2007 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**

2007

CHIEF OF PARTY

LT(jg) Matthew Jaskoski, NOAA

LIBRARY & ARCHIVES

DATE

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

INSTRUCTIONS: N/A.

State:	**NY**		
General Locality:	**New York Harbor**		
Sub-Locality:	**Gravesend Bay**		
Scale:	**N/A**	Date of Survey:	**03/21/07 & 03/28/07**
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**		
	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.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DATA ACQUISITION AND PROCESSING REPORT

to accompany
Field Season 2007 Survey Operations

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

A. EQUIPMENT

With the exception of a second patch test conducted on 12 July 2007, and Sound speed profiler calibration reports, all calibration data were acquired by Navigation Response Team 5 (NRT-5) during the months of March and April, 2007. 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 (June, 2006), and the Field Procedures Manual (May, 2006) with due consideration given to system performance limitations, time availablity, 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 $y = 2(D-d-n)\tan\theta$; 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 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 10.0) 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 thee 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

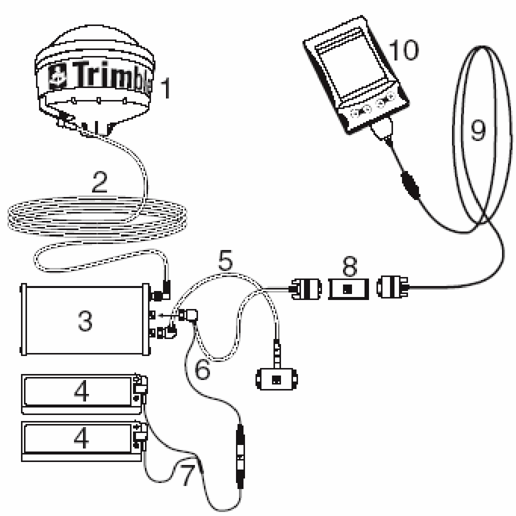
The PCS utilizes data from both the IMU and the two GPS receivers to compute a highly accurate vessel heading. The IMU determines heading during aggressive maneuvers and is not subject to short-period noise. However, IMU accuracy diminishes over time. The two GPS receivers allow the PCU to calculate 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 v.8.5. 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 in raw data files.

MBES data are acquired via the hypack program Hysweep. Vessel offset configurations, attitude data, and 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 data are processed using Caris HIPS v.6.1. 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 v.7.2. 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. GeoZui and Caris HIPS are used for visualization and data comparisons.

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 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 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, and dynamic draft correctors 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.

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

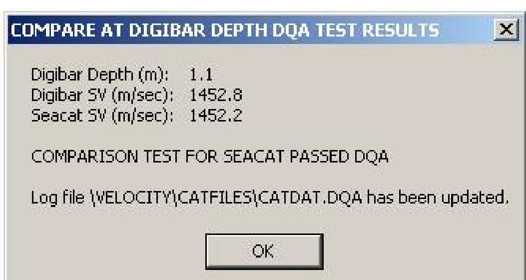
C.1. Sound Speed

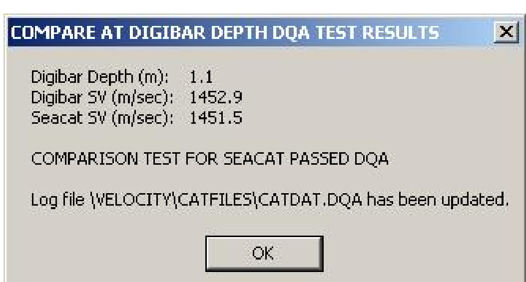
C.1.1 SBE19Plus CTD profiler and Digibar Pro

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 both the Sea-Bird Electronics SeaCat SBE19Plus and the Odom DigibarPro CTD profiler. Raw conductivity, temperature, and pressure data are processed using the program Velocwin which generates sound velocity profiles for Caris HIPS. Sound speed correctors are applied to MBES and VBES data in Caris HIPS during post processing. Calibration reports for the SBE19Plus CTD and Odom Digibar profilers are included in Appendix IV. A CTD and DQA comparison was performed on 6 April 2007, the results of which are listed below. This DQA is produced by comparing both Odom Digibar to a single cast made with the SBE19Plus. Side by side comparison tests as outlined by FPM between the SeaBird 19 Plus and our Digibar are completed at least once a week.

Figure 4: CTD DQA test: 03/06/2007 COMPARISON TEST FOR SEACAT PASSED DQA





C.2. Vessel offsets and Dynamic Draft Corrections

Sensor offsets are stored in the Caris HIPS Vessel Configuration File (3002_mbes & 3002_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 06 April 2006 (see results Appendix III). Dynamic draft measurements for S3002 were made on 28 March 2007 (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	
VCF Name	Survey System
3002_mbes	Kongsberg Simrad EM3000 Multibeam Sonar System
3002_vbes	Odom Echotrac C/V 200
3002sss500k	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 21 & 28 March 2007 at Gravesend Bay Anchorage New York Harbor and 12 July 2007 at President Roads Boston 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 2007

As Chief of Party, I have ensured that standard field surveying and processing procedures were adhered to 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, as updated for March 30, 2007.

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
NRT-5

APPENDIX I

HYDROGRAPHIC SYSTEMS INVENTORY

Hydrographic Vessel Inventory

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

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	28-Mar-07 Base Surface

Additional Information

Hydrographic Hardware Inventory

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

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	EM 3000	306	Hypack Hysweep				127 Beams 1.5° x 1.5° Resolution
Side Scan Sonar	Klein	System 3000	PU=1517, TPU=348, Fish=457	SonarPro 9.6				
Vertical Beam Echosounder	Odom	Echotrac CV-200	23043	Hypack 6.2				
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	Sea-Bird	SeaCat	19P39974-4835					
Sound Speed Profiler	Odom	Digibar Pro	98212					
Surface Sound Velocimeter	Odom	Digibar Pro	98214					
TIDES & LEVELING EQUIPMENT								
Optical Level	Lietz/Sokkisha	B-1	4968			2002?		
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	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	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 Optiplex GX270	Dell Optiplex GX270	Dell Dimension 9150	Dell Latitude D600	Dell Latitude D820	HP	Proprietary	Proprietary	TSCe Field Device
Date Purchased	2003	2003	2006	2003	2006	2004			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	P4, 2.8 GHz	P4, 2.8 GHz	P-Dual Core, 3.00 GHz	P-M, 1.4GHz	Centrino Duo, 2.16GHz		Proprietary		Samsung 300MHz
RAM	1 GB	2.5 GB	2 GB	512 MB	2 GB		Proprietary		64 MB
Video Card	nVidia GeForce FX5200	nVidia GeForce FX5200	nVidia GeForce FX6800	Mobility Radeon 9000	nVidia Quadro NVS 110M		N/A		Proprietary
Video RAM	128 MB	128 MB	256 MB	32 MB	256 MB		N/A		Proprietary
Comments	Upgrade Needed	Possible bad Network Card - also upgrade needed		Upgrade Needed		Upgrade Needed		Upgrade in Oct 2005, larger hard drive, increased RAM.	

SOFTWARE LICENSES

	Software Package	License Numbers								
Acquisition	SonarPro 9.6	x	x	x	x	x	x		x	
	HYPACK MAX 6.2	x	x	x	x		Hardlock			
	Simrad EM Controller 1.0.28	x	x	x	x					
	POS M/V Controller 3.3	x	x	x	x					
	TerraSync 2.41			x						x
Processing	CARIS HIPS & SIPS 6.1	CW9604114		CW9604216						
	Pydro 7.3	d3b9bf48d575c3ffbe	3b9bf48df4152bba7	7a941fee83afe1aee4	d3b9bf48d5023928ea	cdf482d4b3099cd4d9	aef156660a9551026b			
	SeaTerm 1.3	x	x	x	x					
	Velocwin 8.6	x	x	x	x		x			
	GPS Pathfinder Office 3.10	011747-00300-07186	011747-00300-07186	011747-00300-07186	011747-00300-07186					
	Odom Digibar Pro Log 2.3			x			x			
	MapInfo 8.5	MIUWEU0850038761	MIUWEU0850038761	MIUWEU0850038761	MIUWEU0850038761	MIUWEU0850038761				
	Fleudermaus									
Support	Fugawi 3.1			x	x					

OPERATING SYSTEM PACKAGE:

	Machine Name	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	Klein TPU	Klein CPU	
Operating System Installations & Updates (Date)	Windows XP SP2	2/3/2005	2/3/2005	1/1/2006	11/24/2006	12/16/2006		N/A		
	VX Works							N/A	x	
	Windows 2000								x	
	Windows CE									x

ACQUISITION SOFTWARE PACKAGE: HypackMAX

	Machine Name	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	Klein TPU	Klein CPU	Trimble TSCe
Software Installations & Updates (date)	Version 4.3 install	2005	2005	2005	N/A	N/A	2005			
	Version 6.2 install			3/1/2007			3/1/2007			

ACQUISITION SOFTWARE PACKAGE: Klein SonarPro

Software Installations & Updates (date)

Machine Name	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	Klein TPU	Klein CPU	Trimble TSCe
Version 8.0	x	x	x	2/3/2004					
Version 9.6	x	x	x	x	x			x	
Version 10.0			10/16/2006	needs update	needs update			11/1/2006	

PROCESSING SOFTWARE PACKAGE: CARIS HIPS/SIPS

Software Installations & Updates (date)

Machine Name	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	Klein TPU	Klein CPU	Trimble TSCe
Version 6.0	2/5/2005	2/5/2005	5/30/2006	4/12/2006	9/20/2006				
Version 6.1	1/26/2007	1/26/2007	1/26/2007		needs update				

PROCESSING SOFTWARE PACKAGE: Pydro

Software Installations & Updates (date)

Machine Name	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	Klein TPU	Klein CPU	Trimble TSCe
Version 7.1					4/1/2006				
Version 7.3	4/12/2007	4/12/2007	4/12/2007	x - needs update	x - needs update				

PROCESSING SOFTWARE PACKAGE: MapInfo

Software Installations & Updates (date)

Machine Name	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	Klein TPU	Klein CPU	Trimble TSCe
Version 8.5 Install	2/5/2005	2/5/2005	2/12/2007	5/11/2006	5/11/2006				
8.5.1B Update			3/16/2007		x-needs update				

SUPPORT SOFTWARE PACKAGE: MS Office

Software Installations & Updates (date)

Machine Name	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	Klein TPU	Klein CPU	Trimble TSCe
Office XP	2/5/2005	2/5/2005	8/9/2005	12/4/2006	11/8/2006				

SUPPORT SOFTWARE PACKAGE: Adobe Acrobat Professional

Software Installations & Updates (date)

Machine Name	NRT5-1	NRT5_Admin	NRT5-Process	OCS-L-NRT354569	OCS-L-NRT755358	Hypack	Klein TPU	Klein CPU	Trimble TSCe
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: 28-Mar-07
Updated Through: 28-Mar-07

OFFICERS

Name and Grade	Current Position	Years of Hydro Experience	Notes
LT(jg) Matthew Jaskoski	OIC	2.5	

SURVEY DEPARTMENT

Name and Rate	Current Position	Years of Hydro Experience	Notes
Bert Ho	PST	2.5	
Vitad Pradith	PST	2.5	

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

NOAA BOAT S 3002
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)

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

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)

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

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)

NOAA BOAT S 3002
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

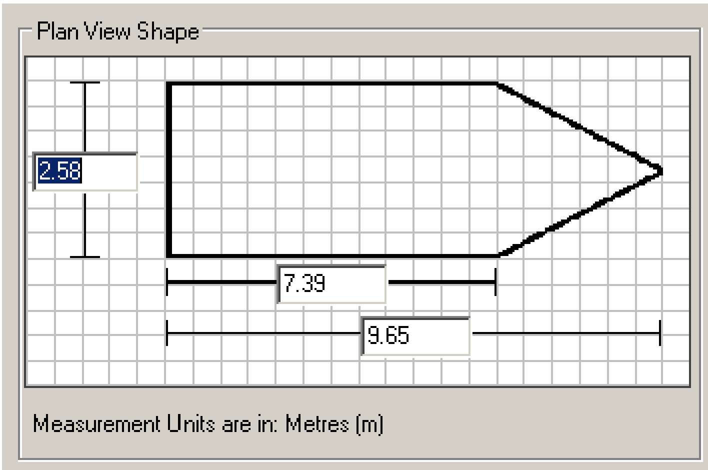
All sensor/benchmark coordinates are contained in spreadsheet "S3002.xls. Included in this spreadsheet is the Multibeam Sensor arm length measurement and also an IMU GPS antenna separation value.

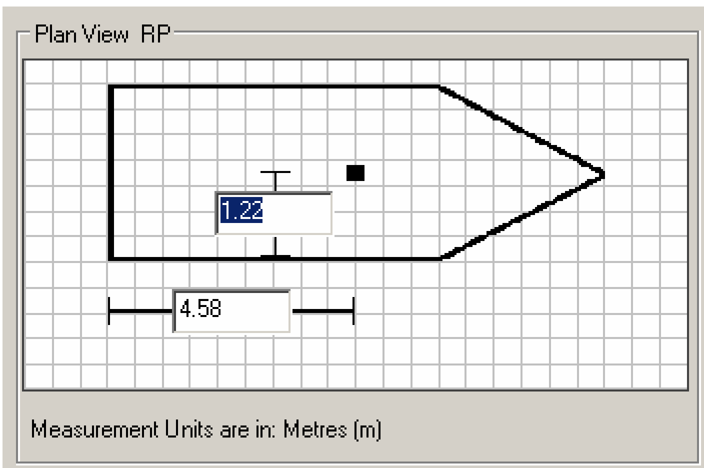
The positions given for all GPS antenna are to the top center of the antenna. To correct the Z value contained in the spreadsheet for each antenna to the electronic phase center, I recommend the following steps be taken;

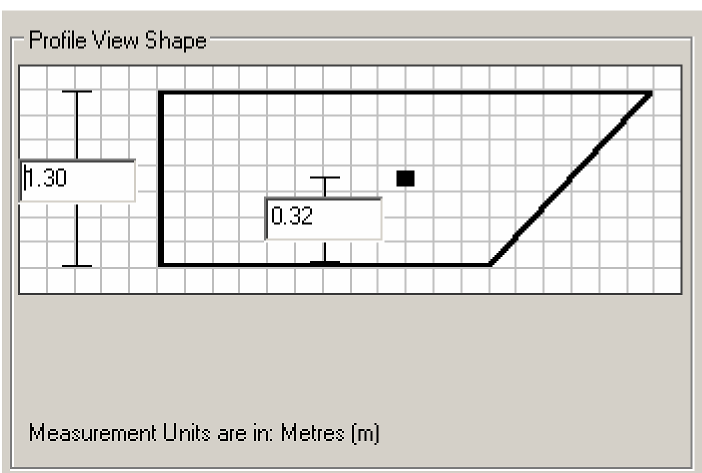
1) Measure the total height of each antenna type. This information is probably located on the antenna or with equipment documentation.
2) Investigate to find the electronic phase center offset of the antenna. This information is probably located on the antenna or with equipment documentation. This value 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

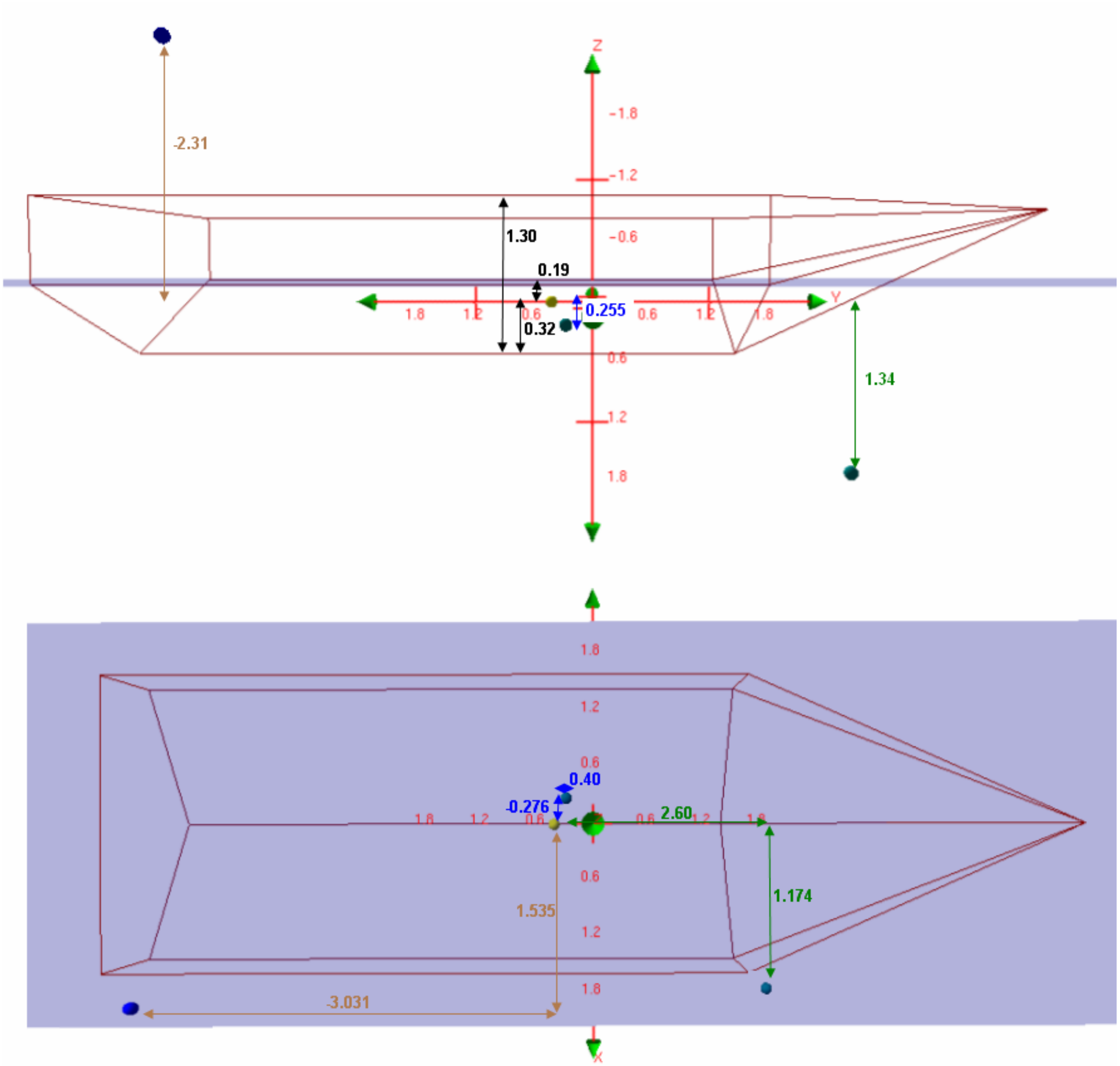
Boat shape characteristics for the Caris HVF were updated using both the final line drawings provided by SeaArk Marine Inc., and measurements taken by NRT-5 personnel.







Caris Offsets for sonar transducers.



S3002 Caris HVF Transducer Offsets: 28 March 2007, DN 087			
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

APPENDIX III

VESSEL DYNAMIC OFFSETS

S3002
Static Draft Test 06 April 2007

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:

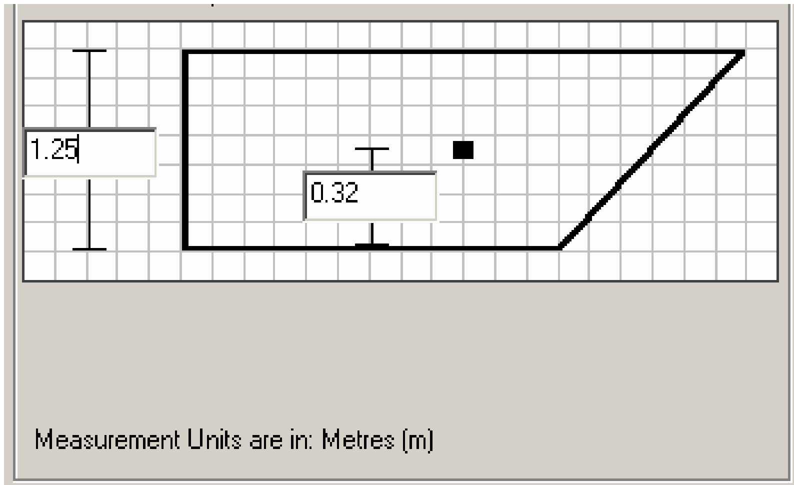
The Static Draft measurements were taken on 06 April 2007 by NRT 5 personnel.

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 PST Ho 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
0.73	STBD	0.52	0.29
0.73	STBD	0.52	0.20
0.75	Port	0.50	0.18
0.73	STBD	0.52	0.20

Caris Offset	-0.19

Table 2 Calculation of Static Draft offset using VBES and Leadline

S3002 SingleBeam Leadline Check					
		A= Raw VBES Depth	B= Leadline Reading	C= VBES offset	D=B-(A+C) IMU Draft
ES Type	Time	Txdcr to Bottom	WL to Bottom	IMU to Txdcr	IMU to WL
Echotrac CV	17:12:15	2.65	3.14	0.255	0.24
Echotrac CV	17:12:42	2.62	3.10	0.255	0.23
Echotrac CV	17:13:18	2.74	3.11	0.255	0.12
Echotrac CV	17:13:44	2.63	3.12	0.255	0.24

Caris Offset					-0.20

The mean value of both these methods agree to within 1cm.

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.

S3002
Dynamic Draft Test 28 March 2007

LT(jg) Matthew Jaskoski

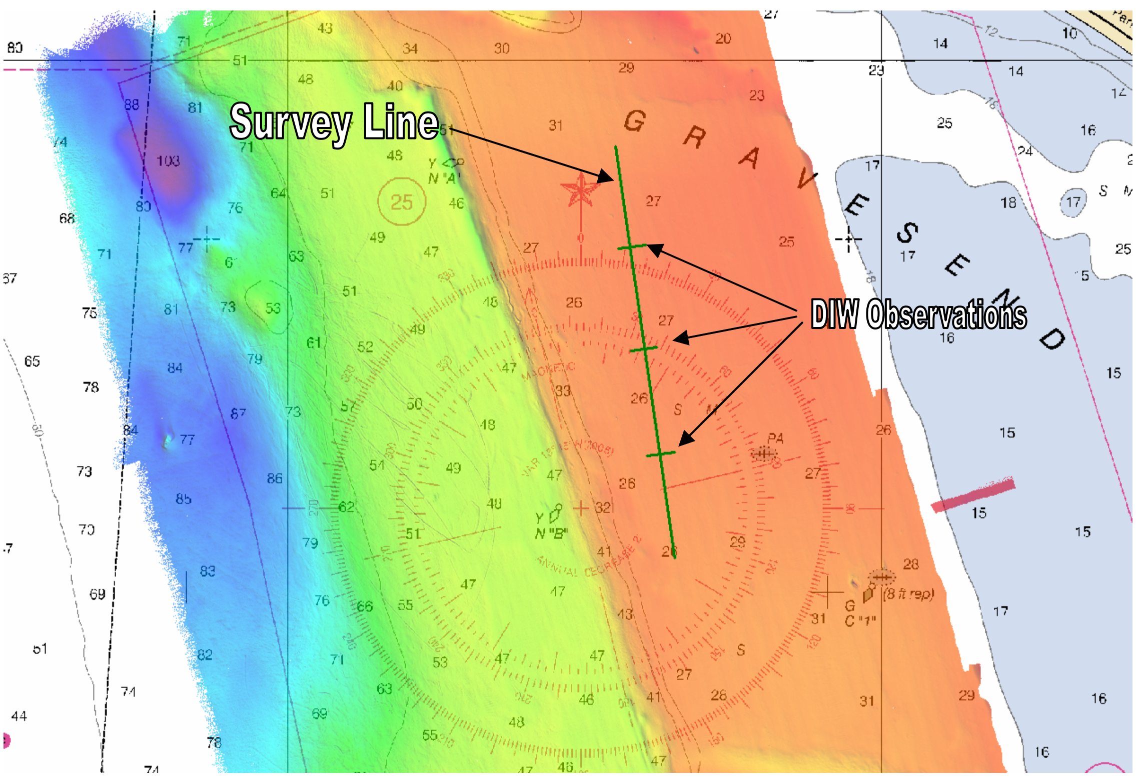
Background:

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 March 28 2007 (DN 088) by LT(jg) Matthew Jaskoski (OIC), PST Bert Ho (launch coxswain), and PST Vitad Pradith (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 CUBE surfaces were generated at 0.50m 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: 28 March 2007, DN 087						
RPM	Speed (kts)	Median A (m)	Median B (m)	Median C (m)	Std. Dev.	Mean (m)
0	0.00	0.00	0.00	0.00	0.05	0.00
900 (1 engine)	2.72	0.01	0.01	0.01	0.04	0.01
900 (both engines)	3.36	0.01	0.04	0.03	0.04	0.02
2000 (Both)	5.91	-0.02	-0.04	0.00	0.04	-0.01
2200 (Both)	6.99	-0.03	0.01	-0.02	0.04	-0.02

Figure 2: Dynamic Draft Offset Data

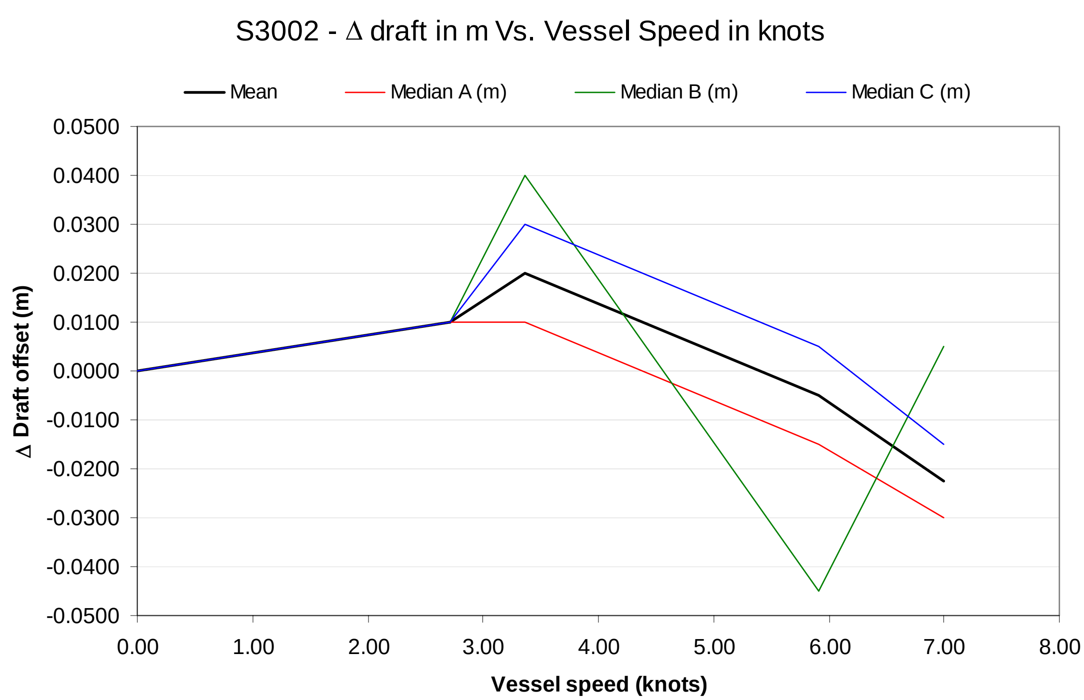
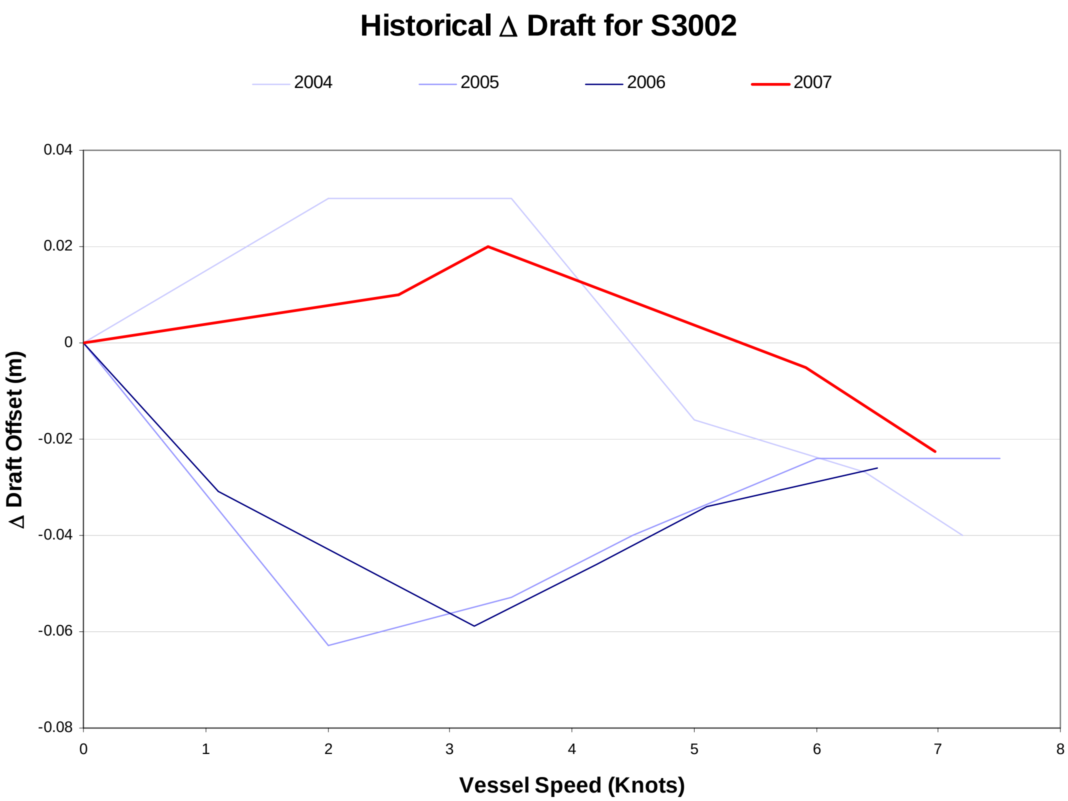


Figure 3: Historical Dynamic Draft Offset Data for S3002



Conclusions:

The multibeam echosounder method of determining the dynamic draft has yielded acceptable results. There is a noticeable difference from the previous two years offset data. However this may be due to two reasons: 1) differing methodology – the previous years data were calculated using the Dave Sinson method which varies slightly in robustness from the current method 2) It is possible that the previous two years data when entered in the offset table of the HVF were entered inversely to there true offset value i.e. the true draft values were entered as apposed to the draft offset values.

APPENDIX IV

CALIBRATION

POS/MV Calibration Report

Field Unit: **NRT-5**

SYSTEM INFORMATION

Vessel: S3002

Date: 6/25/2007 **Dn:** 176

Personnel: Ho, Jaskoski

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: Boston Harbor

Approximate Position:

	D	M	S
Lat	42	21	41
Lon	71	2	50

DGPS Beacon Station: Boston

Frequency: 306 kHZ

Satellite Constellation

Primary GPS (Port Antenna)

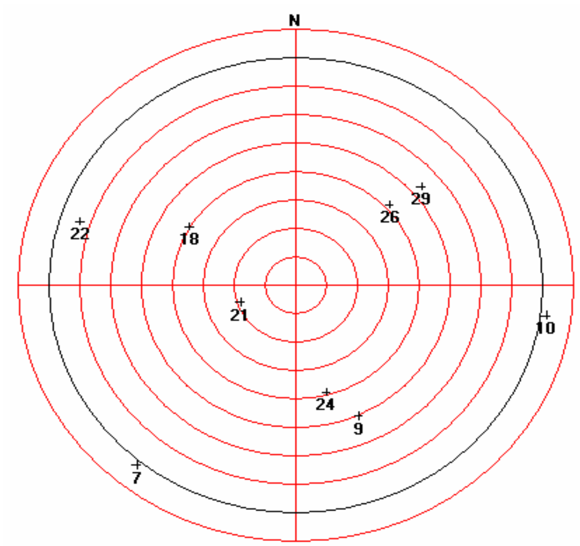
HDOP: 1.11

VDOP: 2.34

Sattelites in Use: 9

7,9,10,18,21,22,24,26,29

PDOP 2.650 (Use View> GAMS Solution)



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

Satellite Info

PRN	SNR	Used	Z-Count	PRC(m)	RRC(m/s)	UDRE(m)	IODE	Az	Elev
7	4.8	Yes	137061.6	-18.61	-0.020	4.0	114	219.2	8.3
9	14.8	Yes	137061.0	-4.01	-0.004	0.0	65	156.0	39.6
10	5.6	Yes	137061.6	-18.63	-0.010	4.0	144	97.5	8.0
18	17.6	Yes	137061.0	-2.31	0.004	0.0	71	300.7	50.0
21	16.6	Yes	137062.8	-1.71	0.000	0.0	21	251.2	71.1
22	8.4	Yes	137061.6	-8.11	-0.002	1.0	116	287.7	16.7
24	17.8	Yes	137062.8	-3.88	0.000	0.0	235	165.2	51.0
26	18.4	Yes	137062.8	-1.63	-0.002	0.0	231	47.2	48.4
29	13.2	Yes	137061.0	-3.29	0.006	0.0	34	49.8	36.5

POS/MV CONFIGURATION

Settings

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

User Entries, Pre-Calibration

1.54	Two Antenna Separation (m)
0.50	Heading Calibration Threshold
0	Heading Correction

Baseline Vector

-0.025	X Component (m)
1.54	YComponent (m)
-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: 14:26 UTC

End time: 14:27 UTC

Heading accuracy achieved for calibration: 0.024

Calibration Results:

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

POS/MV Post-Calibration Values

1.54	Two Antenna Separation (m)
0.500	Heading Calibration Threshold
0	Heading Correction

Baseline Vector

-0.025	X Component (m)
1.54	YComponent (m)
-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:

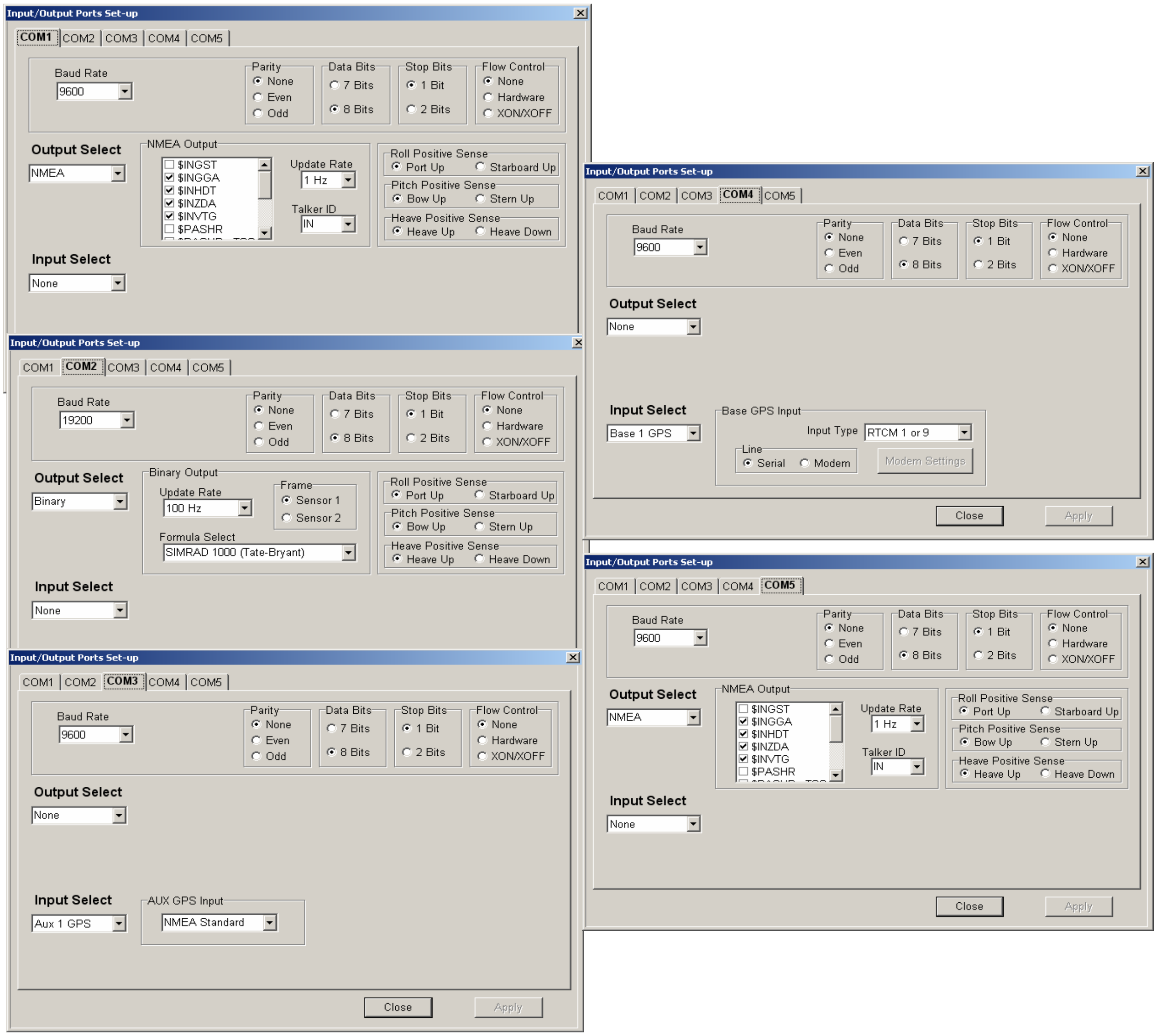
a) Heading rotation - apply a right-hand screw rotation θz about the z-axis to align one frame with the other.

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.

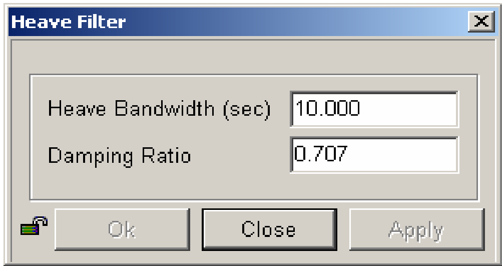
SETTINGS (insert screen grabs)

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

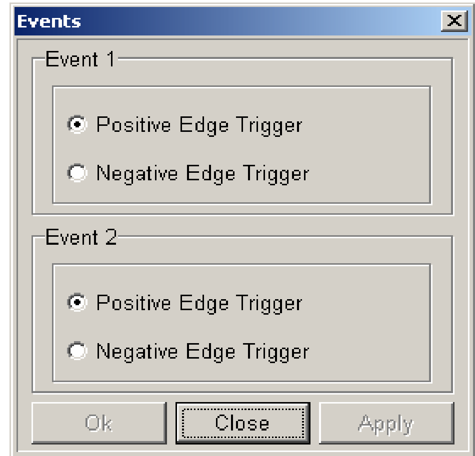


NOTE: COM3 and Analog are not used.

Heave Filter (Use Settings > Heave)

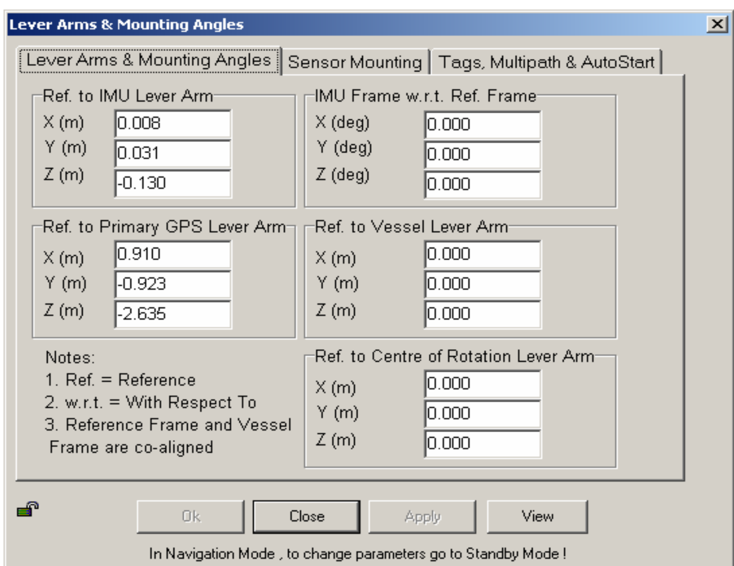


Events (Use Settings > Events)

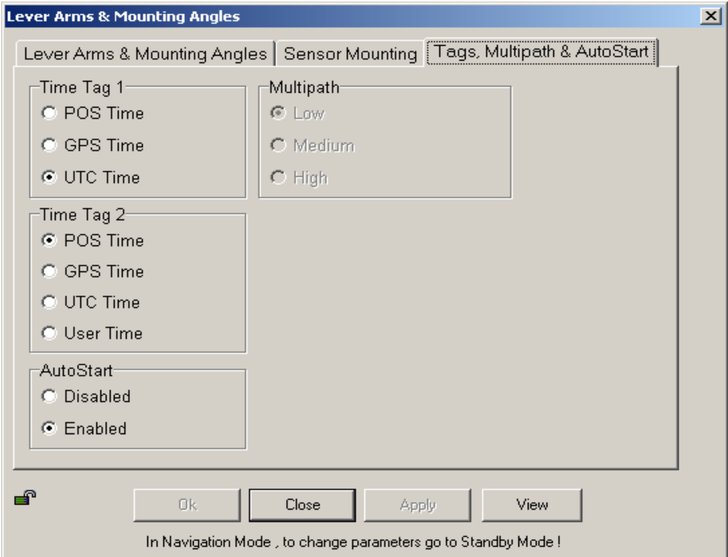


Time Sync (Use Settings > Time Sync)

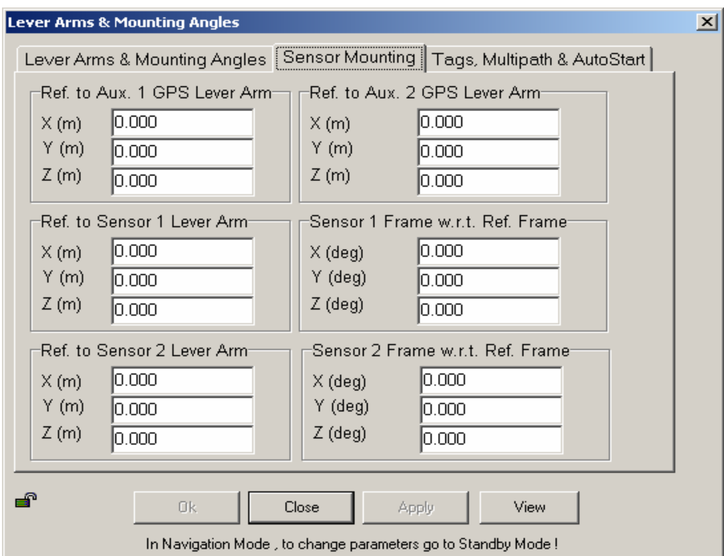
Installation (Use Settings > Installation)



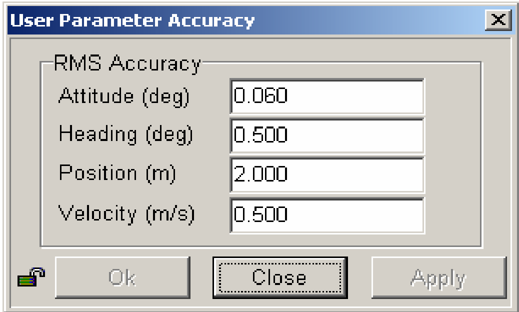
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



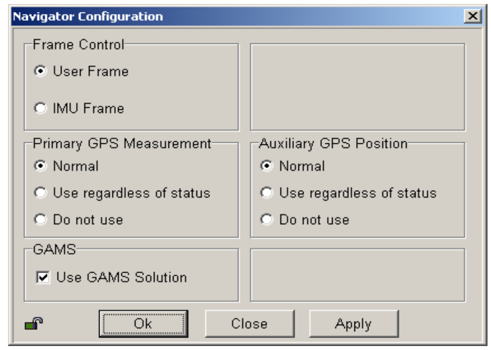
Sensor Mounting (Use Settings > Installation > Sensor Mounting)



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

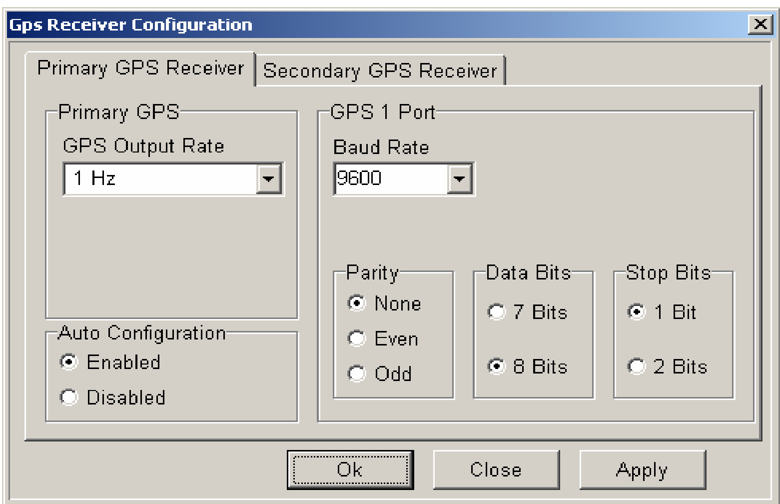


Frame Control (Use Tools > Config)

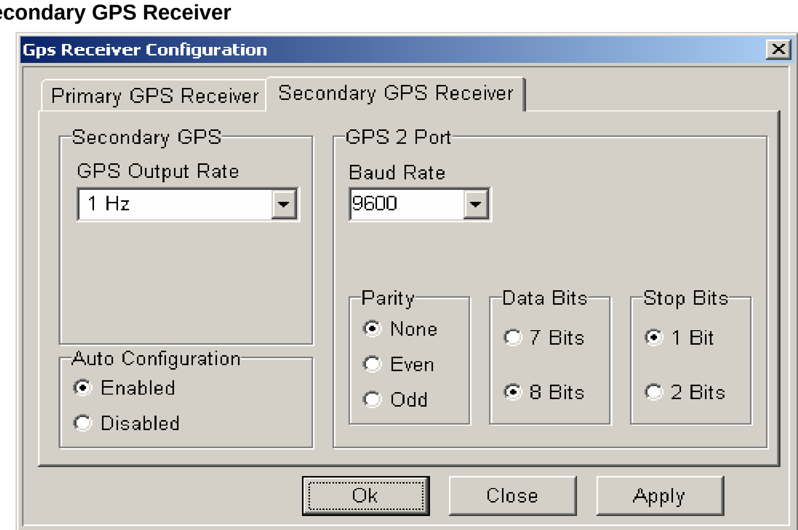


GPS Receiver Configuration (Use Settings> Installation> GPS Receiver Configuration)

Primary GPS Receiver



Secondary GPS Receiver



Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, WA 98005
USA

Phone: (425) 643-9866
Fax: (425) 643-9954
E-mail: seabird@seabird.com
Web: www.seabird.com

APPLICATION NOTE NO. 42 **Revised September 2001**

ITS-90 TEMPERATURE SCALE

Beginning January 1995, Sea-Bird temperature calibration certificates list a new set of coefficients labeled *g*, *h*, *i*, *j*, and *F0*. These coefficients correspond to ITS90 (T90) temperatures and should be entered by those researchers working with SEASOFT-DOS Versions 4.208 and higher (and all versions of SEASOFT-Win32). For the convenience of users who prefer to use older SEASOFT versions, the new certificates also list *a*, *b*, *c*, *d*, and *F0* coefficients corresponding to IPTS68 (T68) temperatures as required by SEASOFT-DOS versions older than 4.208.

It is important to note that the international oceanographic research community will continue to use T68 for computation of salinity and other seawater properties. Therefore, following the recommendations of Saunders (1990) and as supported by the Joint Panel on Oceanographic Tables and Standards (1991), SEASOFT-DOS 4.200 and later and all versions of SEASOFT-Win32 convert between T68 and T90 according to the linear relationship:

$$T_{68} = 1.00024 * T_{90}$$

The use of T68 for salinity and other seawater calculations is automatic in all SEASOFT programs. However, when selecting **temperature** as a display/output variable, you will be prompted to specify which standard (T90 or T68) is to be used to compute temperature. SEASOFT recognizes whether you have entered T90 or T68 coefficients in the configuration (.con) file, and computes T90 temperature directly or calculates it from the Saunders linear approximation, depending on which coefficients were used and which display variable type is selected.

For example, if *g, h, i, j, F0* coefficients (T90) are entered in the .con file and you select temperature variable type as T68, SEASOFT computes T90 temperature directly and multiplies it by 1.00024 to display T68. Conversely, if *a, b, c, d,* and *F0* coefficients (T68) are entered in the .con file and you select temperature variable type as T90, SEASOFT computes T68 directly and divides by 1.00024 to display T90.

Note: The CTD configuration (.con) file is edited using the Configure menu (in SEASAVE or SBE Data Processing in our SEASOFT-Win32 suite of programs) or SEACON (in SEASOFT-DOS).

Also beginning January 1995, Sea-Bird's own temperature metrology laboratory (based upon water triple-point and gallium melt cell, SPRT, and ASL F18 Temperature Bridge) converted to T90. These T90 standards are now employed in calibrating *all* Sea-Bird temperature sensors, and as the reference temperature used in conductivity calibrations. Accordingly, all calibration certificates show T90 (g, h, i, j) coefficients that result directly from T90 standards, and T68 coefficients (a, b, c, d) computed using the Saunders linear approximation.

SBE

Sea-Bird Electronics, Inc.
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com

FAX: (425) 643-9954
Tel:(425)643-9866
Email: seabird@seabird.com

Service Report

SBE Job Number: 43574

Date: 13, July 2006

Customer: NOAA-NAVIGATION RESPONSE BRANCH

Customer Identified Problem:

1. Calibrate SBE 19Plus SEACAT Profiler, S/N 19P39974-4835.

Services Performed:

1. Calibrations and services performed on SBE 19Plus SEACAT Profiler, S/N 19P39974-4835.
   Updated the EPROM to version 1.6a.
   Post calibrated the temperature and conductivity sensors.
   Calibrated the pressure sensor.
   Performed full diagnostic evaluation.

SBE
SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	NOAA-NAVIGATION RESPONSE BRANCH		
Job Number:	43574	Date of Report:	7/11/2006
Model Number	SBE 19Plus	Serial Number:	19P39974-4835

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing the coefficients used to convert sensor frequency to conductivity. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients using the program SEACON. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 7/11/2006 Drift since last cal: -.00150 PSU/month*

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: PSU/month*

Comments:

**Measured at 3.0 S/m*

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4835
CALIBRATION DATE: 11-Jul-06

SBE19plus CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -1.018083e+000
h = 1.319940e-001
i = -2.011500e-004
j = 3.178869e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006

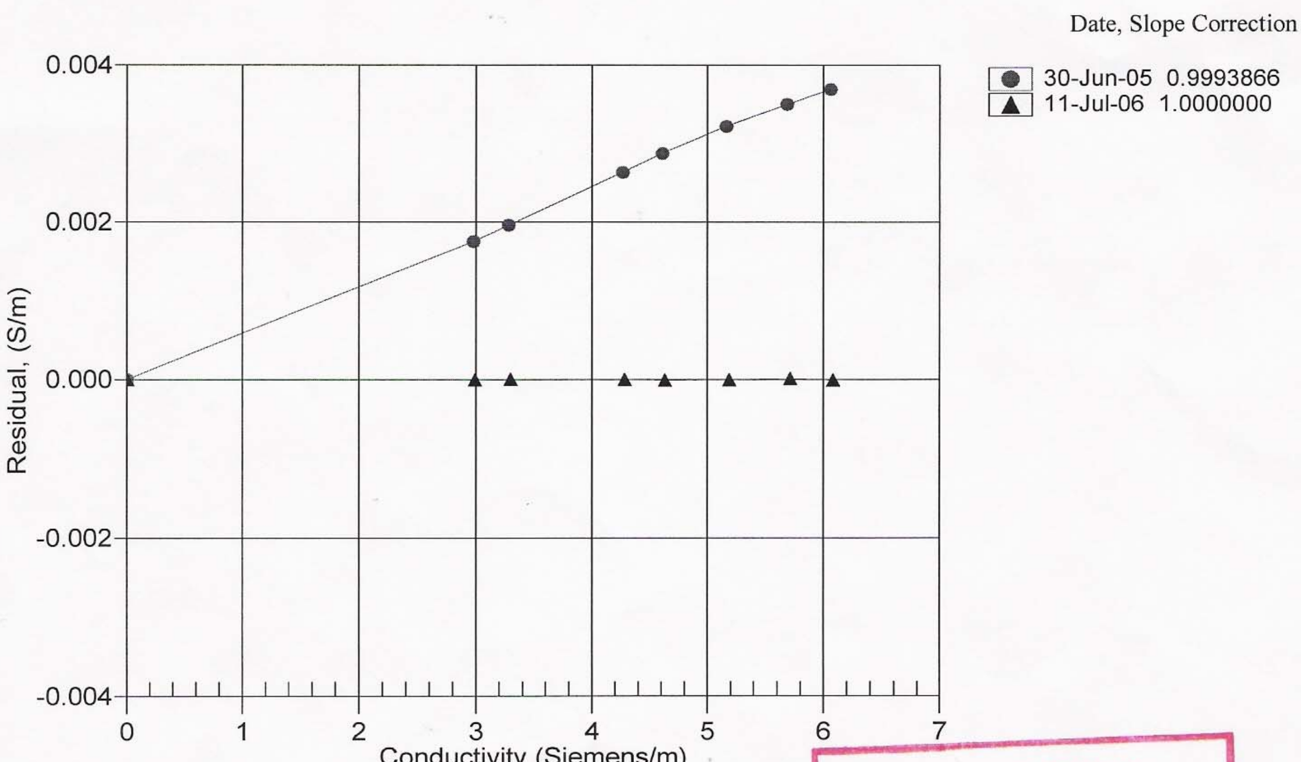
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2780.55	0.0000	0.00000
0.9999	34.9457	2.98596	5510.72	2.9860	-0.00000
4.5000	34.9255	3.29401	5718.10	3.2940	0.00000
15.0000	34.8837	4.27900	6335.02	4.2790	0.00000
18.5000	34.8748	4.62529	6537.79	4.6253	-0.00001
24.0000	34.8654	5.18512	6852.63	5.1851	-0.00000
29.0000	34.8604	5.70873	7134.19	5.7087	0.00001
32.5001	34.8579	6.08243	7328.32	6.0824	-0.00001

f = INST FREQ / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



POST CRUISE CALIBRATION

SBE **SEA-BIRD ELECTRONICS, INC.**
1808 - 136th Place Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	NOAA-NAVIGATION RESPONSE BRANCH		
Job Number:	43574	**Date of Report:**	7/11/2006
Model Number	SBE 19Plus	**Serial Number:**	19P39974-4835

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients using the program SEACON. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 7/11/2006 Drift since last cal: -.00163 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4835
CALIBRATION DATE: 11-Jul-06

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.263807e-003
a1 = 2.606755e-004
a2 = 3.313828e-007
a3 = 1.414077e-007

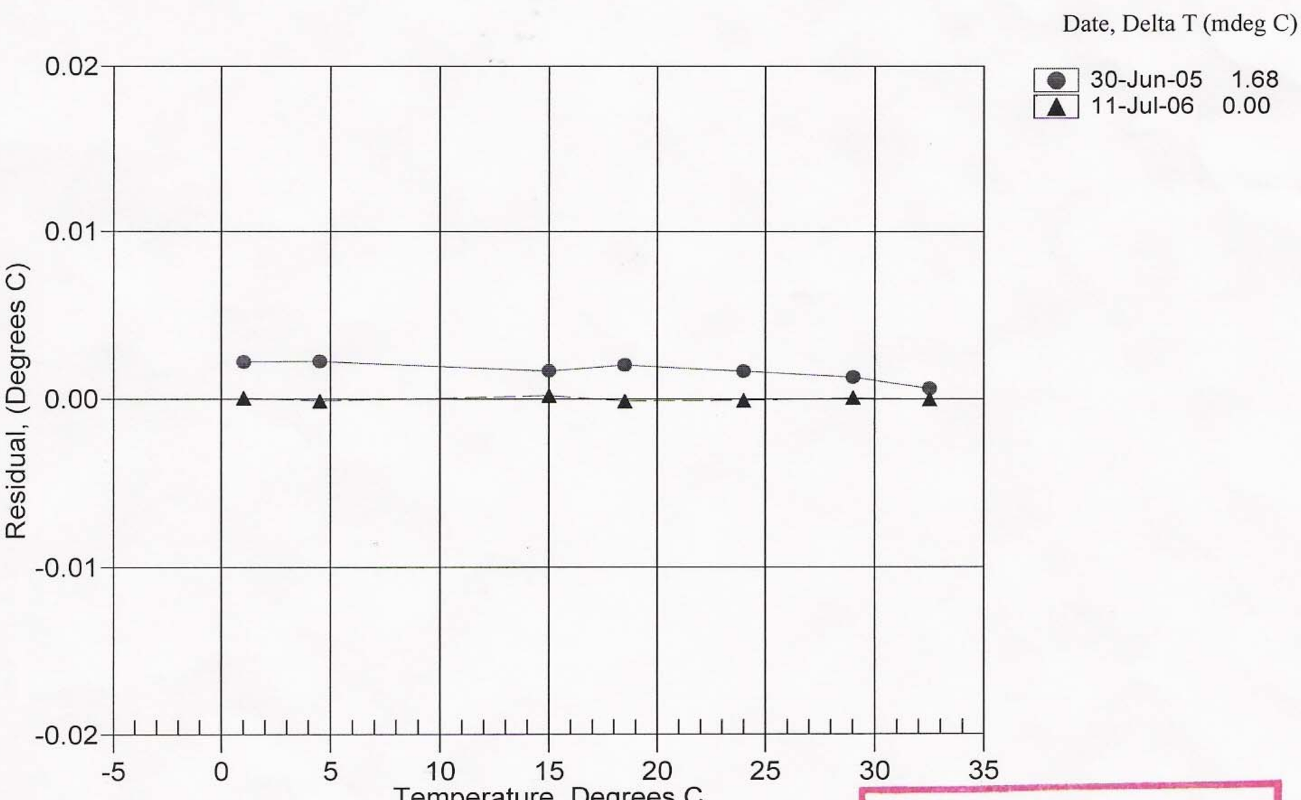
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
0.9999	601006.373	1.0000	0.0001
4.5000	533123.729	4.4999	-0.0001
15.0000	365269.068	15.0002	0.0002
18.5000	320340.373	18.4999	-0.0001
24.0000	259417.220	23.9999	-0.0001
29.0000	213093.864	29.0001	0.0001
32.5001	185132.983	32.5001	-0.0000

MV = (n - 524288) / 1.6e+007

R = (MV * 2.900e+009 + 1.024e+008) / (2.048e+004 - MV * 2.0e+005)

Temperature ITS-90 = $1/\{a0 + a1[ln(R)] + a2[ln^2(R)] + a3[ln^3(R)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4835
CALIBRATION DATE: 07-Jul-06

SBE19plus PRESSURE CALIBRATION DATA
160 psia S/N tspan

COEFFICIENTS:

PA0 = 1.504874e-002	PTCA0 = 5.239214e+005
PA1 = 4.866425e-004	PTCA1 = 8.882021e-001
PA2 = -3.481982e-012	PTCA2 = 2.256796e-002
PTEMPA0 = -6.061920e+001	PTCB0 = 2.512200e+001
PTEMPA1 = 5.330373e+001	PTCB1 = -2.000000e-003
PTEMPA2 = 1.160726e-002	PTCB2 = 0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.78	554247.0	1.5	14.78	0.00
29.90	585300.0	1.5	29.91	0.00
59.89	646868.0	1.5	59.88	-0.01
94.89	718816.0	1.5	94.87	-0.01
124.88	780547.0	1.5	124.87	-0.01
159.88	852684.0	1.5	159.89	0.00
124.88	780580.0	1.5	124.88	0.01
94.88	718840.0	1.5	94.89	0.00
59.89	646899.0	1.5	59.90	0.01
29.89	585314.0	1.5	29.92	0.01
14.81	554257.0	1.5	14.79	-0.01

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	1.75	554542.39
29.00	1.68	554529.02
24.00	1.59	554531.41
18.50	1.48	554514.95
15.00	1.42	554503.47
4.50	1.22	554490.58
1.00	1.16	554493.36

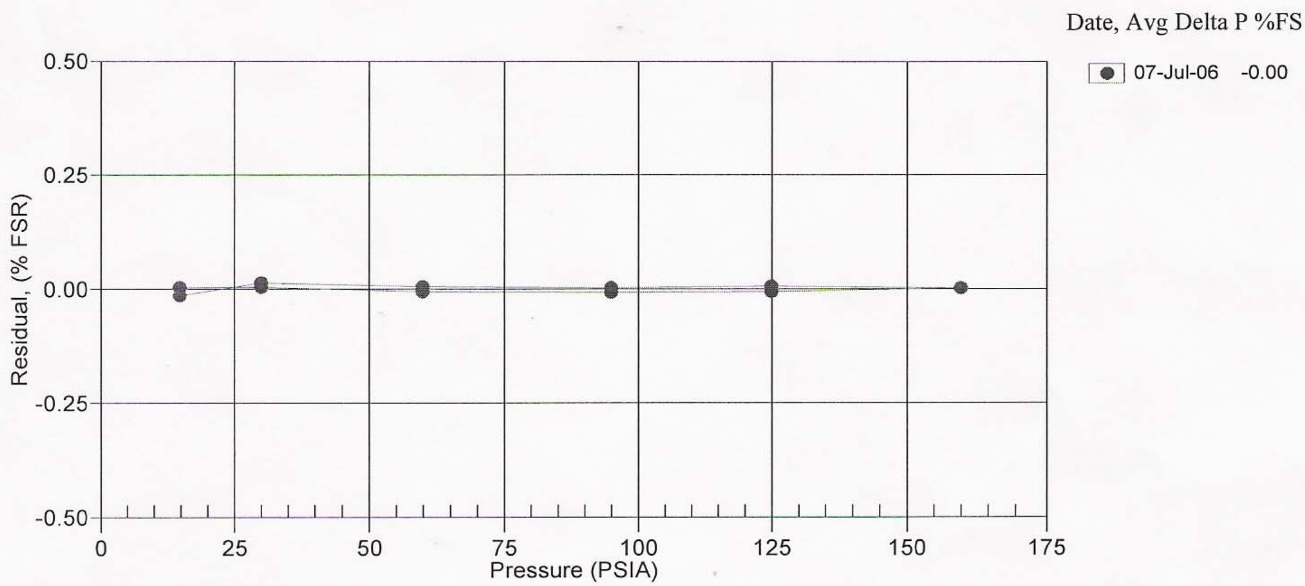
TEMP(ITS90)	SPAN(mV)
-5.00	25.13
35.00	25.05

y = thermistor output; t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2

x = pressure output - PTCA0 - PTCA1 * t - PTCA2 * t^2

n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)

pressure (psia) = PA0 + PA1 * n + PA2 * n^2



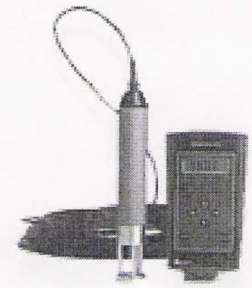
Date:
Jun 06, 2006

Serial #:
98212-060606

DIGIBAR CALIBRATION REPORT

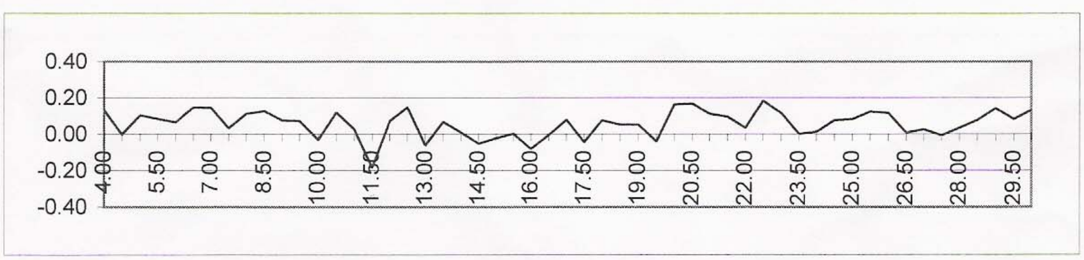
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.



STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5547.01	1421.75	0.13
4.50	1423.90	5555.25	1423.90	0.00
5.00	1426.15	5564.31	1426.26	0.10
5.50	1428.38	5572.79	1428.46	0.08
6.00	1430.58	5581.17	1430.64	0.07
6.50	1432.75	5589.83	1432.90	0.15
7.00	1434.90	5598.08	1435.04	0.15
7.50	1437.02	5605.80	1437.05	0.03
8.00	1439.12	5614.16	1439.23	0.11
8.50	1441.19	5622.17	1441.31	0.13
9.00	1443.23	5629.84	1443.31	0.08
9.50	1445.25	5637.59	1445.33	0.07
10.00	1447.25	5644.86	1447.22	-0.03
10.50	1449.22	5653.02	1449.34	0.12
11.00	1451.17	5660.15	1451.20	0.03
11.50	1453.09	5666.73	1452.91	-0.18
12.00	1454.99	5675.02	1455.07	0.07
12.50	1456.87	5682.51	1457.02	0.15
13.00	1458.72	5688.83	1458.66	-0.06
13.50	1460.55	5696.36	1460.62	0.07
14.00	1462.36	5703.08	1462.37	0.01
14.50	1464.14	5709.70	1464.09	-0.05
15.00	1465.91	5716.58	1465.88	-0.02
15.50	1467.65	5723.36	1467.65	0.00
16.00	1469.36	5729.63	1469.28	-0.08
16.50	1471.06	5736.44	1471.05	0.00
17.00	1472.73	5743.19	1472.81	0.08
17.50	1474.38	5749.06	1474.34	-0.04
18.00	1476.01	5755.78	1476.09	0.08
18.50	1477.62	5761.87	1477.67	0.05
19.00	1479.21	5767.97	1479.26	0.05
19.50	1480.77	5773.63	1480.73	-0.04
20.00	1482.32	5780.35	1482.48	0.16
20.50	1483.84	5786.23	1484.01	0.17
21.00	1485.35	5791.79	1485.46	0.11
21.50	1486.83	5797.43	1486.92	0.10
22.00	1488.29	5802.82	1488.33	0.03
22.50	1489.74	5808.94	1489.92	0.18
23.00	1491.16	5814.15	1491.28	0.12
23.50	1492.56	5819.11	1492.57	0.00
24.00	1493.95	5824.47	1493.96	0.01
24.50	1495.32	5829.97	1495.39	0.08
25.00	1496.66	5835.16	1496.74	0.08
25.50	1497.99	5840.42	1498.11	0.12
26.00	1499.30	5845.42	1499.41	0.12
26.50	1500.59	5849.96	1500.60	0.01
27.00	1501.86	5854.91	1501.88	0.03
27.50	1503.11	5859.60	1503.10	-0.01
28.00	1504.35	5864.50	1504.38	0.03
28.50	1505.56	5869.34	1505.64	0.08
29.00	1506.76	5874.19	1506.90	0.14
29.50	1507.94	5878.50	1508.02	0.08
30.00	1509.10	5883.16	1509.24	0.13



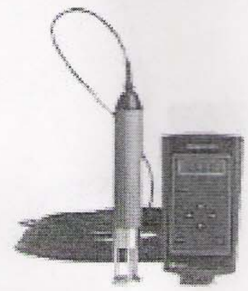
Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

Date:	Jun 06, 2006
Serial #:	98212-060606

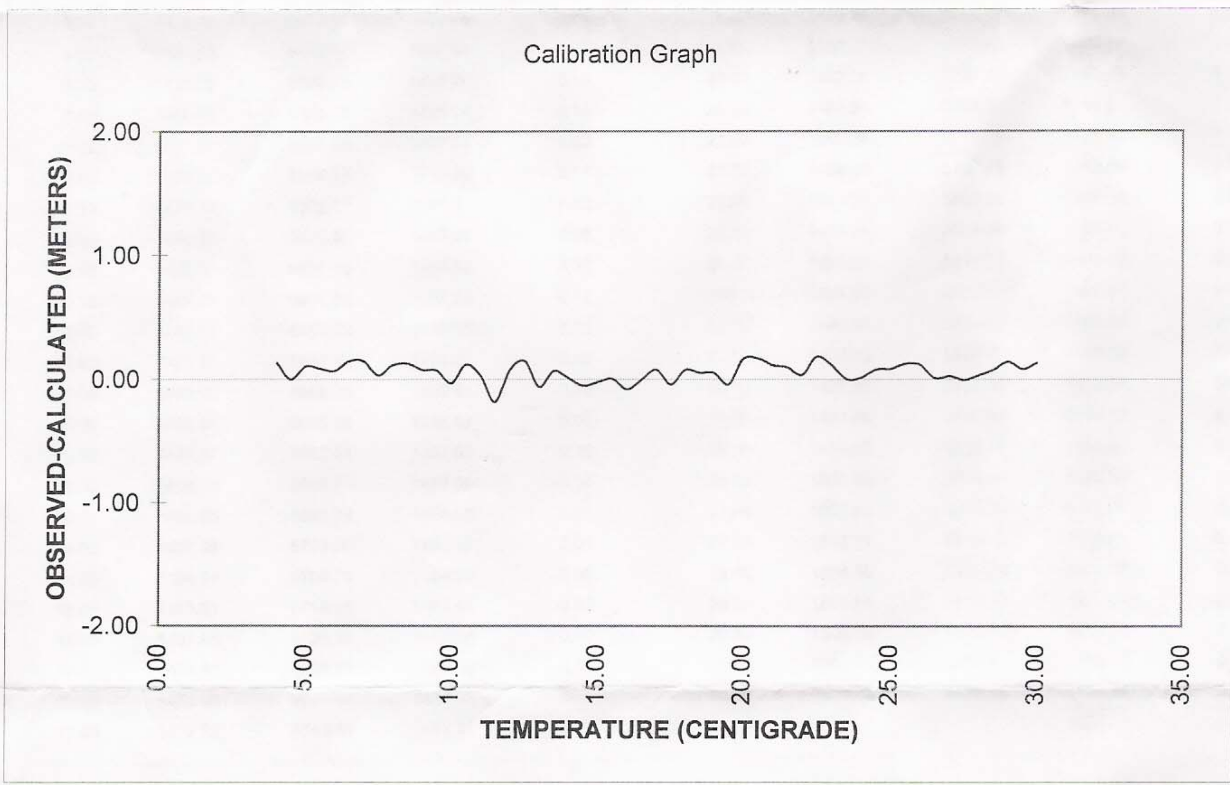
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.



Burn these numbers to EPROM:		
	Gradient	**3332**
	Intercept	**219**



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

Date:
May 19, 2006

Serial #:
98214-051906

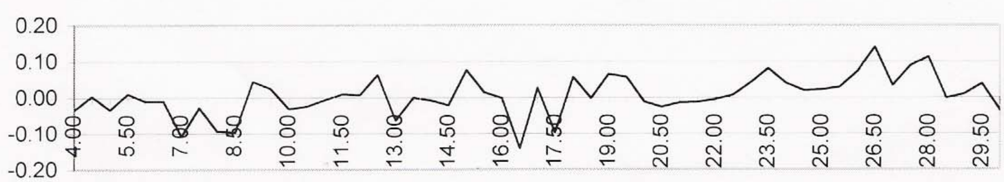
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

STANDARD DEL GROSSO H^{2}O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5548.21	1421.59	-0.03
4.50	1423.90	5557.12	1423.90	0.00
5.00	1426.15	5565.64	1426.12	-0.03
5.50	1428.38	5574.37	1428.39	0.01
6.00	1430.58	5582.75	1430.57	-0.01
6.50	1432.75	5591.11	1432.74	-0.01
7.00	1434.90	5598.99	1434.79	-0.11
7.50	1437.02	5607.46	1436.99	-0.03
8.00	1439.12	5615.27	1439.02	-0.09
8.50	1441.19	5623.22	1441.09	-0.10
9.00	1443.23	5631.63	1443.28	0.04
9.50	1445.25	5639.33	1445.28	0.03
10.00	1447.25	5646.79	1447.22	-0.03
10.50	1449.22	5654.40	1449.20	-0.02
11.00	1451.17	5661.96	1451.16	-0.01
11.50	1453.09	5669.42	1453.10	0.01
12.00	1454.99	5676.72	1455.00	0.01
12.50	1456.87	5684.15	1456.93	0.06
13.00	1458.72	5690.79	1458.66	-0.06
13.50	1460.55	5698.07	1460.55	0.00
14.00	1462.36	5704.99	1462.35	-0.01
14.50	1464.14	5711.80	1464.12	-0.02
15.00	1465.91	5718.95	1465.98	0.08
15.50	1467.65	5725.40	1467.66	0.02
16.00	1469.36	5731.94	1469.36	0.00
16.50	1471.06	5737.92	1470.92	-0.14
17.00	1472.73	5745.00	1472.76	0.03
17.50	1474.38	5750.87	1474.28	-0.10
18.00	1476.01	5757.73	1476.07	0.06
18.50	1477.62	5763.69	1477.62	0.00
19.00	1479.21	5770.05	1479.27	0.07
19.50	1480.77	5776.04	1480.83	0.06
20.00	1482.32	5781.72	1482.30	-0.01
20.50	1483.84	5787.53	1483.82	-0.03
21.00	1485.35	5793.36	1485.33	-0.01
21.50	1486.83	5799.07	1486.82	-0.01
22.00	1488.29	5804.73	1488.29	0.00
22.50	1489.74	5810.33	1489.74	0.01
23.00	1491.16	5815.94	1491.20	0.04
23.50	1492.56	5821.49	1492.65	0.08
24.00	1493.95	5826.66	1493.99	0.04
24.50	1495.32	5831.83	1495.33	0.02
25.00	1496.66	5837.02	1496.68	0.02
25.50	1497.99	5842.15	1498.02	0.03
26.00	1499.30	5847.35	1499.37	0.07
26.50	1500.59	5852.57	1500.73	0.14
27.00	1501.86	5857.05	1501.89	0.03
27.50	1503.11	5862.08	1503.20	0.09
28.00	1504.35	5866.92	1504.46	0.11
28.50	1505.56	5871.16	1505.56	0.00
29.00	1506.76	5875.81	1506.77	0.01
29.50	1507.94	5880.46	1507.98	0.04
30.00	1509.10	5884.65	1509.07	-0.03



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

Date:
May 19, 2006

Serial #:
98214-051906

DIGIBAR CALIBRATION REPORT

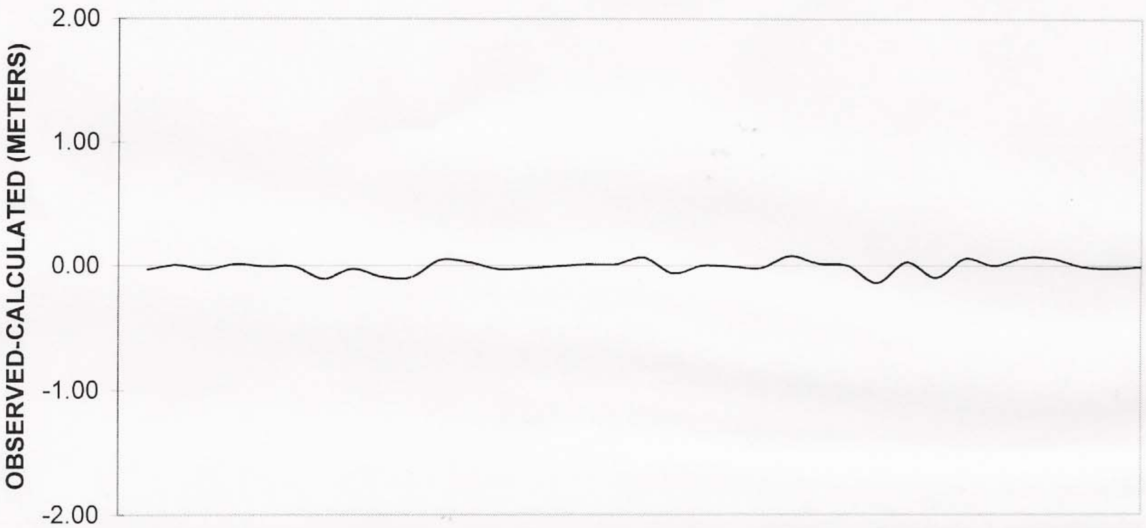
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

Burn these numbers to EPROM:

Gradient	**3329**
Intercept	**211**

Calibration Graph



TEMPERATURE (CENTIGRADE)

Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

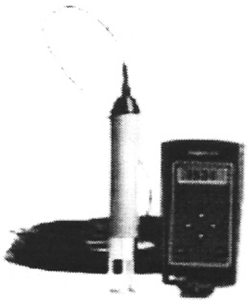
Date:
Jul 06, 2007

Serial #:
98212-070607

DIGIBAR CALIBRATION REPORT

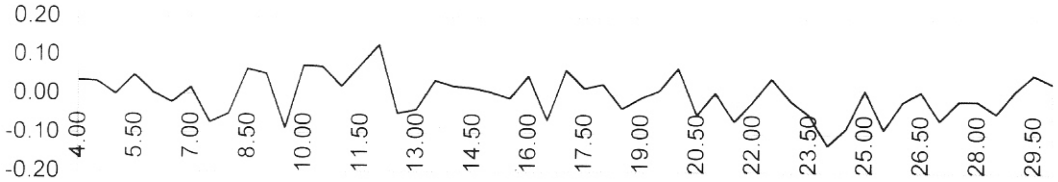
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc



STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5546.83	1421.66	0.03
4.50	1423.90	5555.62	1423.93	0.03
5.00	1426.15	5564.19	1426.15	0.00
5.50	1428.38	5572.97	1428.43	0.05
6.00	1430.58	5581.29	1430.58	0.00
6.50	1432.75	5589.58	1432.73	-0.02
7.00	1434.90	5598.02	1434.92	0.02
7.50	1437.02	5605.86	1436.95	-0.07
8.00	1439.12	5614.04	1439.07	-0.05
8.50	1441.19	5622.48	1441.25	0.07
9.00	1443.23	5630.33	1443.29	0.05
9.50	1445.25	5637.59	1445.17	-0.09
10.00	1447.25	5645.92	1447.33	0.07
10.50	1449.22	5653.52	1449.29	0.07
11.00	1451.17	5660.84	1451.19	0.02
11.50	1453.09	5668.48	1453.17	0.07
12.00	1454.99	5676.02	1455.12	0.13
12.50	1456.87	5682.58	1456.82	-0.05
13.00	1458.72	5689.77	1458.69	-0.04
13.50	1460.55	5697.12	1460.59	0.04
14.00	1462.36	5704.04	1462.38	0.02
14.50	1464.14	5710.91	1464.16	0.02
15.00	1465.91	5717.67	1465.91	0.01
15.50	1467.65	5724.32	1467.64	-0.01
16.00	1469.36	5731.17	1469.41	0.05
16.50	1471.06	5737.27	1470.99	-0.07
17.00	1472.73	5744.23	1472.79	0.06
17.50	1474.38	5750.42	1474.40	0.02
18.00	1476.01	5756.75	1476.04	0.03
18.50	1477.62	5762.72	1477.58	-0.03
19.00	1479.21	5768.95	1479.20	-0.01
19.50	1480.77	5775.07	1480.78	0.01
20.00	1482.32	5781.26	1482.39	0.07
20.50	1483.84	5786.68	1483.79	-0.05
21.00	1485.35	5792.71	1485.35	0.01
21.50	1486.83	5798.15	1486.76	-0.07
22.00	1488.29	5804.00	1488.28	-0.02
22.50	1489.74	5809.80	1489.78	0.04
23.00	1491.16	5815.08	1491.15	-0.01
23.50	1492.56	5820.36	1492.52	-0.05
24.00	1493.95	5825.40	1493.82	-0.13
24.50	1495.32	5830.84	1495.23	-0.08
25.00	1496.66	5836.42	1496.68	0.01
25.50	1497.99	5841.15	1497.90	-0.09
26.00	1499.30	5846.48	1499.28	-0.01
26.50	1500.59	5851.56	1500.60	0.01
27.00	1501.86	5856.18	1501.80	-0.06
27.50	1503.11	5861.21	1503.10	-0.01
28.00	1504.35	5865.98	1504.33	-0.01
28.50	1505.56	5870.55	1505.52	-0.04
29.00	1506.76	5875.40	1506.77	0.01
29.50	1507.94	5880.12	1508.00	0.06
30.00	1509.10	5884.52	1509.14	0.03



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue Baton Rouge Louisiana 70810-6261 USA
Telephone (225)-769-3051 Facsimile (225)-766-5122
E-mail email@odomhydrographic.com HTTP www.odomhydrographic.com

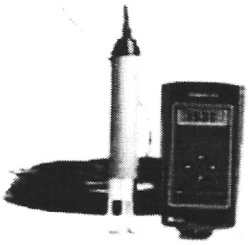
Date:
Jul 06, 2007

Serial #:
98212-070607

DIGIBAR CALIBRATION REPORT

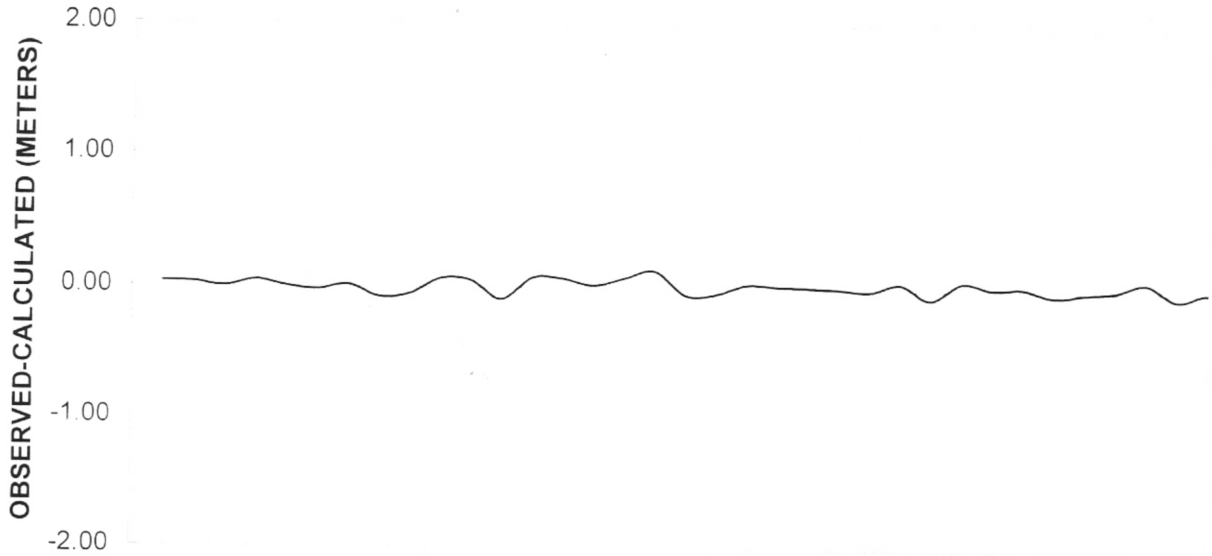
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS Inc



Burn these numbers to EPROM:	Gradient	**3316**
	Intercept	**154**

Calibration Graph



TEMPERATURE (CENTIGRADE)

Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue Baton Rouge Louisiana 70810-6261 USA
Telephone (225)-769-3051 Facsimile (225)-766-5122
E-mail email@odomhydrographic.com HTTP www.odomhydrographic.com

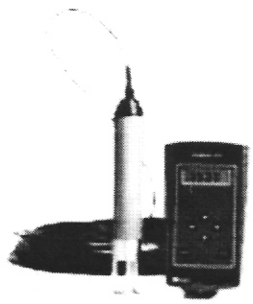
Date:
Jul 06, 2007

Serial #:
98214-070607

DIGIBAR CALIBRATION REPORT

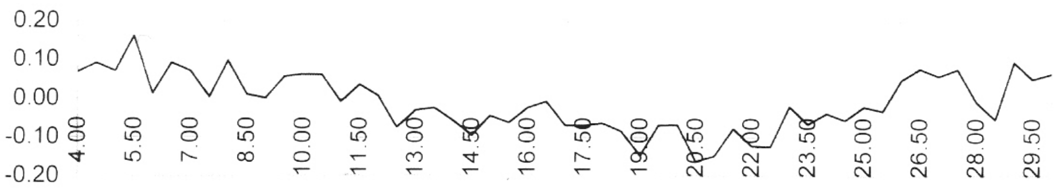
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS Inc



STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL	TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5554.65	1421.69	0.07	17.50	1474.38	5754.62	1474.31	-0.07
4.50	1423.90	5563.40	1423.99	0.09	18.00	1476.01	5760.84	1475.95	-0.06
5.00	1426.15	5571.88	1426.22	0.07	18.50	1477.62	5766.87	1477.53	-0.08
5.50	1428.38	5580.69	1428.54	0.16	19.00	1479.21	5772.66	1479.06	-0.15
6.00	1430.58	5588.48	1430.59	0.01	19.50	1480.77	5778.91	1480.70	-0.07
6.50	1432.75	5597.04	1432.84	0.09	20.00	1482.32	5784.79	1482.25	-0.07
7.00	1434.90	5605.12	1434.97	0.07	20.50	1483.84	5790.22	1483.68	-0.16
7.50	1437.02	5612.93	1437.02	0.00	21.00	1485.35	5795.99	1485.20	-0.15
8.00	1439.12	5621.25	1439.21	0.10	21.50	1486.83	5801.90	1486.75	-0.08
8.50	1441.19	5628.79	1441.20	0.01	22.00	1488.29	5807.29	1488.17	-0.12
9.00	1443.23	5636.53	1443.24	0.00	22.50	1489.74	5812.77	1489.61	-0.12
9.50	1445.25	5644.42	1445.31	0.06	23.00	1491.16	5818.58	1491.14	-0.02
10.00	1447.25	5652.03	1447.31	0.06	23.50	1492.56	5823.74	1492.50	-0.07
10.50	1449.22	5659.52	1449.28	0.06	24.00	1493.95	5829.11	1493.91	-0.04
11.00	1451.17	5666.66	1451.16	-0.01	24.50	1495.32	5834.23	1495.26	-0.06
11.50	1453.09	5674.14	1453.13	0.04	25.00	1496.66	5839.48	1496.64	-0.02
12.00	1454.99	5681.25	1455.00	0.01	25.50	1497.99	5844.48	1497.96	-0.03
12.50	1456.87	5688.07	1456.80	-0.07	26.00	1499.30	5849.76	1499.35	0.05
13.00	1458.72	5695.28	1458.70	-0.03	26.50	1500.59	5854.77	1500.66	0.08
13.50	1460.55	5702.26	1460.53	-0.02	27.00	1501.86	5859.53	1501.92	0.06
14.00	1462.36	5709.00	1462.31	-0.06	27.50	1503.11	5864.36	1503.19	0.08
14.50	1464.14	5715.63	1464.05	-0.09	28.00	1504.35	5868.73	1504.34	-0.01
15.00	1465.91	5722.52	1465.86	-0.04	28.50	1505.56	5873.18	1505.51	-0.05
15.50	1467.65	5729.06	1467.58	-0.06	29.00	1506.76	5878.30	1506.86	0.10
16.00	1469.36	5735.73	1469.34	-0.02	29.50	1507.94	5882.62	1507.99	0.05
16.50	1471.06	5742.23	1471.05	-0.01	30.00	1509.10	5887.09	1509.17	0.07
17.00	1472.73	5748.35	1472.66	-0.07					



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue Baton Rouge Louisiana 70810-6261 USA
Telephone (225)-769-3051 Facsimile (225)-766-5122
E-mail email@odomhydrographic.com HTTP www.odomhydrographic.com

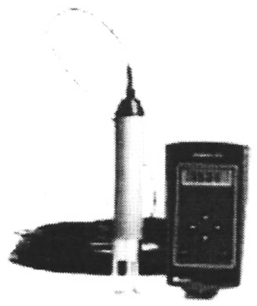
Date:
Jul 06. 2007

Serial #:
98214-070607

DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

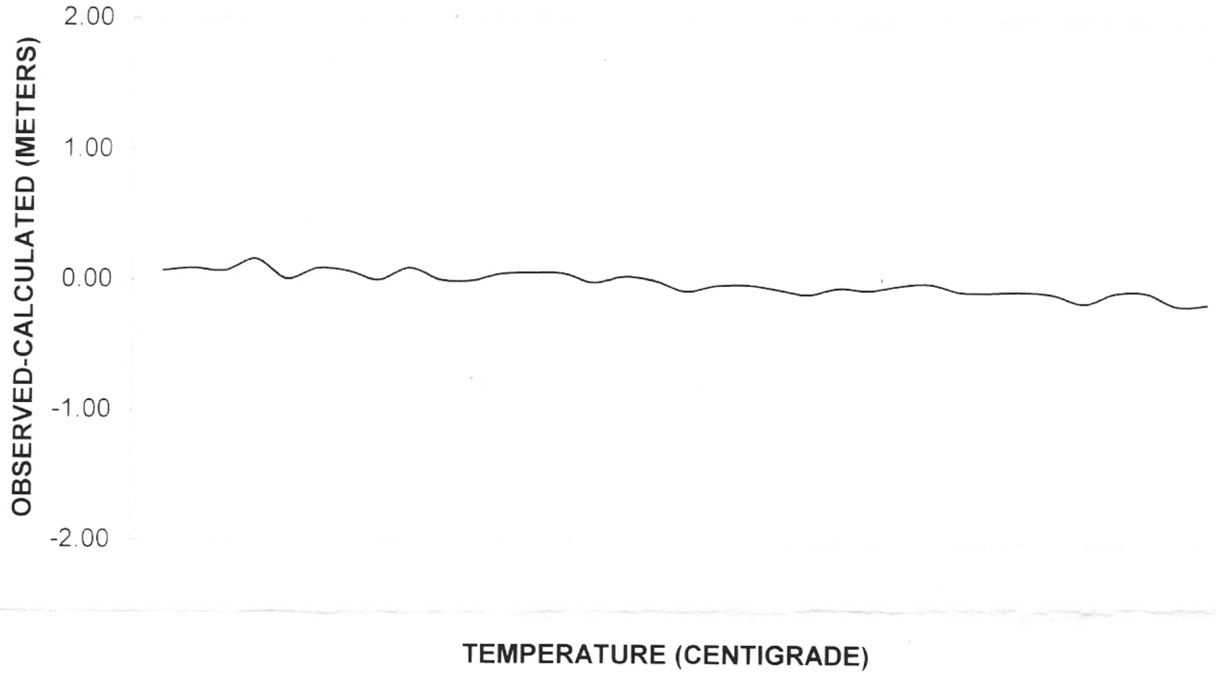
ODOM HYDROGRAPHIC SYSTEMS Inc



Burn these numbers to EPROM:

Gradient	**3369**
Intercept	**401**

Calibration Graph



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue Baton Rouge Louisiana 70810-6261 USA
Telephone (225)-769-3051 Facsimile (225)-766-5122
E-mail email@odomhydrographic.com HTTP www.odomhydrographic.com

S3002
Leadline Comparison 6 April 2007

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 verticalbeam echosounder (VBES) and multibeam echosounder (MBES) was conducted on 6 April 2007 by NRT 5 personnel PST Bert Ho and LT(jg) Matthew Jaskoski. Results of these comparisons are tabulated in Table 1 and Table 2 respectively.

Procedure:

Leadline measurements were made by PST Ho 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 -0.01m; meaning vertical beam depth was on average 1cm shallower than leadline measurements. Similarly, average MBES depth was 0.17m or 17cm 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: **04/06/2007**
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=	B=	C=	D=	(A+C+D)-B
		Raw VBES Depth	**Leadline Reading**	**Draft**	**Draft**	**Raw Depth Correction**
ES Type	Time	Txdcr to Bottom	WL to Bottom	IMU to Txdcr	IMU to WL	Error
Echotrac CV	17:12:15	2.65	3.14	0.255	0.19	-0.05
Echotrac CV	17:12:42	2.62	3.10	0.255	0.19	-0.04
Echotrac CV	17:13:18	2.74	3.11	0.255	0.19	0.08
Echotrac CV	17:13:44	2.63	3.12	0.255	0.19	-0.05

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

Multibeam		A=	B=	C=	D=	(A+C+D)-B
		Raw MBES Depth	**Leadline Reading**	**Draft**	**Draft**	**Raw Depth Correction**
ES Type	Time	Txdcr to Bottom	WL to Bottom	IMU to Txdcr	IMU to WL	Error
EM3000	17:15:36	1.50	2.85	1.342	0.19	0.18
EM3000	17:16:01	1.48	2.87	1.342	0.19	0.14
EM3000	17:16:24	1.50	2.86	1.342	0.19	0.17
EM3000	17:16:48	1.49	2.84	1.342	0.19	0.18

S3002
MBES Patch Test 21 & 28 March 2007

LT(jg) Matthew Jaskoski

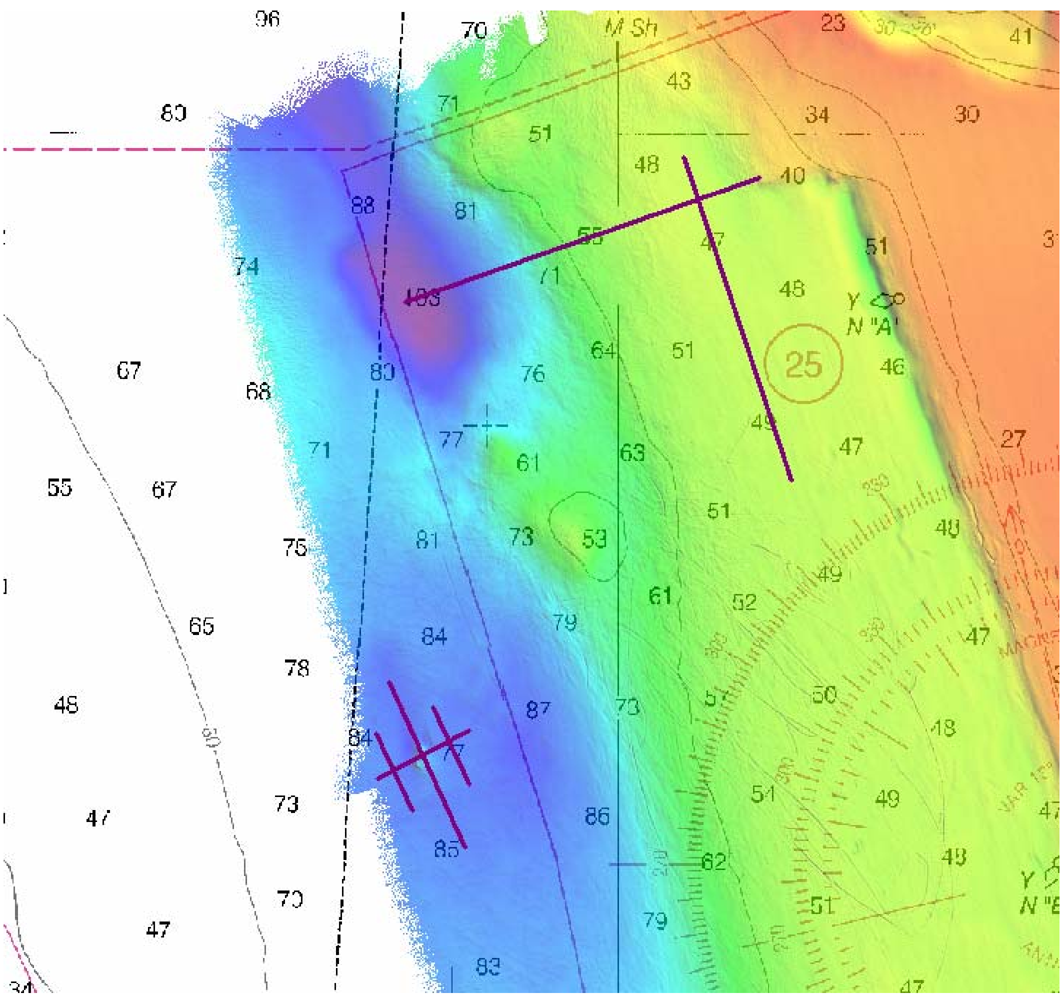
Background:

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 March 28 2007 (DN 088) by LT(jg) Matthew Jaskoski , PST Bert Ho, and PST Vitad Pradith.

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 (appx. 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 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). The line over the sloped area was approximately 600m in length. Both sets of the coincident lines were run at differing speeds of approximately 4 knots and 8 knots respectively. A sound velocity cast was taken near the survey area.

Pitch:
Data were acquired over a sloped area (appx. 30m to 10m 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). The line was approximately 600m in length. The reciprocal lines were run at a survey speed of approximately 7 knots. A sound velocity cast was taken near the survey area.

Roll:
Data were acquired over a flat area (appx. 15m 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). The survey line was approximately 500m in length. The reciprocal lines were run at survey speed. 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 5 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 PST Ho; the second scan was performed by LT(jg) Jaskoski.

The offset values are tabulated below.

Table 1: MBES Dynamic Offset Data

S3002 EM3000 Patch Test Results	
Error/Bias	Offset value
Navigation Timing Error:	-0.12
Pitch bias:	-5.03
Roll bias:	1.84
Yaw/Az/Heading bias:	2.43

Discussion:

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

S3002
MBES Patch Test 12 July 2007

LT(jg) Matthew Jaskoski

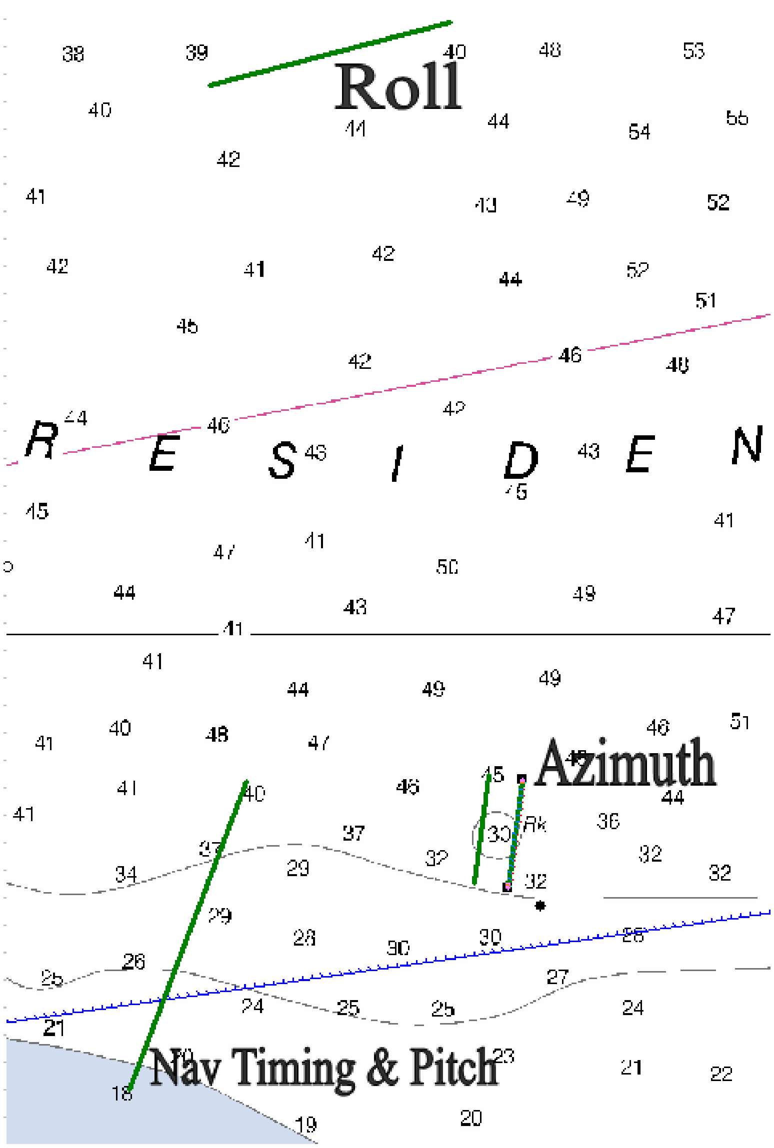
Background:

Following repair work to the MBES support arm, a second patch test was conducted. Data collected after DN 193 have the values determined by this patch test applied to them.

Location, Date, and Personnel:

Sonar data were acquired at President Roads, Boston Harbor, MA (Figure 1) on 12 July 2007 (DN 193) by LT(jg) Matthew Jaskoski , and PST Bert Ho.

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 (appx. 15m to 6m water depth) of the President Roads anchorage. The survey area is located as close as is practicable to the Boston Harbor Harmonic water level station. The survey time was planned to coincide as closely as practicable to slack water. The line over the sloped area was approximately 350m in length. Both sets of the coincident lines were run at differing speeds of approximately 2.5 knots and 6 knots respectively. A sound velocity cast was taken near the survey area.

Pitch:
Data were acquired over a sloped area (appx. 15m to 6m water depth) near the President Roads anchorage. The survey area is located as close as is practicable to the Boston Harbor Harmonic water level station. The survey time was planned to coincide as closely as practicable to slack water. The line was approximately 350m in length. The reciprocal lines were run at a survey speed of approximately 5.5 knots. A sound velocity cast was taken near the survey area.

Roll:
Data were acquired over a flat area (appx. 13m water depth) of the President Roads anchorage. The survey area is located as close as is practicable to the Boston Harbor Harmonic water level station. The survey time was planned to coincide as closely as practicable to slack water. The survey line was approximately 250m in length. The reciprocal lines were run at a survey speed of approximately 5.5 knots. A sound velocity cast was taken near the survey area.

Yaw:
Data were acquired over a conspicuous obstruction near the President Roads Anchorage in approximately 10m water depth. One pair of adjacent lines were run in reciprocal direction at a survey speed of approximately 5.5 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 PST Ho; the second scan was performed by LT(jg) Jaskoski.

The offset values are tabulated below.

Table 1: MBES Dynamic Offset Data

S3002 EM3000 Patch Test Results	
Error/Bias	Offset value
Navigation Timing Error:	-0.160
Pitch bias:	-4.205
Roll bias:	2.025
Yaw/Az/Heading bias:	2.820

Discussion:

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

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

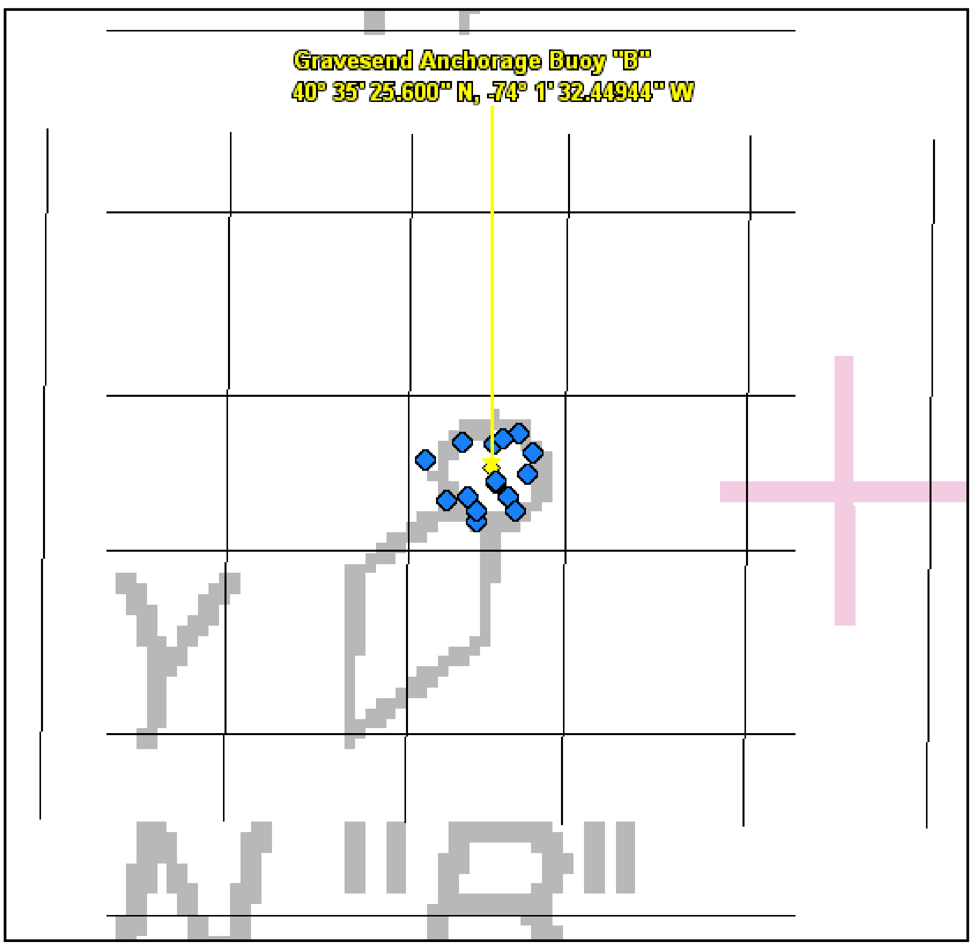
PST Vitad Pradith

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.

A SSS evaluation was performed on March 27, 2007 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 (Figure 1) 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 multi-beam data to ensure a higher confidence in the positional accuracy of the object. For this evaluation, the Anchorage Buoy "B" block (one cubic meter) located in the western region of the anchorage was chosen. This evaluation was conducted under guidance of the FPM (ver 2.1) section 1.5.7.1.2

Figure 1 Line Plan depiction (75 meter range scale)



Results:

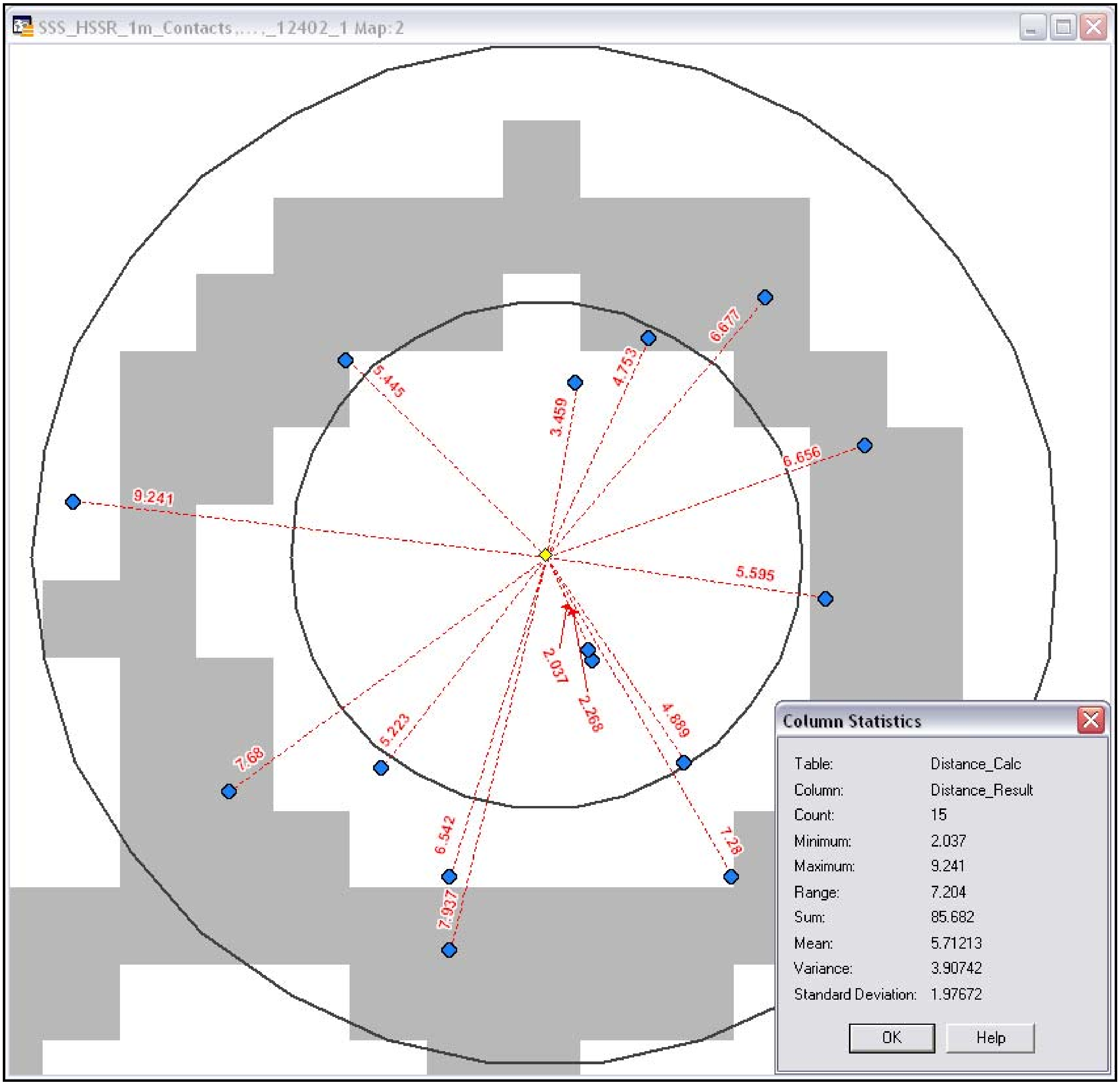


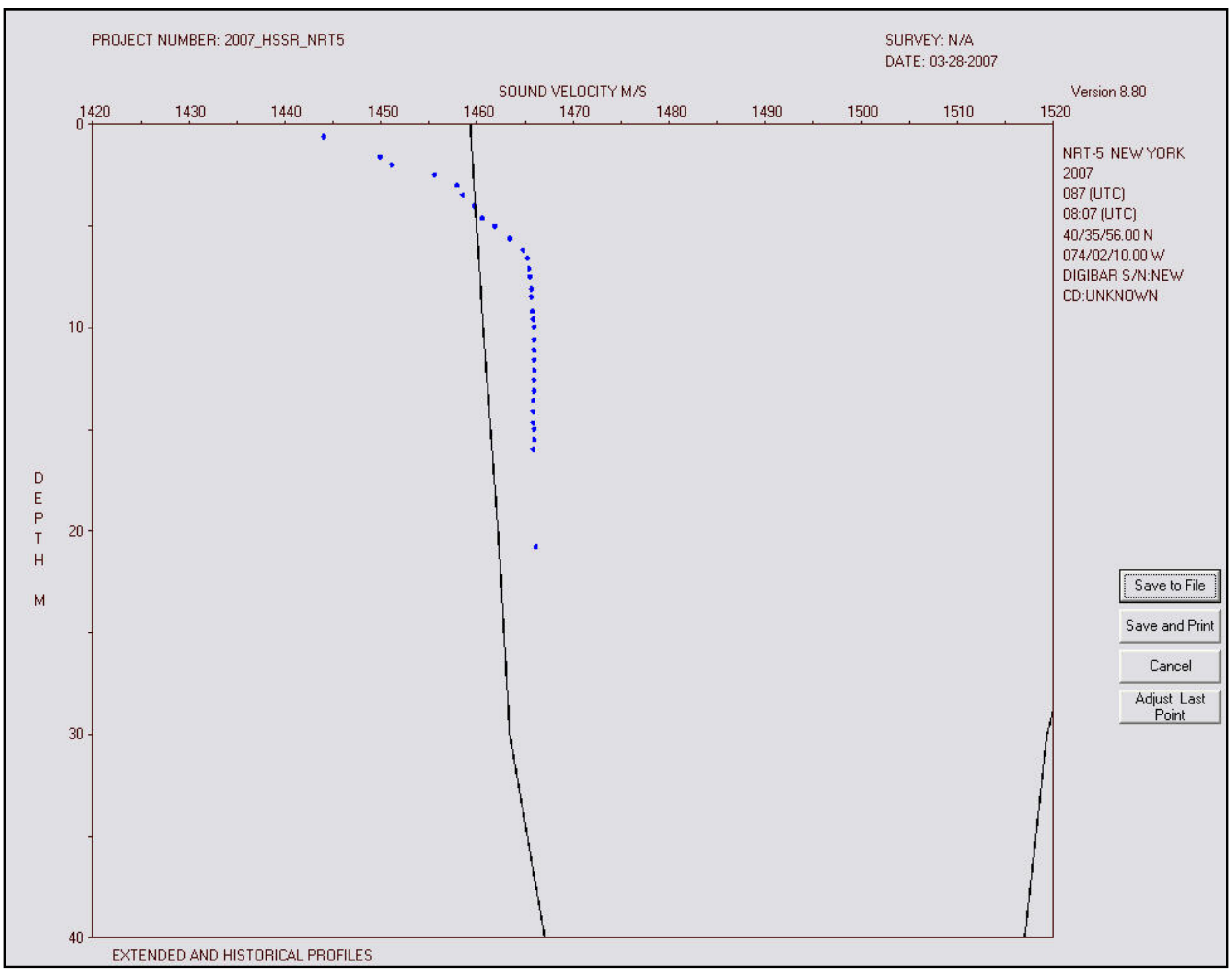
Figure 2 Dispersion of results in concentric 5 meter radii (values in meters)

Discussion:

The most reliable and accurate passes were used toward calculation with the "Calculate Statistics" tool of MapInfo 8.5.1. The evaluation results (Figure 2) produced a standard deviation of 1.97672 at an approximate 95% confidence level (however, a standard z-score is typically 1.96 at a 95% confidence level). The dispersion from the mean (Variance) was approximately 3.90742 meters with the maximum value from the targeted buoy block of 9.241 meters. With the exception of the Standard Deviation, the results of the evaluation meet the FPM (ver 2.1) 1.5.7 ten-meter accuracy requirement. The exception is discussed below.

The evaluation was conducted on a day in waters with a marked change in salinity levels (Figure 3). New York Harbor is typically well mixed, but on this very unusual day, a noticeable halocline was observed causing reduced resolution in the outer fields. In conjunction, strong ebb currents typical of the area were experienced causing noticeable crabbing of the survey vessel and towfish. The combination of these factors negatively affected the positional accuracy of the contact thereby increasing the variance and its subsequent standard deviation.

Figure 3 Sound Speed Values



NRT-5
Horizontal Quality Control 13 April 2007
PST Vitad Pradith

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 April 13, 2007, 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 on the Campus of the New Jersey Institute of Technology of Newark, NJ. A filtered set of 331 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 0.118 meter distance from the known survey mark.

Fig 8: USACE bench mark KV6856 and setup overview

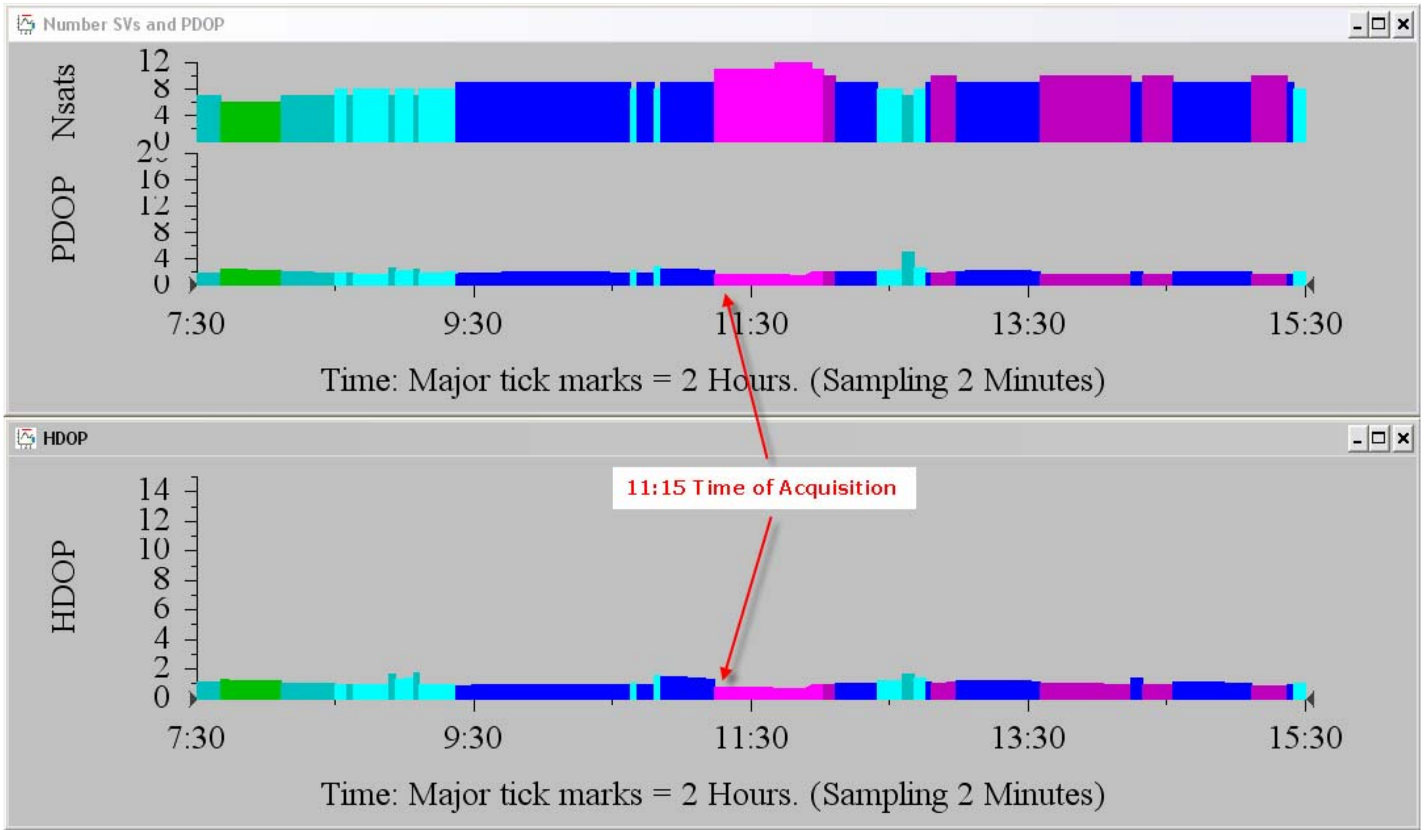


Figure 9, Time of collection influenced to reduce HDOP error.

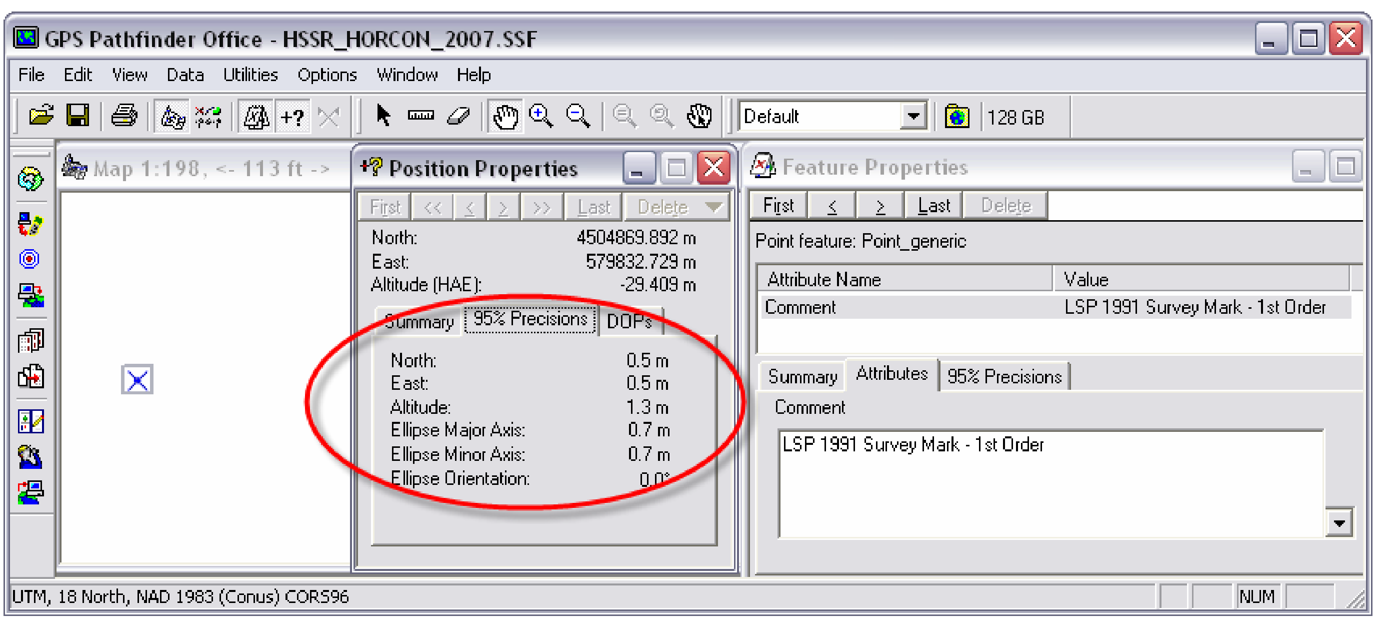


Figure 10 Raw acquired unprocessed data.

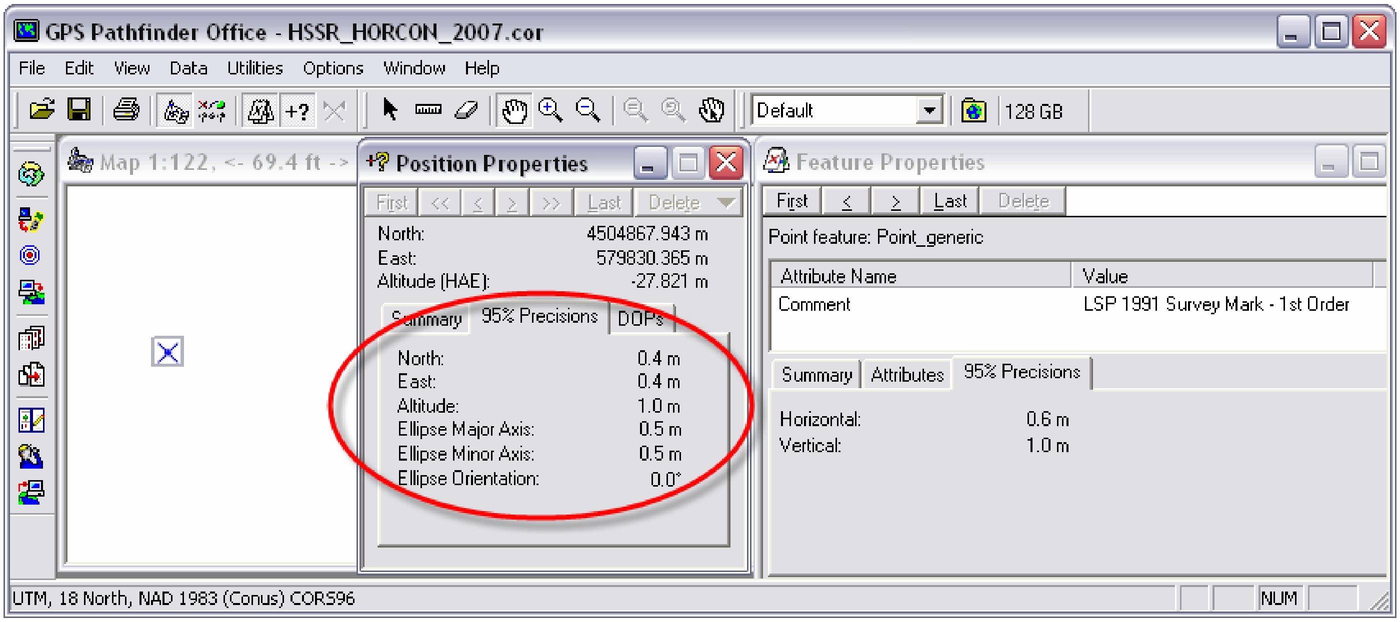


Figure 11, Post Processed using a Coarse Acquisition (C/A) Code algorithm.

.

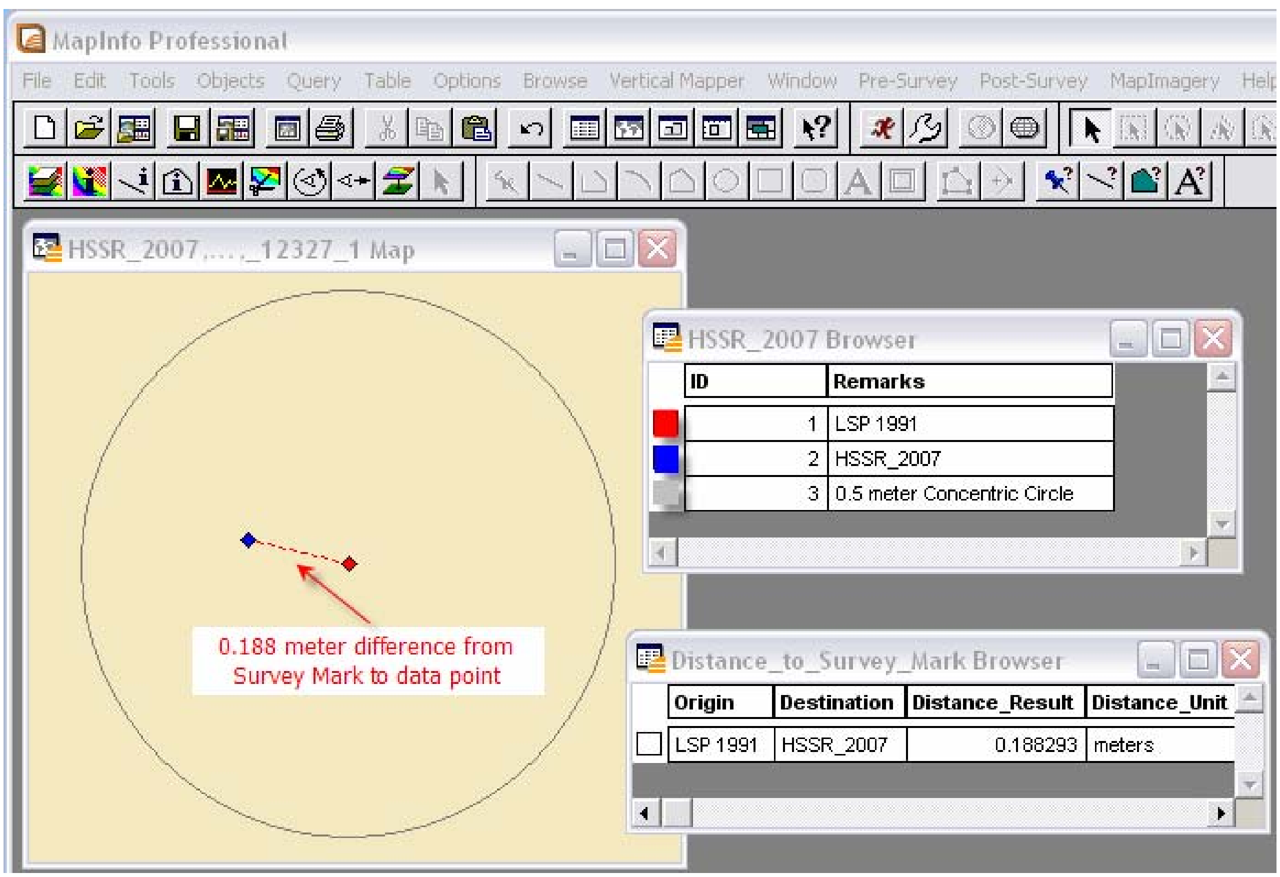


Figure 12, Distance calculated from Survey Mark to data point equaled 0.188 meters.

NGS Data Sheet

```
DATABASE = Sybase ,PROGRAM = datasheet, VERSION = 7.42
1        National Geodetic Survey,   Retrieval Date = APRIL 13, 2007
 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(1996)-  40 41 27.03865(N)    074 03 18.68737(W)     ADJUSTED
 KV6856* NAVD 88     -        2.7    (meters)       9.     (feet)  GPS OBS
 KV6856  ___________________________________________________________________
 KV6856  X           -   1,330,432.940 (meters)                   COMP
 KV6856  Y           -  -4,656,695.851 (meters)                   COMP
 KV6856  Z           -   4,136,432.710 (meters)                   COMP
 KV6856  LAPLACE CORR-           4.99  (seconds)                  DEFLEC99
 KV6856  ELLIP HEIGHT-         -29.33  (meters)         (10/23/02) GPS OBS
 KV6856  GEOID HEIGHT-         -31.98  (meters)                   GEOID03
 KV6856
 KV6856  HORZ ORDER  -  FIRST
 KV6856  ELLP ORDER  -  FOURTH    CLASS I
 KV6856
 KV6856.The horizontal coordinates were established by GPS observations
 KV6856.and adjusted by the National Geodetic Survey in May 1999..
 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       -   206,314.091   187,594.708   MT  0.99991739   +0 17 24.0
 KV6856;SPC NJ       -   676,882.15    615,466.97   sFT  0.99991739   +0 17 24.0
 KV6856;SPC NY L     -    58,209.109   295,334.878   MT  0.99999874   -0 02 10.0
 KV6856;SPC NY L     -   190,974.39    968,944.51   sFT  0.99999874   -0 02 10.0
 KV6856;SPC NY E     -   206,314.091   187,594.708   MT  0.99991739   +0 17 24.0
 KV6856;SPC NY E     -   676,882.15    615,466.97   sFT  0.99991739   +0 17 24.0
 KV6856;UTM  18      - 4,504,867.899   579,830.555   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 (05/14/99)  -29.32   (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