corrections applied, the output from the sensing array maintains the specified 0.05°r.m.s. accuracy required by NOS Hydrographic Survey Specifications & Deliverables.

Data are transmitted to the **HYPACK** acquisition computer as a serial message string. The DMS-05 has the capability to measure attitude to 5% of the translation in question assuming an installation at the vessel's center of motion. This accuracy is degraded if the sensor is mounted further from the vessel's center of motion. The DMS-05 unit is mounted within two meters of the assumed center of motion (reference point, or RP) of the vessel, maintaining the attitude measurements within the desired 5% envelope. The following are the accuracy and resolution specifications for the DMS-05:

Type of Motion	Accuracy	Resolution	Range
Heave	5 cm or 5%	1 cm	+/- 10 m
Roll	+/- 0.05°	0.01°	+/- 30°
Pitch	+/- 0.05°	0.01°	+/- 30°

TSS POS/MV Position and Orientation System

All data acquired after March 27, 2003, utilized the TSS POS/MV for vessel heading and attitude determination. The POS/MV IMU senses linear acceleration and angular motion along the three major axis of the vessel. The two GPS receivers are used to determine vessel heading using carrier-phase differential position measurements.

POS/MV Heading Computation

The POS Computer System (PCS) blends data from both the IMU and the two GPS receivers to compute highly accurate vessel heading. The IMU determines accurate heading during aggressive maneuvers and is not subject to short-period noise. However, IMU accuracy characteristically degrades over time. The GPS receivers compute a vector between two fixed antennas and provide azimuth data using the GPS Azimuth Measurement Subsystem (GAMS). GPS heading data is accurate over time, but is affected by short-period noise. The POS/MV combines both heading measurement systems into a blended solution with accuracies greater than either system could achieve alone. Heading accuracy in the POS/MV Controller software was set to 0.080°.

POS/MV Heave, Pitch, and Roll Computation

Heave is computed in the POS/MV by performing a double integration of the IMU-sensed vertical accelerations. The heave period was left at the TSS default of 200 seconds; the recommended heave damping coefficient of 0.71 was used.

Both roll and pitch measurements are computed by the IMU after sensor alignment and leveling. The IMU mathematically simulates a gimbaled gyro platform and applies the sensed angular accelerations to this model to determine roll and pitch. Attitude accuracy parameters were set to 0.050° in the POS/MV Controller software.

SOFTWARE

All VBES data were acquired using Coastal Oceanographic's **HYPACK MAX** (versions 005b or 2.12) software, and processed with the **CARIS HIPS** Single Beam Editor. Detached positions (DPs) were also acquired with **HYPACK MAX** in the format of target ("*.tgt") file and converted in **PYDRO** using the "Insert **HYPACK** DP" tool. **HYPACK MAX** was also used for vessel navigation and line tracking during all data acquisition.

Shallow-water multibeam and side scan data, along with position and attitude data, were acquired using **TRITON-ELICS' ISIS** software (versions 5.0 through version 6.2) and logged in the Extended Triton Format (*.XTF). SWMB and SSS data were processed using Universal Systems Limited's **CARIS GIS** (version 4.4a) and **CARIS HIPS** and **SIPS** software (versions 5.2 and 5.3).

All Detached Positions, SWMB and VBES soundings, and side scan and SWMB features were analyzed during post-processing using **PYDRO** versions 3.3.1 through 3.7.1. **PYDRO** is an extension package created by the NOS Hydrographic Systems and Technology Programs N/CS11 (HSTP) using the Python 20 programming language to interface with the **CARIS HDCS** data directly.

Soundings and features were exported from **PYDRO** by saving the Preliminary Smooth Sheet (PSS) and drawing into **MAPINFO** (versions 6.0 and/or 6.5) using the **HYDRO_MI** "Draw PSS" function. **MAPINFO** was used for final data analysis and for creating final plots. The **HYDRO_MI** application created by HSTP was used for drawing features, tracks, depths, and Preliminary Smooth Sheets.

Raw sound velocity data were processed using **VELOCWIN** versions 6.01, 7.01, 8.20 and 8.21 supplied by HSTP. **VELOCWIN** uses raw salinity, temperature, and pressure measurements to create a sound velocity profile.

A complete list of software and versions is included in Appendix I.

B. DATA PROCESSING AND QUALITY CONTROL

SHALLOW WATER MULTIBEAM DATA

Shallow-water multibeam data were monitored in real-time using the 2-D and 3-D data display windows in **ISIS** and the on-screen display for the Reson Seabat 8125 sonar processor. Adjustable user parameters are range scale, power, gain, pulse width, swath width and bottom slope type. These parameters were adjusted as necessary to insure the best data quality. Additionally, vessel speed was adjusted as necessary, in accordance with the NOS Specifications and Deliverables and Standing Project Instructions, to ensure the required along-track coverage for object detection.

Following acquisition, shallow-water multibeam data were converted using **CARIS HIPS**, and initially reviewed with **HIPS** Swath Editor. All soundings were reviewed, ping-by-ping, and obvious depth fliers were identified and manually flagged as "rejected" by the hydrographer. Vessel positioning and attitude data from each system were similarly displayed and manually cleaned. Fliers or gaps in positioning and attitude data were rejected and interpolated for small periods in time and entirely rejected for larger periods in time in which the characteristic of the curve was ambiguous. Specific data quality factors are discussed in the Descriptive Report for each survey.

After review and cleaning in Swath Editor, depth, position and attitude data were merged with sound velocity, tide, vessel offset, and dynamic draft correctors to compute the corrected depth and position of each sounding. All soundings were then again reviewed, spatially referenced, using Subset Editor. Data were compared with adjacent lines and crosslines, for systematic errors such as tide or sound velocity errors. Questionable soundings were also compared with adjacent or overlapping data for confirmation or further editing.

Sun-illuminated weighted grids were created in order to demonstrate post-cleaning coverage and to further check for systematic errors such as tide, sound velocity, attitude and/or timing. Weighted grids used to determine data coverage were created at a resolution of 1 meter.

A statistical analysis of all bathymetric data was performed using the **CARIS GIS** HIPS Quality Control Report function. VBES crosslines were compared with mainscheme (VBES and SWMBS) soundings, beam-by-beam, in order to statistically determine the accuracy of each beam and confirm that 95% confidence levels have been met for the assigned IHO S-44 Order of each survey. It should be noted that this analysis method is intended for 100% SWMB surveys. BAY HYDROGRAPHER typically performs 200% SSS with VBES bathymetric mainscheme, SWMB contact developments and VBES crosslines. Due to the large footprint and positioning methods associated with the VBES, the Quality Control Report often appears to indicate a confidence level less than 95%. VBES crosslines are manually compared with mainscheme soundings to confirm data quality. Results from each survey's Quality Control Report can be found in the respective Descriptive Report.

VERTICAL BEAM ECHOSOUNDER DATA

VBES data was acquired using **HYPACK MAX** software. **CARIS HIPS** tools generic data parser and **HYPACK** converter were utilized for converting raw-data into readable digital format for **HIPS** Single Beam Editor. Prior to the start of surveys for which this DAPR is applicable, the practice of recording analog paper VBES records was discontinued. This requirement was reinstated May 28, 2003. Analog paper records of vertical-beam echo soundings were used for comparison to digital data when the digital data was ambiguous or extraordinarily noisy. All selected VBES soundings were combined with SWMB soundings, excessed using **PYDRO** and plotted in **MAPINFO** to compare the two types of bathymetric data with each other as well as with charted depths.

VBES data were also acquired concurrently with BAY HYDROGRAPHER's SWMB data. The VBES data were compared to nadir beams of multibeam in real-time during data acquisition to confirm multibeam data quality.

To produce the reduced, shoal-biased data set represented in the final field sheet, all non-rejected soundings which passed all other quality-assurance checks were imported into **PYDRO** using the "Insert **CARIS** Line Bathy" tool. Depths were inserted into **PYDRO** using a 15 meter bathymetry grid resolution and an over-plot removal character size of 1.5 millimeters at the scale of the survey.

Data processing flow diagrams are included in Appendix II of this report.

SIDE SCAN SONAR DATA

Side scan sonar data were acquired with the Klein 5250 Towfish using **ISIS** (versions 5.0 through version 6.2). Side scan sonar data were converted from **XTF** (**ISIS** raw format) and post-processed using **CARIS SIPS**.

Post-processing of side scan data consisted of first examining and editing fish height, vessel heading (gyro), and vessel navigation records. Fish navigation was then recalculated using the **CARIS SIPS "**Recompute Towfish Navigation" sub-program. During Recompute Towfish Navigation, tow point measurements (A-frame and cable out), fish height, and depth are used to calculate horizontal layback. Once fish navigation was re-calculated, side scan imagery data was slant-range corrected. The slant-range corrected side scan imagery was scanned, and check-scanned, for any significant contacts. Contacts in less than or equal to 20meters of water were determined significant if their computed target height (based on shadow lengths obtained using SIPS) were at least 1meter. In depths greater than 20 meters contacts with computed target heights rising above the bottom at least 10 percent of the depth were considered significant. Significant contacts were saved in a **CARIS** contact file, and contact snapshot (*.tif) images were created to aid in analysis and contact classification in **PYDRO**.

All contacts were imported into **PYDRO** using the “Insert **CARIS** Line Features” tool. Contacts were arranged by day and line and could be selected in the data “Tree” window. Information concerning a specific contact was displayed in **PYDRO**’s “Editor Notebook Window” including contact position, AWOIS item positions, surrounding depths, contact cross references, and charting recommendations. Each contact was reviewed, and information flags were set accordingly. If there were multiple contacts for a single feature, then the one providing the best SSS image of the feature was chosen as “Primary”. Any items that were to be addressed in the Item Investigation section of the Descriptive Report were flagged as “Chart”. Items which had the “Chart” flag set could also be further designated for inclusion in the Danger To Navigation Report by choosing the “DTON” flag. “Snapshots” of contacts were displayed in **PYDRO**’s “Image Notebook Editor”. Contacts appearing significant were further investigated with SWMB. Final positioning and least depth determinations of significant items were accomplished using multibeam and/or diver investigation.

Side scan-sonar coverage was verified using **CARIS SIPS** generated side scan mosaics imported into **MAPINFO** for analysis. Any deficiencies in the side scan sonar data were filled by completing a holiday line plan to meet the 200% requirement. Confidence checks were performed by noting changes in linear bottom features extending to the outer edges of the digital side scan image and by correlating sonar contacts to known features such as aids to navigation. These checks were performed in real time during data acquisition each day.

PRELIMINARY SMOOTH SHEET

Once all sounding data and features were reviewed and analyzed using **PYDRO**, the data was saved into a Preliminary Smooth Sheet (PSS). The PSS is a working file, that does not actually contain data, but contains links to the data with specific path information as well as ancillary data flag information which is not supported in the **HDCS** file structure. The PSS was then imported into **MAPINFO** via the **HYDRO_MI** “Draw PSS” function. Final field analysis of the PSS was performed in **MAPINFO**.

C. CORRECTIONS TO ECHO SOUNDINGS

SOUND VELOCITY CORRECTION

Sound velocity profiles were acquired with either a SeaBird Electronics SeaCat SBE19 Conductivity, Temperature, and Depth (CTD) profiler (S/N's 2039 and 1251) or SBE 19 Plus profiler S/N 4472. Raw conductivity, temperature, and pressure data were processed using the program **VELOCWIN** (versions 6.01, 7.01, 8.20 and 8.21), which generates sound velocity profiles for **CARIS**. Sound velocity correctors were applied to SWMB and VBES soundings in **CARIS HIPS** during post processing. CTD calibration reports and dates are included in Appendix IV of this report.

The speed of sound through water was determined by a minimum of one cast every four hours of SWMB acquisition, and one cast every week for VBES acquisition, in accordance with the Draft Standing Project Instructions and NOS Specifications and Deliverables for Hydrographic Surveys (March 2003). Additional casts were conducted when changing survey areas or if it was felt that conditions, such as a change in weather, tide, or current, would warrant additional sound velocity profiles.

VESSEL OFFSETS AND DYNAMIC DRAFT CORRECTORS

A separate **CARIS** Vessel Configuration File (VCF) was created for each survey system utilized and after any major configuration changes. The following table lists each Vessel Configuration File.

VCF NAME	SURVEY SYSTEM
BH00	Stern mount SWMB, towed SSS, TrimbleDSM212L positioning
BH02	Port side mount SWMB, towed SSS, Trimble DSM212L positioning
BH_POS_03	Port side mount SWMB, towed SSS, TSS POS/MV positioning
BH_SB	VBES, Trimble DSM212L positioning
BH_POS_SB_03	VBES, TSS POS/MV positioning
BH_DP	Used for detached positions only, referenced to waterline

Static draft corrections for BAY HYDROGRAPHER were measured in April 2002, prior to installing a new Reson SeaBat 8125 SWMB system. The value of 0.84 meters was determined for the vessel static draft.

Settlement and squat correctors for BAY HYDROGRAPHER were determined on February 26, 1998 using on the floy GPS for relative measurements. An Ashtech M12 receiver was set up on a mark on the pier at NOAA's Atlantic Marine Center, Norfolk, VA and a second was set up on BAY HYDROGRAPHER. Both receivers logged data for two continuous hours as the vessel ran a series of reciprocal courses at varying speeds. The data was then processed to yield a relative vertical change versus time and speed table. These values were confirmed in May 2000, using rod level techniques.

Sensor offsets and dynamic draft values are stored in the **CARIS** VCFs and were applied to VBES, SWMB and SSS data in **CARIS** during post-processing. Vessel offset diagrams are included in Appendix III of this report. The Vessel Configuration Files have been submitted with the digital processed data.

HEAVE, PITCH, ROLL AND HEADING, INCLUDING BIASES AND NAVIGATION TIMING ERRORS

In 2002, BAY HYDROGRAPHER crew installed a Reson SeaBat 8125 multibeam system. Prior to use for acquisition of official survey data, a retractable mounting system was installed on the port side of the vessel. A patch test was conducted on DN 094 to determine residual offsets associated with the new sonar and mounting system. These values were entered into the BH02 VCF.

In 2003, the vessel navigation system was upgraded from a Trimble DSM212 DGPS receiver to a TSS POS/MV Position and Orientation System. Due to this change in systems, another patch test was required for the multibeam system. The patch test was performed on DNs 212 and 219, and offset values were entered into the BH_POS_03 VCF file.

Vessel offsets, dynamic draft correctors, and system bias values are contained in the applicable **CARIS** Vessel Configuration Files which were created using the program "**VCFEDIT**" in **CARIS**. These offsets and biases were applied to the sounding data during processing in **CARIS**. VCFs have been submitted with the digital processed data.

WATER LEVEL CORRECTION

Soundings were reduced to Mean Lower-Low Water (MLLW) using verified observed tide data (unless otherwise noted in the DR) from each tide station applicable for a specific survey sheet. All tide data was obtained from the Center for Operational Oceanographic Products and Services (CO-OPS) web site http://co-ops.nos.noaa.gov/hydro.html. These data were used to create a CARIS HIPS Tide file (.tid). Final tide correctors applied to soundings have been fully adjusted for the tidal zoning scheme supplied with the Hydrographic Survey Letter Instructions. Refer to individual Descriptive Reports for further information regarding water level correctors specific to each survey.

BAY HYDROGRAPHER personnel installed no tide gauges in conjunction with the survey projects referenced in this report.

D. APPROVAL

As Chief of Party, I have ensured that standard field surveying and processing procedures were utilized during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables (March 2003).

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

Submitted: Peter Holmberg, NOAA
Physical Scientist

Approved and Forwarded: LTJG Holly A. DeHart, NOAA
Officer-In-Charge