2008 DAPR NRT-5

NOAA FORM 76-35A

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

Data Acquisition & Processing Report

Field Unit: **Navigation Response Team 5**

Operational Area: **Northeast Coast**

LOCALITY

State: **NY**

General Locality: **New York Harbor**

Sub-locality: **Gravesend Bay**

2008

CHIEF OF PARTY

LT(jg) Matthew Jaskoski, NOAA

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DATE

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION **HYDROGRAPHIC TITLE SHEET**	REGISTRY NUMBER: **N/A**

INSTRUCTIONS: N/A.

State:	**NY**		
General Locality:	**New York Harbor**		
Sub-Locality:	**Gravesend Bay**		
Scale:	**N/A**	Date of Survey:	**04/18/08 & 05/13/08**
Instructions Dated:	**N/A**	Project Number:	**N/A**
Change No.1 Dated:	**N/A**		
Change No.2 Dated:	**N/A**		
Vessel:	**NOAA NRT-5 S3002**		
Chief of Party:	**LT(jg) Matthew Jaskoski, NOAA**		
Surveyed by:	**NRT-5**		
Soundings by:	**Kongsberg Simrad EM 3000 multibeam echosounder**		
	Kongsberg Simrad EM 3002 multibeam echosounder		
	Odom CV 200 single beam echosounder		
Graphic record checked by:	**N/A**		
Protracted by:	**N/A**	Automated Plot:	**N/A**
Verification by:	**Atlantic Hydrographic Branch Personnel**		
Soundings in:	**Meters at MLLW**		

Remarks:
1) All Times are UTC.
2) This is a DAPR to accompany all Hydrographic Survey Projects for calendar year 2007.
3) Projection is UTM Zone 18.

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DATA ACQUISITION AND PROCESSING REPORT

to accompany
Field Season 2008 Survey Operations

NOAA Navigation Response Team 5
LT(jg) Matthew Jaskoski, OIC

A. EQUIPMENT

With the exception of sound speed profiler calibration reports, all calibration data were acquired by Navigation Response Team 5 (NRT-5) personnel during the months of April and May, 2008. NRT-5 data acquisition systems include side scan sonar (SSS), multibeam echosounder (MBES), vertical beam echosounder (VBES), position and orientation system (POS) surface sound speed sensor (SSVS), sound speed profilers (SVP) and a GPS backpack. Vessel description and offset measurements are described in Appendix III. Any subsequent deviations from this report will be addressed in the respective survey Descriptive Reports.

Methods used to test and calibrate all equipment were determined by the hydrographer in accordance with the Hydrographic Survey Specifications and Deliverables (2007), and the Field Procedures Manual (2007) with due consideration given to system performance limitations, time availability, and vessel and crew safety.

A.1 Bathymetric Sounding Equipment

A.1.1 Odom Echotrac CV 200 Vertical-Beam Echosounder

S-3002 is equipped with an Odom CV 200 vertical beam echosounder (VBES). The Odom echosounder has a single-frequency (appx 100kHz) unit with a digital recorder. This unit transducer operates at 208 KHz with a circular beam footprint of 8° at the –12 dB point.

A.1.2 Kongsberg Simrad EM 3000 Multibeam Echosounder

For shallow water bathymetry S-3002 is equipped with a pole-mounted Kongsberg Simrad EM 3000 MBES (Fig 2). The EM 3000 is a 300 kHz system with an operating depth range of 1m below the transducer to 150m water depth. Transmit beamwidth is 120° acrosstrack and 1.5° alongtrack; receive beamwidth is 30° alongtrack and 1.5° acrosstrack. The system has a maximum ping rate of 25 Hz, and a total effective beamwidth of 1.5° alongtrack by 1.5° acrosstrack.

Figure 1: Pole-mounted Kongsberg EM3000

The EM 3000 Processing Unit performs beamforming, bottom detection and controls the sonar head with respect to gain, ping rate and receive beam angles. The sonar processor also incorporates real time surface sound speed measurements for initial beam forming and steering. The EM 3000 Controller application is a Microsoft Windows application designed to run under Microsoft Windows 2000. The application provides control and monitoring of the EM 3000 and the sensors connected to the Processing Unit. The controller can be used to run the Built-In Self Test (BIST) programs of the system. Sonar parameters and vessel speed are adjusted as necessary to ensure adequate coverage in accordance with the NOS Specifications and Deliverables and the Project Instructions.

Main scheme MBES line plans generally run parallel to the contours using a line spacing of $y = 2(D\text{-}d\text{-}n)\tan\theta$; where $\theta = ½$ of the swath angle, D = water depth in meters, d = Transducer draft in meters, and n = the vertical resolution. For item developments, operational swath angle is reduced to $\theta = ¼$ of the total swath angle to ensure least-depth determination by MBES near-nadir beams.

A.1.3 Kongsberg Simrad EM 3002 Multibeam Echosounder

For a period during the field season S-3002 used a Kongsberg-Simrad EM3002 processing unit (PU) in consort with the pole-mounted EM3000 transducer head. The EM3002 PU was used as a controller only, data were acquired using HYSWEEP and acquisition procedures followed the established SOPs for EM3000 data acquisition with the following exceptions. 1) Hypack HSX data when converted could not have Caris SVP files correctly applied to it, the EM3002 used SV profiles applied through Kongsberg's SIS controller program at the time of acquisition. 2) The EM3002 beamforming capabilities allowed for twice as many beams as that of the EM3000, i.e. 254 as apposed to 127. A separate Caris HVF was developed for the EM3002 data using the current HVF values for the EM3000. As there was no change to the sonar head, patch test values collected on DN 109 were used in this HVF. Similarly all offsets, dynamic draft values, waterline height, and TPE values are the same as those used for the EM3000.

A.1.4 Leadline

Leadlines are used for single beam and multibeam echosounder comparisons. Reports for the leadline comparisons are included in Appendix IV.

A.2. Side Scanning Imagery Sonar

A.2.1 L-3 Klein System 3000

The L-3 Klein System 3000 includes the Model 3210 towfish, 35m of Kevlar reinforced tow cable, the Transceiver and Processing Unit (TPU) with VX Works operating system, and Klein workstation with SonarPro. The Model 3210 towfish (fig 3) operates at a nominal frequency of 500/100 kHz and has a vertical beam angle of 40 degrees. Klein TPU contains a network card for transmission of the sonar data to the Klein acquisition computer. The acquisition software (SonarPro) is capable of saving raw data in SDF and/or XTF format.

Figure 2: Klein 3000

The SSS towfish is deployed from a davit arm located on starboard quarter using a Dayton electric-hydraulic winch spooled with approximately 30 meters of cable. Tow cable is lead from the winch upward along the davit arm. The tow cable at the winch is connected electro-mechanically to a deck cable through a slip ring assembly. Cable out is controlled manually and is computed by the Dyna Pro cable counter by the number of revolutions of the cable drum sheave. The cable counter provides a serial message to the Hypack acquisition computer. The message is parsed over delph-serial connection from the Hypack to the Klein computer and included in the raw data. Cable-out is adjusted to 2.0 meters before deployment of the towfish to account for the distance from the water surface to the wheel.

To minimize towing gear stress, and reduce strumming, towed SSS operations are typically limited to approximately 6 knots speed-over-ground. Turns to port require the towfish be drawn in to prevent the tow cable from swinging into the propellers.

Line spacing for side scan sonar (SSS) operations is determined by range scale and the estimated position error (EPE). EPE is taken as 1.5mm at survey scale. For 200% coverage NRT-5 uses the formula y=R-epe.

A towfish altitude of 8-20% of the range scale is maintained during data acquisition. Altitude is adjusted by cable out, and vessel speed.

Confidence checks are performed daily by observing changes in linear bottom features extending to the outer edges of the digital side scan image, features on the bottom in survey area, and by passing aids to navigation.

A.3 Vessel Position and Orientation Equipment

A.3.1 Trimble DSM212L DGPS Receiver

S-3002 is equipped with a Trimble DSM212L Differential GPS receiver. USCG beacons are used for horizontal position control. The DSM212L is an integrated 12-channel GPS receiver and dual-channel differential beacon receiver. The beacon receiver can simultaneously monitor two beacon stations if within broadcast range. Correctors are received from only one beacon station during data acquisition. Receiver parameters are configured using Trimble TSIPTalker and 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 deg). Receiver parameters and configuration are monitored throughout data acquisition.

Position quality is monitored by the operator using the POS/MV v.4 controller software. The primary positional quality monitored is HDOP. Where HDOP exceeds 2.5, the data are examined during post-processing, and if necessary, positions interpolated or rejected.

A.3.2 TSS POS/MV Position & Orientation Sensor

An Applanix POS/MV 320 Version 4 is used to determine vessel position and orientation. NRT-5 uses the POS/MV for both data acquisition purposes (bathymetry and imagery) and navigation purposes. Position accuracy and quality are monitored by the operator during data acquisition using the POS/MV Controller software to ensure compliance with NOS Hydrographic Surveys Specifications and Deliverables. The POS/MV combines GPS and Inertial Measurement Unit (IMU) sensor data into an integrated navigation solution. There are two navigation algorithm designs incorporated into the system. In the first algorithm the GPS receiver is strictly a sensor of the GPS observables, i.e. the navigation functions in the GPS receiver are not used. In the second algorithm, GPS position and velocity solution are processed to aid the inertial navigator. The system will automatically switch between the two algorithms to ensure appropriate performance. The POS/MV is capable of delivering data including: Geographic position (latitude, longitude and altitude), Heading, Attitude (roll and pitch), Vertical displacement (heave), Velocity, Acceleration, and Angular rate of turn

Within the IMU are three solid-state linear accelerometers and three solid-state gyros arranged in a triaxial orthogonal array. This configuration allows for the accelerometers to sense acceleration in all three directions, and three gyros to sense angular motion around all three axes centered on the IMU. The POS Computer System (PCS) receives these measurements from the IMU and uses them to compute the measurements of motion. Pitch and roll measurements are computed by the IMU after sensor alignment and leveling. The IMU mathematically simulates a gimbaled gyro platform and applies the angular accelerations to this model to determine roll and pitch. Position and attitude data are logged in the raw data file during acquisition. True Heave is based on a two sided filter, making use of both past and present vertical motion data to compute a heave estimate. True heave is applied in post processing

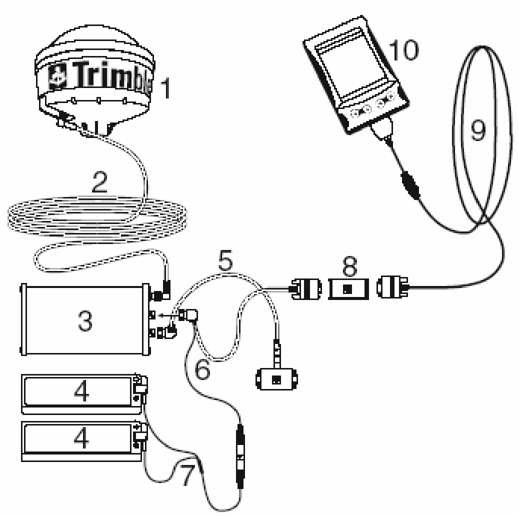
The PCS utilizes data from both the IMU and the two GPS receivers to compute a highly accurate vessel heading. The IMU determines heading during aggressive maneuvers and is not subject to short-period noise. However, IMU accuracy diminishes over time. The two GPS receivers allow the PCU to calculate vessel heading using carrier-phase differential position measurements. The PCU computes a vector between the two fixed antennas and provides azimuth data using the GPS Azimuth Measurement Subsystem (GAMS). GPS heading data is accurate over time, but is affected by short-period noise. Heading accuracy for the system is ±0.02°.

A.4. Shoreline - ENC Validation Equipment

A.4.1 Trimble GPS Backpack

NRT-5 is equipped with a Trimble GPS backpack for shoreline and ENC validation. TerraSync software is used to process shoreline data (see sec A.5). The hardware components of the GPS backpack are detailed in figure 4. The data logger may contain a custom data dictionary that allows feature objects and their corresponding attribution to be collected using the IHO S57 standard

Figure 3 Hardware components of the Trimble GPS backpack.



No.	Part No.	Description
1	33580-50	Combined L1 GPS/MSK beacon/satellite differential antenna
2	22628	Antenna cable
3	33302-51	12-channel Pro XRS receiver
4	17466	Camcorder batteries
5	30232-00	NMEA/RTCM cable
6	30231-00	Data/power cable
7	24333	Dual battery cable
8	43197	Null modem adaptor
9	Custom data cable (supplied with field computer)	
10	Field computer with custom serial port	

A.5. Software

Survey planning is done using Mapinfo. Mapinfo allows the user to import raster nautical charts (RNC) survey limits, pertinent AWOIS item positions and search radii, as well as allowing the user to create line plans that can be exported to Hypack format.

Hypack Inc. Hypack MAX is used for vessel navigation and line tracking during acquisition of bathymetry and imagery data. All VBES and MBES data are acquired in Hypack *.hsx format for raw data files.

MBES data are acquired via the hypack program Hysweep. Vessel offset configurations, attitude data, and (with the exception of EM3002 data see A.1.3) sound speed profiles are applied during post-processing.

Raw sound velocity data are processed using Velocwin, supplied by NOAA Hydrographic Systems and Technology Program (HSTP). Velocwin uses raw conductivity, temperature, and pressure measurements to create a sound velocity profile.

All bathymetry and imagery data are processed using Caris HIPS & SIPS. Caris software applies vessel configurations, allows the user to apply tide, sound speed, and true heave corrections, calculates total propagated error (TPE), and allows the user to determine bias error values in calibration mode. Caris uses a combined uncertainty model to estimate a bathymetric surface and generate a digital terrain model (DTM)

Imagery data are processed and examined using Caris SIPS v.6.1.

Bathymetry data and imagery features are managed using Pydro. This program was created by the NOS Hydrographic Systems and Technology Programs N/CS11 (HSTP) using the Python 23 programming language to interface with the HIPS and SIPS data directly.

Bathymetry data and imagery features can be exported from Pydro in MIF/MID (MapInfo Interchange) format, and imported into MapInfo. Soundings are imported into MapInfo to generate a Preliminary Smooth Sheet. MapInfo is used for final data analysis and for creating final plots.

TerraSync is the software utilized in mapping operations in support of Shoreline Verification, Detached Positions (DP's), and Electronic Navigational Charts (ENC) data acquisition using a Trimble ProXRS backpack system and a data logger (TSCe). The ProXRS is capable of 30 – 50cm accuracy post processed.

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

B. DATA PROCESSING AND QUALITY CONTROL

B.1. Multibeam Echosounder Data

Raw multibeam data are converted to HDCS format in Caris HIPS 6.1. Transformation parameters pertaining to the source of the attitude packet is stored in the log file located in line directory of the HIPS data. After conversion, True heave, Tide and sound speed corrections are applied (with the exception of EM3002 data see A.1.3) to the dataset and Total Propagated Error (TPE) is calculated. TPE is calculated using the Caris implementation of the multibeam error model. A table of these values is provided in Appendix IV.

Vessel heading, attitude, and navigation data are reviewed and edited in line mode. Fliers or gaps in heading, attitude, or navigation data were manually rejected or interpolated for small periods of time.

Vessel static and Dynamic offsets are applied to the data during the conversion and post processing procedures. The dynamic draft for a vessel of this size is typically quite small (0.5-2cm). Nonetheless, NRT-5 follows HSTP suggestions to maintain a consistent engine trim during survey operations. The trim indicator has been marked to insure the trim is set correctly for operations.

After data conversion and application of correctors, all sounding data have estimates of uncertainty in three dimensions attached to them. Uncertainty associated with sensor data (Heave, Pitch, Roll, Position, Heading, Sound speed, and Tide) as well as uncertainties in static and dynamic offsets measurements are used to calculate the total uncertainty for each sounding. These uncertainty-attributed depth measurements are inputted into the Combined Uncertainty Bathymetry Estimator (CUBE) algorithm. The end result of which is a mathematical estimate of the bathymetric surface. The CUBE surface products are then used to evaluate MBES coverage, and to further check for systematic errors such as tide, sound velocity, or attitude and timing errors.

The resolution chosen for finalized CUBE surfaces is 0.75m, as per recommendations by HSTP. Once the CUBE surface has been finalized, they are inserted into Pydro for feature evaluation and generation of the smooth sheet and feature reports.

B.2. Single-Beam Echosounder Data

VBES data are acquired concurrently with both MBES data and SSS data. In cases where VBES data is not the primary source of bathymetry, i.e. MBES data is also acquired; VBES data is used only for troubleshooting or confidence check purposes. In these cases, the raw VBES data are submitted for archival purposes only. This data should not be used in the creation of final hydrographic products.

In cases where VBES data are the primary source of bathymetry VBES data are processed, passed through quality control, and submitted for the purposes of product creation. Following acquisition, single-beam echosounder data are converted from raw format to HDCS using Caris HIPS 6.1. Each line is viewed in Caris HIPS Single Beam Editor against the digital trace of the VBES data. Selected soundings are scanned for missed depths. Additional selected soundings are inserted where necessary to define peaks and abrupt changes in slope.

After review and cleaning, Caris HIPS is used to merge depth, position and attitude data with sound velocity, tide, vessel offset, dynamic draft correctors and TPE values to compute the corrected depth and position of each sounding. All soundings are reviewed again in HIPS Subset Mode. Data are compared with adjacent lines and crosslines for systematic errors such as tide or sound velocity errors. Caris HIPS uncertainty weighted and/or swath angle grids are created for VBES data at 2m resolution.

B.3. Side Scan Sonar Data

Side scan sonar data were converted from *.SDF (SonarPro raw format) to SIPS format using Caris SIPS 6.1.

Post-processing side scan data includes examining and editing fish height, vessel heading (gyro), and vessel navigation records. Towfish navigation is recalculated using Caris SIPS 6.1. Tow point measurements (C-frame and cable out), fish height, and depth are used to calculate horizontal layback.

After towfish 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 are evaluated as potential contacts based on apparent shadow length and appearance; particularly targets which appear to be anthropogenic 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.

Targets are exported to the line file and inserted into Pydro for feature evaluation and correlation with associated bathymetry data.

C. CORRECTIONS TO ECHO SOUNDINGS

C.1. Sound Speed

C.1.1 SBE19Plus CTD profiler and Digibar Pro

Speed of sound through water is determined by a minimum of one cast every four to six hours of MBES data acquired, in accordance with the Standing Letter Instructions and NOS Specifications and Deliverables for Hydrographic Surveys.

S3002 is equipped with an Odom Digibar Pro surface sound velocity sensor to measure sound speed at the mutibeam transducer head. For water column sound speed profiles NRT-5 uses an Odom DigibarPro CTD profiler. Raw conductivity, temperature, and pressure data are processed using Velocwin which generates sound velocity profiles for Caris HIPS (*.svp) and Kongsberg SIS (*.aasv). With the exception of Simrad EM3002 data, sound speed correctors are applied to MBES and VBES data in Caris HIPS during post processing. Calibration reports for the Odom Digibar profilers are included in Appendix IV.

C.2. Vessel offsets and Dynamic Draft Corrections

Sensor offsets are stored in the Caris HIPS Vessel Configuration File (NRT5_S3002_EM3000_MBES, NRT5_S3002_EM3002_MBES & NRT5_S3002_Echotrac_VBES) and are applied to MBES & VBES data in post-processing. Vessel offset measurements were made by National Geodetic Survey on S3002 in Norfolk, VA on February 17, 2004 (see Appendix II). Static IMU draft corrections for S3002 were measured 16 April 2008 (see results Appendix III). Dynamic draft measurements for S3002 were made on 18 April 2008 (see Appendix III).

The following table lists each Vessel Configuration File.

Table 1: Vessel Configuration Files

S3002 Caris Vessel Configuration Files: 06 April 2007, DN 096	
HVF Name	Survey System
NRT5_S3002_EM3000_MBES	Kongsberg Simrad EM3000 Multibeam Sonar System
NRT5_S3002_EM3002_MBES	Kongsberg Simrad EM3002 Multibeam Processing Unit
NRT5_S3002_Echotrac_VBES	Odom Echotrac C/V 200
NRT5_S3002_Klein3000_SSS	Klein 3000 Side Scan Sonar High Frequency

C.3. Pitch, Roll, Azimuth and Navigation Timing Errors

Static pitch, roll, azimuth and navigation latency biases for the Simrad EM3000 were determined during Patch Tests conducted on 18 April 2008 at Gravesend Bay Anchorage New York Harbor (See Appendix IV).

C.4. Water Level Corrections

Tide data are downloaded from the Center for Operational Oceanographic Products and Services (CO-OPS) website (http://tidesandcurrents.noaa.gov/olddata/) and applied via a zone definition file (*.zdf) provided by CO-OPS for each project. Approved final tides are applied by field personnel upon receipt.

D. APPROVAL SHEET

Data Acquisition and Processing Report
Navigational Response Team 5
Northeast

For all Hydrographic Surveys & ENC Validation conducted during
Field Season 2008

As Chief of Party, I have ensured that standard field surveying and processing procedures were adhered to during this project in accordance with the most recent editions of; Hydrographic Manual, Hydrographic Survey Guidelines, Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables.

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

Respectfully,

____
Matthew Jaskoski, LT(jg)/NOAA
Officer In Charge
NOAA NRT-5

APPENDIX I

HYDROGRAPHIC SYSTEMS INVENTORY

Hydrographic Vessel Inventory

Field Unit: NRT-5
Effective Date: 18-Apr-08
Updated Through: 18-Apr-08

SURVEY VESSEL

Vessel Name	NOAA NRT-5
Hull Number	S3002
Call Letters	
Manufacturer	SeaArk Marine Inc., Portobello, Arkansas
Year of Construction	2003
Type of Construction	Aluminum
Length Overall	31' 8" / 9.65m
Beam	8'6" / 2.58m
IMU Draft	1' / 0.32m
Date of Effective Full Vessel Static Offset Survey	17-Feb-05
Organization which Conducted the Effective Full Offset Survey	NGS
Date of Last Partial Survey or Offset Verification & Methods Used	
Date of Last Static Draft Determination & Method Used	
Date of Last Settlement and Squat Measurements & Method Used	18-Apr-08 Base Surface

Additional Information

Hydrographic Hardware Inventory

Field Unit: NRT-5
Effective Date: 15-Apr-08
Updated Through: 15-Apr-08

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Version Install Date	Date of last Calibration	Date of last Service	Additional Information
SONAR & SOUNDING EQUIPMENT								
Multibeam Echosounder	Kongsberg Simrad	EM3000 EM3002 (PU only)	306	Hypack 2008 SIS (controller only)	May-08	Apr-08		127 Beams 1.5° x 1.5° Resolution
Side Scan Sonar	Klein	System 3000	PU=1517, TPU=348, Fish=457	SonarPro 10		May-08		
Vertical Beam Echosounder	Odom	Echotrac CV-200	23043	Hypack 2008	May-08	Apr-08		
POSITIONING & ATTITUDE EQUIPMENT								
GPS Aided Inertial Naviation	Applanix	POS/MV 320 V4	2034, IMU=377					Roll/Pitch Accuracy: 0.02° Heave Accuracy: the greater of 5cm or 5% for periods of 20s or less
DGPS Reciever	Trimble	DSM212L	O220309909					
SOUND SPEED MEASUREMENT EQUIPMENT								
Sound Speed Profiler	Odom	Digibar Pro	98212			Jun-08		
Surface Sound Velocimeter	Odom	Digibar Pro	98214			Jun-08		
TIDES & LEVELING EQUIPMENT								
Optical Level								
Level Rod								
HORIZONTAL AND VERTICAL CONTROL EQUIPMENT								
GPS Backpack	Trimble	Pathfinder Pro XRS	224078542	ver 1.70	2005	N/A		
OTHER EQUIPMENT								

Hydrographic Software Inventory

Field Unit: NRT-5
Effective Date: 28-Mar-07
Updated Through: 28-Mar-07

COMPUTERS

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU	Trimble TSCe
Location	Office Trailer	Office Trailer	Office Trailer	Office Trailer	Office Trailer	S3002	S3002	S3002	Office Trailer
Make/Model	Dell Presision T3400	Dell Optiplex GX270	Dell Dimension 9150	Dell Latitude D600	Dell Latitude D820	Dell Optiplex GX270	Proprietary	Proprietary	TSCe Field Device
Date Purchased	2008	2003	2006	2003	2006	2003			2005
Date of Last Rebuild	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Processor, Speed	Q 6700, 2.66 GHz	P4, 2.8 GHz	P-Dual Core, 3.00 GHz	P-M, 1.4GHz	Centrino Duo, 2.16GHz	P4, 2.8 GHz	Proprietary		Samsung 300MHz
RAM	4 GB	2.5 GB	2 GB	512 MB	2 GB	1 GB	Proprietary		64 MB
Video Card	mVidia Quatro FX1700	nVidia GeForce FX5200	nVidia GeForce FX6800	Mobility Radeon 9000	nVidia Quadro NVS 110M	nVidia GeForce FX5200	N/A		Proprietary
Video RAM	512 MB	128 MB	256 MB	32 MB	256 MB	128 MB	N/A		Proprietary
Comments		Possible bad Network Card - also upgrade needed		Upgrade Needed		Upgrade Needed		Upgraded in Oct 2005, larger hard drive, increased RAM.	

SOFTWARE LICENSES

	Software Package	License Numbers								
Acquisition	SonarPro 9.6 & 10									
	HYPACK 2008									
	Simrad EM Controller 1.0.28									
	POS M/V Controller 3.3									
	TerraSync 2.41									
	EM3002 SIS									
Processing	CARIS HIPS & SIPS 6.1	CW9604114		CW9604216						
	Pydro 8.5	d3b9bf48d575c3ffbe	3b9bf48df4152bba7	7a941fee83afe1aee4	d3b9bf48d5023928ea	cdf482d4b3099cd4d9	aef156660a9551026b			
	SeaTerm 1.3						x			
	Velocwin 8.92						Jun-08			
	GPS Pathfinder Office 3.10	011747-00300-07186	011747-00300-07186	011747-00300-07186	011747-00300-07186					
	Odom Digibar Pro Log 2.3						x			
	MapInfo 8.5	MIUWEU0850038761	MIUWEU0850038761	MIUWEU0850038761	MIUWEU0850038761	MIUWEU0850038761				
Support										

OPERATING SYSTEM PACKAGE:

Operating System Installations & Updates (Date)

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU	
Windows XP SP2	Jun-08	Feb-05	Jan-06	Nov-05	Dec-06	Feb-05			
VX Works								x	
Windows 2000								x	
Windows CE									x

ACQUISITION SOFTWARE PACKAGE: HypackMAX

Software Installations & Updates (date)

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU
Hypack 2008			Jun-08			Jun-08		

ACQUISITION SOFTWARE PACKAGE: Klein SonarPro

Software Installations & Updates (date)

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU
Version 8.0								
Version 9.6								Nov-06
Version 10.0								Apr-08

PROCESSING SOFTWARE PACKAGE: CARIS HIPS/SIPS

Software Installations & Updates (date)

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU
Version 6.1	Jan-07	Jan-07	Jan-07	Jun-08	Jun-08			

PROCESSING SOFTWARE PACKAGE: Pydro

Software Installations & Updates (date)

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU
Version 8.5	Jun-08	Jun-08	Jun-08	Jun-08	Jun-08			

PROCESSING SOFTWARE PACKAGE: MapInfo

Software Installations & Updates (date)

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU
Version 8.5 Install	Jun-08	Feb-05	Feb-07	May-06	May-06			
8.5.1B Update	Jun-08	Jun-08	Mar-07	Jun-08				

SUPPORT SOFTWARE PACKAGE: MS Office

Software Installations & Updates (date)

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU
Office XP	6/1/2008	2/5/2005	8/9/2005	12/4/2006	11/8/2006	2/5/2005		

SUPPORT SOFTWARE PACKAGE: Adobe Acrobat Professional

Software Installations & Updates (date)

Machine Name	OCS-W-NSD-612984	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	NRT5-1	Klein TPU	Klein CPU
Version 6.0	3/1/2006	3/1/2006	3/1/2006	3/1/2006				
Version 8.0					4/5/2007			

Hydrographic Personnel Roster

Field Unit: NRT-5
Effective Date: 15-Apr-08
Updated Through: 15-Apr-08

OFFICERS

Name and Grade	Current Position	Years of Hydro Experience	Notes
LT(jg) Matthew Jaskoski	OIC	3.5	

SURVEY DEPARTMENT

Name and Rate	Current Position	Years of Hydro Experience	Notes
Bert Ho	PST	3.5	
Jack Herbert	PST	2	

ROTATING HYDROGRAPHERS & VISITORS (involved in survey work)

Name and Rate	Current Position	Years of Hydro Experience	Notes & Dates Embarked

NOTES:

APPENDIX II

VESSEL STATIC OFFSETS

US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall L. Fancher
February 17, 2005

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to accurately determine the spatial relationship of various components of a POS MV navigation system aboard the NOAA boat SS 3002. Additionally, various reference points (bench marks) and a GPS antenna used for navigation were established onboard the vessel to aid in future spatial surveys aboard the boat.

PROJECT DETAILS

This survey was conducted at the I & M Branch facility in Corbin, VA on the 16th of February. The weather was unusually mild with a steady breeze.

INSTRUMENTATION

The Leica (Wild) TC2002 precision total station was used to make all measurements.

Technical Data:

Angle Measurement

Resolution	0.03 seconds
Smallest unit in display	0.1 seconds

Standard Deviation

Horizontal angle	0.5 seconds
Vertical angle	0.5 seconds
Distance measurement	1mm + 1ppm

A standard “peanut” prism was used as a sighting target. This prism was configured to have a zero mm offset.

PERSONNEL

Kendall Fancher NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
Steve Breidenbach NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243

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POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

ESTABLISHING THE REFERENCE FRAME

A primary reference point, CL1, was set on the centerline of the boat and near the physical center of the boat. To conduct this survey a local coordinate reference frame was established where the X axis runs along the centerline of the boat and is positive from the primary reference point towards the bow of the boat. The Y axis is perpendicular to the centerline of the boat (X axis) and is positive from the primary reference point towards the right, when looking at the boat from the stern. The Z axis is positive in an upward direction from the primary reference point. In this reference frame CL1, the primary reference point, has the following coordinates;
X = 0.000(m)
Y = 0.000(m)
Z = 0.000(m)

A secondary reference point (CL2) was set on the centerline of the boat, near the stern. The Y value of the secondary reference point was assumed to be zero. Determination of the X value for CL2 was accomplished by measuring the horizontal distance from CL1. Determination of the Z value for CL2 was accomplished by trigonometric leveling from CL1. The determined coordinates for CL2 are;
X = -3.115(m)
Y = 0.000(m)
Z = -0.008 (m)

ESTABLISHING ALL OTHER POINTS

While occupying CL1, a bearing of 180.0000 was input into the instrument and CL2 was input for initialization. After initialization was conducted, angular and distance measurements were taken to establish the following points; BM2 and TP1. TP1 is a temporary point set off of the boat. The established coordinates for TP1 were then stored internally in the instrument.

While occupying TP1, the previously determined bearing to CL1 was recalled and initialization was conducted to CL1. After initialization was conducted, angular and distance measurements were taken to establish the following points; IMU, BM4, BM3, GPS, L1, L2, and TP2. TP2 is a temporary point set off of the boat. The established coordinates for TP2 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously established points;
BM2
X = 0.001(m)
Y = 0.003(m)
Z = 0.007(m)

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CL2
X = 0.005(m)
Y = 0.000(m)
Z = 0.005(m)

While occupying TP02, the previously determined bearing to TP01 was recalled and initialization was conducted to TP01. After initialization was conducted, angular and distance measurements were taken to establish the following points; BM1, MB1, SB, and TP3. TP3 is a temporary point set off of the boat. The established coordinates for TP3 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously determined points;

CL1
X = -0.002(m)
Y = -0.003(m)
Z =   0.013(m)

IMU
X = 0.006(m)
Y = -0.010(m)
Z =   0.003 (m)

CL2
X = 0.001(m)
Y = 0.003(m)
Z = 0.007(m)

BM3
X = -0.002(m)
Y = -0.004(m)
Z =   0.000(m)

BM2
X = 0.003(m)
Y = -0.005(m)
Z =   0.003 (m)

GPS
X = 0.003(m)
Y = -0.005(m)
Z =   0.003(m)

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L1
X = 0.003(m)
Y = -0.004(m)
Z = 0.003(m)

While occupying TP3, the previously determined bearing to TP2 was recalled and initialization was conducted to TP2. After initialization was conducted, angular and distance measurements were taken to establish the following points; BM1, MB1, SB, MB2, and MB3. During these observations, coordinate checks were made to the following previously determined points;

CL1
X = -0.002(m)
Y = 0.002(m)
Z = 0.013(m)

IMU
X = -0.004(m)
Y = 0.000(m)
Z = 0.005(m)

CL2
X = 0.008(m)
Y = -0.008(m)
Z = 0.002(m)

BM3
X = -0.002(m)
Y = 0.000(m)
Z = 0.005(m)

GPS
X = 0.005(m)
Y = 0.006(m)
Z = 0.003(m)

L1
X = 0.001(m)
Y = -0.003(m)
Z = 0.004(m)

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POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

L2
X = -0.004(m)
Y = -0.002(m)
Z = 0.001 (m)

BM1
X = -0.001(m)
Y = 0.000(m)
Z = 0.003(m)

MB1
X = 0.003(m)
Y = -0.001(m)
Z = 0.002(m)

TP1
X = 0.000(m)
Y = 0.000(m)
Z = 0.007(m)
Points MB2 and MB3 were established for the purpose of determining a length for the Mulitbeam Sensor arm. A plumb bob was used to project the top center of the arm onto the deck. A plumb bob was also used to project the center of the bottom of the Multibeam Sensor can onto the deck. An inverse was computed between these two surveyed positions for a length value of 1.544(m).

DISCUSSION

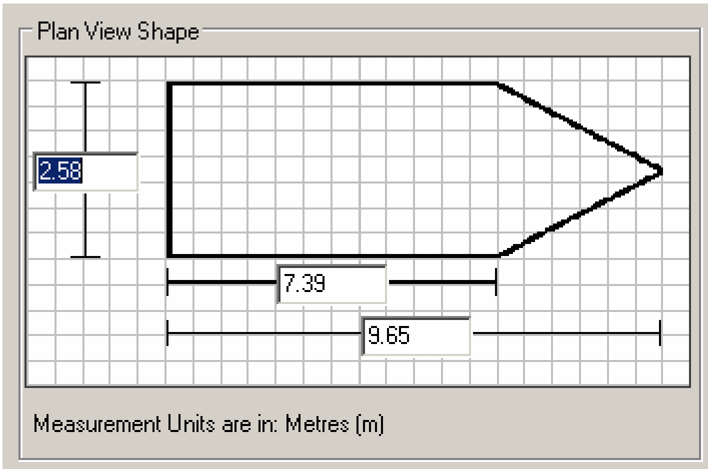
All sensor/benchmark coordinates are contained in spreadsheet "S3002.xls. Included in this spreadsheet is the Multibeam Sensor arm length measurement and also an IMU GPS antenna separation value.

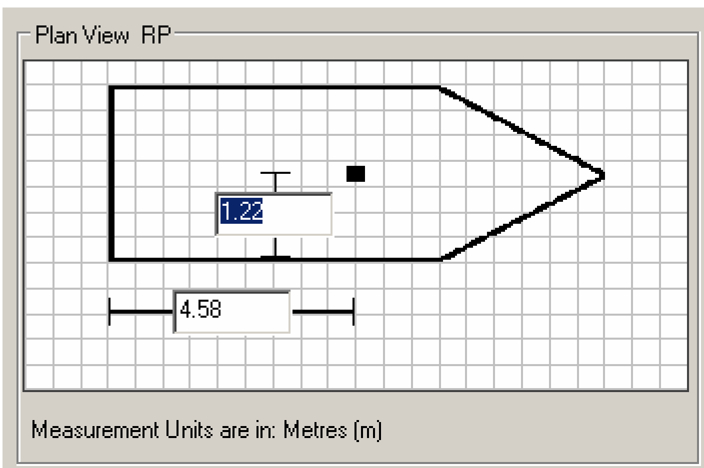
The positions given for all GPS antenna are to the top center of the antenna. To correct the Z value contained in the spreadsheet for each antenna to the electronic phase center, I recommend the following steps be taken;

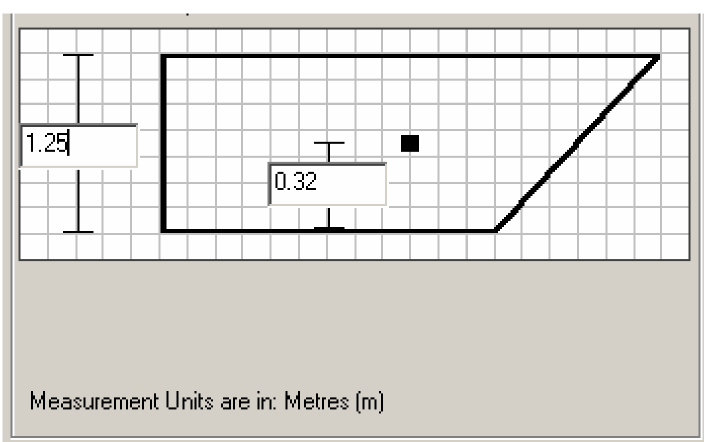
1) Measure the total height of each antenna type. This information is probably located on the antenna or with equipment documentation.
2) Investigate to find the electronic phase center offset of the antenna. This information is probably located on the antenna or with equipment documentation. This value may also be available at the NGS website for antenna modeling.
3) Subtract the total height of the antenna from the spreadsheet Z value for each antenna. This will give you a Z value for the antenna ARP (antenna reference point)
4) Then add to this value the electronic phase center offset value.

S3002 Boat Shape Characteristics

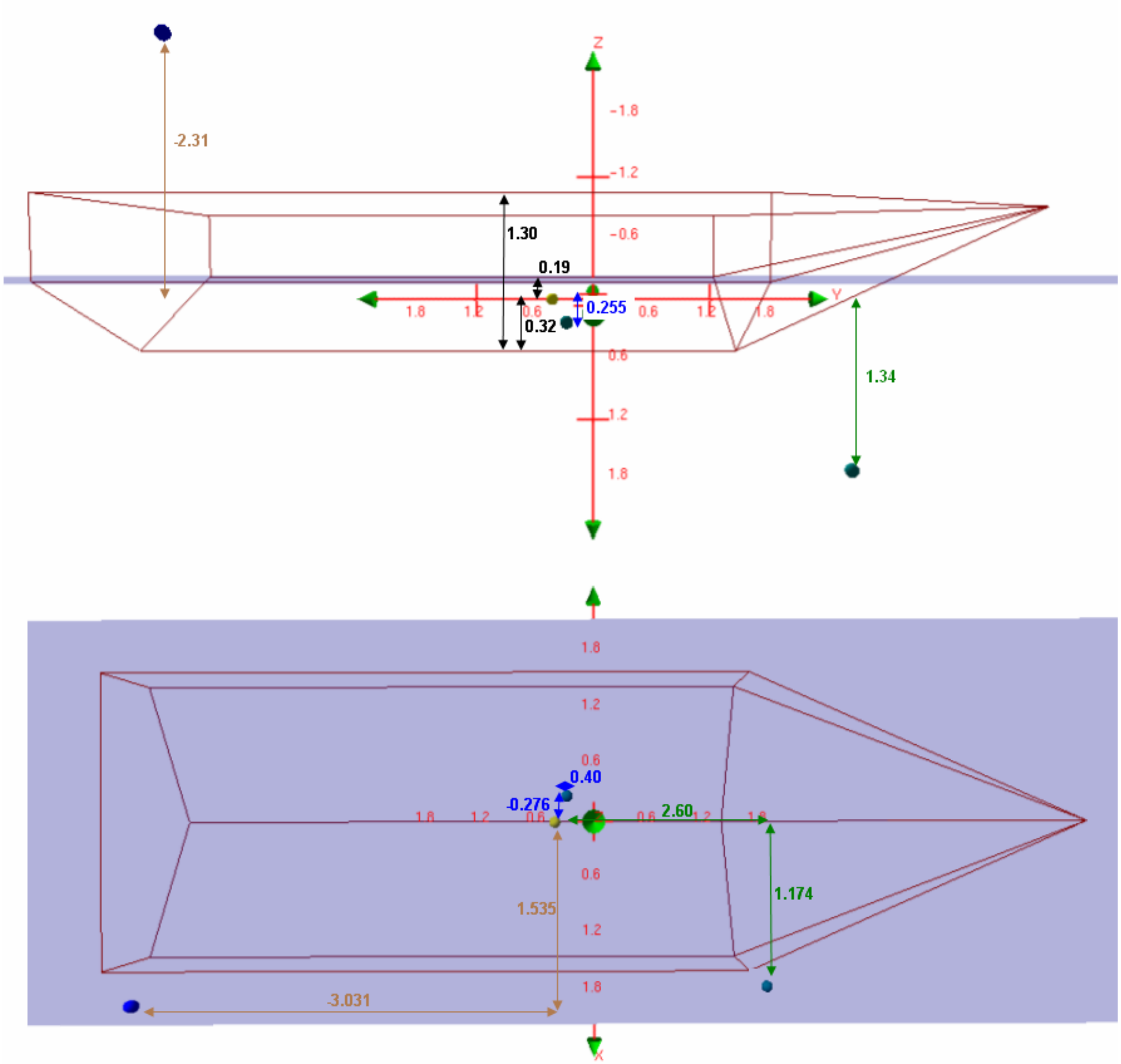
Boat shape characteristics for the Caris HVF were updated using both the final line drawings provided by SeaArk Marine Inc., and measurements taken by NRT-5 personnel.



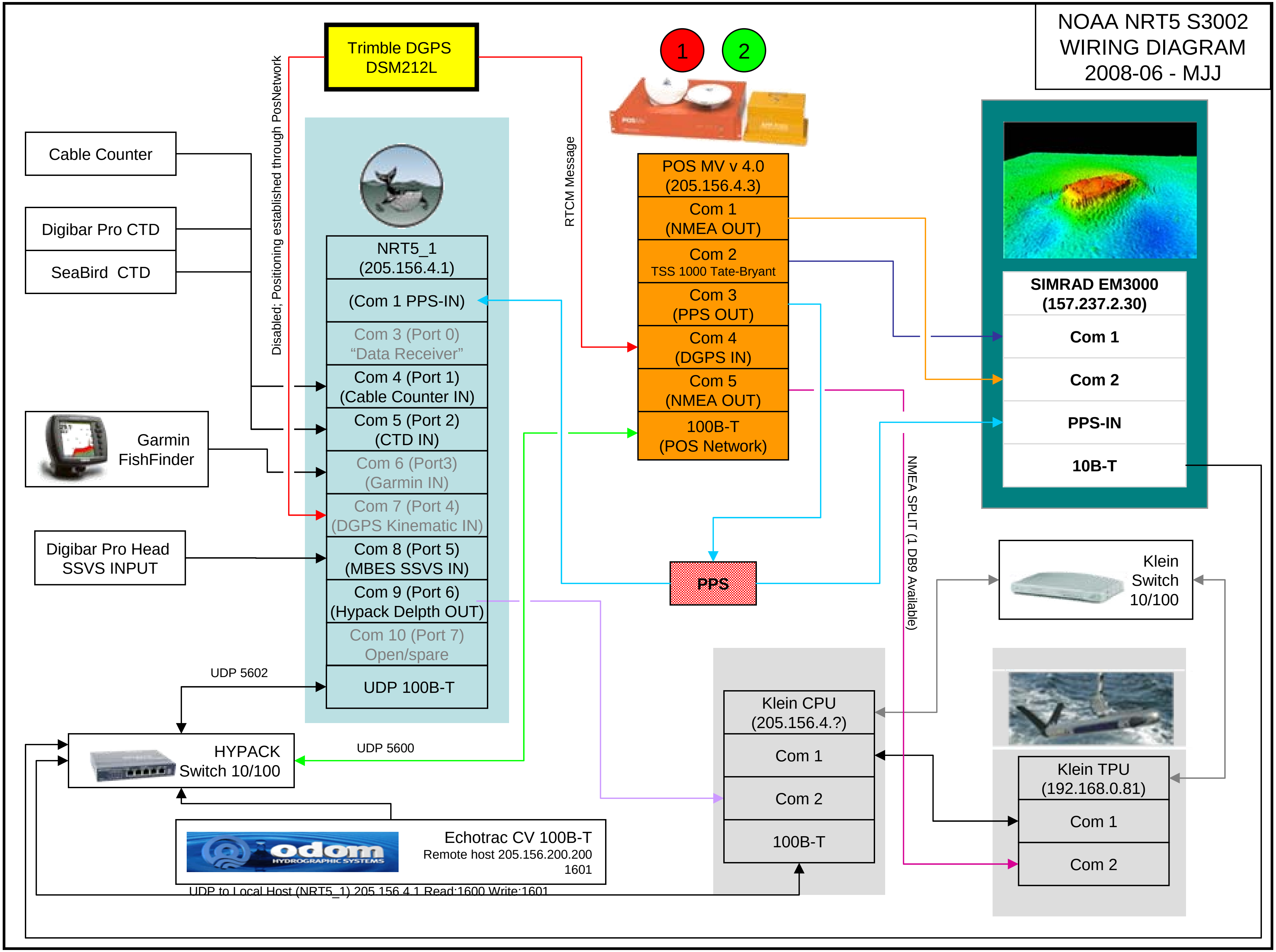




Caris Offsets for sonar transducers.



S3002 Caris HVF Transducer Offsets:			
Object	x	y	z
IMU	0.000	0.000	0.000
Odom Echotrac VBES	-0.276	0.400	0.255
Simrad EM3000 MBES	1.174	2.600	1.340
Klein 3000 SSS	1.535	-3.031	-2.310



NOAA NRT5 S3002
WIRING DIAGRAM
2008-06 - MJJ
Trimble DGPS
DSM212L
1
2
Cable Counter
Digibar Pro CTD
SeaBird CTD
Garmin
FishFinder
Digibar Pro Head
SSVS INPUT
Disabled; Positioning established through PosNetwork
RTCM Message
NRT5_1
(205.156.4.1)
(Com 1 PPS-IN)
Com 3 (Port 0)
"Data Receiver"
Com 4 (Port 1)
(Cable Counter IN)
Com 5 (Port 2)
(CTD IN)
Com 6 (Port3)
(Garmin IN)
Com 7 (Port 4)
(DGPS Kinematic IN)
Com 8 (Port 5)
(MBES SSVS IN)
Com 9 (Port 6)
(Hypack Delpth OUT)
Com 10 (Port 7)
Open/spare
UDP 100B-T
POS MV v 4.0
(205.156.4.3)
Com 1
(NMEA OUT)
Com 2
TSS 1000 Tate-Bryant
Com 3
(PPS OUT)
Com 4
(DGPS IN)
Com 5
(NMEA OUT)
100B-T
(POS Network)
SIMRAD EM3000
(157.237.2.30)
Com 1
Com 2
PPS-IN
10B-T
NMEA SPLIT (1 DB9 Available)
PPS
Klein
Switch
10/100
Klein CPU
(205.156.4.?)
Com 1
Com 2
100B-T
Klein TPU
(192.168.0.81)
Com 1
Com 2
UDP 5602
UDP 5600
HYPACK
Switch 10/100
Echotrac CV 100B-T
Remote host 205.156.200.200
1601
odom
HYDROGRAPHIC SYSTEMS
UDP to Local Host (NRT5_1) 205.156.4.1 Read:1600 Write:1601

APPENDIX III

VESSEL DYNAMIC OFFSETS

S3002
Dynamic Draft Test 17 April 2008

LT(jg) Matthew Jaskoski

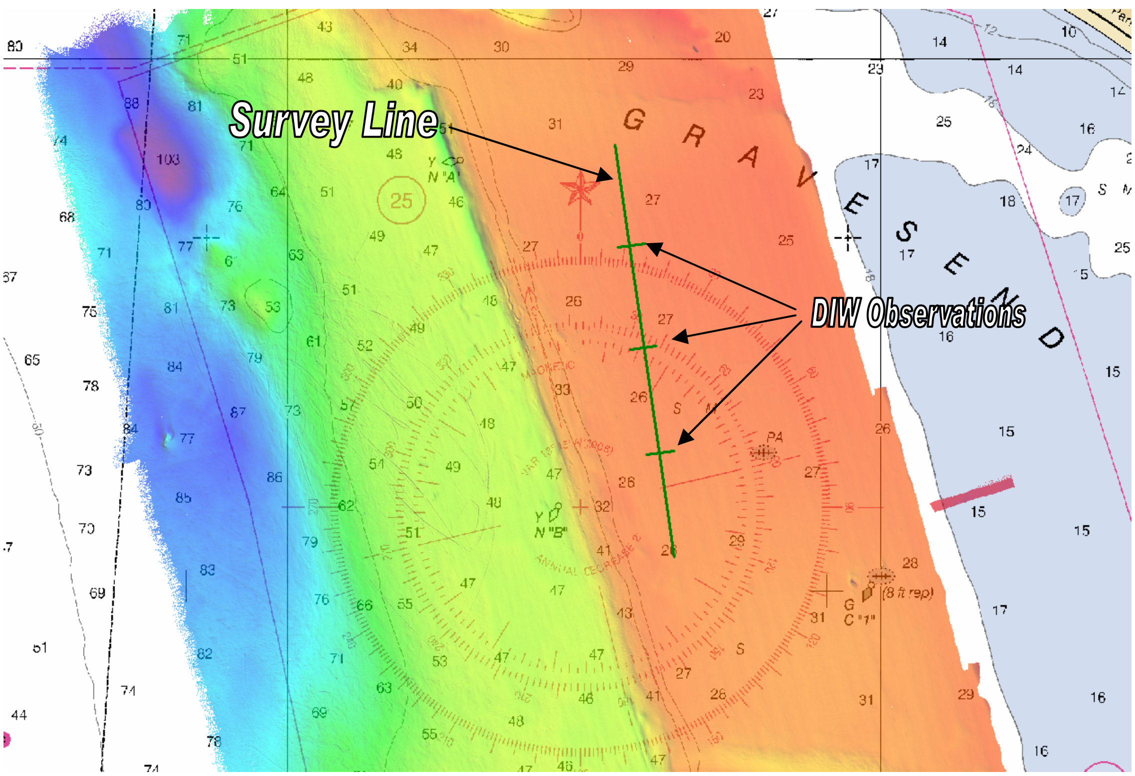
Background:

NRT-5 is capable of acquiring both bathymetry data and side scan sonar imagery. Accuracy in data processing is in part dependent on the determination of the change in vessel draft in relation to vessel speed through the water. This test empirically determines the dynamic draft of S3002 using the multibeam echosounder method.

Location, Date, and Personnel:

Sonar data were acquired at Gravesend Bay, New York Harbor, NY (Figure 1) on April 17 2008 (DN 108) by LT(jg) Matthew Jaskoski (OIC), PST Bert Ho (launch coxswain), and PST Jack Herbert (data recorder).

Figure 1: Work Site



Equipment:

TSS POS/MV version 4 + Precise Timing
Aero Antenna DSM 212L DGPS receiver
Kongsberg Simrad EM 3000
Odom Digibar Pro Sound Velocimeter

Procedure:

Data Acquisition:

Data were acquired over a flat relatively shallow area (appx. 8m water depth) of the Gravesend Bay anchorage. The survey area is located as close as is practicable to the Battery Park Harmonic water level station. The survey time was planned to coincide as closely as practicable to slack water, however there was still a pronounced current (approximately 1.5 knots). Due to the current S3002 made repeated passes at various speed intervals over the survey line in both directions. However, at low speeds it was impossible to make way into the current, these lines were run only in one direction. The change in draft for a vessel of this size and weight is minimal at slow speed and it is unlikely that this inability to collect data in apposing directions at slow speed adversely affected the results. The survey line was approximately 1000m in length, and dead in the water (DIW) data were acquired at positions 250m, 500m and 750m along the line. A sound velocity cast was taken near the survey area.

Data Processing:

Data were converted and processed in accordance with established protocols with the following exceptions; 1) True heave was not applied as long period heave may bias dynamic draft calculations – random short period heave will be canceled out by using the median reference surface depth, and 2) a dummy dynamic draft table was created in the HVF to ensure that historic dynamic draft measurements would not be applied to the dataset. Subsets were cleaned of fliers and Uncertainly weighted surfaces were generated at 0.75m resolution. Surfaces were queried for depth and standard deviation these values were entered into an Excel spreadsheet where the median was calculated for depth and the mean was calculated for standard deviation. Vessel speed was queried in the subsets, entered in the Excel spread sheet and averaged for all subsets. The dynamic draft offset was calculated for each reference area by subtracting the median reference surface depth from median depths for each RPM/speed interval. The mean dynamic draft was calculated by averaging the median values for the subsets at ¼ and ¾ the length of the line (subsets A and C).

These values are tabulated below.

Table 1: Dynamic Draft Offset Data

S3002 Dynamic Draft: 17 April 2008, DN 108						
RPM	Speed (kts)	Median A (m)	Median B (m)	Median C (m)	Std. Dev.	Mean (m)
Idle	0.00	0.00	0.00	0.00	0.05	0.00
900 (1 engine)	2.63	0.01	-0.04	-0.02	0.04	-0.01
900 (both engines)	3.21	-0.04	0.00	-0.03	0.04	-0.03
2000 (Both)	6.08	-0.05	-0.03	-0.02	0.04	-0.04
2200 (Both)	6.96	-0.05	0.01	-0.04	0.04	-0.05

Figure 2: Dynamic Draft Offset Data

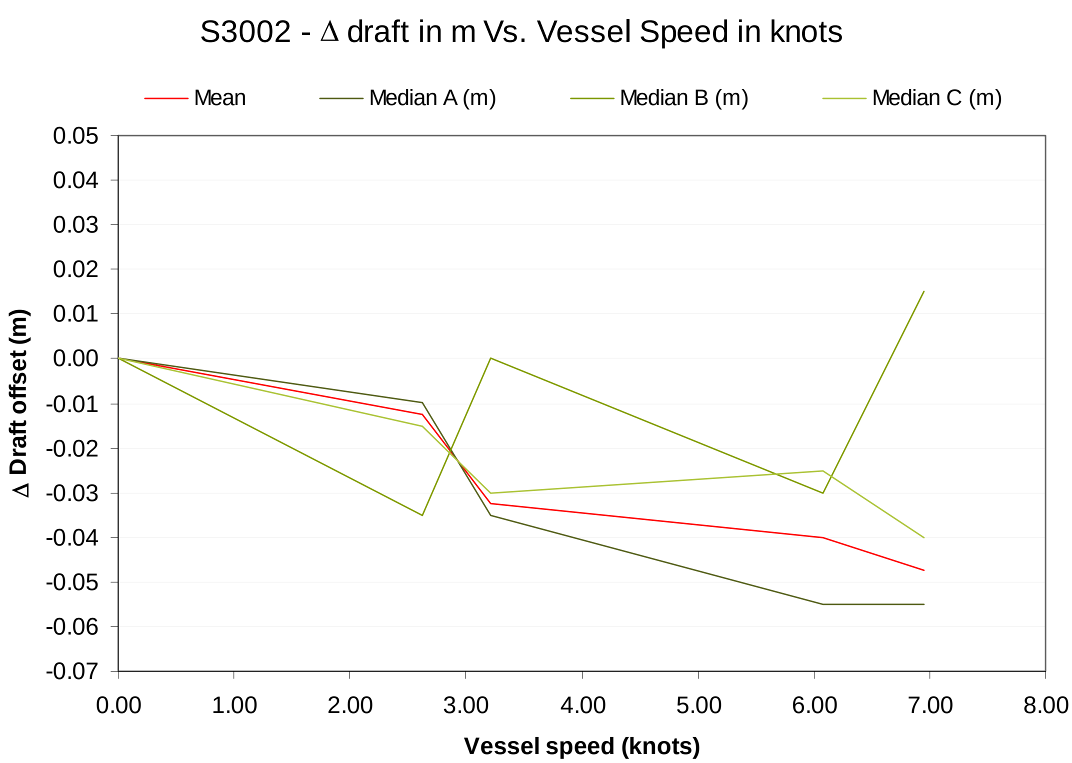
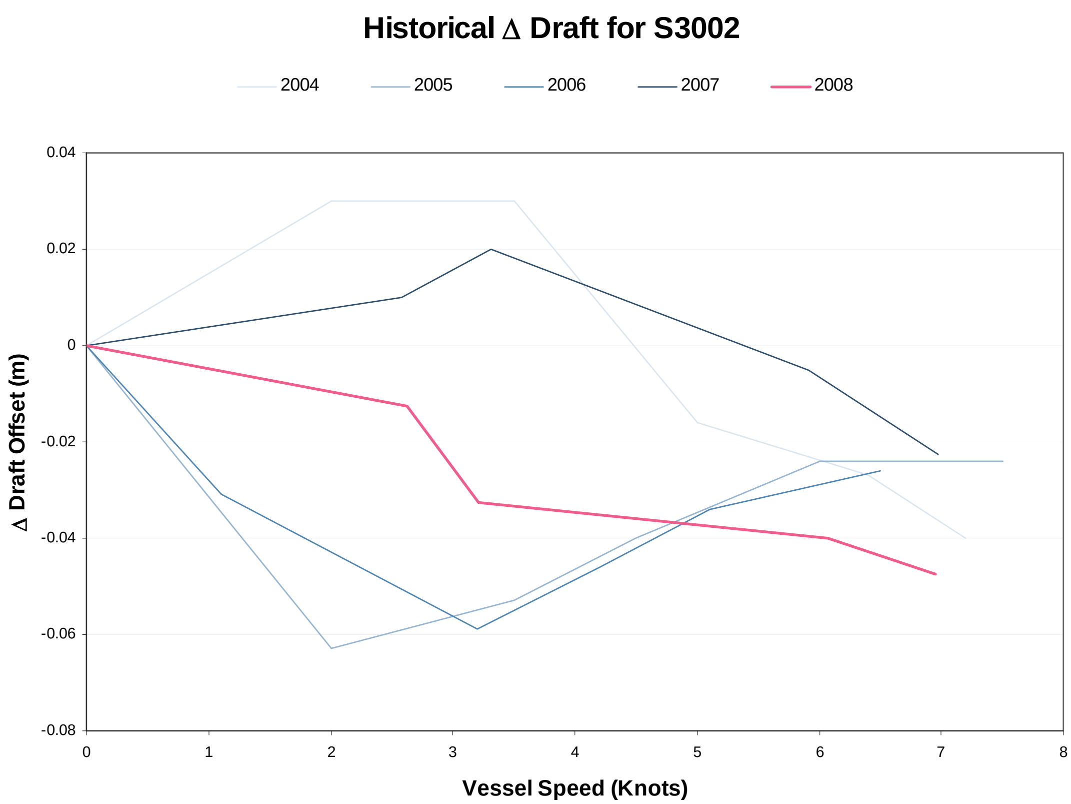


Figure 3: Historical Dynamic Draft Offset Data for S3002



Conclusions:

The multibeam echosounder method of determining the dynamic draft has yielded acceptable results, current dynamic draft numbers fall within the range of previous years' results.

S3002
Static Draft Test 16 April 2008

LT(jg) Matthew Jaskoski

Background:

NRT-5 is capable of acquiring both bathymetry data and side scan sonar imagery. Accuracy in data processing is in part dependent on the determination of the vessel draft in relation to the reference point (IMU). This test empirically determines the dynamic draft of S3002.

Intro:

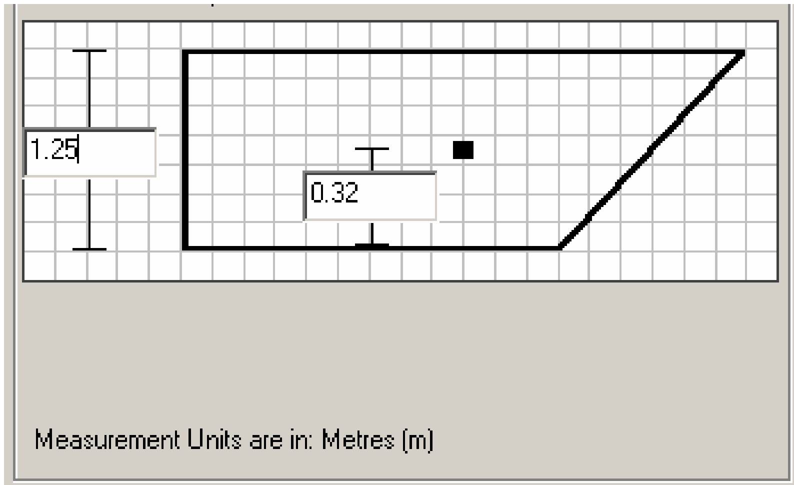
The Static Draft measurements were taken on 16 April 2008 by NRT 5 personnel.

Procedure:

Waterline measurements were made using a nylon tape measure with attached lead weight measured from the vessel rubrail to the waterline. The measurement point was laterally offset from the IMU by approximately 1.22m to STBD and approximately 1.50m to port. Draft was determined by subtracting the waterline measurement from the freeboard and draft of the hull (fig 1). Vessel freeboard and draft were determined while the vessel was trailered. Measurements were taken from the rubrail reference point to the ground and from the ground to the keel. Freeboard and draft was determined by subtracting the ground to keel measurement from the rubrail reference point to ground measurement. Freeboard and draft was determined to be 1.25m at the rubrail reference point. IMU draft was determined by measuring from the verticalbeam echosounder (VBES) transducer face to the keel. The distance from the transducer face to the keel was determined to be 0.065m The VBES transducer face has a surveyed vertical offset from the IMU or 0.255m. IMU draft was determined by adding the transducer to keel measurement to the IMU to transducer face offset, i.e. 0.320m (fig. 1).

IMU draft was also measured by leadline comparison. Leadline measurements were made by PSTs Ho and Herbert using a nylon tape measure with attached lead weight. Measurements were taken at the rubrail reference point. Simultaneously LT(jg) Jaskoski recorded raw echosounder data on a log sheet. The transducer to IMU offset was applied to raw echosounder depths. IMU draft was determined by subtracting the leadline measurement from the sum of the raw echosounder depth and IMU offset (Table 2).

Figure 1. Vessel freeboard and IMU Draft



Results:

Static draft offset was calculated at -0.19m.

Table 1 Calculation of Static Draft offset using tape measure

S3002 Static Draft			
WL measurement	Side	Draft (1.25-WL)	IMU Draft (Draft-0.32)
0.75	Port	0.50	0.18
0.75	Port	0.50	0.18
0.75	Port	0.50	0.18
0.73	STBD	0.52	0.20
0.73	STBD	0.52	0.20
0.73	STBD	0.52	0.20

Caris Offset	-0.19

Table 2 Calculation of Static Draft offset check using VBES and Leadline

S3002 SingleBeam Leadline Check					
		A=	B=	C=	D=B-(A+C)
		Raw VBES Depth	Leadline Reading	VBES offset	IMU Draft
ES Type	Time	Txdcr to Bottom	WL to Bottom	IMU to Txdcr	IMU to WL
Echotrac CV	13:22	2.36	2.72	0.255	0.11
Echotrac CV	13:23	2.40	2.74	0.255	0.09
Echotrac CV	13:24	2.35	2.70	0.255	0.10
Echotrac CV	13:25	2.28	2.68	0.255	0.15

Caris Offset					-0.11

The mean value of both these methods agree to within 8cm.

Conclusions:

Due to making several measurements - both from the reference point and to the waterline - draft determination using this method is subject to multiple points of potential error. A better method of draft determination would be to use a bubble tube. However, S3002 is not equipped with a bubble tube. This method of determining IMU draft has yielded acceptable results.

APPENDIX IV

CALIBRATION

POS/MV Calibration Report

Field Unit: NRT-5

SYSTEM INFORMATION

Vessel: S3002

Date: 4/17/2008 **Dn:** 108

Personnel: Jaskoski, Ho, Herbert

PCS Serial # 2034

IP Address: 205.156.4.3

POS controller Version (Use Menu Help > About) 3.3

POS Version (Use Menu View > Statistics) MV320 Ver4

GPS Receivers

Primary Receiver SGN 99330009

Secondary Receiver SGN 98370085

CALIBRATION AREA

Location: Gravesend Bay, NY

Approximate Position:

	D	M	S
Lat	40	35	51
Lon	74	1	51

DGPS Beacon Station: Sandy Hook

Frequency: 286 kHZ

Satellite Constellation

Primary GPS (Port Antenna)

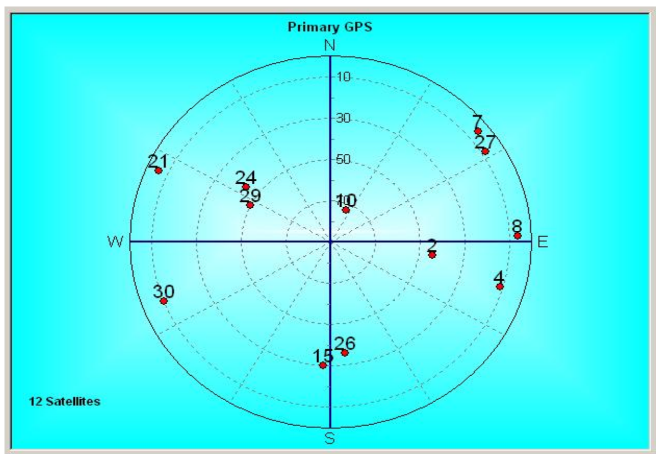
HDOP: 0.741

VDOP: 0.985

Sattelites in Use: 12

2,4,7,8,10,15,21,24,26,27,29,30

PDOP 2.030 (Use View> GAMS Solution)



Note: Secondary GPS satellite constellation and number of satellites were exactly the same as the Primary GPS

SV	2	4	7	8	10	15	21	24	26	27	29	30
Status	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc	L1 ph lc
Azimuth	98.0	106.0	51.0	88.0	24.0	183.0	294.0	305.0	173.0	58.0	296.0	249.0
Elevatior	44.0	11.0	5.0	6.0	73.0	30.0	6.0	44.0	36.0	8.0	50.0	10.0
L1 SNR	47.0	36.8	41.5	39.5	50.0	46.3	38.0	47.0	46.0	34.8	48.0	40.5
L2 SNR	36.3	20.5	20.5	17.8	41.8	33.5	16.3	35.0	32.5	19.0	38.8	21.5

POS/MV CONFIGURATION

Settings

Gams Parameter Setup (Use Settings > Installation > GAMS Intallation)

User Entries, Pre-Calibration		Baseline Vector	
1.54	Two Antenna Separation (m)	**-0.025**	X Component (m)
0.50	Heading Calibration Threshold	**1.54**	YComponent (m)
0	Heading Correction	**-0.007**	Z Component (m)

Configuration Notes:

POS/MV CALIBRATION

Calibration Procedure:

(Refer to POS MV V3 Installation and Operation Guide, 4-25)

Start time: 13:32 UTC

End time: 13:34 UTC

Heading accuracy achieved for calibration: 0.024

Calibration Results:

Gams Parameter Setup (Use Settings > Installation > GAMS Intallation)

POS/MV Post-Calibration Values		Baseline Vector	
1.543	Two Antenna Separation (m)	**-0.022**	X Component (m)
0.500	Heading Calibration Threshold	**1.543**	YComponent (m)
0	Heading Correction	**-0.007**	Z Component (m)

GAMS Status Online? Y

Save Settings? Y

Calibration Notes:

Save POS Settings on PC (Use File > Store POS Settings on PC)

File Name: 2007_06_25

GENERAL GUIDANCE

The POS/MV uses a Right-Hand Orthogonal Reference System

The right-hand orthogonal system defines the following:

- The x-axis is in the fore-aft direction in the appropriate reference frame.
- The y-axis is perpendicular to the x-axis and points towards the right (starboard) side in the appropriate reference frame.
- The z-axis points downwards in the appropriate reference frame.

The POS/MV uses a Tate-Bryant Rotation Sequence

Apply the rotation in the following order to bring the two frames of reference into complete alignment:

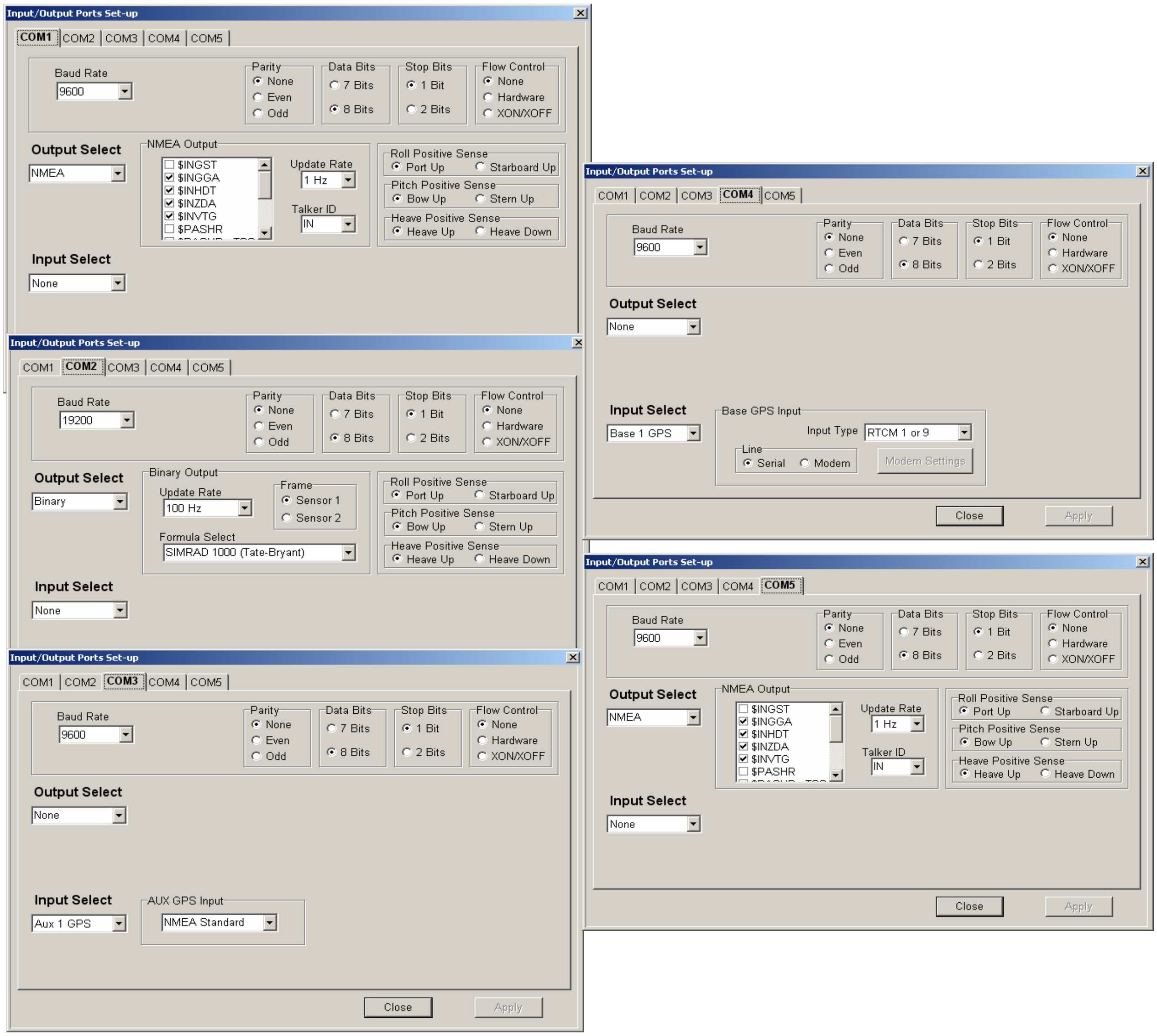
a) Heading rotation - apply a right-hand screw rotation θz about the z-axis to align one frame with the other.

b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

c) Roll rotation - apply a right-hand screw rotation θx about the twice-rotated x-axis to align one frame with the other.

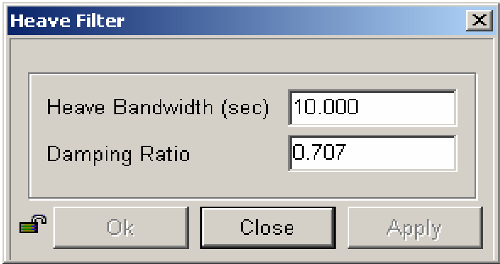
SETTINGS (insert screen grabs)

Input/Output Ports (Use Settings > Input/Output Ports)

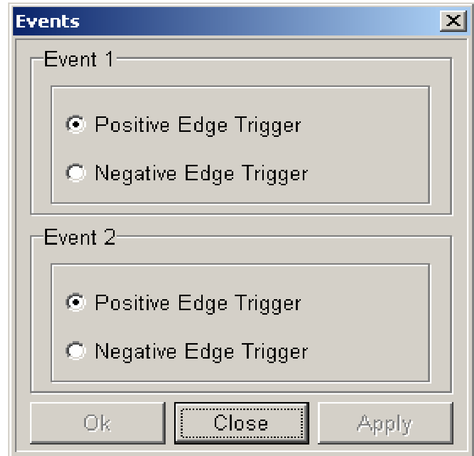


NOTE: COM3 and Analog are not used.

Heave Filter (Use Settings > Heave)

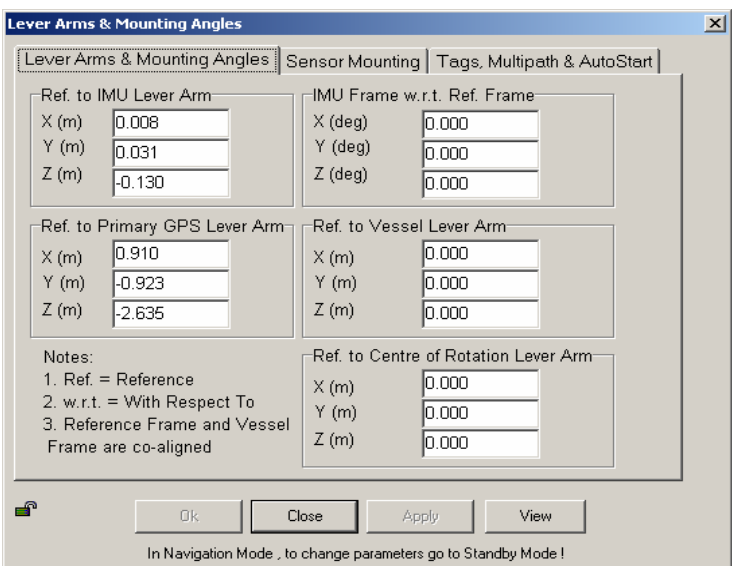


Events (Use Settings > Events)

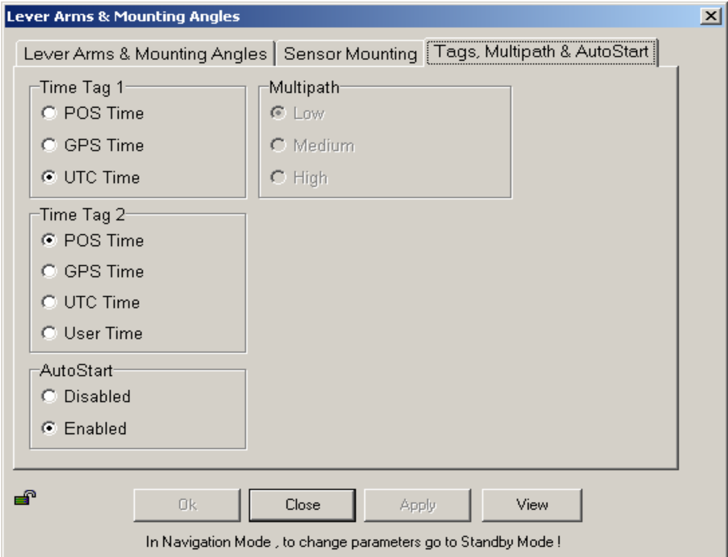


Time Sync (Use Settings > Time Sync)

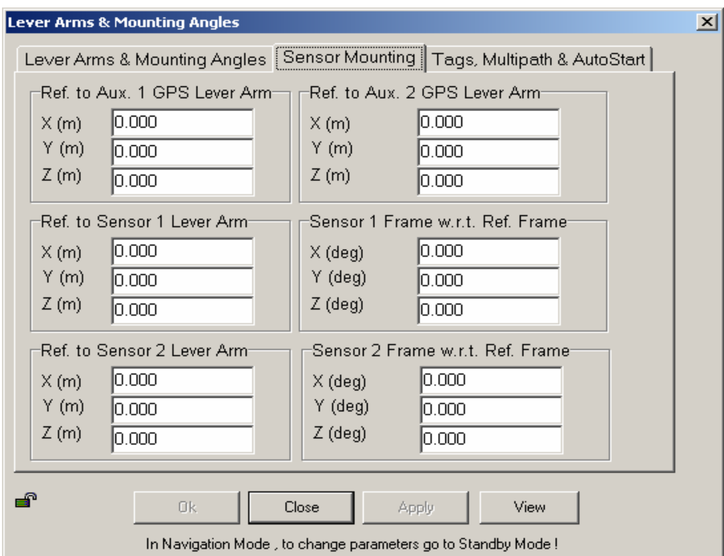
Installation (Use Settings > Installation)



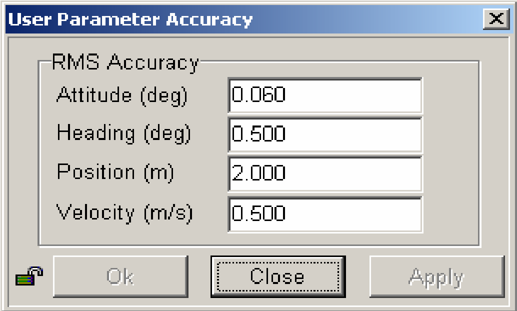
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



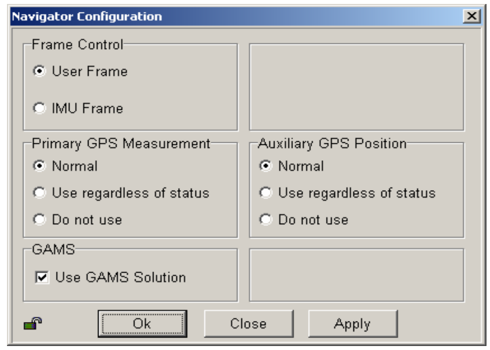
Sensor Mounting (Use Settings > Installation > Sensor Mounting)



User Parameter Accuracy (Use Settings > Installation > User Accuracy)



Frame Control (Use Tools > Config)



GPS Receiver Configuration (Use Settings> Installation> GPS Receiver Configuration)

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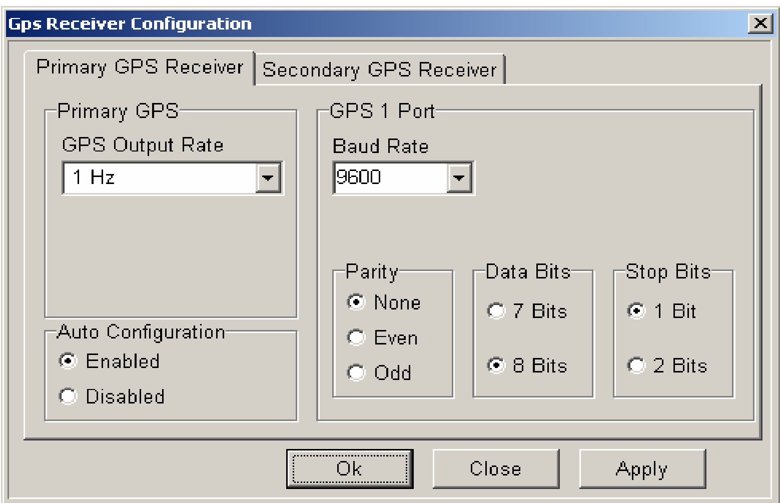

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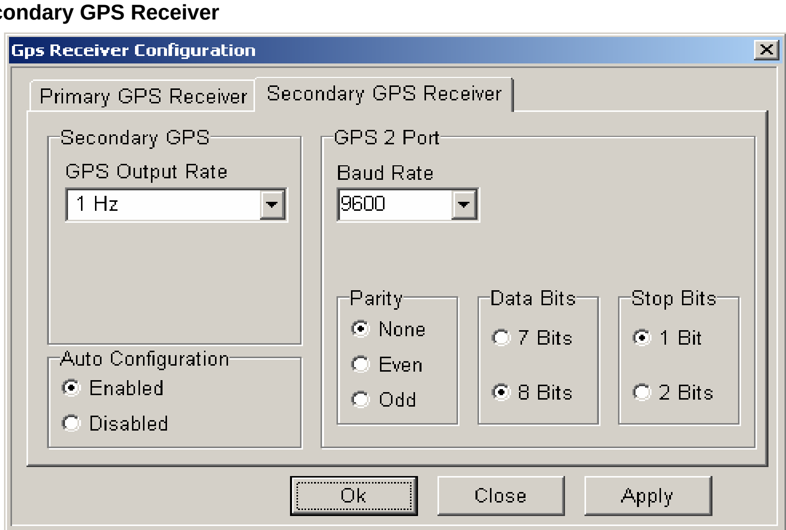

Date:
Jun 24, 2008

Serial #:
98212-062408

DIGIBAR CALIBRATION REPORT

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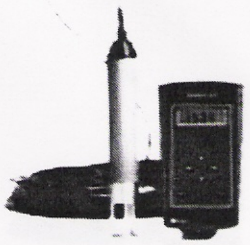

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
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4.50	1423.90	5557.30	1424.17	0.27
5.00	1426.15	5565.28	1426.27	0.11
5.50	1428.38	5574.12	1428.59	0.21
6.00	1430.58	5582.02	1430.67	0.09
6.50	1432.75	5590.44	1432.89	0.14
7.00	1434.90	5598.63	1435.04	0.15
7.50	1437.02	5606.84	1437.20	0.18
8.00	1439.12	5614.34	1439.18	0.06
8.50	1441.19	5622.23	1441.26	0.07
9.00	1443.23	5630.21	1443.36	0.12
9.50	1445.25	5637.84	1445.36	0.11
10.00	1447.25	5644.92	1447.23	-0.02
10.50	1449.22	5652.71	1449.28	0.05
11.00	1451.17	5659.90	1451.17	0.00
11.50	1453.09	5666.85	1453.00	-0.10
12.00	1454.99	5674.26	1454.95	-0.05
12.50	1456.87	5681.38	1456.82	-0.05
13.00	1458.72	5688.38	1458.67	-0.06
13.50	1460.55	5695.47	1460.53	-0.02
14.00	1462.36	5702.58	1462.40	0.04
14.50	1464.14	5708.42	1463.94	-0.21
15.00	1465.91	5715.56	1465.82	-0.09
15.50	1467.65	5722.21	1467.57	-0.08
16.00	1469.36	5729.18	1469.40	0.04
16.50	1471.06	5735.22	1470.99	-0.06
17.00	1472.73	5741.58	1472.67	-0.06

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
17.50	1474.38	5747.84	1474.31	-0.07
18.00	1476.01	5753.91	1475.91	-0.10
18.50	1477.62	5759.86	1477.48	-0.14
19.00	1479.21	5765.90	1479.07	-0.14
19.50	1480.77	5771.36	1480.50	-0.27
20.00	1482.32	5777.74	1482.18	-0.13
20.50	1483.84	5783.55	1483.71	-0.13
21.00	1485.35	5789.76	1485.35	0.00
21.50	1486.83	5795.26	1486.80	-0.03
22.00	1488.29	5800.65	1488.21	-0.08
22.50	1489.74	5806.17	1489.67	-0.07
23.00	1491.16	5811.45	1491.06	-0.10
23.50	1492.56	5816.99	1492.51	-0.05
24.00	1493.95	5821.95	1493.82	-0.13
24.50	1495.32	5827.12	1495.18	-0.13
25.00	1496.66	5832.37	1496.56	-0.10
25.50	1497.99	5837.75	1497.98	-0.01
26.00	1499.30	5842.75	1499.29	0.00
26.50	1500.59	5847.49	1500.54	-0.05
27.00	1501.86	5852.30	1501.81	-0.05
27.50	1503.11	5856.98	1503.04	-0.07
28.00	1504.35	5861.68	1504.28	-0.07
28.50	1505.56	5866.92	1505.66	0.09
29.00	1506.76	5871.49	1506.86	0.10
29.50	1507.94	5875.87	1508.01	0.07
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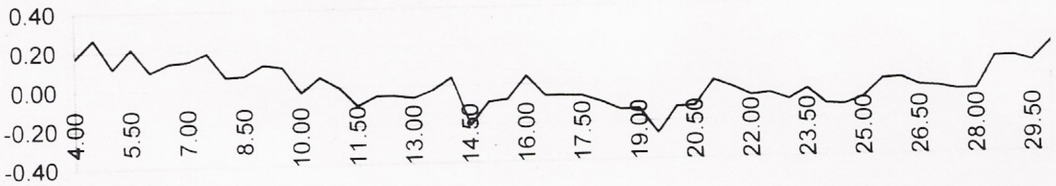

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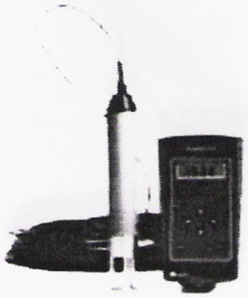

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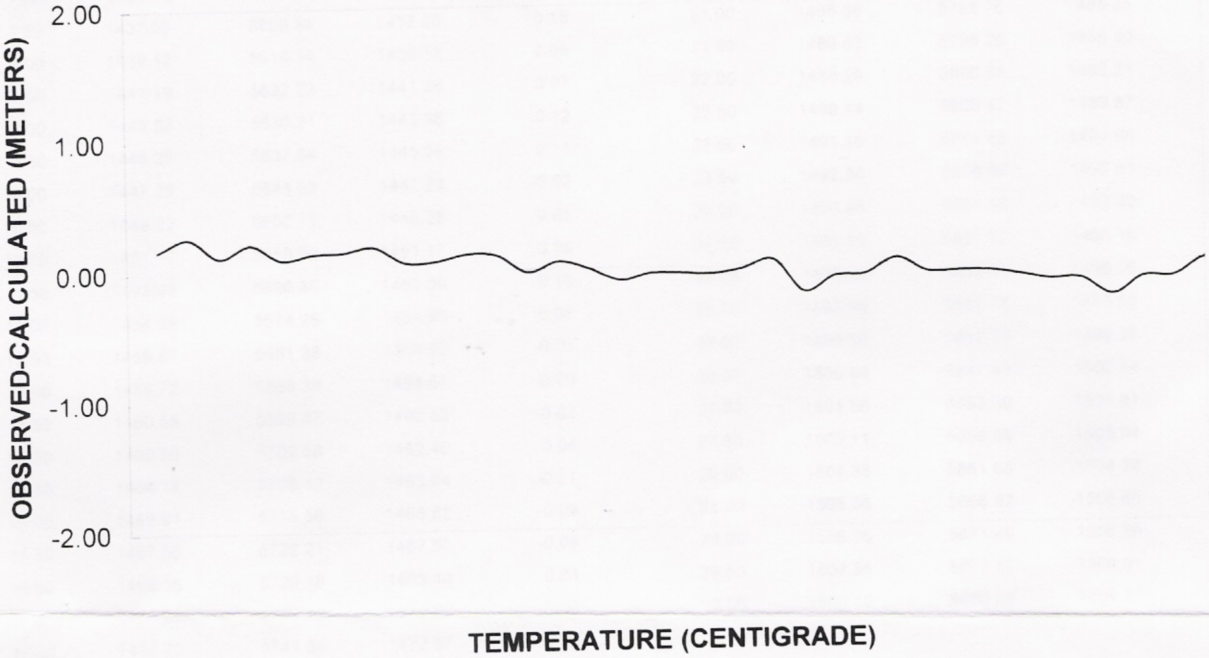
Calibration Graph



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Date:
Jun 20. 2008

Serial #:
98214-062008

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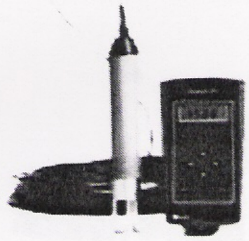

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
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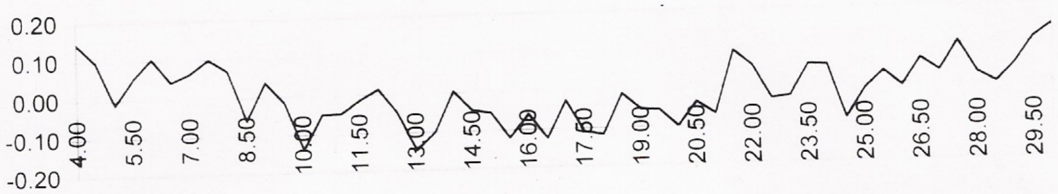
4.50	1423.90	5565.64	1424.00	0.10
5.00	1426.15	5573.76	1426.14	-0.01
5.50	1428.38	5582.45	1428.43	0.05
6.00	1430.58	5590.98	1430.68	0.10
6.50	1432.75	5598.99	1432.80	0.04
7.00	1434.90	5607.21	1434.96	0.06
7.50	1437.02	5615.39	1437.12	0.10
8.00	1439.12	5623.22	1439.19	0.07
8.50	1441.19	5630.58	1441.13	-0.06
9.00	1443.23	5638.71	1443.27	0.04
9.50	1445.25	5646.17	1445.24	-0.02
10.00	1447.25	5653.27	1447.11	-0.14
10.50	1449.22	5661.09	1449.17	-0.05
11.00	1451.17	5668.48	1451.12	-0.05
11.50	1453.09	5675.90	1453.08	-0.01
12.00	1454.99	5683.21	1455.01	0.01
12.50	1456.87	5690.09	1456.82	-0.05
13.00	1458.72	5696.74	1458.58	-0.15
13.50	1460.55	5703.85	1460.45	-0.10
14.00	1462.36	5711.10	1462.37	0.00
14.50	1464.14	5717.67	1464.10	-0.05
15.00	1465.91	5724.32	1465.85	-0.05
15.50	1467.65	5730.66	1467.52	-0.12
16.00	1469.36	5737.40	1469.30	-0.06
16.50	1471.06	5743.58	1470.93	-0.12
17.00	1472.73	5750.29	1472.70	-0.03
17.50	1474.38	5756.24	1474.27	-0.11
18.00	1476.01	5762.39	1475.89	-0.12
18.50	1477.62	5768.88	1477.61	-0.01
19.00	1479.21	5774.74	1479.15	-0.05
19.50	1480.77	5780.67	1480.72	-0.06
20.00	1482.32	5786.36	1482.22	-0.10
20.50	1483.84	5792.38	1483.80	-0.04
21.00	1485.35	5797.96	1485.28	-0.07
21.50	1486.83	5804.20	1486.92	0.09
22.00	1488.29	5809.60	1488.35	0.05
22.50	1489.74	5814.75	1489.70	-0.03
23.00	1491.16	5820.17	1491.13	-0.03
23.50	1492.56	5825.80	1492.62	0.05
24.00	1493.95	5831.04	1494.00	0.05
24.50	1495.32	5835.69	1495.23	-0.09
25.00	1496.66	5841.08	1496.65	-0.01
25.50	1497.99	5846.28	1498.02	0.03
26.00	1499.30	5851.09	1499.29	-0.01
26.50	1500.59	5856.25	1500.65	0.06
27.00	1501.86	5860.94	1501.89	0.03
27.50	1503.11	5865.98	1503.22	0.11
28.00	1504.35	5870.35	1504.37	0.02
28.50	1505.56	5874.86	1505.56	0.00
29.00	1506.76	5879.58	1506.80	0.04
29.50	1507.94	5884.31	1508.05	0.11
30.00	1509.10	5888.85	1509.25	0.15



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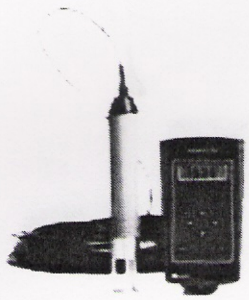

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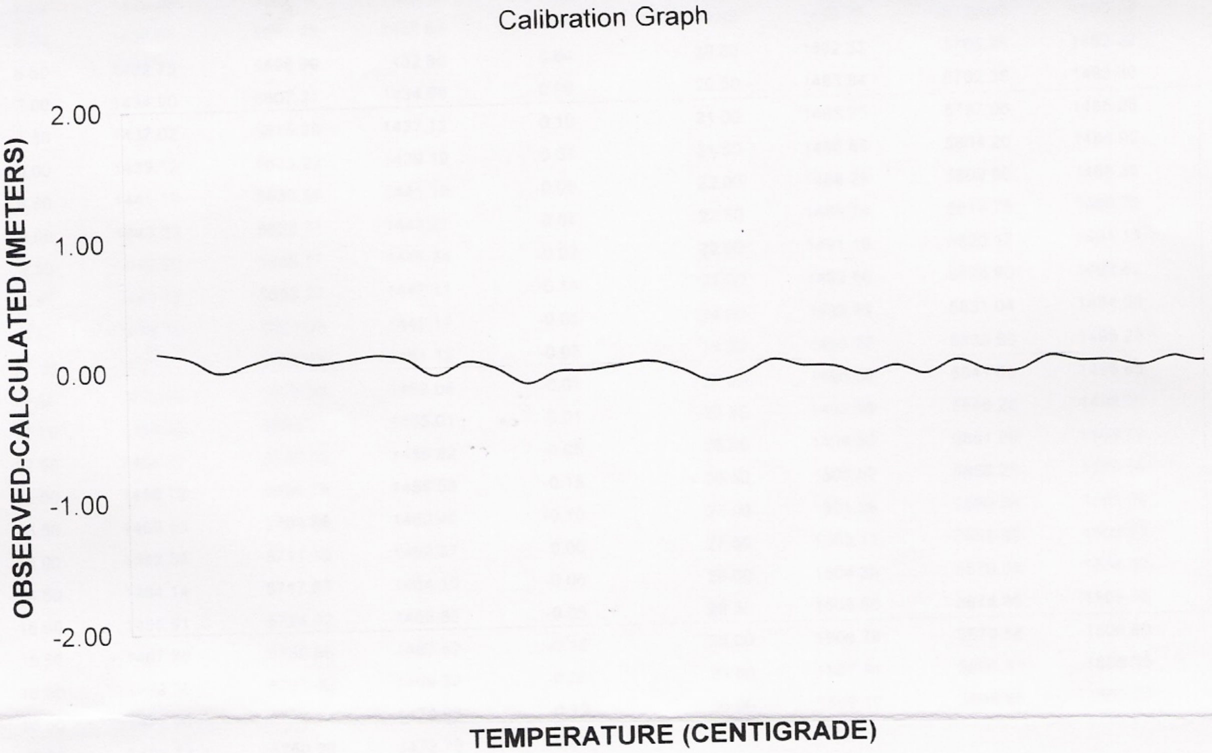

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S3002
Leadline Comparison 16 April 2008

LT(jg) Matthew Jaskoski

Background:

NRT-5 is capable of acquiring both bathymetry data and side scan sonar imagery. Accuracy in echosounder data is in part determined by a comparison of echosounder depth measurements to leadline measurements taken in relation to the reference point (IMU). This test empirically compares leadline depth to transducer depth measurements for S3002.

Intro:

The Leadline comparison for both singlebeam echosounder (VBES) and multibeam echosounder (MBES) was conducted on 16 April 2008 by NRT 5 personnel PSTs Bert Ho, Jack Herbert and LT(jg) Matthew Jaskoski. Results of these comparisons are tabulated in Table 1 and Table 2 respectively.

Procedure:

Leadline measurements were made by PSTs Ho and Herbert using a nylon tape measure with attached lead weight. Measurements were taken at the waterline. The measurement point was laterally offset from the IMU by approximately 1.22m to STBD and approximately 1.50m to port. Simultaneously LT(jg) Jaskoski recorded raw echosounder nadir beam data on a log sheet. Transducer and IMU draft measurements were applied to raw echosounder depths. Transducer error was then determined by subtracting the transducer readings from the leadline measurement (see Tables 1 & 2). Leadline measurements taken off port side were compared to VBES data, leadline measurements take off starboard side were compared to MBES data.

Results:

The average error for VBES depth was 0.08m; meaning vertical beam depth was on average 8cm deeper than leadline measurements. Similarly, average MBES depth was 0.22m or 22cm deeper than leadline depth. Both of these differences are within IHO order 1 allowable sounding error.

Conclusions:

The leadline comparison has yielded acceptable results.

LEADLINE COMPARISON:

Vessel: **S3002**
Date: **04/16/2008**
Depth units: **Meters**
LAT: **40° 40.76'**
LON: **074° 02.59'**

Table 1: Leadline comparison data for Odom Echotrac C/V 200 VBES

SingleBeam		A= Raw VBES Depth	B= Leadline Reading	C= Draft	D= Draft	(A+C+D)-B Raw Depth Correction
ES Type	Time	Txdcr to Bottom	WL to Bottom	IMU to Txdcr	IMU to WL	Error
Echotrac CV	13:22	2.36	2.72	0.255	0.19	0.08
Echotrac CV	13:23	2.40	2.74	0.255	0.19	0.11
Echotrac CV	13:24	2.35	2.70	0.255	0.19	0.09
Echotrac CV	13:25	2.28	2.68	0.255	0.19	0.04

Table 2: Leadline comparison data for Kongsberg-Simrad EM3000 MBES

Multibeam		A= Raw MBES Depth	B= Leadline Reading	C= Draft	D= Draft	(A+C+D)-B Raw Depth Correction
ES Type	Time	Txdcr to Bottom	WL to Bottom	IMU to Txdcr	IMU to WL	Error
EM3000	14:33	0.75	2.06	1.342	0.19	0.22
EM3000	14:34	0.73	2.03	1.342	0.19	0.23
EM3000	14:35	0.75	2.05	1.342	0.19	0.23
EM3000	14:36	0.71	2.04	1.342	0.19	0.20

S3002
MBES Patch Test 18 April 2008

LT(jg) Matthew Jaskoski

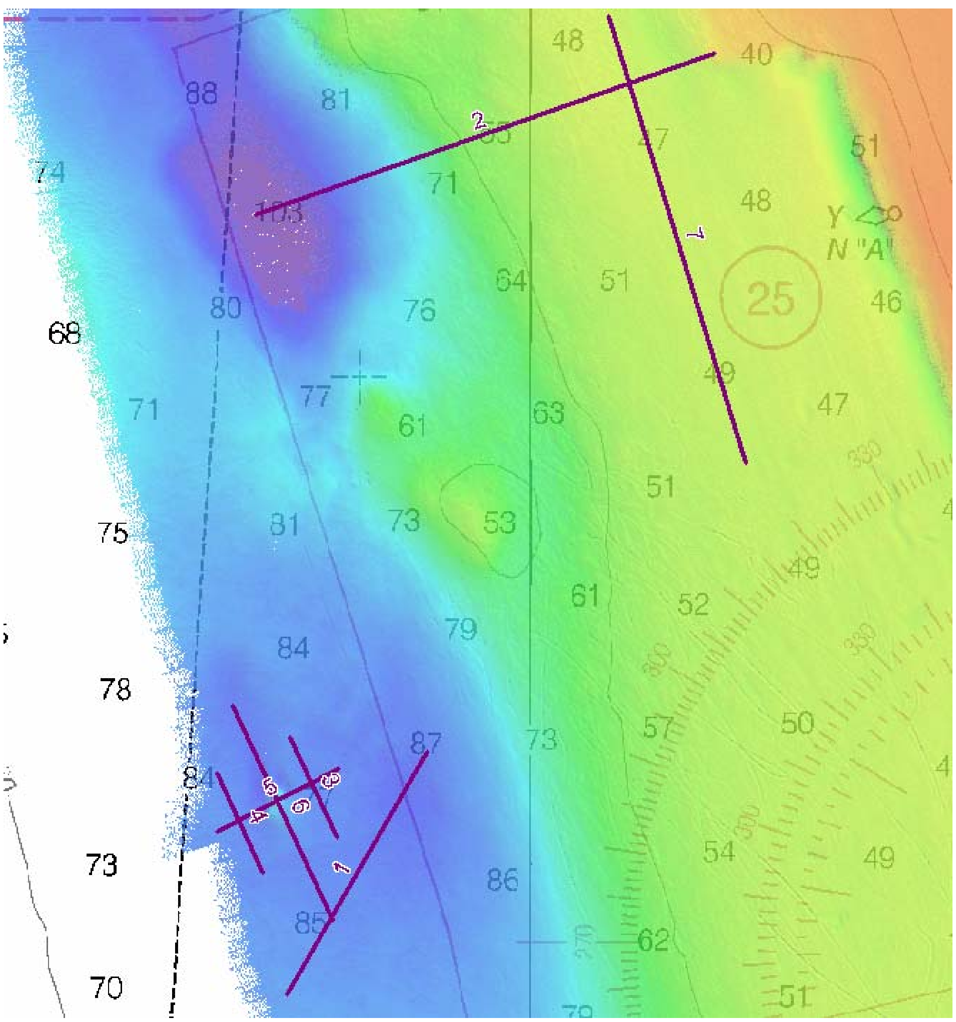
Background:

NRT-5 is capable of acquiring both bathymetry data and side scan sonar imagery. Multibeam bathymetry data are acquired using a pole mounted Kongsberg Simrad EM 3000 Shallow-Water Multibeam echosounder (MBES). Accuracy in data processing is in part dependent on the determination of the dynamic offsets (Navigation timing error, & Pitch, Roll and Heading biases) of the MBES transducer head. This test empirically determines the dynamic offsets of the EM 3000 MBES.

Location, Date, and Personnel:

Sonar data were acquired at Gravesend Bay, New York Harbor, NY (Figure 1) on April 18 2008 (DN 109) by LT(jg) Matthew Jaskoski , PST Bert Ho, and PST Jack Herbert.

Figure 1: Patch Test Work Site



Equipment:

TSS POS/MV version 4 + Precise Timing
Aero Antenna DSM 212L DGPS receiver
Kongsberg Simrad EM 3000
Odom Digibar Pro Sound Velocimeter

Procedure:

Data Acquisition:

Navigation Time:
Data were acquired over a sloped area (approximately 30m to 10m water depth) of the Gravesend Bay anchorage. A second set of lines were run over a conspicuous obstruction near the anchorage. The survey area is located as close as is practicable to the Sandy Hook, NJ Harmonic water level station. The survey time was planned to coincide as closely as practicable to slack water. The lines over the sloped area were approximately 600m in length. Both sets of the coincident lines were run at differing speeds of approximately 2 knots and 7 knots respectively. The lines over the conspicuous object were approximately 250m in length. Both sets of the coincident lines were run at differing speeds of approximately 2 knots and 6 knots respectively. A sound velocity cast was taken near the survey area.

Pitch:
Data were acquired over a sloped area (approximately 30m to 10m water depth) of the Gravesend Bay anchorage. The survey area is located as close as is practicable to the Sandy Hook, NJ Harmonic water level station. The survey time was planned to coincide as closely as practicable to slack water. The line was approximately 600m in length. The lines were run at a survey speeds of approximately 2 and 6 knots. A sound velocity cast was taken near the survey area.

Roll:
Data were acquired over two flat areas (approximately 15m and 25m water depth) of the Gravesend Bay anchorage. The survey area is located as close as is practicable to the Sandy Hook, NJ Harmonic water level station. The survey time was planned to coincide as closely as practicable to slack water. The survey lines were approximately 300m and 500m in length respectively. The reciprocal lines were run at survey speed of approximately 6-7 knots. A sound velocity cast was taken near the survey area.

Yaw:
Data were acquired over a conspicuous obstruction near the Gravesend Bay Anchorage in approximately 25m water depth. One pair of adjacent lines were run in reciprocal direction at a survey speed of approximately 6-7 knots. A sound velocity cast was taken near the survey area.

Data Processing:

Data were converted and processed in accordance with established protocols; observed tide, true heave and sound speed correctors were applied. Data were analyzed using Caris HIPS 6.1 calibration tool. Calibration methods followed those detailed in the Caris HIPS Operator manual Ch. 21 *Calibration*. The offset values for error/bias were determined in the following order: Timing, Pitch, Roll and Yaw. For the first scan multiple evaluations were made at various points on each line, and the mean for each offset was then calculated. Offset values were then scanned a second time by a second party in the same fashion the mean for each offset was again calculated. For each offset the mean of the two scans was calculated and taken as the offset value. Offset values were then entered into the HVF. The first scan was performed by LT(jg) Jaskoski; the second scan was performed by PST Ho.

The offset values are tabulated below.

Table 1: MBES Dynamic Offset Data

S3002 EM3000 Patch Test Results	
Error/Bias	Offset value
Navigation Timing Error:	-0.17
Pitch bias:	-4.90
Roll bias:	1.91
Yaw/Az/Heading bias:	2.82

Discussion:

The patch test has yielded acceptable results. Current offset data were generally in agreement with previous offset data.

S3002
Side Scan Sonar (SSS) Calibration Test 28 March 2007

LT(jg) Matthew Jaskoski

Daily confidence checks are conducted by observing side scan imagery in the vicinity of known contacts such as buoy blocks or charted wrecks at the dual operating frequencies of 100/500 kHz along with periodic "rub tests" to confirm proper towfish operation. Imagery is considered satisfactory if the selected contacts are distinguishable throughout the entire range of the side scan record.

Prcedure:

A SSS evaluation was performed on May 13, 2008 within Gravesend Anchorage. (A deep-water vessel anchorage located in the lower bay of New York Harbor located just south of the Verrazano-Narrows Bridge). The evaluation reflected the parameters typically used for normal survey operations. Line plans were drawn with opposing azimuths to expose port and starboard side transducers and were also drawn to different scales of 15, 45, and 60 meters across a 75-meter range scale with the intention of ensonifying a contact at a minimum of 10 passes.

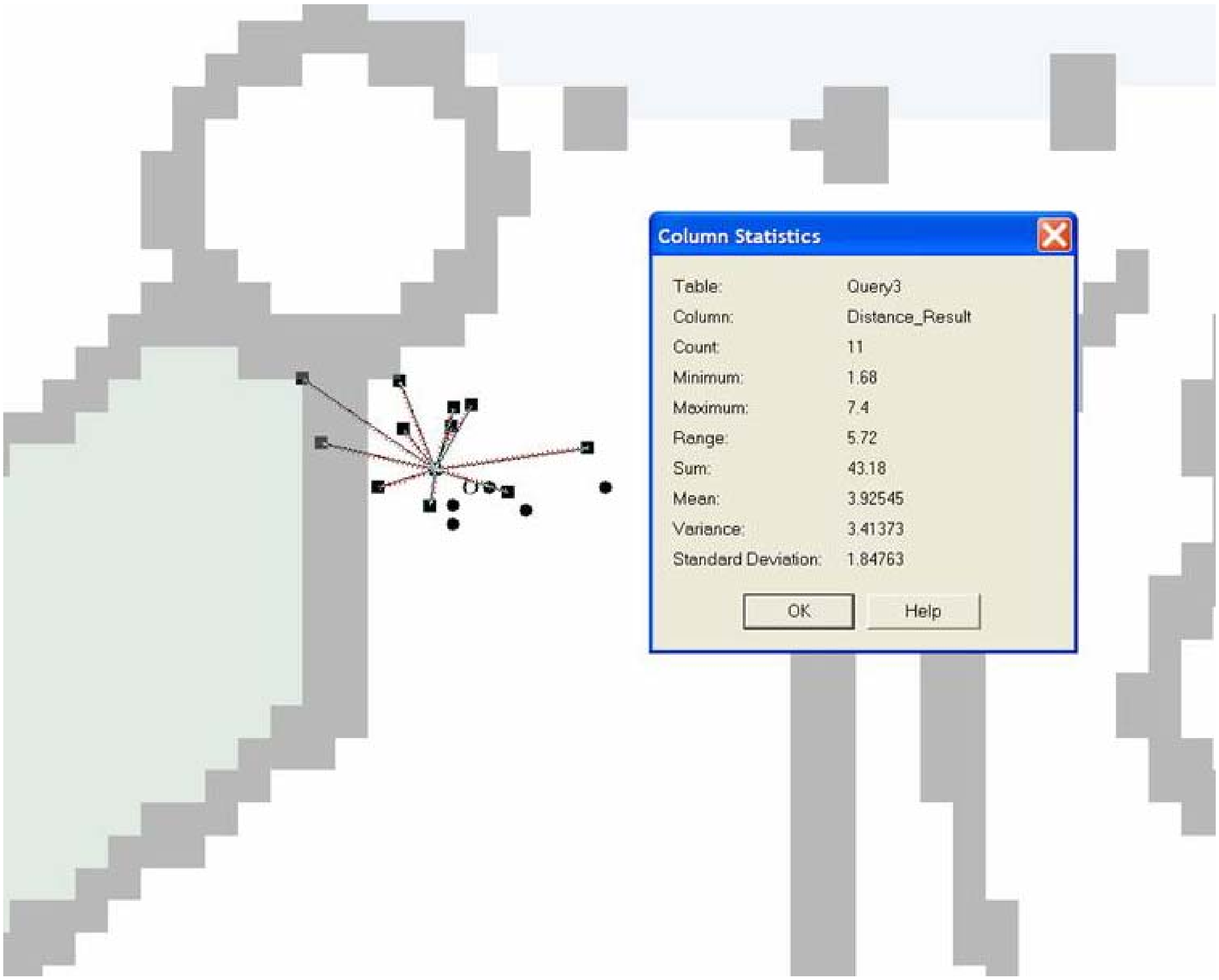
A targeted contact was selected using existing multi-beam data to ensure a higher confidence in the positional accuracy of the object. For this evaluation, charted wreck located in the southern region of the anchorage was chosen. The center of the wreck was chosen for all contacts and for the MBES sounding position data. This evaluation was conducted under guidance of the FPM (ver 2.1) section 1.5.7.1.2

Results:

The most reliable and accurate passes were used toward calculation with the "Calculate Statistics" tool of MapInfo 9. A total of 9 contact positions were evaluated. The evaluation results (Figure 2) produced a standard deviation of 1.85 at an approximate 95% confidence level (a standard z-score is typically 1.96 at a 95% confidence level). The dispersion from the mean (Variance) was approximately 3.41 meters with the maximum value from the target of 7.40 meters. The results of the evaluation meet the FPM (ver 2.1) 1.5.7 ten-meter accuracy requirement. The exception is discussed below.

Strong ebb currents were experienced causing noticeable crabbing of the survey vessel and towfish. It is believed that this crabbing negatively affected the positional accuracy of the contact thereby increasing the variance and its subsequent standard deviation.

Figure 1 Plot of contact results minimum range 1.68m to 7.40m



NRT-5
Horizontal Quality Control 7 May 2008
PST Bert Ho

Horizontal Quality Control

Horizontal accuracy was determined using Post Processed Differential GPS (DGPS) techniques. DGPS performance checks were conducted in accordance with the Field Procedures Manual (FPM) Section 3.4.3 (Horizontal & Vertical Control) by comparing the position of the GPS receiver to a survey mark (First Order Horizontal). These techniques utilized the United States Coast Guard DGPS nationwide radio beacon network, a surveyor's tripod, and an optically centered/leveled tribrach and tribrach adapter mounted ProXRS antenna.

Trimble ProXRS GPS Control

On May 7, 2008, an evaluation of the Trimble ProXRS was conducted on a known NGS benchmark labeled "KV6856" located inside Liberty State Park of Jersey City, NJ (see figure 8). Data acquisition consisted of a one-second logging interval for the duration of 5 minutes as outlined by FPM 3.4.3. Acquired data were then post-processed in Trimble's Pathfinder Office 3.10 using a NGS Continuously Operating Reference Station (CORS*)* site located at the Lamont-Doherty Earth Observatory in Palisades, NY. A filtered set of 302 points were accepted by the C/A code post processing algorithm. At a 95% confidence level, the horizontal accuracy of the unit was determined to be 0.4 meters (see figure 9, 10 & 11) with a 0.21 meter distance from the known survey mark.

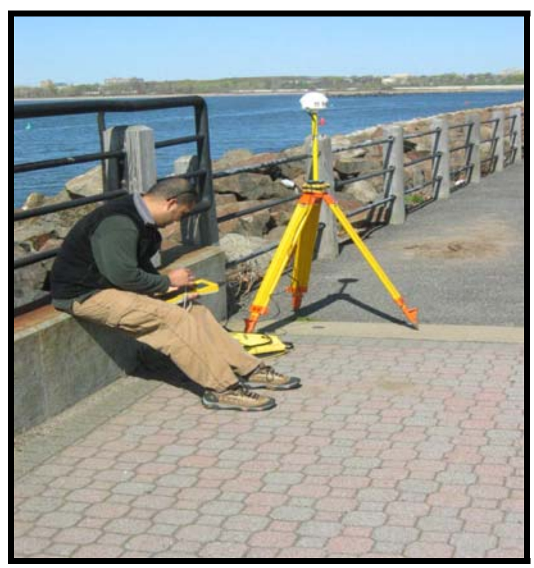


Fig 8: USACE bench mark KV6856 and setup overview

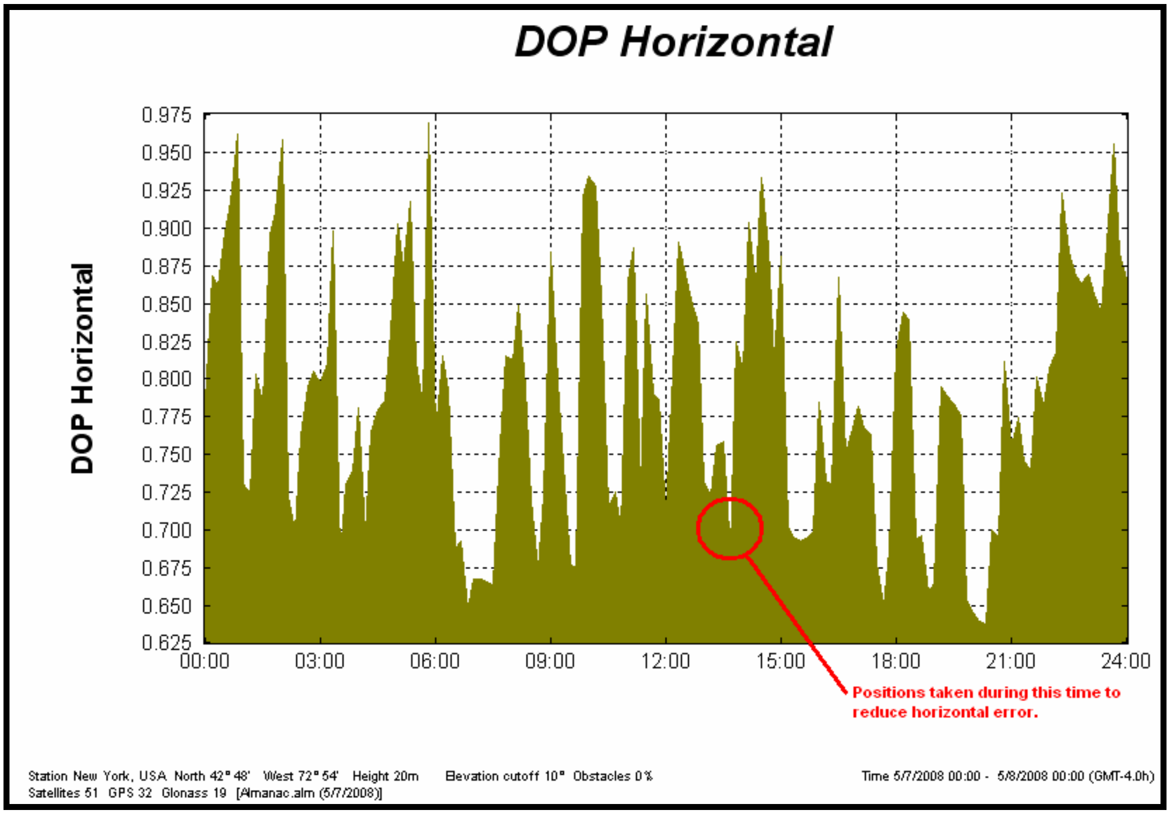


Figure 9, Time of collection influenced to reduce HDOP error.

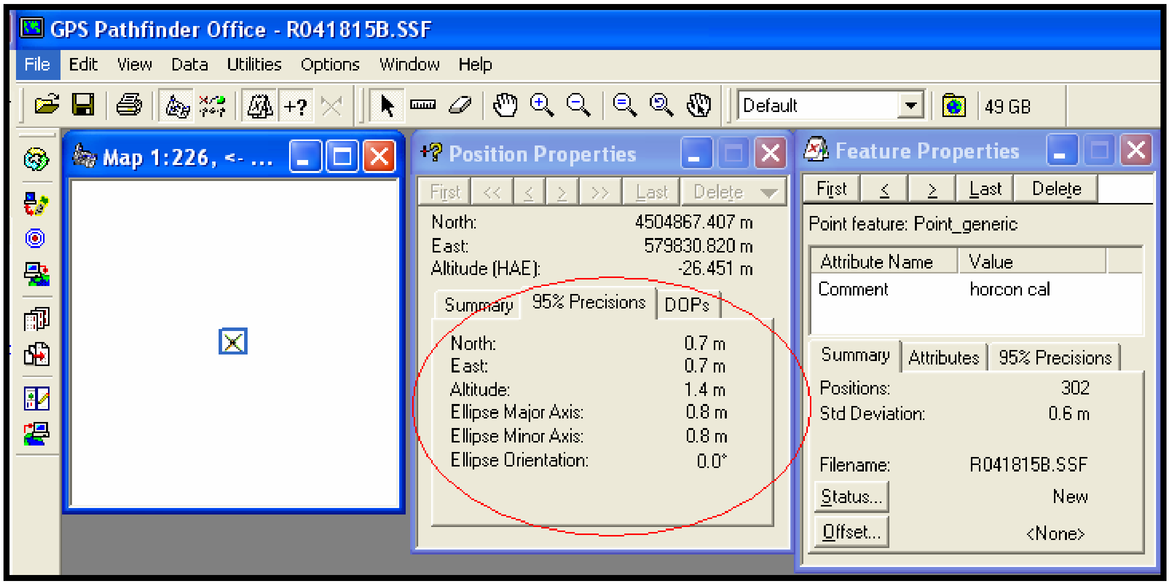


Figure 10 Raw acquired unprocessed data.

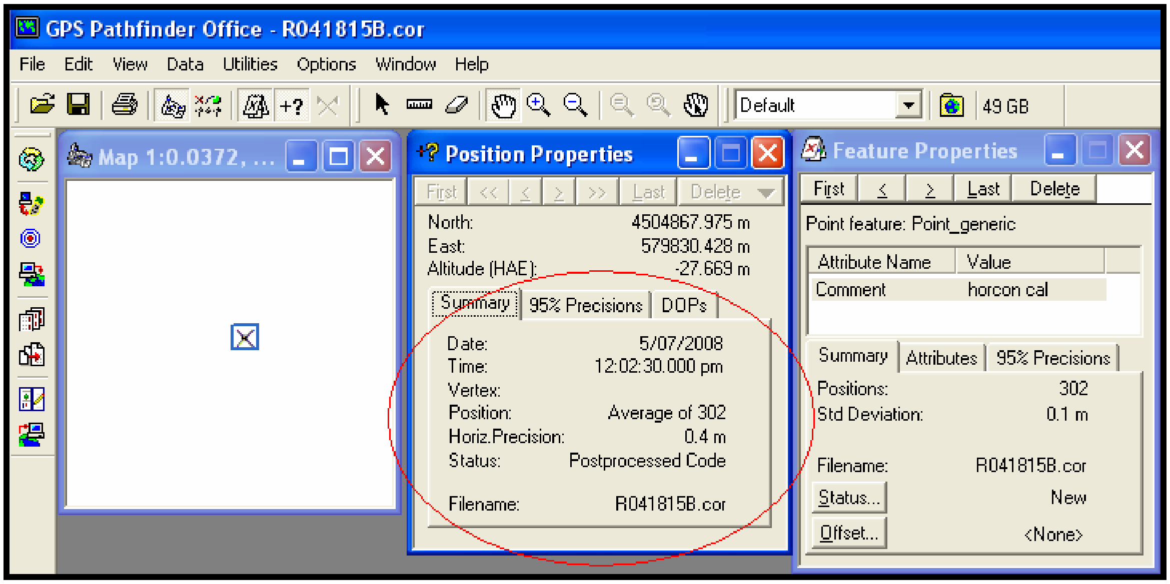


Figure 11, Post Processed using a Coarse Acquisition (C/A) Code algorithm.

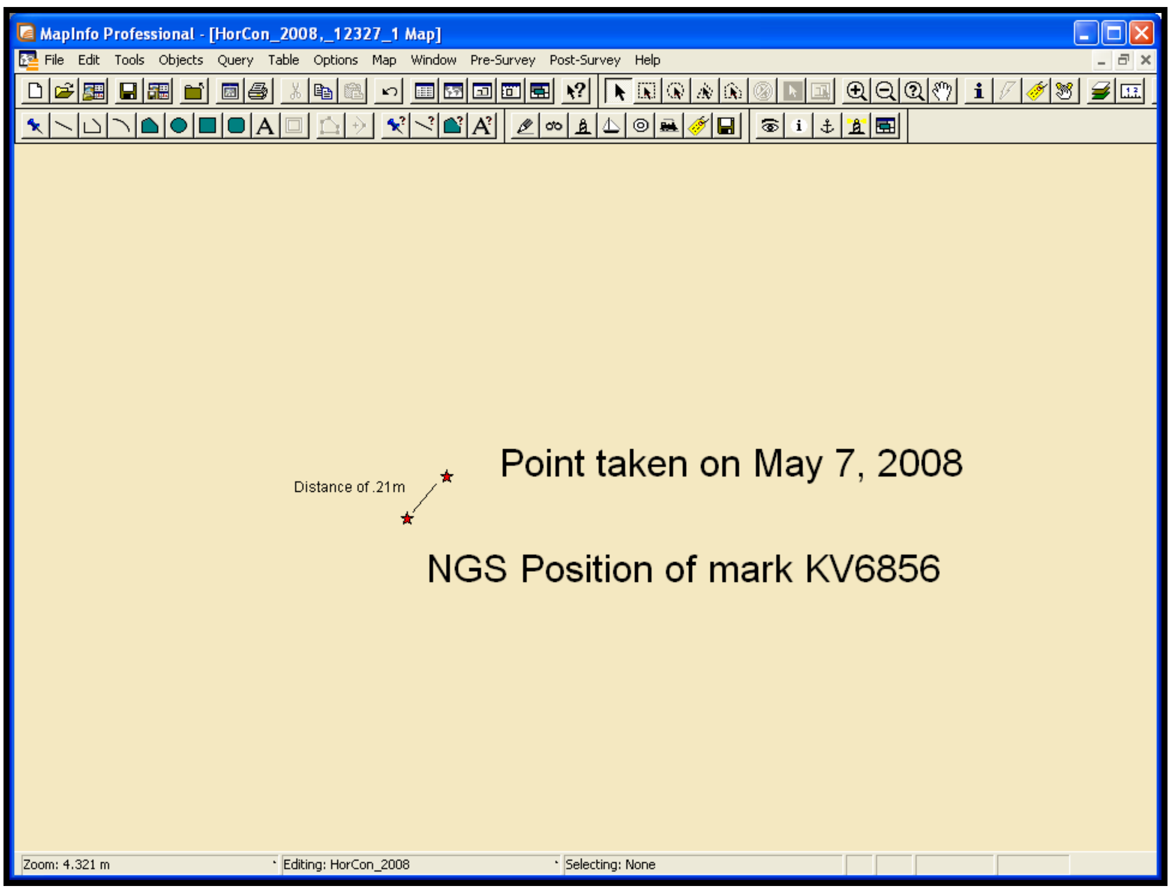


Figure 12, Distance calculated from Survey Mark to data point equaled 0.21 meters.

NGS Data Sheet

```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.59
1        National Geodetic Survey,   Retrieval Date = MAY  7, 2008
 KV6856 ***********************************************************************
 KV6856  DESIGNATION -  LSP SOUTH
 KV6856  PID         -  KV6856
 KV6856  STATE/COUNTY-  NJ/HUDSON
 KV6856  USGS QUAD   -  JERSEY CITY (1981)
 KV6856
 KV6856                          *CURRENT SURVEY CONTROL
 KV6856
___________________________________________________________________
 KV6856* NAD 83(2007)-  40 41 27.03835(N)    074 03 18.68704(W)
ADJUSTED
 KV6856* NAVD 88     -         2.7    (meters)       9.     (feet)  GPS
OBS
 KV6856
___________________________________________________________________
 KV6856  EPOCH DATE  -        2002.00
 KV6856  X           -   1,330,432.949 (meters)
COMP
 KV6856  Y           -  -4,656,695.852 (meters)
COMP
 KV6856  Z           -   4,136,432.700 (meters)
COMP
 KV6856  LAPLACE CORR-           4.99  (seconds)
DEFLEC99
 KV6856  ELLIP HEIGHT-         -29.334 (meters)          (02/10/07)
ADJUSTED
 KV6856  GEOID HEIGHT-         -31.98  (meters)
GEOID03
 KV6856
 KV6856  ------- Accuracy Estimates (at 95% Confidence Level in cm) ---
-----
 KV6856  Type    PID    Designation                         North   East
Ellip
 KV6856  ---------------------------------------------------------------
-----
 KV6856  NETWORK KV6856 LSP SOUTH                            0.25   0.24
0.69
 KV6856  ---------------------------------------------------------------
-----
 KV6856
 KV6856.The horizontal coordinates were established by GPS observations
 KV6856.and adjusted by the National Geodetic Survey in February 2007.
 KV6856
 KV6856.The datum tag of NAD 83(2007) is equivalent to NAD
83(NSRS2007).
 KV6856.See National Readjustment for more information.
 KV6856.The horizontal coordinates are valid at the epoch date
displayed above.
 KV6856.The epoch date for horizontal control is a decimal equivalence
 KV6856.of Year/Month/Day.
 KV6856
 KV6856.The orthometric height was determined by GPS observations and a
 KV6856.high-resolution geoid model.
 KV6856
```

```
 KV6856.The X, Y, and Z were computed from the position and the
ellipsoidal ht.
 KV6856
 KV6856.The Laplace correction was computed from DEFLEC99 derived
deflections.
 KV6856
 KV6856.The ellipsoidal height was determined by GPS observations
 KV6856.and is referenced to NAD 83.
 KV6856
 KV6856.The geoid height was determined by GEOID03.
 KV6856
 KV6856;                    North         East     Units Scale Factor
Converg.
 KV6856;SPC NJ       -   206,314.082   187,594.716   MT  0.99991739
+0 17 24.0
 KV6856;SPC NJ       -   676,882.12    615,467.00   sFT  0.99991739
+0 17 24.0
 KV6856;SPC NY L     -    58,209.100   295,334.885   MT  0.99999874   -
0 02 10.0
 KV6856;SPC NY L     -   190,974.36    968,944.54   sFT  0.99999874   -
0 02 10.0
 KV6856;SPC NY E     -   206,314.082   187,594.716   MT  0.99991739
+0 17 24.0
 KV6856;SPC NY E     -   676,882.12    615,467.00   sFT  0.99991739
+0 17 24.0
 KV6856;UTM  18      - 4,504,867.890   579,830.563   MT  0.99967844
+0 36 57.7
 KV6856
 KV6856!             -  Elev Factor  x  Scale Factor =   Combined
Factor
 KV6856!SPC NJ       -   1.00000460  x   0.99991739  =   0.99992199
 KV6856!SPC NY L     -   1.00000460  x   0.99999874  =   1.00000334
 KV6856!SPC NY E     -   1.00000460  x   0.99991739  =   0.99992199
 KV6856!UTM  18      -   1.00000460  x   0.99967844  =   0.99968304
 KV6856
 KV6856                          SUPERSEDED SURVEY CONTROL
 KV6856
 KV6856  ELLIP H (10/23/02)  -29.328  (m)                      GP(
) 4 1
 KV6856  NAD 83(1996)-  40 41 27.03865(N)    074 03 18.68737(W) AD(
) 1
 KV6856  ELLIP H (05/14/99)  -29.323  (m)                      GP(
) 4 1
 KV6856  NAD 83(1996)-  40 41 27.03859(N)    074 03 18.68742(W) AD(
) 1
 KV6856  NAD 83(1996)-  40 41 27.03774(N)    074 03 18.68818(W) AD(
) 1
 KV6856  NAD 83(1992)-  40 41 27.03675(N)    074 03 18.68962(W) AD(
) 1
 KV6856  NAD 83(1986)-  40 41 27.03687(N)    074 03 18.68962(W) AD(
) 1
 KV6856
 KV6856.Superseded values are not recommended for survey control.
 KV6856.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 KV6856.See file dsdata.txt to determine how the superseded data were
derived.
 KV6856
 KV6856_U.S. NATIONAL GRID SPATIAL ADDRESS: 18TWL7983104868(NAD 83)
```

```
 KV6856_MARKER: DD = SURVEY DISK
 KV6856_SETTING: 4 = OBJECT SURROUNDED BY MASS OF CONCRETE
 KV6856_SP_SET: SURROUNDED BY MASS OF CONCRETE
 KV6856_STAMPING: LSP SOUTH 1991
 KV6856_MARK LOGO: USE
 KV6856_MAGNETIC: N = NO MAGNETIC MATERIAL
 KV6856_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
 KV6856_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
 KV6856+SATELLITE: SATELLITE OBSERVATIONS - April 26, 2004
 KV6856
 KV6856  HISTORY     - Date     Condition        Report By
 KV6856  HISTORY     - 1991     MONUMENTED       USE
 KV6856  HISTORY     - 19920306 GOOD             NJGS
 KV6856  HISTORY     - 19950920 GOOD             NJGS
 KV6856  HISTORY     - 20010902 GOOD             NJDEP
 KV6856  HISTORY     - 20040426 GOOD             PORANY
 KV6856
 KV6856                          STATION DESCRIPTION
 KV6856
 KV6856'DESCRIBED BY NEW JERSEY GEODETIC SURVEY 1992
 KV6856'THE STATION IS LOCATED IN THE CITY OF JERSEY CITY ON THE
GROUNDS OF
 KV6856'LIBERTY STATE PARK AT THE SOUTHERN MOST POINT OF THE MONUMENT
 KV6856'OVERLOOK.  TO REACH THE STATION FROM THE NEW JERSEY TURNPIKE
EXIT
 KV6856'14B, GO 0.9 MI (1.4 KM) SOUTHEAST ON MORRIS PESIN DRIVE TO THE
 KV6856'LIBERTY STATE PARK VISITORS CENTER.  ACCESS TO THE OVERLOOK AND
 KV6856'PERMISSION TO OCCUPY THE STATION MUST BE OBTAINED FROM RANGER
CHUCK
 KV6856'SARY, PHONE               201 915 3401        WHO REQUESTS A
ONE WEEK ADVANCE NOTICE SO
 KV6856'THAT HE CAN DETERMINE IF ANY SPECIAL EVENTS WILL TAKE PLACE
DURING
 KV6856'OUR OBSERVATION PERIOD.  HE ALSO REQUESTS THAT OUR VEHICLES
KEEP OFF
 KV6856'THE LAWNS DUE TO A SHALLOW SPRINKLER SYSTEM.  THE STATION IS
0.6 M
 KV6856'(2.0 FT) NORTHEAST FROM THE SOUTHWEST CONCRETE WALL, 6.5 M
(21.3 FT)
 KV6856'NORTHWEST FROM THE BOTTOM STEP LEADING TO THE BRICK OBSERVATION
AREA,
 KV6856'11.5 M (37.7 FT) SOUTH FROM THE SOUTHERN MOST WOOD LAMP POST
NUMBER
 KV6856'1918, 16.3 M (53.5 FT) SOUTH FROM THE CENTER OF AN INLET IN THE
LAWN
 KV6856'AND 10.0 M (32.8 FT) WEST FROM THE WESTERN MOST OF THREE LIGHT
POLES
 KV6856'ON THE BRICK OBSERVATION AREA.  THE STATION IS SET FLUSH IN A
FLUSH
 KV6856'MOUNTED CONCRETE RETAINER FOR THE BRICK PAVED WALKWAY
SURROUNDING THE
 KV6856'BRICK OBSERVATION DECK.
 KV6856
 KV6856                          STATION RECOVERY (1995)
 KV6856
 KV6856'RECOVERY NOTE BY NEW JERSEY GEODETIC SURVEY 1995 (FAC)
 KV6856'REECOVERED AS DESCRIBED.
 KV6856
```

```
 KV6856                          STATION RECOVERY (2001)
 KV6856
 KV6856'RECOVERY NOTE BY NJ DEPT OF ENVIR PRO 2001 (BMC)
 KV6856'CONTACT NOW IS PARK SUPERINTENDENT STEVE ELLIS. ELEVATION
TRANSFERRED
 KV6856'FROM KV0611, +8.75 FEET NAVD 88.
 KV6856
 KV6856                          STATION RECOVERY (2004)
 KV6856
 KV6856'RECOVERY NOTE BY PORT AUTHORITY OF NY + NJ 2004 (SSZ)
 KV6856'NEW CONTACT INFORMATION AS FOLLOWS. CONTACT SUPERINTENDENT OR
CHIEF
 KV6856'RANGER AT              201-915-3403        AT LEAST A WEEK IN
ADVANCE.

 *** retrieval complete.
 Elapsed Time = 00:00:00
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