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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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DATA ACQUISITION AND PROCESSING REPORT

Type of Survey Navigable area survey

Project No. OPR-N360_NRT3_2011

Time Frame April – December 2011

LOCALITY

State Washington

General Locality Southern Puget Sound

Sublocality Tacoma

2011

CHIEF OF PARTY

Dan Jacobs

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Data Acquisition and Processing Report

NOAA Navigation Response Team 3 (S1212)

OPR-N360-NRT3-11

Southern Puget Sound, Washington

Hydrographic Survey Project Instructions dated March 25, 2011

Chief of Party: Dan Jacobs, Physical Science Technician

Introduction

NOAA Navigation Response Team 3 (NRT3) is a mobile hydrographic survey team that operates in the near-shore, coastal waters of the northwestern United States. The team belongs to NOAA's Navigation Services Division (NSD), which provides a focal point for customer requests and associated responses on charting issues, short-term (fast response) hydrographic surveys as well as routine, navigable area surveys. NRT3 is staffed by three Physical Science Technicians.

Typical stakeholders requesting NRT3 surveys are the U.S. Coast Guard (USCG), local pilot associations, the U.S. Army Corps of Engineers (USACE), harbormasters, and NOAA'S National Ocean Service (NOS).

The Purpose of this report is to give a detailed discussion on NRT3's equipment, quality control methodologies, and corrections to echo soundings.

A. Equipment

Vessel


SeaArk Commander, S1212

The primary survey platform for NRT3 is NOAA Launch S1212, a 30 foot *Commander* built by SeaArk of Monticello, Arkansas. NOAA's Small Boat Safety Board categorizes S1212 as a Class II Boat, based on the "26 to less than 40 feet length overall" vessel classification. The vessel was acquired in January 2001 and modified in August of 2004 for the accommodation of two 150 horsepower Yamaha four-stroke outboard motors. In October of 2009 the two original Yamaha motors were replaced with newer motors of the same make and model. S1212 is eight feet wide and displaces 4.8 tons. S1212 is equipped to acquire vertical beam echosounder (VBES), multibeam echosounder (MBES), side scan sonar (SSS) data and shoreline feature data. S1212 is also outfitted with a Kohler generator (model 7.3E), which provides 110 VAC power for survey equipment. NOAA Launch S1212 was surveyed by the National Geodetic Survey on June 21, 2006 in Seattle, WA. The boat was hauled out of the water, placed on its trailer and leveled with jacks. The target atop the Inertial Motion Sensor (IMU) served as the primary reference point (RP) for the survey. An XYZ coordinate system, each 100 meters from this IMU Reference Point served as the reference frame. Horizontal and vertical accuracy for all objects was +/- 1 centimeter at the 95% confidence level. Please reference Appendix 1 for complete documentation of this full vessel survey.

Positioning Systems

A wiring diagram detailing survey equipment configuration may be found in Appendix 2.

Applanix POS/MV

NOAA Survey Launch S1212 is equipped with an Applanix Model 320, Version 4 POS/MV, interfaced with POS View controller software installed on the acquisition computer. The POS/MV is a GPS-aided inertial navigation system which provides a blended position solution derived from both an Inertial Motion Unit (IMU) and an integrated GPS receiver. With this arrangement, positional accuracy is preserved during short GPS outages.

POS/MV and IMU

The IMU contains three solid-state, linear accelerometers and three, solid state, gyros and provides angular accuracy to better than 0.05 degrees. Antennae for POS/MV systems are mounted on a horizontal bar, atop the vessel's cabin. The DGPS antenna is mounted atop S1212's folding aluminum mast. The IMU is mounted below deck, just forward of the vessel's AC generator.

A GAMS calibration was performed on March 7, 2011. The results were as follows:

Baseline Vector: X Component=1.903, Y Component=.015, Z Component=.025.

Two Antennae Separation: 1.903

Following an IMU failure and replacement, a second GAMS calibration was conducted on October 25th, 2011, DN298. The results, effecting Sheet H12312, were as follows:

Basline Vector: X Component = 1.902, Y Component = .015, Z Component .025.

Two Antennae Separation= 1.902

See Appendix 3 for a complete report for 2011's HSRR GAMS Calibration.

Applanix "TrueHeave" values were recorded for OPR-N360-NRT3-11 and processed using a delayed filtering technique to eliminate artifacts present in real time heave data. TrueHeave data were applied to Simrad bathymetry in CARIS HIPS post processing.

Trimble GeoXH

NRT3 uses a Trimble GeoXH 2008 Series GPS for shoreline-feature positioning and attribution. The GeoXH uses the Windows Mobile 6 operating system to run TerraSync, a Trimble field-software program used to configure receiver settings and

Trimble GeoXH

acquire data. NRT3 transfers and post-processes these data using Trimble Pathfinder Office software v4.20, installed on workstations in the office trailer.

The GeoXH provides reliable accuracy to within 1 to 3 meters with real-time or post-processed differential correction.

To achieve higher accuracy, the GeoXH can employ H-Star technology, a logging and processing schema that provides 10- to 30-cm accuracy. H-Star logging requires three or more, dual-frequency (L1 and L2) base stations within 200 km of the receiver or 1 dual frequency base station within 80 km. However, the optional Zephyr antenna must be used to attain accuracies below 30 cm. NRT3's GPS settings for OPR-N360-NRT3-11 conform to the specifications set forth in 2011 Field Procedures Manual, Paragraph 3.5.3.

Trimble GeoXH Settings	
Setting	**Option**
Datum	WGS 1984
Altitude Reference	Height Above Ellipsoid
Coordinate System	Latitude/Longitude
Altitude Units	Meters
Distance Units	Meters
Area Units	Square Meters
North Reference	True
Latitude/Longitude Format	DD.MM.SS.ss
Angle Units	Degrees
Real-time setting, choice 1	Integrated SBAS (WAAS)
HDOP	2.5
Elevation Mask	10 Degrees

Table 1 Trimble GPS Settings

Trimble DSM-212L

S1212 is equipped with a Trimble DSM-212L receiver. It is an integrated 12-channel GPS receiver and dual channel DGPS beacon receiver. There 3 modes of operation: Auto Range, Auto Power, and Manual. Auto Range mode automatically selects the closest USCG DGPS beacon while Auto Power automatically selects the USCG DPS beacon with the strongest signal. Manual mode does neither; rather it prompts the user to input a desired frequency/beacon for use. The controller software TSIP Talker, version 2.0, for DSM-212L is installed onNRT3's data acquisition computer.

NRT3 usually operates DSM-212L in manual mode, outputting an "RTCM" corrector message to the POS/MV. It is configured to go offline when the age of the GPS correctors exceed 20 seconds. Additionally, the DSM-212L is programmed to reject all satellite vehicles lower than 8 degrees above the horizon.

Sound Speed Measurement Instruments

Odom Digibar Pro

Flat-faced transducers, such as NRT3's Kongsberg EM 3002 SWMB require continuous sound speed measurement at the water's surface. As such, an Odom Digibar Pro sound speed probe measures surface temperature, conductivity and pressure to correct for refraction errors at the water/transducer interface. The instrument's probe is mounted on the outside, bottom of the S12121's transom, just forward of the outboard motors. Its measurements, accurate to 0.3 meters per second, are sent to a controller/display unit and then relayed to NRT3's acquisition computer via RS232 cabling. Digibar Pro settings for integration with Hypack and Simrad software are listed in the Table 2.

COM>Output>Type	AML
COM>Output>During	Yes
COM>Baud Rate	9600
Setup>Time Interval	1
Setup>Depth Interval	.5
Setup>Units	Meters
Setup>Store Cast Data	No
Setup>Depth Average	4
Setup>Velocity Average	1
Simulator	Off

Table 2 Digibar Settings

Sea-Bird SeaCat SBE 19, SeaCat SBE19+ CTD Profiler

NRT3 collects conductivity, temperature and density (CTD) data using Seabird's SBE 19+ profiler to determine sound speed profiles, which are used to correct multibeam sonar data. The SBE 19 generates a raw hexadecimal file (*.hex) which is used by VELOCWIN, a NOAA in-house program that converts .hex files to files used to correct multibeam data. (VELOCWIN is discussed Section C.) Please reference Appendix 4 for annual manufacturer's calibration data for all sound speed profilers.

Depth Measuring Equipment


MBES, hull-mounted on S1212

Side Scan Sonar (SSS)

NRT3 operates a Klein 3000 side scan sonar system, used for detecting submerged wrecks and obstructions. The system operates at 500 kHz and 100 kHz and is able to provide side scan data from ranges of 25 to 450 meters. Included in the system are:

- Transceiver Processing Unit (TPU)
- Workstation Display and Control Unit (WDCU)
- Thirty-five meters of Kevlar reinforced tow cable
- SonarPro software and VX Works TPU operating system.

The horizontal, or along-track, beam-widths for the low and high frequencies are 0.7° and 0.21°, respectively; the vertical, or across-track, beam-width is 40°. Maximum range scale for the Klein 3000 is 150 meters at high frequency and 450 meters at low frequency. During data collection, high-frequency data are recorded while the low-frequency data are only monitored.

Multibeam Echosounder (MBES)

S1212 is equipped with Kongsberg's EM3002 multibeam echosounder (MBES) installed December, 2009. The EM3002 replaced an older EM3000. No structural modifications of the boat hull were necessary to install the EM3002, which has the same physical dimensions and mounting configuration as the EM3000. The processing unit (PU) was also replaced.

The EM3002 operates at a nominal frequency of 300 kHz, with a typical range of 1 to 200 meters (in cold ocean water) and a range resolution of 1 cm. It has 254 beams covering a 130° maximum swath width. The transmit beam width is 1.5°, and the receive beam width ranges from 1.5° (at nadir) to 3° (60° from nadir).

The system is pitch-stabilization capable, but NRT3 generally does not run with pitch-stabilization enabled, to simplify any potential post-processing requirements. The cylindrical sonar head is mounted to the hull of the vessel at the keel, beneath the inertial measurement unit (IMU).

Vertical Beam Echo Sounder (VBES)

An Odom Echotrac CV vertical beam echosounder (VBES) employing a single-frequency transducer with beam width set at eight degrees is used for single beam data collection. The echosounder, which is operated at 200 kHz, records both analog and digital data which may be acquired in feet or meters. Soundings are acquired in meters with an assumed speed of sound through water of 1500 m/sec. During data collection the echosounder is controlled and the trace is monitored via an Ethernet driver connection to the HYPACK Survey program. The echosounder trace is recorded to .BIN files which are logged automatically alongside HYPACK line files during acquisition. These files are used for reference during digital data processing. HYPACK Max Survey Software is used for vessel navigation and line tracking during hydrographic data acquisition. The HYPACK software log "raw" VBES data and record detached positions in the format of ".tgt" files.

Currently, the Odom vertical beam echosounder control software is out of date and unstable. In addition to installing new controller software, updating the VBES system is not the primary tool for acquiring bathymetric data. NRT3 will need to send the transceiver to Odom for an estimate upgrade cost, should NSD deem it worthwhile.

Lead Line

For purposes of data integrity, NRT3 has in its possession one (1) 30 meter long lead line. The lead line was fabricated and calibrated in April, 2010. Lead line checks are performed periodically throughout the project to verify fathometer accuracy. The line is graduated in 1 decimeter increments by bands of tape along the entire length of the polypropylene line. Annual calibration each year involves comparing the length of the lead line against a survey grade, steel tape in accordance with FPM Section 1.5.3.1.1. See Appendix 7.

Computers and Software

A complete tabulation of computers and operating systems is included in the Appendix 5.

Office and Vessel Workstations

NRT3 possesses 4 Dell workstations and one Dell laptop. All computers except the acquisition computer are set up in the mobile office. The acquisition computer is rack mounted inside S1212's cabin and is solely dedicated to vessel navigation and data collection. The office computers are used for office tasks such as data processing, project reporting, computer-based training, and email correspondence with headquarters. Each office workstation and the laptop run the Windows XP operating system and are

networked to three Buffalo Terrastation Pro servers. Each server has a 1TB storage capacity. Refer to Appendix 5, *Hydrographic Systems Inventory* for all computer specifications.

Software

A complete list of software and versions is included in Appendix 5, *Hydrographic Systems Inventory*.

- Hypack

Simrad MBES data for Southern Puget Sound were collected on S1212 using HYPACK 2009a hydrographic survey software. Data was logged in the ASCII (.hsx) format.
Due to multiple computer freeze-ups, NRT3 migrated to HYPACK 2011 on August 25, DN237.

- Sonar Pro

Klein Associates' Sonar Pro 11 software was not used for OPR-N360-NRT3-11.

- CARIS Hips/Sips

OPR-N360-NRT3-11 bathymetry was processed with CARIS Hydrographic Information Processing System (HIPS) 7.1, Hotfix 3.

- HSTP Software and MapInfo

All PCs are also loaded with the latest versions of Pydro and MapInfo(10.0) – programs used for survey planning and preparation, feature and data management, and compilation of the Descriptive Report.
NOAA's Pydro software supplied by the Hydrographic Systems and Technology Program (HSTP) was used for shoreline feature attribution, for processing and editing detached positions, and for decimating data in the creation of preliminary smooth sheet (PSS) files.
HSTP's HydroMI Mapbasic program was used in combination with MapInfo software for a number of pre- and post-survey applications.
HSTP's VelocWin v8.96 program was used to process sound velocity data obtained with Seacat SBE-19 and SBE 19 plus CTD's and an Odom Digibar profiler.

B. Data Processing and Quality Control

Project Management

NRT's data processing and quality control procedures are described in flow diagrams, Appendix 8.

NRT3's Project Instructions precipitate from the NSD Headquarters, Silver Spring, MD to NRT3's Team Leader. They are reviewed by all team members. Preliminary questions and concerning the project's specified requirements are addressed and resolved via voice conference and/or email correspondence prior to survey sheet assignments.

Ideally, members manage their own, individual sheet; however, depending upon the project size, this plan may not be possible. Thusly, a survey sheet may become a small, collaborative project, with divided responsibilities.

Typically the sheet manager and a teammate will spend a day collecting data. Upon the close of operations, the sheet manager converts and applies (batch processes) correctors/filters in CARIS HIPS 7.1. The newly acquired data is added to the BASE surface for quick assessment and for planning the next day's operations.

Additional, directed editing methods are reserved for foul weather days when a surface is more carefully analyzed, re-gridded and added to a survey-wide BASE surface. Ultimately, this survey-wide surface is finalized and submitted to the Pacific Hydrographic Branch (PHB), Sand Point, WA.

Quality control reviews occur throughout data acquisition and processing in accordance with all applicable guidance (FPM, HSSD) by the Team Leader. Thorough documentation of all sound speed, tidal, and systematic artifacts occur during this phase of the project. The Team Leader accomplishes a complete review of the project, once data acquisition has ended. Recommended changes are passed back to the sheet manager before finally being submitted to PHB.

Multibeam Echosounder Data

NRT3's data acquisition begins by creating polygons in CARIS Notebook. First, polygons are drawn to shrink the survey sheet into smaller, more manageable pieces, several of which may be completed in one boat day. A chart's contours and soundings - intrinsic to a polygon's design - govern their shape (longitudinal, parallel to shore) while charted soundings dictate the appropriate coverage resolution per the FPM. This way, coxswains know where to acquire bathymetry and the sheet manager is apprised of the appropriate matrix resolution for Hypack's Hysweep add-on module. Next, the polygons are exported from CARIS Notebook in the ".000" format and overlaid onto an electronic chart display in HYPACK 2011. Finally, the matrix, a MBES coverage grid depicting the sonar swath, is "painted" inside the polygon in real time, as data is acquired aboard S1212. Matrices are now the sole method through which survey coverage is assessed while collecting MBES data on NRT3. (Prior years relied on planned line files.)

NRT3's main MBES data review and cleaning tool is the Combined Uncertainty Bathymetric Estimator (CUBE) - a weighting algorithm executed from the CARIS HIPS program. During CUBE surface creation, soundings are weighted and contribute to surface grid nodes based on uncertainty values and distance from the nodes.

As soundings are propagated to a node, a hypothesis representing a probable depth value is developed for the node. A node can contain more than one hypothesis. Should a sounding value differ significantly from its neighbors CUBE creates an alternative hypothesis resulting in a new node and correlating surface. Ultimately, the finalized surface is produced through careful choosing of hypotheses for each resolution/depth range (i.e. 1 meter/0 to 20 meters depth, 2 meter/ 18 to 40 meters depth, etc.).

An individual sounding's uncertainty, or Total Propagated Uncertainty (TPU), is derived from the assumed uncertainty in the echosounder measurement itself, as well as the contributing correctors from sound speed, water levels, position, and attitude. TPU values for tide and sound velocity must be entered for each vessel during TPU computation. See table 3.

- **Tide values measured** uncertainty value is the RSS of the error estimates associated with each six minute tidal value.
- **Tide values zoning** is provided with tide report for each project at the 95% CL. The value must be divided by two before it can be entered into CARIS (which expects a 1 sigma value).
- **Sound Speed value** measured error ranges from 0.5 to 4 m/s, dependent on spatial/temporal variability. Based on the practical experience gained from NOAA SHIP RAINIER and NOAA SHIP FAIRWEATHER, a value of .5m seems to be the best value for modeling this error.
- **Sound Speed value surface** is dependent on the manufacturer specifications of unit utilized to measure surface SV values for refraction corrections to flat-faced transducers. For NRT3's purposes this unit is an Odom Digibar Pro.

Vessel	Tide values Measured	Tide Values Zoning	Sound Speed Values Measured	Sound Speed Values, Surface
Simrad 3002	0.01	0.12	0.5	0.3

Table 3 TPU Values

All other error estimates are read from the Hydrographic Vessel File (HVF) and Device Model File. The HVF contains all offsets and system biases for the survey vessel and its systems, as well as error estimates for latency, sensor offset measurements, attitude and navigation measurements, and draft measurements.

The exact behavior of CUBE is determined by the values set in the CUBE parameters file, a .xml file which can be selected by the user in CARIS Tools->Options->Environment tab. The Hydrographic Surveys Division (HSD) has created and provided a customized CUBE surface that is required for each grid resolution (CUBParams_NOAA_2011.xml). During the creation of CUBE surfaces the user is given the option to select parameter configurations based upon surface resolutions which have been tuned to optimize the performance of the CUBE algorithm (i.e. 0-20 meters depth = 1m resolution, 18-40 meters depth = 2m resolution, etc.

NRT3's raw multibeam data is processed in CARIS HIPS and SIPS 7.1 in the following sequence:

1. Raw ".hsx" files from HYPACK are converted to the HDCS data format.

2. Predicted/Preliminary Tides are loaded from the FETCHTIDES utility.
3. Sound velocity IS NOT loaded, since it was already applied in real-time in SIS.
4. Data is "Merged" – CARIS applies position, attitude, vessel offsets and dynamic draft correctors to bathymetry to compute the corrected depth and position of each sounding.
5. Total Propagated Uncertainty is computed for each sounding.
6. CUBE surfaces are created at appropriate resolutions, as dictated by the following depth ranges in Table 4, per FPM 2011.

7. Finally, swath data is examined in Subset Editor where noise (i.e. fliers, double pings) are rejected, tidal and sound speed artifacts assessed and documented, and seafloor depths are compared against charted soundings. Examining data for systematic errors such as tide or dynamic draft artifacts is accomplished by exaggerating a surface's vertical axis by a factor of 3 or more and comparing overlapping soundings from adjacent survey lines.

See processing workflow diagram entitled Raw Data to HDCS in Appendix 8.

Resolution squared (meters)	Depth range (meters)
1m	0-20
2m	18-40
4m	36-160
8m	72-160

Table 4 CUBE Surface Resolutions

From time to time, a CUBE surface may not accurately capture the shoalest points of irregular features such as rock pinnacles or pilings. In such cases, NRT3 manually "designates" the shoalest sounding and documents their findings in the Descriptive Report. The sounding will be "honored" by the CUBE surface upon finalization.

As a quality control measure, NRT3 acquires crossline data perpendicular to the main scheme lines of prior days and compares the results in subset mode. The total length of these crosslines is 4 % or more of the total length of all main scheme lines on a survey sheet in accordance with *NOS 2011 Hydrographic Specifications and Deliverables* (HSSD) paragraph 5.2.4.3.

Feature Data

OPR-N360-NRT3-11 shoreline features were received with the project instructions issued from the Navigation Response Branch. Limited shoreline verification was accomplished using the Project

Reference File (PRF) and the Assigned Feature File (AFF) provided with the project instructions. The PRF contains the limits of the assigned survey area and the Automated Wreck and Obstruction Information System (AWOIS) features and search radii. The AFF is a subset of the Composite Source File (CSF) which includes those features specifically assigned for investigation by this survey. Both the PRF and the AFF are S-57 attributed datasets in .000 file format.

Limited shoreline verification was conducted near predicted low water in accordance with the Specifications and Deliverables and FPM sections 4.4.5. and 4.4.6. Assigned features seaward of the Navigation Area Limit Line (NALL) were addressed as required, S-57 attributed and recorded in the appropriate CARIS Notebook (v3.0, SP1, HF1) .hob files indicated in Table 5 and submitted with this survey.

Shoreline File	Description
HXXXXX_Original_AFF.hob	Original source data (0_1AFF01.000) as provided for project OPR-N360-NRT3-11 and clipped to the limits of survey H123XX and converted to .hob format.
HXXXXX_Field_Verified_AFF.hob	An exact copy of H12311_Original_AFF.hob modified by the field unit to best represent shoreline features at survey scale. This includes addition of new features and modification of source features. This file retains all features neither verified nor disproved by this survey.
HXXXXX_Disprovals.hob	Features deleted from H123XX_Field_Verified.hob based on survey findings.
0_4PRF01.000 (example)	Project Reference File with survey limits and AWOIS item positions and search radii.

Table 5 Feature Data

Additional features including Dangers to Navigation (DTON) and Automated Wreck and Obstruction Information System (AWOIS) items were processed using Pydro version 11.10 and included in each survey's feature report, Appendix 2 of the Descriptive Report.

C. Corrections to Soundings

Sound Speed

The speed of sound through the water is determined by sound velocity casts conducted in accordance with the NOS Hydrographic Surveys Specifications and Deliverables (HSSD). Corrections for speed of sound through the water column are computed from data obtained from Seabird's SBE-19 Seacat CTD, SBE-19 Plus, and an Odom Digibar Pro sensor. NOAA's VelocWin, Version 8.96 software is used to process casts and generates sound velocity files for CARIS HIPS.
Although sound velocity correctors are normally applied to sounding data in CARIS HIPS after data is acquired, NRT3's flat-faced multibeam echosounder dictates a different method. Velocity casts are applied real-time in Simrad's SIS acquisition program through use of two sensors. One sensor (Digibar Pro) is transom mounted and continuously sends surface readings to SIS for the purpose of beam formation. The second sensor, the SBE-19/19 Plus, is used several times a day to capture complete SV water column profiles which are applied real-time in SIS, as soundings are logged. Operators are prompted to take a new cast when surface readings between the two sensors differ by more than 2 meters a second. See processing workflow diagram entitled *RAW SSS Data to HDCS* in Appendix 8.

Currently, NRT3 is working with HSTP and other NRTs on a more desirable acquisition configuration and processing workflow for sound speed. Calibration reports for the Odom Digibar, SBE-19 Seacat and SBE-19 Seacat Plus are included in Appendix 4.

Static Draft

The Static Draft of S1212's Multibeam Echosounder (MBES) is the distance from the waterline to the MBES transducer. To determine the "static draft" (i.e., the height of the waterline above/below the reference point), two new reference marks and an easily repeatable method were established. A reference mark was established on the port and starboard gunwales, closely aligned with the RP, or IMU, in the along ship dimension (Figure 2, below).

The static draft was calculated by subtracting the waterline-to-gunwale vertical distance (0.631 m) from the RP-to-gunwale vertical distance (0.608 m) in Figure 1.

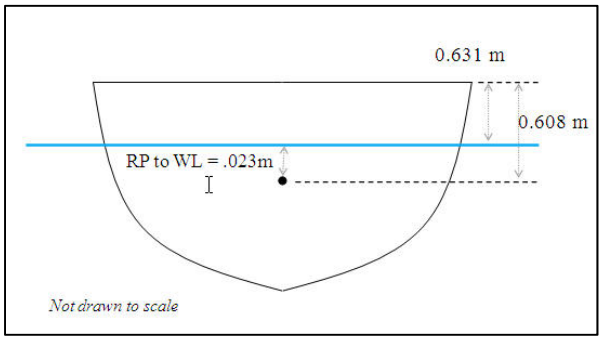


Figure 1 Static Draft Measurement

The hydrographer found excellent agreement between the original NGS Survey of the waterline and the HSRR verification survey performed in February, 2011. A 1 millimeter difference was noted; however the original value of .022 meters shall be retained in the Hydrographic Vessel File. Refer to Appendix 6 and Figure 1.

Dynamic Draft

To determine S1212's Dynamic Draft, MBES data were collected on DN087 April, 2011 employing the FPM's "Echosounder Method" in Chapter 1.4.2.1.2. Data were acquired during high, slack tide in calm waters of Gig Harbor, Washington. Depths were 8 to 10 meters in this area and afforded a relatively flat, featureless seafloor.

Upon processing the soundings and plotting their speed vs. depth, it became immediately evident that the speed range was inadequate, compared with the previous year. Historical speed/rpm values ranged from 1 to 13 knots but the Gig harbor sounding values ranged from 1 to 7 knots. Although there was close correlation between 2010 and 2011s' draft difference values within the 1 to 7 knot speed range, NRT3 will not be utilizing these values on account of their incompleteness. NRT3 will continue to use 2010's HVF Draft values which provide a more thorough model of speed vs. draft. See *Hydrographic Vessel File* in Appendix 6 for current draft values.

Draft (Meters)	Speed (Meters per Second)
.01	2.41
.01	2.74
.02	3.08
.03	3.49
.03	3.80
.04	4.08
.04	4.20
.04	4.44
.02	4.80
-.01	5.42
-.05	6.39

Table 6: Dynamic Draft Values, 2011 Field Season.

True Heave

Heave data is calculated using a double integration of acceleration over a period of time. When recording heave in real-time, the calculation is performed using only past measurements of acceleration. An improved estimate of vessel low-frequency heave can be calculated by performing the integration of a time period centered on the time of interest, resulting in "true heave."
Employing the POS/MV4 and the POS MV Controller version 4.3.4.0 NRT3 continuously records true heave during MBES surveys by selecting "Heave Time 1" in POS View. NRT3 post-processes the data in CARIS HIPS via the Load True Heave Tool.

Tide Corrections

The vertical datum for this project is Mean Lower-Low Water (MLLW). The operating National Water Level Observation Network (NWLON) stations at Tacoma, WA (944-6484) served as datum control for the survey area. No tertiary gauges were required. As per the Project Instructions; all data were reduced to MLLW using the final approved water levels (smooth tides) from these stations by applying tide files 9446484.tid with time and height correctors through the zone corrector file, N360NRT32011CORP.zdf. Preliminary zoning was accepted as the final zoning for the H12311. It will not be necessary for the Hydrographic Branch to reapply the final approved water levels (smooth tides) to the survey data during final processing.

The request for Final Approved Water Levels for H12311 was submitted to CO-OPS on June 24, 2011 in accordance with the Field Procedures Manual (FPM), dated April, 2011. The Final Tide note was received on July 7, 2011.

MBES Patch Test

Per FPM, paragraph 1.5.5.1.2 a MBES Calibration (Patch Test) should be conducted annually to quantify the accuracy, precision, and alignment of the MBES. Accordingly, NRT3 ran 8 calibration lines on April

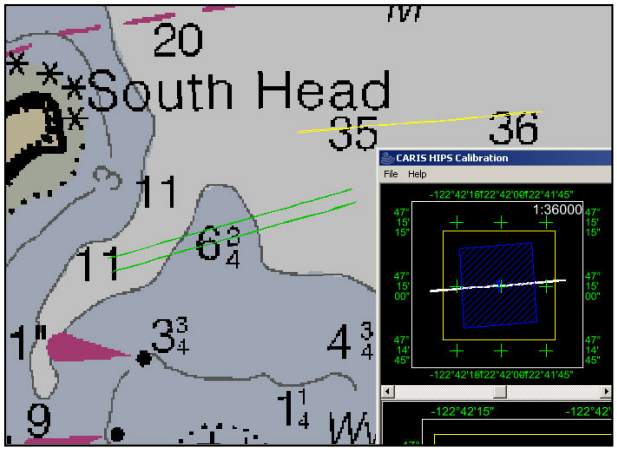


Figure 2 Patch Test Lines, Wyckoff Shoal, Chart 18448.

	RESULTS A	RESULTS B	RESULTS C	CUMULATIVE
NAVTIME BIAS	0	0	0	AVERAGES
	0	0	0	
	0	0	0	
	0	0	0	
	0	0	0	
AVERAGE	0	0	0	0.00
PITCH BIAS	0.12	0.02	0	
	0.14	0.01	-3	
	0.12	0.02	3.82	
	0.06	-0.03	0	
	-0.02	-0.01	0	
AVERAGE	0.084	0.002	0.164	0.08
ROLL BIAS	-0.08	-0.06	-0.1	
	-0.09	-0.08	-0.08	
	-0.08	-0.05	-0.08	
	-0.09	-0.06	-0.06	
	-0.08	-0.04	-0.1	
AVERAGE	-0.084	-0.058	-0.084	-0.08
YAW BIAS	0.02	0.14	0	
	0.03	0.05	0	
	0.01	0.25	0	
	0.07	0.31	0	
	0.04	0.61	0	
AVERAGE	0.034	0.272	0	0.10

Table 7: 2011 Patch Test Results

19, 2011 in Carr Inlet, WA to discover angular and timing biases. Sounding data was processed with CARIS HIPS 7.0 using the software's "Calibration Mode." New angular and timing offsets were entered into the hydrographic vessel file (HVF) included Appendix 6. Value differences from prior years exhibited excellent (sub-degree) conformity. Five, randomly chosen observations per axes were performed independently by each team member. Results are listed in Table 7.

A second patch test was performed on October 25, 2011 subsequent to an IMU replacement. Sounding data was processed with CARIS HIPS 7.1 using the calibration mode. The new values were entered in the HVF on DN299. These values were only applicable to Sheet H12312, Northern Carr Inlet and can be found in the HVF, Appendix 6.

SSS Calibration

In accordance with FPM Paragraph 1.5.7.1.2 a SSS confidence test was carried out on DN116 using a 75 meter range scale. A prominent rock on the Wyckoff Shoal was used as a target (below graphic). Each of 9 passes successfully esonified the rock target however, a systematic horizontal error was evident in CARIS Side Scan Editor during post-processing. The error in both axes exceeded the 10 meter confidence radius error budget. An improper layback value of 7.4 meters and 4 knot currents are likely factors which confounded this test. NRT3 will be replacing this SSS system with a newer EdgeTech 4125,

in Fall, 2011 and has not used SSS in the rocky, deep undersea terrain of Puget Sound. For this reason, NRT3 chose to register the system's deficiency as a Category 2 in the 2011 HSRR Memo.

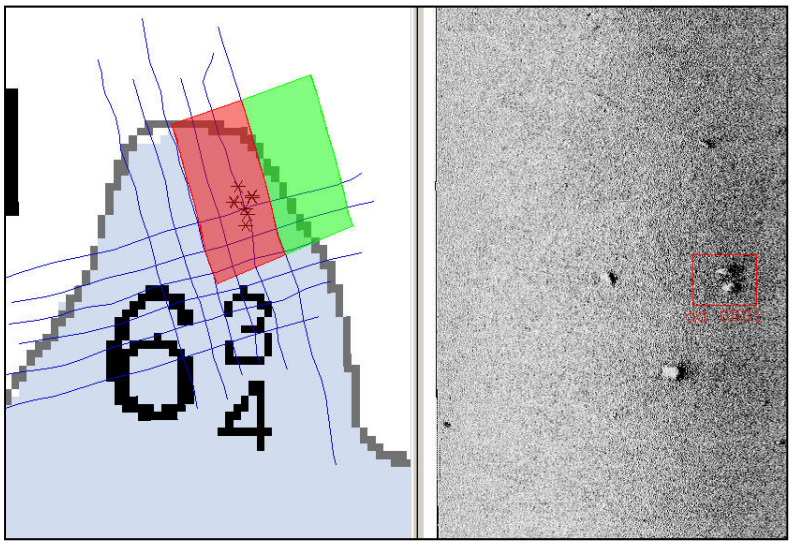


Figure 3: SSS Contacts, Wyckoff Shoal, Chart 18448.

D. Approval Sheet

As Chief of Party, I have ensured that standard field surveying and processing procedures were used 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 Manual, as updated for 2011.

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

Approved and Forwarded:

Dan Jacobs, Team Lead

Navigation Response Team 3

Appendix 1: NGS Spatial Relationship Survey Report

US DEPARTMENT OF COMMERCE

NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION

NATIONAL OCEAN SERVICE

NATIONAL GEODETIC SURVEY

GEODETIC SERVICES DIVISION

INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA SURVEY VESSEL S1212

POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

FIELD REPORT

Kendall L. Fancher

JUNE 21, 2006

NOAA SURVEY VESSEL S1212

POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to accurately determine the spatial relationship of various sensors, and the components of a POS MV navigation system aboard the NOAA survey vessel S1212.

PROJECT DETAILS

This survey was conducted in Seattle, WA on the 21st of June, 2006. The weather was cool and overcast in the morning, with warm and partly cloudy conditions in the afternoon. The vessel was hauled out of the water and placed on its trailer to conduct this survey. The water mark stain around the perimeter of the vessel was used to level up the vessel. Vertical angles were measured at two water marks on the stern, and one mark near the bow. Two trailer jacks located at the rear of the trailer, and the trailer tongue jack, were manipulated based upon the vertical angles measured, until they were in coincidence with one another.

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

Standard “peanut” prisms were used as sighting targets. Prisms were configured to have a zero mm offset.

PERSONNEL

Kendall Fancher NOAA/NOS/NGS/GSD/I&M BRANCH

(540) 373-1243

Charles Geoghegan NOAA/NOS/NGS/GSD?I&M BRANCH

(540) 373-1243

NOAA SURVEY VESSEL S1212

POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

ESTABLISHING THE REFERENCE FRAME

The target atop the Inertial Motion Unit (IMU) served as the primary reference point for this survey To conduct this survey a local coordinate reference frame was established where the Northing (Y) axis runs along the centerline of the boat and is positive from the primary reference point towards the bow of the boat. The Easting (X) axis is perpendicular to the centerline of the boat and is positive from the primary reference point towards the right, when looking at the boat from the stern. The Up (Z) axis is positive in an upward direction from the primary reference point. In this reference frame IMU, the primary reference point, has the following coordinates;

X = 100.000(m)

Y = 100.000(m)

Z = 100.000(m)

A secondary centerline control point, CL1,was established atop, and at the center of the transom. The Y value of CL1 was assumed to be zero. Determination of the X value for TP1 was accomplished by measuring the horizontal distance from IMU. Determination of the Z value for TP1 was accomplished by trigonometric leveling from IMU. The determined coordinates for CL1 are;

X = 97.873(m)

Y = 100.000(m)

Z = 100.444 (m)

ESTABLISHING ALL OTHER POINTS

While occupying IMU, a bearing of 180.0000 was input into the instrument and CL1 was input for initialization. After initialization was conducted, angular and distance measurements were taken to establish the following points; TP1 and TP2. TP1and TP2 are temporary points set off of the boat. The established coordinates for TP2 were stored internally in the instrument.

While occupying TP2, the previously determined bearing to IMU was recalled and initialization was conducted to IMU. After initialization was conducted, angular and distance measurements were taken to establish the following points; GPSP, GPSS, GPS, CL1, SSST, MB, SB, and TP1. 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;

TP1

X = 0.010(m)

Y = 0.001(m)

Z = 0.001(m)

NOAA SURVEY VESSEL S1212

POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

While occupying TP1, 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 following previously determined points;

IMU

X = 0.000(m)

Y = 0.004(m)

Z = 0.007(m)

GPSP

X = 0.002(m)

Y = 0.006(m)

Z = 0.001 (m)

GPSS

X = 0.001(m)

Y = 0.001(m)

Z = 0.002(m)

GPS

X = 0.000(m)

Y = 0.007(m)

Z = 0.003(m)

CL1

X = 0.001(m)

Y = 0.011(m)

Z = 0.002 (m)

SSST

X = 0.000(m)

Y = 0.009(m)

Z = 0.002(m)

MB

X = 0.000(m)

Y = 0.007(m)

Z = 0.002(m)

NOAA SURVEY VESSEL S1212

POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

SB

X = 0.001(m)

Y = 0.007(m)

Z = 0.002(m)

DISCUSSION

All coordinates are contained in spreadsheet "S1212.xls. Included in this spreadsheet is the IMU GPS antenna separation value, as determined by inverse between the positions of the two GPS antenna.

After reviewing the check positions, the horizontal and vertical accuracy of the unadjusted values for all objects is +/- 1 Centimeter at the 95% confidence level.

The boat was surveyed on a trailer. To level the boat up, relative to a water stain, identified by Kathryn Simmons as the water level mark, 3 points were identified along the stain line (2 at either end of the stern and 1 along the starboard side and near the bow). Trigonometric height values were determined at these points, and the boat manipulated via the tongue jack, and two trailer jacks at the rear of the vessel, until the height values were in coincidence. At this time the boat was considered to be level with the water level mark. This value was recorded to be 0.022 m below the level of the IMU target.

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 appropriate for the antenna model.

NOAA SURVEY VESSEL S1212

POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Station Listing

CL1- CENTERLINE SECONDARY REFERENCE POINT

A punch mark set in top of the center of the transom.

MB- MULTIBEAM TRANSDUCER REFERENCE POINT

The center of the bottom of the Multibeam Transducer.

SB- SINGLE BEAM TRANSDUCER REFERENCE POINT

The center of the bottom of the Singlebeam Transducer.

SSST- SIDE SCAN SONAR REFERENCE POINT

A punch mark set in top of the swing arm, and directly over the pivot point for the Side Scan Sonar sheave. The correction from the punch mark to the center of the Side Scan Sonar cable is 0.318(m) and has been accounted for in the spreadsheet value for this sensor.

IMU- IMU REFERENCE TARGET

Center of a target affixed to the top of the IMU housing. This is also the Primary Centerline Reference Point.

GPS- NAVIGATION GPS ANTENNA REFERENCE POINT

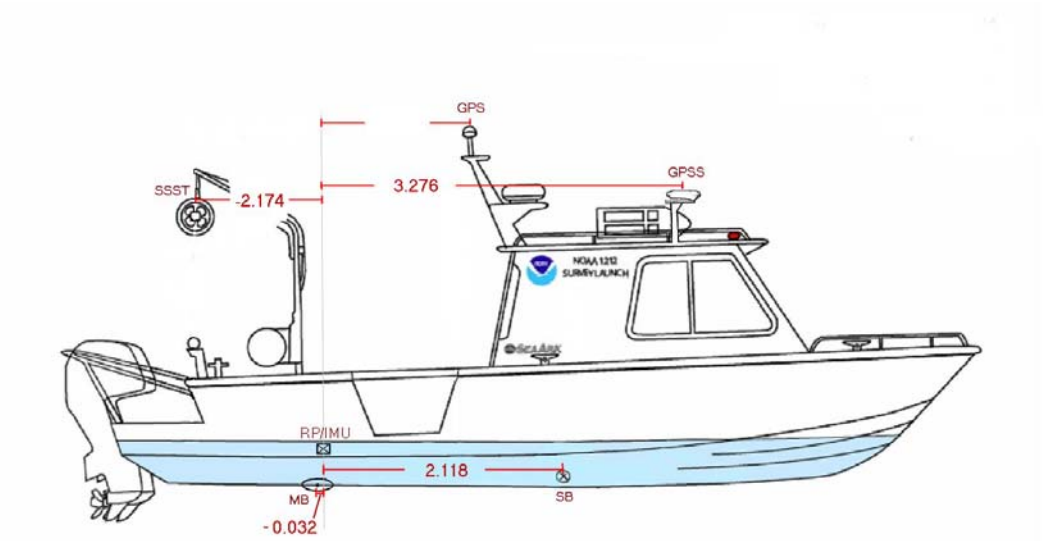
The top center of the navigation system GPS antenna.

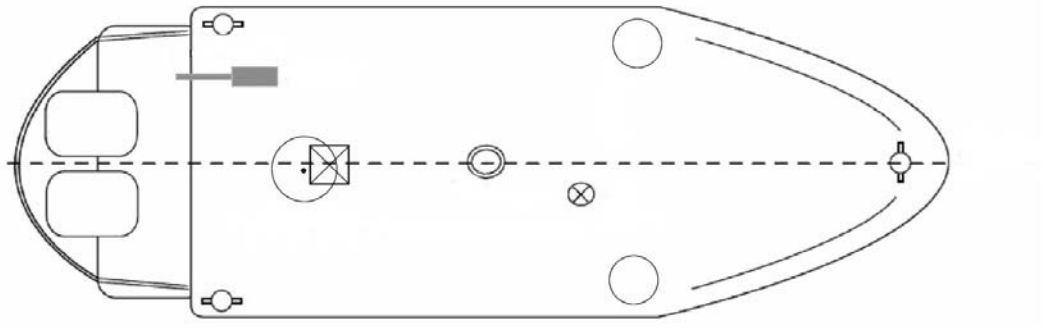
GPSP- POS GPS ANTENNA REFERENCE POINT

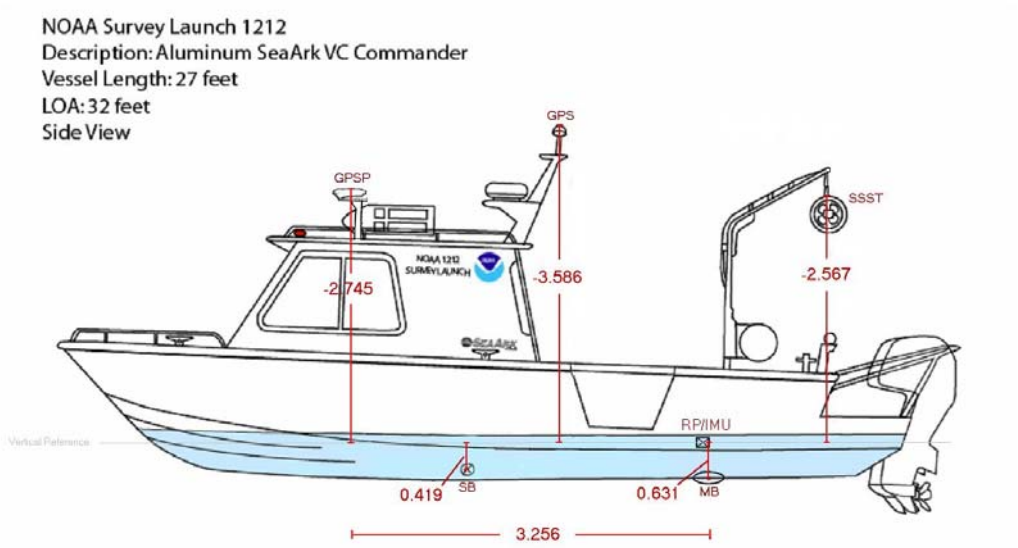
The top center of the port side GPS antenna for the POS system.

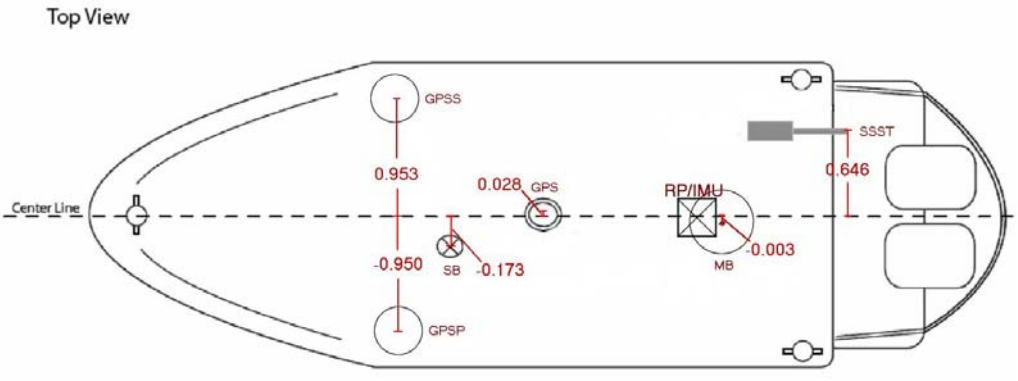
GPSS- POS GPS ANTENNA REFERENCE POINT

The top center of the starboard side GPS antenna for the POS system.

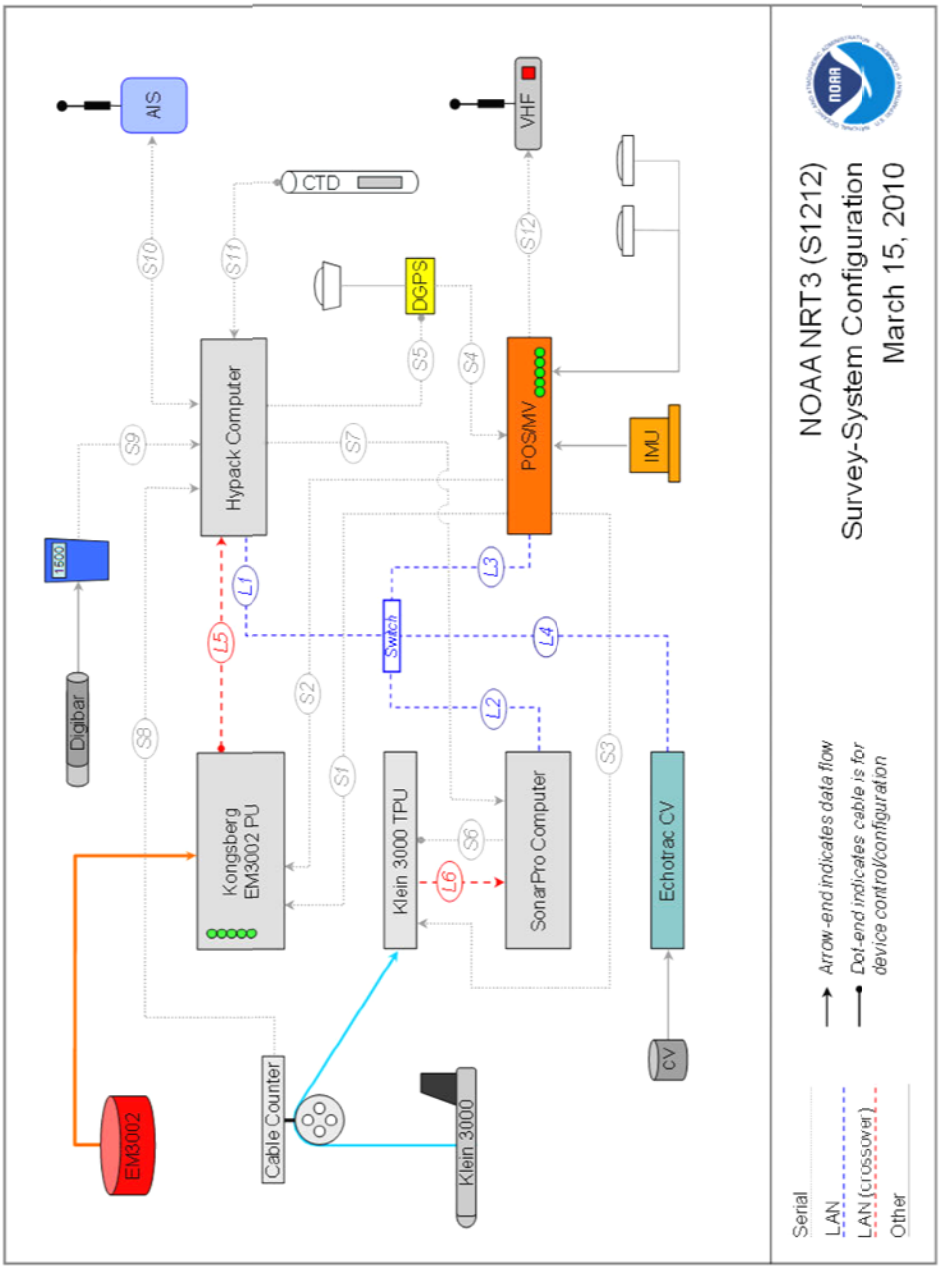

GPS
SSST
-2.174
3.276
GPSS
NOAA 1212
SURVEY LAUNCH
R.P./IMU
2.118
MB
SB
-0.032




NOAA Survey Launch 1212
Description: Aluminum SeaArk VC Commander
Vessel Length: 27 feet
LOA: 32 feet
Side View
GPS
GPSP
SSST
-2.745
-3.586
-2.567
RP/IMU
0.419
SB
0.631
MB
3.256


Top View
GPSS
0.953
0.028
GPS
SSST
0.646
RP/IMU
Center Line
-0.950
SB
-0.173
-0.003
MB
GPSP

Appendix 2: Wiring Diagram


NOAA NRT3 (S1212)
Survey-System Configuration
March 15, 2010
AIS
VHF
CTD
DGPS
Hypack Computer
POS/MV
IMU
1500
Digibar
Switch
Kongsberg EM3002 PU
Klein 3000 TPU
SonarPro Computer
Echotrac CV
EM3002
Cable Counter
Klein 3000
CV
L1
L2
L3
L4
L5
L6
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
Serial
LAN
LAN (crossover)
Other
Arrow-end indicates data flow
Dot-end indicates cable is for device control/configuration

Cable	End1	End2	Settings	Description
L1	Hypack Computer 129.100.1.230 255.255.0.0	Network Switch	n/a	Connects to SonarPro Computer, POS/MV and Echotrac CV
L2	SonarPro Computer 129.100.1.240 255.255.0.0	Network Switch	n/a	Network share with Hypack Computer for SSS data download
L3	POS/MV 129.000.1.231 255.255.0.0	Network Switch	n/a	UDP broadcast of depth, attitude, & PosPac data to Hypack
L4	Echotrac CV3 Automatic IP	Network Switch	n/a	UDP broadcast to Hypack
L5	EM3002 157.237.2.61 255.255.255.0	Hypack Computer 157.237.2.30 255.255.255.0	Port 16103	UDP broadcast of various EM datagrams (crossover)
L6	Klein 3000 TPU 192.168.0.81 255.255.255.0	SonarPro Computer 192.168.0.82 255.255.255.0	n/a	SSS data stream (crossover)
S1	POS/MV Com 1	EM3002 PU Com 3	9600,8,n,1	Position data to EM3002 (GGA) @ 1 Hz
S2	POS/MV Com 2	EM3002 PU Com 2	19200,8,n,1	Attitude data to EM3002 (Simrad 1000 TSS1) @ 50 Hz
S3	POS/MV Com 4	Klein 3000 TPU Com 2	4800,8,n,1	Position and Speed to Klein TPU (RMC & VTG)

S4	Trimble DGPS Port B	POS/MV Com 3	9600,8,n,1	RTCM DGPS correctors to POS/MV
S5	Trimble DGPS Port A	Hypack Computer Com 4	9600,8,n,1	Trimble DGPS configuration via TSIP talker
S6	SonarPro Computer Com 1	Klein 3000 TPU Com 1	9600,8,n,1	HyperTerminal connection to view Klein TPU bootup sequence
S7	Hypack Computer Com 3	SonarPro Computer Com 2	9600,8,n,1	Cable out to SonarPro via Hypack-generated delph string
S8	Cable Counter	Hypack Computer Com 5	2400,7,n,1	Cable out from Dynapar unit to Hypack
S9	Digibar	Hypack Computer Com 10	9600,8,n,1	Surface sound speed to SIS for EM3002 beam forming/steering
S10	AIS Transceiver	Hypack Computer Com 6	38400,8,n,1	AIS (automatic identification system) broadcast and receive
S11	Seabird SBE 19+	Hypack Computer Com 9	9600,8,n,1	Download CTD cast data
S12	POS/MV Com 5	VHF radio	4800,8,n,1	Position (GGA) sent to non-NOAA VHF radio for DSC (digital selective calling) capability

Appendix 3: GAMS Calibration Report

POS/MV Calibration Report

Field Unit: NRT 3

SYSTEM INFORMATION

Vessel: S1212

Date: 3/7/2011 **Dn:** 66

Personnel: Jacobs, Jackson

PCS Serial # 2245 (A014934)

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 3.4.00

POS Version (Use Menu View > Statistics) MV-320, Version 4

GPS Receivers

Port Receiver 1441021298

Starboard Recceiver 1441021080

CALIBRATION AREA

Location: Carr Inlet, WA

	D	M	S
Approximate Position: Lat	47	16	12 N
Lon	122	37	48 W

DGPS Beacon Station: Robinson

Frequency: 323 kHz

Satellite Constellation

Primary GPS (Port Antenna)

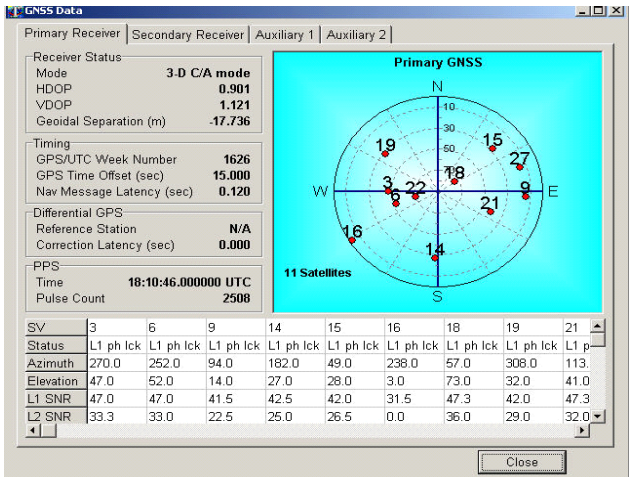
HDOP: 0.091

VDOP: 1.121

Sattelites in Use: 11

19,16,3,6,14,21,9,15,18,22,27

PDOP 1.352 (Use View> GAMS Solution)



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

POS/MV CONFIGURATION

Settings

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

User Entries, Pre-Calibration		Baseline Vector	
1.903	Two Antenna Separation (m)	**0.015**	X Component (m)
0.50	Heading Calibration Threshold	**1.903**	YComponent (m)
0	Heading Correction	**0.025**	Z Component (m)

Configuration Notes: Annual Calibration

POS/MV CALIBRATION

Calibration Procedure:

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

Start time: 10:18 UTC
End time: 10:29
Heading accuracy achieved for calibration: 0.099

Calibration Results:

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

POS/MV Post-Calibration Values		Baseline Vector	
1.903	Two Antenna Separation (m)	**1.903**	X Component (m)
0.500	Heading Calibration Threshold	**0.5**	YComponent (m)
0	Heading Correction	**0.025**	Z Component (m)

GAMS Status Online? X
Save Settings? X

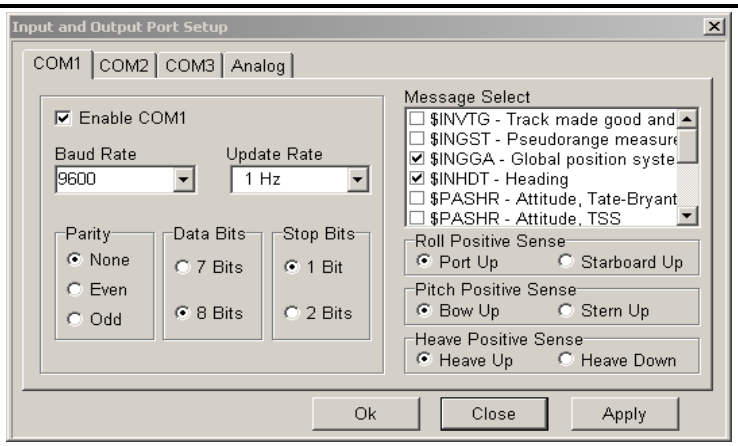
Calibration Notes.

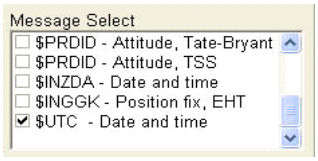
Save POS Settings on PC (Use File > Store POS Settings on PC)
File Name: POSMV_2011.nvm

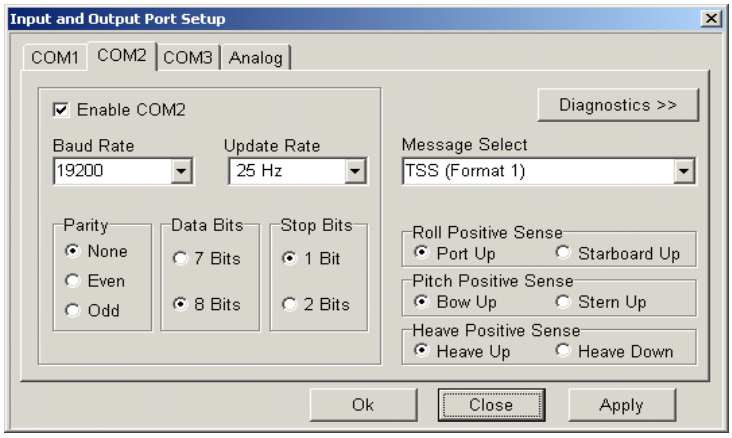
GENERAL GUIDANCE
The POS/MV uses a Right-Hand Orthogonal Reference System
The right-hand orthogonal system defines the following:
• The x-axis is in the fore-aft direction in the appropriate reference frame.
• The y-axis is perpendicular to the x-axis and points towards the right (starboard) side in 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)

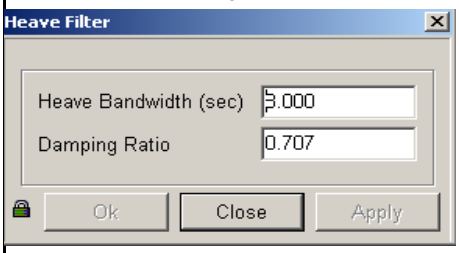




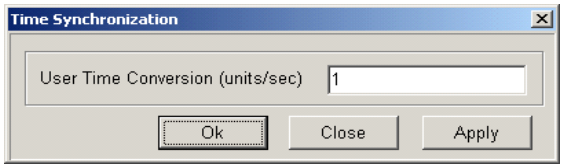


NOTE: COM3 and Analog are not used.

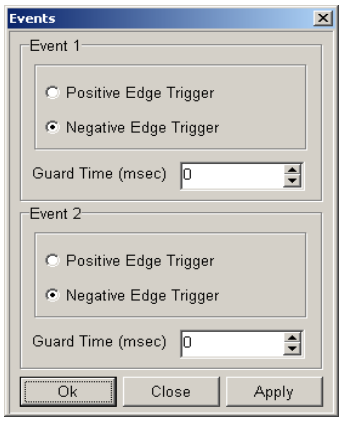
Heave Filter (Use Settings > Heave)



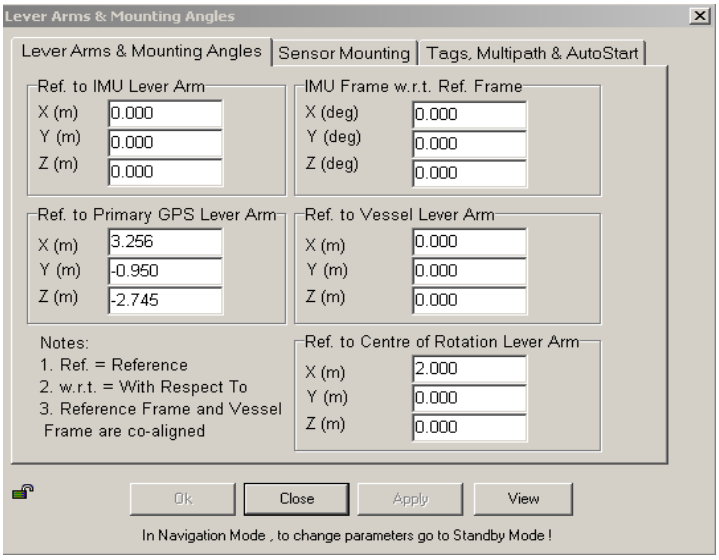
Time Sync (Use Settings > Time Sync)



Events (Use Settings > Events)



Installation (Use Settings > Installation)



Appendix 4: Sound Speed Sensors Annual Calibration

Date: Feb 23, 2011

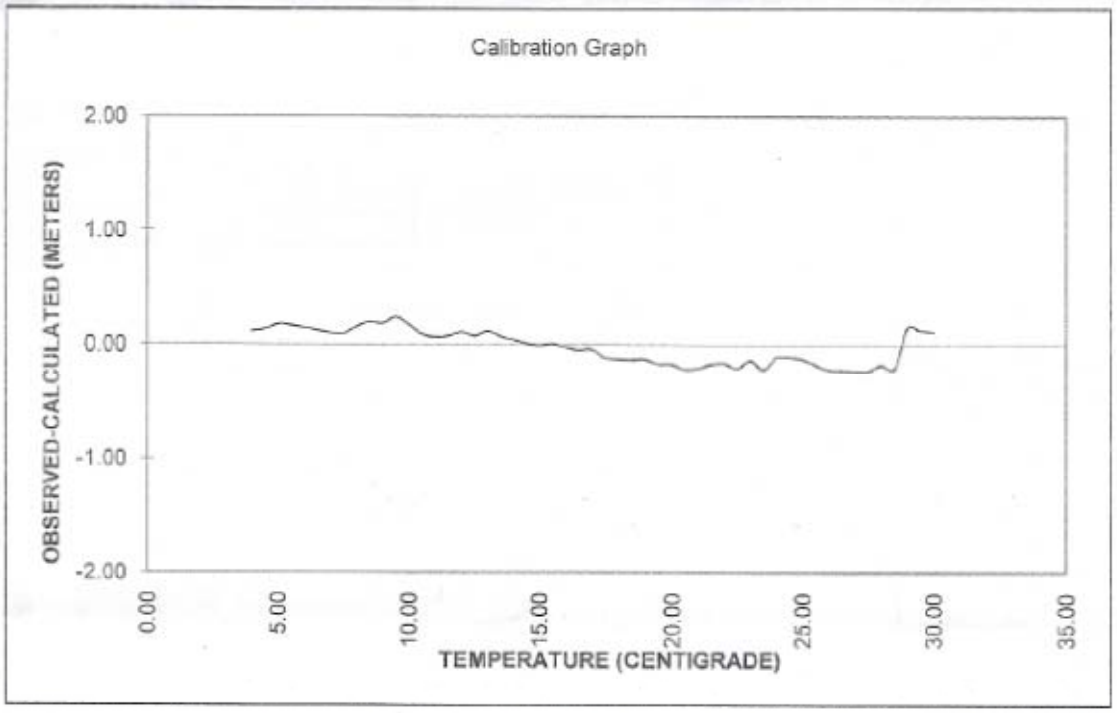
Serial #: 98314-022311

DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

Burn these numbers to EPROM:		
	Gradient	3378
	Intercept	411



The instruments used in this calibration have been calibrated to the published manufacturer specifications using standards traceable to NIST, to consensus standards, to ratio methods, or to acceptable values of natural physical constants that meets the requirements of ANSI/NCSL Z540-1, ISO 9001, ISO 10012 and ISO 17025. Certificate/traceability numbers: 0002-2655.00-23491-001, 0002-2655.00-23491-002. ID#'s:294,295,762,172,56

Odom Hydrographic Systems, Inc.
1450 Seaboard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-766-3051, Facsimile: (225)-766-6122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

Date:
Feb 23, 2011

Serial #:
98314-022311

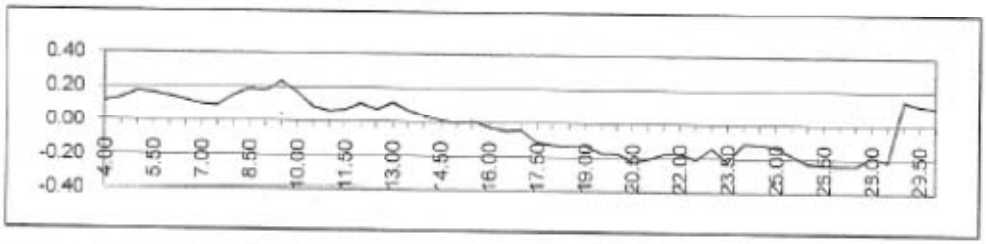
DIGIBAR CALIBRATION REPORT

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	5543.53	1421.73	0.11
4.50	1423.90	5552.24	1424.03	0.13
5.00	1426.15	5560.93	1426.33	0.17
5.50	1428.38	5569.33	1428.54	0.16
6.00	1430.58	5577.59	1430.72	0.14
6.50	1432.75	5585.74	1432.87	0.12
7.00	1434.90	5593.79	1435.00	0.10
7.50	1437.02	5601.81	1437.11	0.09
8.00	1439.12	5609.98	1439.27	0.15
8.50	1441.19	5617.96	1441.38	0.19
9.00	1443.23	5625.89	1443.41	0.18
9.50	1445.25	5633.55	1445.49	0.24
10.00	1447.25	5640.88	1447.42	0.17
10.50	1449.22	5648.04	1449.31	0.09
11.00	1451.17	5655.33	1451.24	0.09
11.50	1453.09	5662.65	1453.17	0.07
12.00	1454.99	5669.99	1455.10	0.11
12.50	1456.87	5678.97	1456.95	0.07
13.00	1458.72	5684.15	1458.84	0.12
13.50	1460.55	5690.91	1460.62	0.07
14.00	1462.36	5697.63	1462.40	0.04
14.50	1464.14	5704.29	1464.15	0.01
15.00	1465.91	5710.91	1465.90	0.00
15.50	1467.65	5717.54	1467.65	0.01
16.00	1469.36	5723.93	1469.34	-0.02
16.50	1471.06	5730.27	1471.01	-0.05
17.00	1472.73	5736.63	1472.69	-0.04
17.50	1474.38	5742.61	1474.27	-0.11
18.00	1476.01	5748.74	1475.88	-0.13
18.50	1477.62	5754.81	1477.49	-0.13
19.00	1479.21	5760.84	1479.08	-0.13
19.50	1480.77	5766.61	1480.60	-0.17
20.00	1482.32	5772.46	1482.14	-0.17
20.50	1483.84	5778.06	1483.62	-0.22
21.00	1485.35	5783.81	1485.14	-0.21
21.50	1486.83	5789.50	1486.65	-0.17
22.00	1488.29	5795.13	1488.12	-0.17
22.50	1489.74	5800.45	1489.53	-0.21
23.00	1491.16	5806.11	1491.02	-0.14
23.50	1492.56	5811.12	1492.34	-0.22
24.00	1493.95	5816.79	1493.84	-0.11
24.50	1495.32	5821.95	1495.20	-0.11
25.00	1496.66	5826.99	1496.53	-0.13
25.50	1497.99	5831.83	1497.81	-0.18
26.00	1499.30	5836.62	1499.07	-0.22
26.50	1500.59	5841.48	1500.36	-0.23
27.00	1501.86	5846.28	1501.62	-0.24
27.50	1503.11	5851.03	1502.86	-0.24
28.00	1504.35	5855.91	1504.16	-0.18
28.50	1505.56	5860.40	1505.35	-0.21
29.00	1506.76	5866.31	1506.91	0.15
29.50	1507.94	5870.69	1508.06	0.12
30.00	1509.10	5875.06	1509.22	0.11



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-6122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

SEA-BIRD ELECTRONICS, INC.
13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Service Report

RMA Number 63201

Customer Information:

Company	NOAA / NRT3 Pier 7, port of Tacoma	**Date**	3/8/2011
Contact	Dan Jacobs		
PO Number	TBD		

Serial Number	19P44126-4778
Model Number	SBE 19Plus

Services Requested:

1. Evaluate/Repair Instrumentation.
2. Perform Routine Calibration Service.

Problems Found:

Services Performed:

1. Performed initial diagnostic evaluation.
2. Performed "Post Cruise" calibration of the temperature & conductivity sensors.
3. Calibrated the pressure sensor.
4. Performed complete system check and full diagnostic evaluation.

Special Notes:

SEA-BIRD ELECTRONICS, INC.

13431 NE 20th Street, Bellevue, Washington, 98005-2010 USA

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

SENSOR SERIAL NUMBER: 4778
CALIBRATION DATE: 23-Feb-11

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.237223e-003
a1 = 2.670691e-004
a2 = -5.886140e-007
a3 = 1.735301e-007

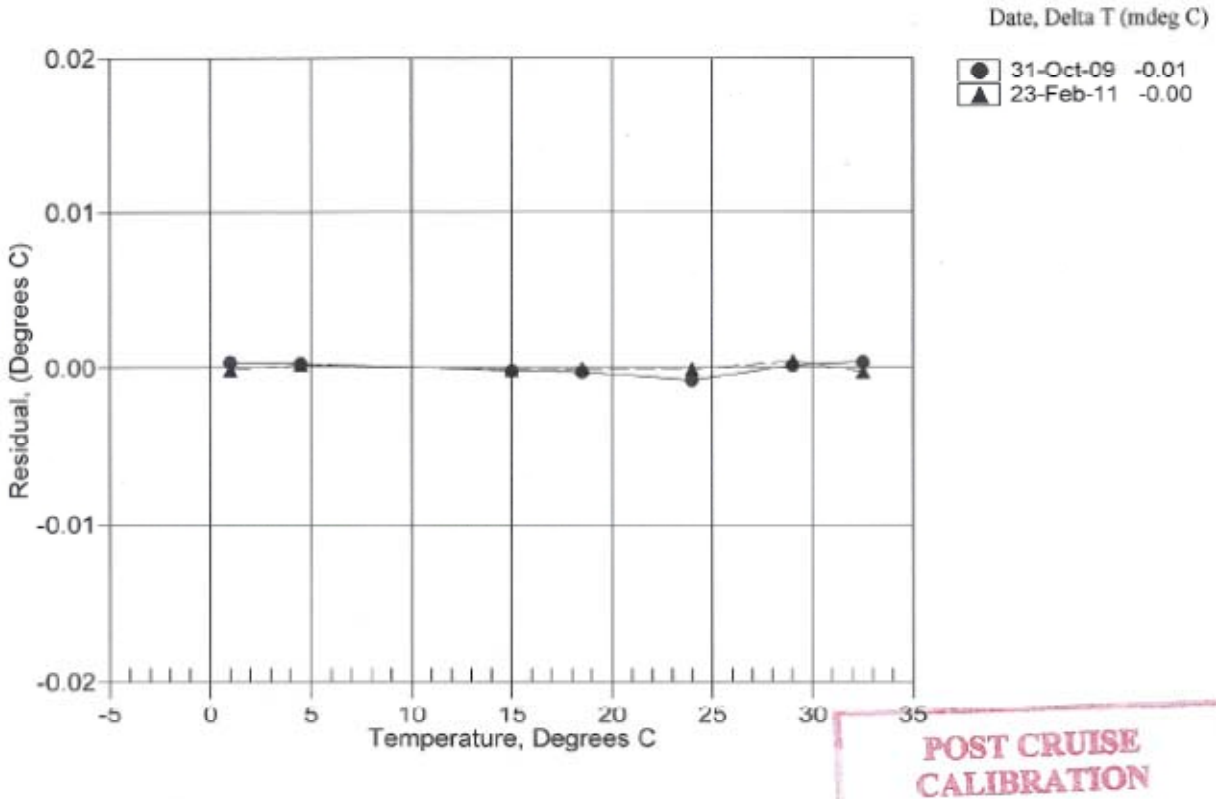
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	631211.850	0.9999	-0.0001
4.4999	560949.900	4.5001	0.0002
15.0000	386180.033	14.9999	-0.0001
18.5000	339158.217	18.4999	-0.0001
24.0000	275263.633	23.9999	-0.0001
29.0000	226579.850	29.0004	0.0004
32.5000	197166.383	32.4998	-0.0002

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.
13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	63201	**Date of Report:**	2/24/2011
Model Number	SBE 19Plus	**Serial Number:**	19P44126-4778

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: 2/23/2011 **Drift since last cal:** +0.00001 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: **Drift since Last cal:** Degrees Celsius/year

Comments:

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13431 NE 20th Street, Bellevue, Washington, 98005-2010 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4778
CALIBRATION DATE: 23-Feb-11

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

COEFFICIENTS:

g = -1.025728e+000
h = 1.569686e-001
i = -5.956505e-004
j = 7.102925e-005

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

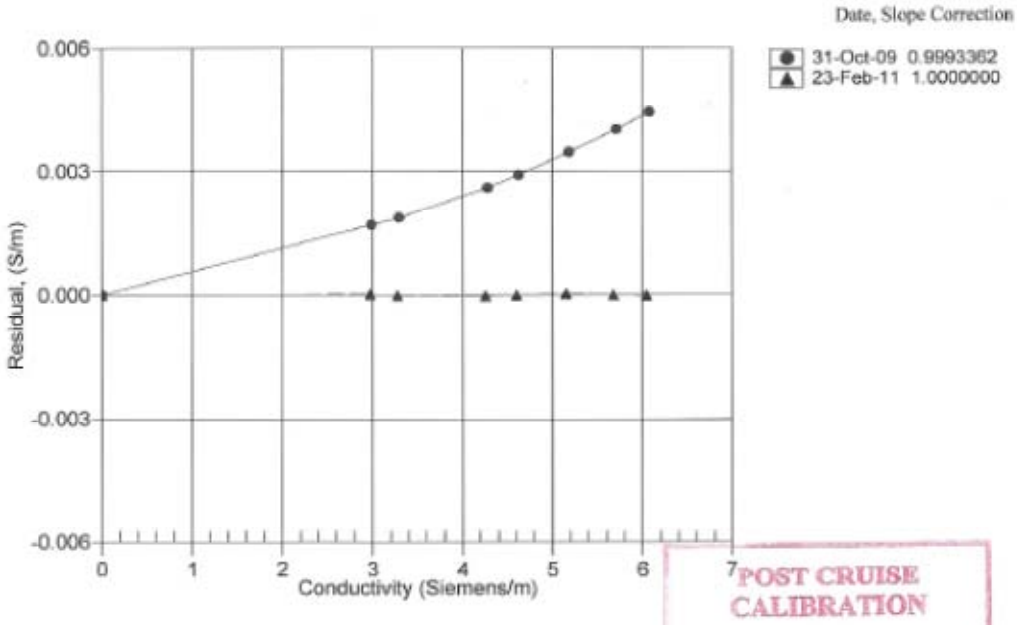
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2564.97	0.0000	0.00000
1.0000	34.6902	2.96621	5062.28	2.9662	0.00002
4.4999	34.6703	3.27229	5252.35	3.2723	-0.00001
15.0000	34.6275	4.25090	5817.72	4.2509	-0.00002
18.5000	34.6179	4.59488	6003.52	4.5949	-0.00001
24.0000	34.6066	5.15087	6291.90	5.1509	0.00003
29.0000	34.5976	5.67052	6549.56	5.6705	0.00001
32.5000	34.5896	6.04091	6726.96	6.0409	-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



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

Conductivity Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	63201	Date of Report:	2/24/2011
Model Number	SBE 19Plus	Serial Number:	19P44126-4778

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: 2/23/2011 Drift since last cal: -0.00130 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.

13431 NE 20th Street, Bellevue, Washington, 98005-2010 USA

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

SENSOR SERIAL NUMBER: 4778
CALIBRATION DATE: 18-Feb-11

SBE19plus PRESSURE CALIBRATION DATA
508 psia S/N 6975

COEFFICIENTS:

PA0 =	-1.885235e-001	PTCA0 =	5.333653e+005
PA1 =	1.550754e-003	PTCA1 =	-3.068870e+000
PA2 =	7.744532e-012	PTCA2 =	-1.158722e-001
PTEMPA0 =	-7.455873e+001	PTCB0 =	2.569000e+001
PTEMPA1 =	4.870199e+001	PTCB1 =	-2.000000e-004
PTEMPA2 =	-3.795803e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.53	542732.0	2.0	14.53	-0.00
104.77	600907.0	2.0	104.79	0.00
204.79	665304.0	2.0	204.78	-0.00
304.80	729672.0	2.0	304.78	-0.01
404.80	794017.0	2.0	404.80	0.00
504.80	858299.0	2.0	504.80	-0.00
404.80	794028.0	2.0	404.82	0.00
304.82	729700.0	2.0	304.82	0.00
204.82	665333.0	2.0	204.82	0.00
104.81	600921.0	2.0	104.82	0.00
14.54	542733.0	2.0	14.53	-0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	2.24	542892.48
29.00	2.16	542924.16
24.00	2.06	542973.75
18.50	1.94	543019.53
15.00	1.87	543037.56
4.50	1.64	543099.85
1.00	1.57	543108.35

TEMP(ITS90)	SPAN(mV)
-5.00	25.69
35.00	25.68

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) = $PA0 + PA1 * n + PA2 * n^2$

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13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Service Report

RMA Number 62180

Customer Information:

Company	NOAA / NRT3 Pier 7, port of Tacoma	Date	12/15/2010
Contact	Barry Jackson		
PO Number	Credit card		

Serial Number	1913768-2039
Model Number	SBE 19

Services Requested:

1. Evaluate/Repair Instrumentation.
2. Perform Routine Calibration Service.

Problems Found:

Services Performed:

1. Performed initial diagnostic evaluation.
2. Performed "Post Cruise" calibration of the temperature & conductivity sensors.
3. Calibrated the pressure sensor.
4. Performed complete system check and full diagnostic evaluation.

Special Notes:

SEA-BIRD ELECTRONICS, INC.

13431 NE 20th Street, Bellevue, Washington, 98005-2010 USA

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

SENSOR SERIAL NUMBER: 2039
CALIBRATION DATE: 04-Dec-10

SBE19 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.17032910e-003
h = 5.93410273e-004
i = 2.41327879e-006
j = -2.21924855e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS

a = 3.64763231e-003
b = 5.84036229e-004
c = 8.34069270e-006
d = -2.21891790e-006
f0 = 2426.946

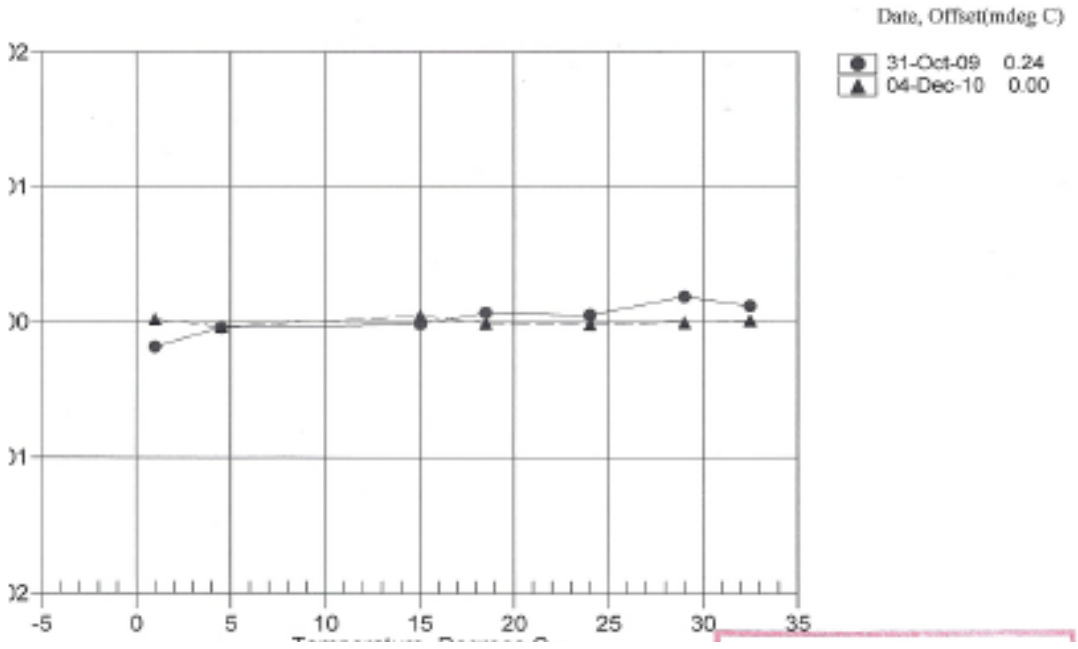
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2426.946	1.0002	0.00020
4.5000	2625.996	4.4996	-0.00038
15.0000	3292.309	15.0005	0.00046
18.5000	3538.490	18.4999	-0.00013
23.9999	3951.047	23.9997	-0.00020
29.0000	4354.298	29.0000	-0.00005
32.5000	4653.078	32.5001	0.00010

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature IPTS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



SEA-BIRD ELECTRONICS, INC.
13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	62180	Date of Report:	12/6/2010
Model Number	SBE 19	Serial Number:	1913768-2039

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: 12/4/2010 Drift since last cal: -0.00022 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

SEA-BIRD ELECTRONICS, INC.

13431 NE 20th Street, Bellevue, Washington, 98005-2010 USA

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

SENSOR SERIAL NUMBER: 2039
CALIBRATION DATE: 04-Dec-10

SBE19 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

```
g = -3.94879631e+000
h =  4.70961716e-001
i =  1.22599241e-003
j = -3.30049407e-005
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  4.67889920e-002
b =  4.20867978e-001
c = -3.93609553e+000
d = -1.30798035e-004
m =  2.1
CPcor = -9.5700e-008 (nominal)
```

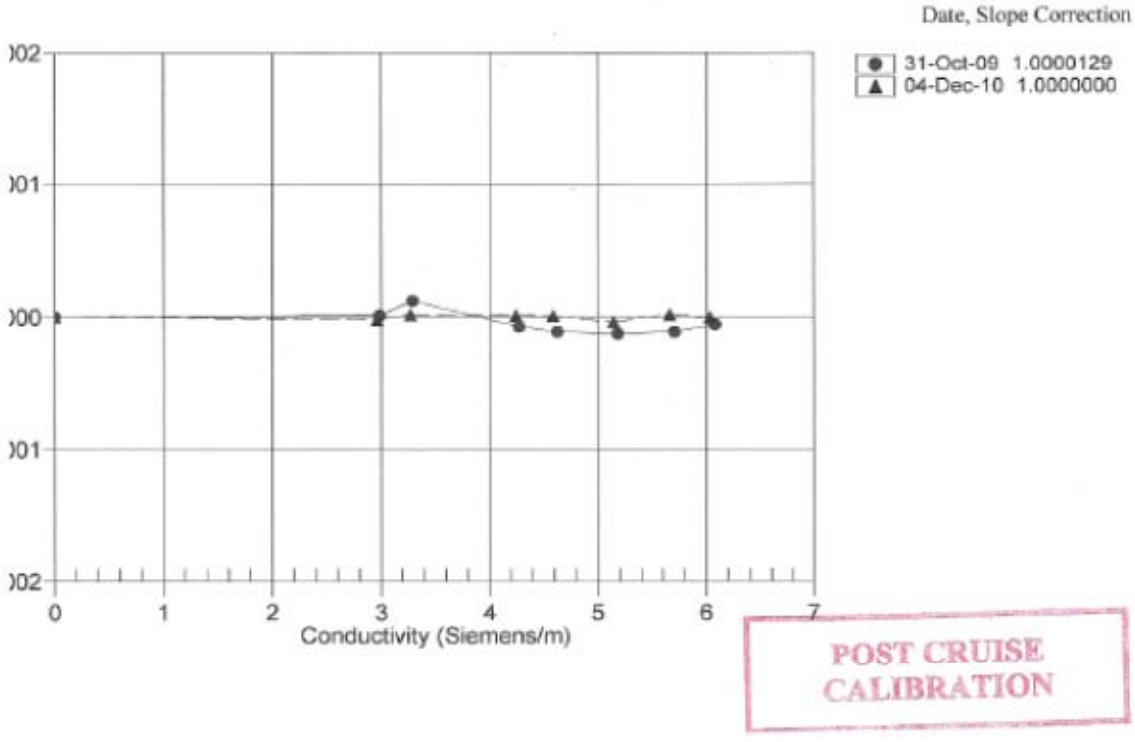
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88563	0.00000	0.00000
1.0000	34.6370	2.96210	8.37231	2.96208	-0.00002
4.5000	34.6126	3.26739	8.74259	3.26741	0.00002
15.0000	34.5667	4.24422	9.83298	4.24423	0.00001
18.5000	34.5565	4.58761	10.18833	4.58762	0.00001
23.9999	34.5445	5.14263	10.73757	5.14260	-0.00004
29.0000	34.5372	5.66173	11.22685	5.66175	0.00002
32.5000	34.5319	6.03198	11.56305	6.03198	-0.00000

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

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

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.
13431 NE 20th Street Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	62180	**Date of Report:**	12/6/2010
Model Number	SBE 19	**Serial Number:**	1913768-2039

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: 12/4/2010 **Drift since last cal:** 0.0000 **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.

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

Conductivity Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	62180	**Date of Report:**	12/6/2010
Model Number	SBE 19	**Serial Number:**	1913768-2039

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: 12/4/2010 Drift since last cal: 0.0000 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.

13431 NE 20th Street, Bellevue, Washington, 98005-2010 USA

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

SENSOR SERIAL NUMBER: 2039
CALIBRATION DATE: 09-Dec-10

SBE19 PRESSURE CALIBRATION DATA
300 psia S/N 133248 TCV: 489

QUADRATIC COEFFICIENTS:

PA0 = 1.484703e+002
PA1 = -3.906197e-002
PA2 = 2.546366e-008

STRAIGHT LINE FIT:

M = -3.905960e-002
B = 1.486135e+002

PRESSURE PSIA	INST OUTPUT(N)	COMPUTED PSIA	ERROR %FS	LINEAR PSIA	ERROR %FS
14.54	3438.0	14.48	-0.02	14.33	-0.07
59.78	2278.0	59.62	-0.05	59.64	-0.05
119.81	739.0	119.62	-0.06	119.75	-0.02
179.78	-799.0	179.70	-0.03	179.82	0.01
239.78	-2333.0	239.74	-0.01	239.74	-0.02
299.80	-3863.0	299.75	-0.02	299.50	-0.10
239.79	-2337.0	239.90	0.04	239.90	0.04
179.78	-806.0	179.97	0.06	180.10	0.10
119.82	732.0	119.89	0.02	120.02	0.07
59.82	2270.0	59.93	0.04	59.95	0.04
14.54	3433.0	14.67	0.04	14.52	-0.01

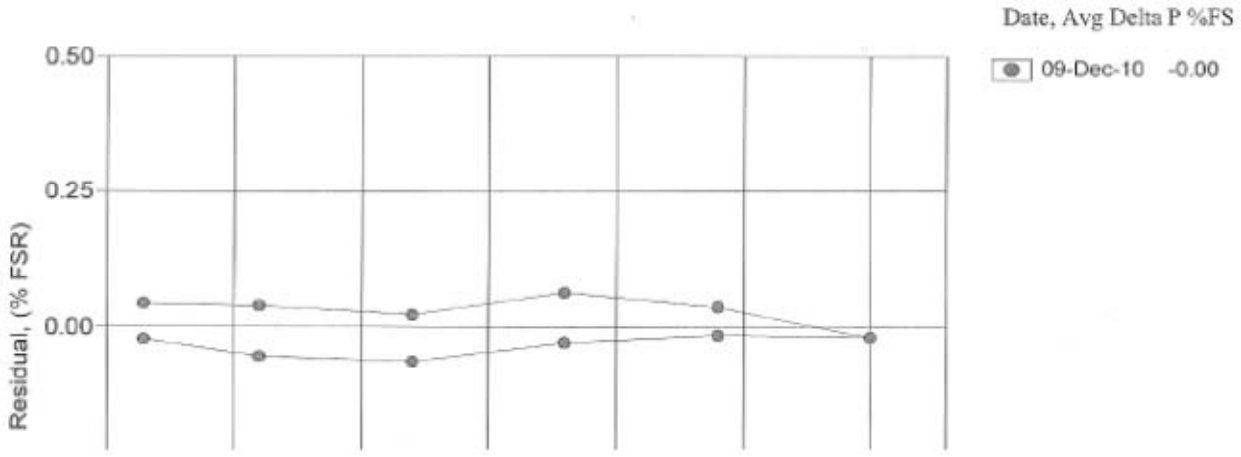
Straight Line Fit:

Pressure (psia) = M * N + B (N = binary output)

Quadratic Fit:

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

Residual = (instrument pressure - true pressure) * 100 / Full Scale Range



Appendix 5: Hydrographic Systems Inventory

Hydrographic Personnel Roster			
	Field Unit: NRT3		
	Effective Date: 02/28/2011		
	Updated Through: 04/11/2011		
Team Leader			
Name and Grade	***Current Position***	***Years of Hydrographic Experience***	***Notes***
Dan Jacobs (Acting Team Lead)	*Physical Scientist*	*5*	
Team Members			
Name and Rate	***Current Position***	***Years of Hydrographic Experience***	***Notes***
Barry Jackson	*Physical Science Technician*	*5*	
Ian Colvert	*Physical Science Technician*	*5*	
ROTATING HYDROGRAPHERS & VISITORS *(involved in survey work)*			
Name and Rate	***Current Position***	***Years of Hydrographic Experience***	***Notes & Dates Embarked***
NOTES:			

HYDROGRAPHIC HARDWARE INVENTORY | NRT3

Effective Date	Updated Through
1/4/2011	2/20/2011

SONAR & SOUNDING EQUIPMENT

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Version Install Date	Date of last Calibration	Date of last Service	Additional Information
Single Beam Echosounder	Odom	Echotrac CV (ETCVX2)	23015					Acquired 10/24/2005
Multibeam Echosounder	Kongsberg	Simrad EM3002	358	DSP High/Low v1.26, Transducer v1.21	Unknown	4/19/2011		Dongle # 040131, 8/1/2006
Multibeam Control Unit	Kongsberg	Simrad EM3002	1534					Acquired 8/1/2006
Side Scan Sonar Towfish	Klein	System 3000--Model 3210	456			4/25/2010		In service 3/3/2004
Side Scan Sonar TPU	Klein	System 3000	392					In service 5/20/2008 until 5/30/2008
Side Scan Sonar TPU	Klein	System 3000	312					In service 3/3/2004
Lead Line		Traditional	NA					.

POSITIONING & ATTITUDE EQUIPMENT

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Version Install Date	Date of last Calibration	Date of last Service	Additional Information
Position/Orientation System Control Unit	Applanix	POS/MV 320 V4	A009170			12/4/2008 calibrated for S1212		RA 6 POS from PMC. In use for Hylebos barge investigation DN343, DN347, DN349 2008.
Position/Orientation System IMU	Applanix	POS/MV 320 V4	371	unknown	10/26/2011	10/26/2011		on loan from BHII
Position/Orientation System IMU	Applanix	POS/MV 320 V4	2245 (A014934)	3.42	3/18/2008	4/20/2009		Acquired 8/1/2006
Position/Orientation System Control Unit	Applanix	POS/MV Model # MVV4	2245 (A014934)	3.42	3/18/2008	4/20/2009		Acquired 8/1/2006
Position/Orientation System Antennas	Trimble	Zephyr	Port-1441021298 Stbd-1441021080	2.27	3/18/2008	3/7/2011		Acquired 8/1/2006
DGPS Antenna	Trimble	33580-00	220330095					On launch
DGPS Reciever	Trimble	DSM212L	220164491					On launch
GPS Handheld Receiver/Datalogger	Trimble	GeoXH	70950-00	TerraSync 4.2				
Sound Speed Profiler (CTD)	Sea-Bird	SeaCat SBE-19	1913768- 2039			1/15/2011	4/01/2006 5/23/2007 1/24/2009	Acquired 9/5/2006 from NRT-7
Sound Speed Profiler (CTD)	Sea-bird	SeaCat SBE-19+	19P44126-4778			12/15/2010	9/1/2006 1/30/2008 2/12/2009	Acquired 10/10/2006
Velocimeter probe	Odom	Digibar Pro	98314				8/1/2007 2/12/2009	Acquired 8/1/2006 Malfunction 05/17/07 Repaired and in-service 08/1/07
Velocimeter Controller	Odom	Digibar Pro	98308			3/15/2011	3/15/2011	In use, on survey launch
Velocimeter Controller	Odom	Digibar Pro	98314					In office trailer

OTHER EQUIPMENT								
Equipment Type	*Manufacturer*	*Model*	*Serial Number*	*Firmware and/or Software Version*	*Version Install Date*	*Date of last Calibration*	*Date of last Service*	*Additional Information*
Towfish Cable Counter	Dynapar	Max Count	Unknown					

COMPUTERS								
Machine Name	OCS-W-NRT3-1	OCS-W-NRT3-2	OCS-L-NSD764992	Laptop	Hypack Computer	Klein Computer		
Service Tag #	9VQLKB1	BVQLKB1	27SLRJ1		B7F8M41	22-291		
Location	Office	Office	Office	Office	Launch	Launch		
Make/Model	Dell Precision 690	Dell Precision 690	Dell Precision T3400	Dell Latitude D630	Dell	Klein WSCU3000		
Date Purchased	8/1/2006	8/1/2006	6/1/2009	?	8/1/2006	3/3/2004		
Date of Last Rebuild	NA	NA	NA		NA	NA		
Processor	Intel Xeon 5060, 3.2 GHz (x2)	Intel Xeon 5060, 3.2 GHz (x2)	Intel Core 2 Duo 3.2 GHz	Intel Core 2 Duo 2.2 GHz	Intel Pentium 4, 2.8 GHz	Intel Pentium 3, 1.2 GHz		
RAM	2 GB	2 GB	3 GB	2G	2.5 GB	523,740 KB		
Video Card	nVidia Quadro FX 550	nVidia Quadro FX 550	nVideo Quadro FX 1700	Intel Graphic Media Accelerator Driver	nVidia GeForce FX 5500	Matrox Millenium G450 AGP		
Video RAM	128 MB	128 MB	512 MB	384MB	256 MB	32 MB		
Comments	MAC Address: 00-13-72-9B-8A-BF	MAC Address: 00-1A-A0-BA-BE-12	00-22-19-2F-A8-51	MAC Address: 00-1E-4C-8C-C0-22	Acquired from PHB	In-service date 3/3/2004		
IP Address	192.168.11.1	192.168.0.19	192.168..0.1	192.168.0.122	129.100.1.230	192.168.0.82		

NRT3 Hydrographic Software Inventory

		OCS-W-NRT3-1	*OCS-W-NRT3-2 (in repair, Silver Spring)*	*OCS-L-NSD764992*	*Laptop*	*Hypack Computer*	*Klein Computer*
Operating System							
Windows 2000							
	5.0.2195, SP4	NA	NA	NA	NA	NA	3/3/2004
Windows XP							
	5.1.2600, SP 2	8/1/2006	3/22/2007			2005	3/19/2008
	SP3	9/8/2008	11/4/2008	6/8/2009	6/8/2009		
Acquisition Software							
Echotrac Controller							
	3.08	NA	NA	NA	NA	(8/1/06)	NA
EM3002 Controller							
	SIS 2.2	NA	NA	NA	NA	12/5/2009	NA
HypackMAX							
	6.2.0.25, SP1	1/29/2007	1/21/2010	NA	NA	8/1/2006	NA
	6.2a					5/18/2007	
	6.2b					3/18/2008	
	Hypack 2008					5/1/2008	
	Hypack 2008 SP1					9/2/2008	
	Hypack 2009					4/20/2009	
	Hypack 2010					9/1/2011	
Klein Sonar Pro							
	9.6	NA	8/1/2006	NA	NA	NA	7/14/2005
	11.2		3/4/2008				3/15/2008
POS-MV Controller							
	3.3.0.1	NA	NA	NA	NA	8/1/2006	NA
TSIP Talker							
	2.0	NA	NA	NA	NA	8/1/2006	NA
TerraSync							
	2.41	NA	3/15/2008	NA	NA		NA
	3.3		2/10/2009				
	4.1	NA	3/10/2010				

Processing Software							
CARIS HIPS/SIPS							
	6.0, SP2, HF 21	12/12/2006	N/A			NA	NA
	6.1, SP1	7/16/2007	7/16/2007				
	SP1 HF 1-12	4/3/2008	4/3/2008				
	6.1 SP2	7/17/2008	7/17/2008		11/3/2009		
	SP2 HF 1	8/5/2008	8/5/2008		11/3/2009		
	SP2 HF 2-3	11/3/2008			11/3/2009		
	SP2 HF 4	11/14/2008	11/17/2008		1/14/2009		
	SP2 HF 5	12/29/2008	1/5/2009				
	SP2 HF 6	1/12/2009	1/12/2009				
	SP2 HF 7	2/9/2009	2/10/2009	6/8/2010			
	SP2HF8						
	CARIS 7.0		12/21/2009		12/31/2009		
	SP1		1/20/2010		1/20/2010		
	HF 1		1/20/2010		3/11/2010		
	HF2		3/11/2010		3/11/2010		
	HF3		3/11/2010		3/11/2010		
	HF4		3/17/2010		3/17/2010		
	HF5			7/29/2010			
CARIS Notebook							
	2.2, SP1	8/1/2006	N//A			NA	NA
	3	??	3/1/2007		5/5/2009		
	3, SP1			6/8/2010	5/5/2009		
	3.1		11/5/2009		12/17/2009		
	3.1, HF1		11/9/2009		3/11/2010		

Support Software							
HydroMI							
	6.8.1	8/1/2006	8/1/2006			NA	NA
	6.10.2	1/29/2007	10/24/2006				
	8.1		7/2/1905				
	8.3						
MapInfo							
	8.5	8/1/2006				NA	NA
	9.0.2	9/24/2007			3/6/2008		
	9.5	10/14/2008		6/8/2009			
	V9.5.1	6/8/2009		6/8/2009			
	10		11/19/2009	11/19/2009			
Pathfinder Office							
	3.0	8/1/2006			N/A	NA	NA
	4.1			6/8/2009			
	4.2		3/1/2010				
Pydro							
	6.4.9	8/1/2006	8/1/2006			NA	NA
	6.10.0	10/31/2006	10/31/2006				
	6.10.1	12/12/2006	12/12/2006				
	7.1.0	1/29/2007	1/29/2007				
	7.3.0	5/7/2007	3/22/2007				
	9.4	4/14/2009	4/14/2009	6/8/2009			
	9.6		7/13/2009				
	9.1		3/10/2010				
	9.9 (r2712)				3/11/2010		
SBE							
	5.27a	8/1/2006	3/22/2007	NA	N/A	8/1/2006	NA
	5.37e		3/10/2010				
Seaterm							
	1.3	8/1/2006	3/22/2007	NA	N/A	8/1/2006	NA
	1.57		3/18/2010			5/1/2007	

VelocWin							
	8.8	8/1/2006	8/1/2006	NA	N/A	8/1/2006	NA
	8.83	1/29/2007	3/22/2007			1/29/2007	NA
	8.85	5/7/2007	5/7/2007				NA
	8.86		5/21/2007			5/21/2007	NA
	8.96						
Vertical Mapper							
	2.0.0	8/1/2006	3/22/2007	NA		NA	NA
Adobe Acrobat Professional							
	7.0	8/1/2006	3/22/2007	6/8/2009	4/4/2008	NA	NA
Buffalo Tera Navigator							
	1.2.0	1/8/2006	3/22/2007	NA	N/A	NA	NA
Microsoft Office Professional							
	Verson 2003						
	SP2	8/1/2006	3/22/2007			NA	NA
	Version Plus 2007	2/18/2009	2/18/2009	6/8/2009			
	SP2				6/8/2009		
PosPac MMS							
		NA	NA	NA		NA	NA
	5.2, SP1						
	5.3				3/12/2010		
	5.3, SP1						

Keys and Licenses						
Acquisition						
SonarPro						
HYPACK 2009a	15686383 2/2/2010					
HYSWEEP	Hysweep Key, parallel interface, Dongle # 040131, 8/1/2006					
TerraSync 2.30	SN 0021101404503274, Key 1B02AFEA					
TerraSync 2.41	509645-00110-06002-54ED070D					
Terrasync 3.30	509645-00110-09227-4D565538					
Processing						
CARIS HIPS/SIPS	CW9605098	CW9605485	CW9606060 (RA_key)			
CARIS Notebook	CW9604697					
PF Office (HSTP Key)	02368-00300-04325-0B4698A3					
PF Office 4.0	030602-00300-10001-DEF24AC1					
POSPac MMS						
Support						
MapInfo 10.0	S/N: MINWEU1000051173; ACCESS CODE:398338					

Hydrographic Vessel Inventory							
		Field Unit: NRT3					
		Effective Date: 1/31/2007					
		Updated Through: 8/6/2011					
SURVEY VESSELS							
Vessel Name	NOAA Launch 1212 						
Hull Number	S1212						
Call Letters	S1212						
Manufacturer	Sea Ark						
Year of Construction	2000						
Type of Construction	Aluminum						
Length Overall	32						
Beam	2.4 m (8 ft)						
Draft	0.4 m						
Date of Effective Full Vessel Static Offset Survey	6/21/2006						
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	4/5/2011						
Date of Last Settlement and Squat Measurements & Method Used	3/17/2011 MBES used to determine settlement & squat						
Additional Information							

Appendix 6: Hydrographic Vessel File (HVF)

```
Vessel Name: NRT3_2011_EM3002.hvf
Vessel created: November 15, 2011


Depth Sensor:

      Sensor Class:      Swath
      Time Stamp:  2009-345 00:00

      Comments: EM3002 replaced old EM3000 in 12/09
      Time Correction(s) 0.000

      Transduer #1:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      -0.175
      Azimuth Offset:   0.050

      DeltaX:     -0.003
      DeltaY:     -0.032
      DeltaZ:     0.631

      Manufacturer:      Kongsberg
      Model:             em3002
      Serial Number:

Depth Sensor:

      Sensor Class:      Swath
      Time Stamp:  2010-074 00:00

      Comments: 2010 HSRR Patch Test in Anacortes, WA, no sonar offsets are
entered in SIS
      Time Correction(s) 0.000

      Transduer #1:
      -------------
      Pitch Offset:     -0.177
      Roll Offset:      -0.150
      Azimuth Offset:   -0.009

      DeltaX:     -0.003
      DeltaY:     -0.032
      DeltaZ:     0.631

      Manufacturer:      Kongsberg
```

```
      Model:             em3002
      Serial Number:

Depth Sensor:

      Sensor Class:      Swath
      Time Stamp:  2010-096 00:00

      Comments: sonar offsets were entered in SIS, BUT because we had the
"Use EM combined..." option NOT checked, the vertical sonar offset was not
reflected in the data logged to hsx files
      Time Correction(s) 0.000

      Transduer #1:
      -------------
      Pitch Offset:     -0.177
      Roll Offset:      -0.150
      Azimuth Offset:   -0.009

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.631

      Manufacturer:      Kongsberg
      Model:             em3002
      Serial Number:

Depth Sensor:

      Sensor Class:      Swath
      Time Stamp:  2010-097 00:00

      Comments: sonar offsets were entered in SIS, and because we had the
"Use EM combined..." option NOT checked, the vertical sonar offset was not
reflected in the data logged to hsx filessonar offsets were entered in SIS,
BUT because we had the "Use EM combined..." option checked, they are
reflected in the data logged to hsx files, so we don't need to have in HVF
      Time Correction(s) 0.000

      Transduer #1:
      -------------
      Pitch Offset:     -0.177
      Roll Offset:      -0.150
      Azimuth Offset:   -0.009

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000

      Manufacturer:      Kongsberg
      Model:             em3002
      Serial Number:
```

```
Depth Sensor:

      Sensor Class:      Swath
      Time Stamp:  2011-109 00:00

      Comments:
      Time Correction(s) 0.000

      Transduer #1:
      -------------
      Pitch Offset:     0.080
      Roll Offset:      -0.080
      Azimuth Offset:   0.100

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.631

      Manufacturer:      Kongsberg
      Model:             em3002
      Serial Number:     308

Depth Sensor:

      Sensor Class:      Swath
      Time Stamp:  2011-298 00:00

      Comments: POS MV IMU replaced DN298 2011
      Time Correction(s) 0.000

      Transduer #1:
      -------------
      Pitch Offset:     -0.920
      Roll Offset:      -0.150
      Azimuth Offset:   -0.110

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000

      Manufacturer:      kongsberg
      Model:             em3002
      Serial Number:

_____________________________________________________________________
Navigation Sensor:

      Time Stamp:  2006-234 00:00

      Comments: RP
      Time Correction(s) 0.000
```

```
DeltaX:     0.000
DeltaY:     0.000
DeltaZ:     0.000

Manufacturer:      Applanix
Model:             POS/MV4
Serial Number:     (null)


Time Stamp:  2009-345 00:00

Comments:
Time Correction(s) 0.000
DeltaX:     0.000
DeltaY:     0.000
DeltaZ:     0.000

Manufacturer:
Model:
Serial Number:


Time Stamp:  2010-074 00:00

Comments:
Time Correction(s) 0.000
DeltaX:     0.000
DeltaY:     0.000
DeltaZ:     0.000

Manufacturer:      Applanix
Model:             POS/MV4
Serial Number:


Time Stamp:  2011-109 00:00

Comments:
Time Correction(s) 0.000
DeltaX:     0.000
DeltaY:     0.000
DeltaZ:     0.000

Manufacturer:
Model:
Serial Number:


Time Stamp:  2011-298 00:00

Comments: Replaced POS MV IMU
Time Correction(s) -0.020
```

```
      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000

      Manufacturer:      Applanix
      Model:             POS/MV4
      Serial Number:
```

```
Gyro Sensor:

      Time Stamp:  2006-234 00:00

      Comments: (null)
      Time Correction(s) 0.000


      Time Stamp:  2009-345 00:00

      Comments:
      Time Correction(s) 0.000


      Time Stamp:  2010-074 00:00

      Comments:
      Time Correction(s) 0.000
```

```
Heave Sensor:

      Time Stamp:  2006-234 00:00

      Comments: (null)
      Apply Yes
      Time Correction(s) 0.000
      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000
      Offset:     0.000

      Manufacturer:      Applanix
      Model:             POS/MV4
      Serial Number:     (null)


      Time Stamp:  2009-345 00:00

      Comments:
      Apply No
      Time Correction(s) 0.000
      DeltaX:     0.000
```

```
      DeltaY:     0.000
      DeltaZ:     0.000
      Offset:     0.000

      Manufacturer:      Applanix
      Model:             POS MV4
      Serial Number:


      Time Stamp:  2010-074 00:00

      Comments: heave applied real time in SIS
      Apply No
      Time Correction(s) 0.000
      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000
      Offset:     0.000

      Manufacturer:
      Model:
      Serial Number:


      Time Stamp:  2011-109 00:00

      Comments:
      Apply Yes
      Time Correction(s) 0.000
      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000
      Offset:     0.000

      Manufacturer:
      Model:
      Serial Number:

_____________________________________________________________
Pitch Sensor:

      Time Stamp:  2006-234 00:00

      Comments: (null)
      Apply Yes
      Time Correction(s) 0.000
      Pitch offset: 0.000

      Manufacturer:      Applanix
      Model:             POS/MV4
      Serial Number:     (null)
```

```
      Time Stamp:  2009-345 00:00

      Comments:
      Apply No
      Time Correction(s) 0.000
      Pitch offset: 0.000

      Manufacturer:      Applanix
      Model:             POS MV4
      Serial Number:


      Time Stamp:  2010-074 00:00

      Comments: pitch applied real time by SIS
      Apply No
      Time Correction(s) 0.000
      Pitch offset: 0.000

      Manufacturer:
      Model:
      Serial Number:

_____________________________________________________________
Roll Sensor:

      Time Stamp:  2006-234 00:00

      Comments: (null)
      Apply Yes
      Time Correction(s) 0.000
      Roll offset: 0.000

      Manufacturer:      Applanix
      Model:             POS/MV4
      Serial Number:     (null)


      Time Stamp:  2009-345 00:00

      Comments:
      Apply No
      Time Correction(s) 0.000
      Roll offset: 0.000

      Manufacturer:      Applanix
      Model:             POS MV4
      Serial Number:


      Time Stamp:  2010-074 00:00
```

```
      Comments: applied real time by SIS
      Apply No
      Time Correction(s) 0.000
      Roll offset: 0.000

      Manufacturer:
      Model:
      Serial Number:

_____________________________________________________________
Draft Sensor:

      Time Stamp:  2006-234 00:00

      Apply Yes
      Comments: (null)
      Time Correction(s) 0.000

      Entry 1) Draft: 0.000   Speed: 4.599
      Entry 2) Draft: -0.003  Speed: 5.171
      Entry 3) Draft: 0.029   Speed: 5.853
      Entry 4) Draft: 0.028   Speed: 6.685
      Entry 5) Draft: 0.044   Speed: 7.361
      Entry 6) Draft: 0.014   Speed: 8.013
      Entry 7) Draft: 0.032   Speed: 8.421
      Entry 8) Draft: -0.013  Speed: 9.251
      Entry 9) Draft: -0.064  Speed: 10.503
      Entry 10) Draft: -0.048 Speed: 11.848
      Entry 11) Draft: -0.140 Speed: 14.153

      Time Stamp:  2009-345 00:00

      Apply No
      Comments: ERS
      Time Correction(s) 0.000


      Time Stamp:  2010-074 00:00

      Apply Yes
      Comments:
      Time Correction(s) 0.000

      Entry 1) Draft: 0.014   Speed: 4.675
      Entry 2) Draft: 0.010   Speed: 5.332
      Entry 3) Draft: 0.024   Speed: 5.985
      Entry 4) Draft: 0.032   Speed: 6.778
      Entry 5) Draft: 0.032   Speed: 7.394
      Entry 6) Draft: 0.036   Speed: 7.935
      Entry 7) Draft: 0.036   Speed: 8.162
      Entry 8) Draft: 0.037   Speed: 8.627
```

```
      Entry 9) Draft: 0.020   Speed: 9.334
      Entry 10) Draft: -0.011 Speed: 10.536
      Entry 11) Draft: -0.049 Speed: 12.415
```

TPU

```
      Time Stamp:  2009-345 00:00

      Comments:
      Offsets

      Motion sensing unit to the transducer 1
            X Head 1 -0.003
            Y Head 1 -0.032
            Z Head 1 0.631
      Motion sensing unit to the transducer 2
            X Head 2 0.000
            Y Head 2 0.000
            Z Head 2 0.000
      Navigation antenna to the transducer 1
            X Head 1 -0.947
            Y Head 1 3.288
            Z Head 1 3.376
      Navigation antenna to the transducer 2
            X Head 2 0.000
            Y Head 2 0.000
            Z Head 2 0.000

      Roll offset of transducer number 1 0.000
      Roll offset of transducer number 2 0.000

      Heave Error: 0.050 or 5.000'' of heave amplitude.
      Measurement errors: 0.020
      Motion sensing unit alignment errors
      Gyro:0.500  Pitch:0.010 Roll:0.010
      Gyro measurement error: 0.020
      Roll measurement error: 0.020
      Pitch measurement error: 0.020
      Navigation measurement error: 0.700
      Transducer timing error: 0.010
      Navigation timing error: 0.001
      Gyro timing error: 0.001
      Heave timing error: 0.001
      PitchTimingStdDev: 0.001
      Roll timing error: 0.001
      Sound Velocity speed measurement error: 0.000
      Surface sound speed measurement error: 0.000
      Tide measurement error: 0.000
      Tide zoning error: 0.000
      Speed over ground measurement error: 0.030
      Dynamic loading measurement error: 0.030
      Static draft measurement error: 0.050
```

```
      Delta draft measurement error: 0.010
      StDev Comment: (null)
_____________________________________________________________________
Svp Sensor:

      Time Stamp:  2006-234 00:00

      Comments:
      Time Correction(s) 0.000

      Svp #1:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     -0.003
      DeltaY:     -0.032
      DeltaZ:     0.631

      SVP #2:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000


      Time Stamp:  2006-248 00:00

      Comments: (null)
      Time Correction(s) 0.000

      Svp #1:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     -0.003
      DeltaY:     -0.032
      DeltaZ:     0.631

      SVP #2:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000
```

```
      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000


      Time Stamp:  2009-345 00:00

      Comments:
      Time Correction(s) 0.000

      Svp #1:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     -0.003
      DeltaY:     -0.032
      DeltaZ:     0.631

      SVP #2:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000


      Time Stamp:  2010-074 00:00

      Comments: data is NOT SVP corrected in CARIS at present time because
Hypack receives already ray-traced depths
      Time Correction(s) 0.000

      Svp #1:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     -0.003
      DeltaY:     -0.032
      DeltaZ:     0.631

      SVP #2:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000
```

```
      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000


      Time Stamp:  2010-096 00:00

      Comments: data is NOT SVP corrected in CARIS at present time because
Hypack receives already ray-traced depthsdata is NOT SVP corrected in CARIS
at present time because Hypack receives already ray-traced depths
      Time Correction(s) 0.000

      Svp #1:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.631

      SVP #2:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000


      Time Stamp:  2010-097 00:00

      Comments: data is NOT SVP corrected in CARIS at present time because
Hypack receives already ray-traced depthsdata is NOT SVP corrected in CARIS
at present time because Hypack receives already ray-traced depths
      Time Correction(s) 0.000

      Svp #1:
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000

      SVP #2:
```

```
-------------
Pitch Offset:     0.000
Roll Offset:      0.000
Azimuth Offset:   0.000

DeltaX:     0.000
DeltaY:     0.000
DeltaZ:     0.000


Time Stamp:  2011-109 00:00

Comments:
Time Correction(s) 0.000

Svp #1:
-------------
Pitch Offset:     0.000
Roll Offset:      0.000
Azimuth Offset:   0.000

DeltaX:     0.000
DeltaY:     0.000
DeltaZ:     0.631

SVP #2:
-------------
Pitch Offset:     0.000
Roll Offset:      0.000
Azimuth Offset:   0.000

DeltaX:     0.000
DeltaY:     0.000
DeltaZ:     0.000


Time Stamp:  2011-298 00:00

Comments:
Time Correction(s) 0.000

Svp #1:
-------------
Pitch Offset:     0.000
Roll Offset:      0.000
Azimuth Offset:   0.000

DeltaX:     0.000
DeltaY:     0.000
DeltaZ:     0.000

SVP #2:
```

```
      -------------
      Pitch Offset:     0.000
      Roll Offset:      0.000
      Azimuth Offset:   0.000

      DeltaX:     0.000
      DeltaY:     0.000
      DeltaZ:     0.000
```

```
WaterLine:

      Time Stamp:  2006-234 00:00

      Comments: RP to WL as surveyed
      Apply Yes
      WaterLine 0.020

      Time Stamp:  2009-345 00:00

      Comments: HOOD RIVER ERS
      Apply No
      WaterLine 0.000

      Time Stamp:  2010-074 00:00

      Comments: Anacortes HSRR
      Apply Yes
      WaterLine -0.022

      Time Stamp:  2010-096 00:00

      Comments: the water line was entered into SIS, BUT because we did not
have the "Use EM Combined..." option checked in Hyspwee Hardware, it was not
included in the data stored in the hsx.
      Apply Yes
      WaterLine -0.022

      Time Stamp:  2010-097 00:00

      Comments: the water line is accounted for in SIS (the "Use EM
Combined..." option was checked (therefore, it's reflected in the data stored
in the hsx)
      Apply No
      WaterLine 0.000

      Time Stamp:  2011-109 00:00

      Comments: waterline is not accounted for during acquisition.  ("Use EM
Combined..." option NOT checked.)
      Apply Yes
      WaterLine -0.022
```

Appendix 7: Lead Line Calibration

Lead Line & Sounding Pole Calibration Report

Field unit: NRT3

Lead Line / Sounding Pole Identification Number: 7-pound lead, 20m 5/16" Samson "Stable Braid" line, constructed 2/15/2007
(Unique Identifier, with equipment type, date made, etc.)

Date of Calibration: 3/04/2011

Method of Calibration: Steel tape **Permanent graduation marks** X
Other

Location: Tacoma Narrows Marina

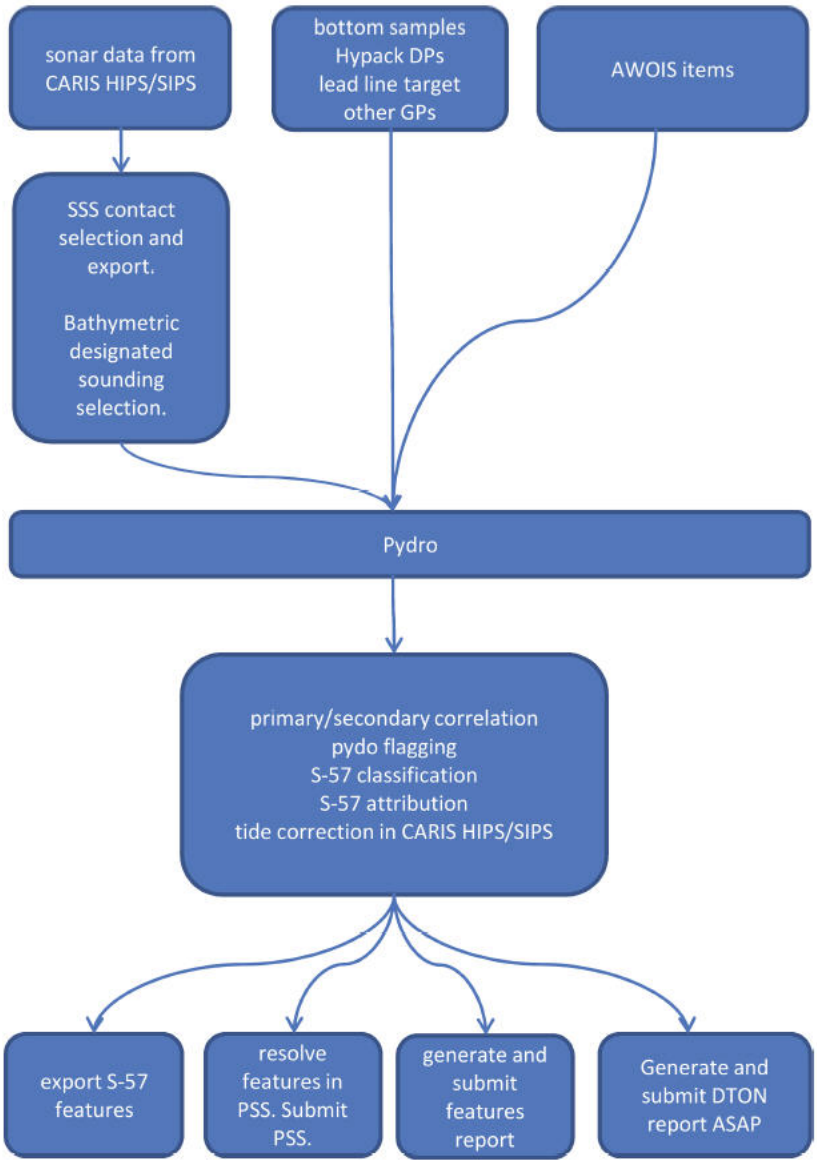
Chief of Party: **Dan Jacobs**

Lead Line / Sounding Pole Unit of Measure: Meters (This should always be meters!)

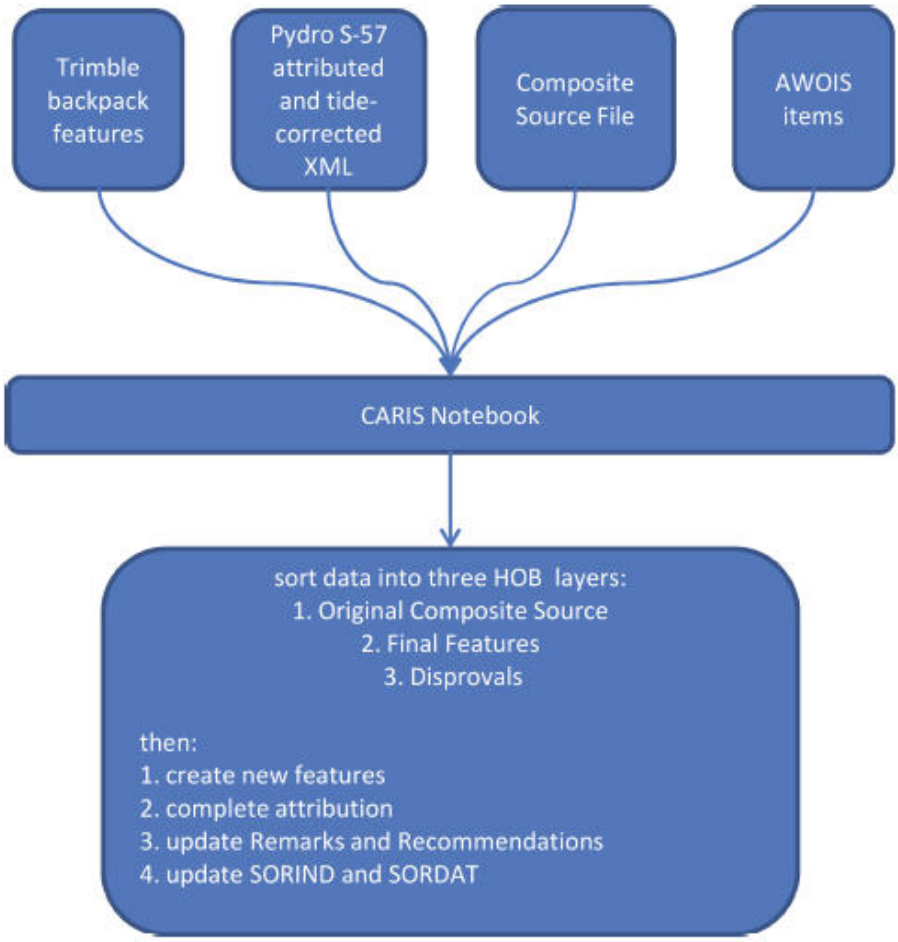
Measured by: I.Colvert	**Recorded by:** I.Colvert	**Checked by:** B.Jackson
Graduated Marking (a)	**Calibration Measurement (b)**	**Lead Line Corrector (c = b - a)**
1.0	1.0	0.0
1.5	1.5	0.0
2.0	2.0	0.0
2.5	2.5	0.0
3.0	3.0	0.0
3.5	3.5	0.0
4.0	4.0	0.0
4.5	4.5	0.0
5.0	5.0	0.0
5.5	5.5	0.0
6.0	6.0	0.0
6.5	6.5	0.0
7.0	7.0	0.0
7.5	7.5	0.0
8.0	8.0	0.0
8.5	8.5	0.0
9.0	9.0	0.0
9.5	9.5	0.0
10.0	10.0	0.0
10.5	10.5	0.0
11.0	11.0	0.0
11.5	11.5	0.0
12.0	12.0	0.0
12.5	12.5	0.0
13.0	13.0	0.0
13.5	13.5	0.0
14.0	14.0	0.0
14.5	14.5	0.0
15.0	15.0	0.0
15.5	15.5	0.0
16.0	16.0	0.0
16.5	16.5	0.0
17.0	17.0	0.0
17.5	17.5	0.0
18.0	18.0	0.0
18.5	18.5	0.0
19.0	19.0	0.0
19.5	19.5	0.0
20.0	20.0	0.0

Appendix 8: Processing Flow Diagrams

Feature Processing Flow Diagram (Pydro)



Feature Processing Flow Diagram, CARIS Notebook



Multibeam Processing Flow Diagram