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

Data Acquisition & Processing Report

Type of Survey	**Navigable Area**
Project No.	**M-H712-FH-11 & OPR-D304-FH-11**
Registry No.	**D00158, H12346 & F00607**
Time Frame	**25 June 2011 - 10 November 2011**

LOCALITY

State	**Florida, Georgia, N. Carolina, S. Carolina & Virginia**
General Locality	

LCDR Benjamin K. Evans, NOAA

CHIEF OF PARTY

2011

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DATE

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Data Acquisition and Processing Report

NOAA Ship *Ferdinand R. Hassler*
Chief of Party: LCDR Benjamin K. Evans, NOAA
Year: 2011
Version: 1.0
Publish Date: 2012-04-27

A. Equipment

A.1 Survey Vessels

A.1.1 NOAA Ship Ferdinand R. Hassler

Name	NOAA Ship Ferdinand R. Hassler	
Hull Number	S250	
Description	Ferdinand R. Hassler is a small waterplane area, twin-hull coastal mapping vessel.	
Utilization	Hydrographic Survey	
Dimensions	*LOA*	37.7 meters
	Beam	18.5 meters
	Max Draft	3.85 meters
Most Recent Full Static Survey	*Date*	2009-11-04
	Performed By	Raymond C. Impastato, Professional Land Surveyor
	Discussion	This survey was provided by the shipbuilder, V.T. Halter Marine, and performed in the shipyard prior to delivery.
Most Recent Partial Static Survey	*Date*	2011-03-30
	Performed By	Kevin Jordan, NGS
	Discussion	This survey was performed after the POS/MV antenna mounts were reconfigured from the mast to newly fabricated mounts; ties the POS antennae into benchmarks on the 02 level.
Most Recent Full Offset Verification	Full offset verification was not performed.	

Most Recent Partial Offset Verification	Partial offset verification was not performed.	
Most Recent Static Draft Determination	*Date*	2012-07-12
	Method Used	Calculation from design waterline and measured offsets
	Discussion	Design waterline of 3.85m and measured offsets to IMU were used to determine static draft of reference point. Draft of ship is operationally managed with ballast to achieve design draft. Uncertainty is estimated at 0.05 m.
Most Recent Dynamic Draft Determination	*Date*	2011-07-12
	Method Used	Ellipsoid referenced dynamic draft (ERDDM)
	Discussion	Data were acquired with canards 15 degrees up, 15 degrees down, and at zero trim angle. The zero trim angle results are used for the dynamic draft table in the Caris HVF files. During all surveys operations, the canards are set to zero trim angle.

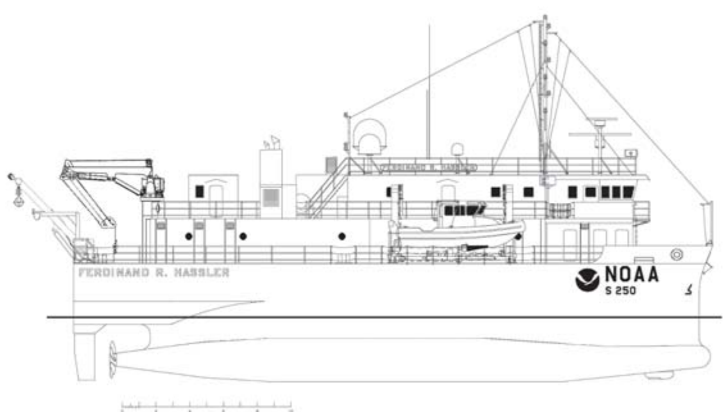


Figure 1: NOAA Ship Ferdinand R. Hassler, Starboard View

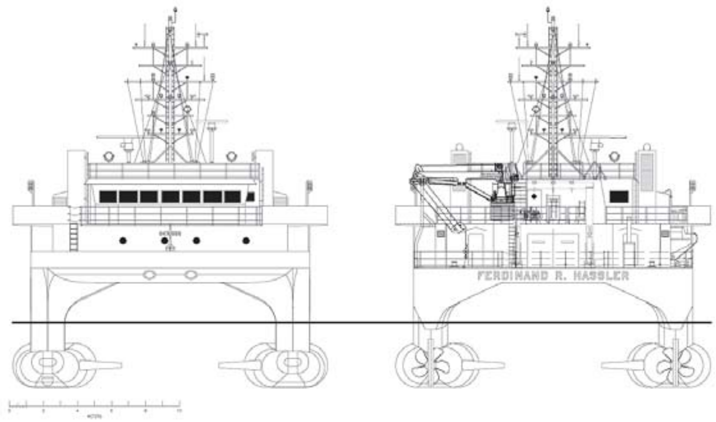


Figure 2: NOAA Ship Ferdinand R. Hassler, Bow and Hull View

A.2 Echo Sounding Equipment

A.2.1 Side Scan Sonars

A.2.1.1 Klein 5000

<table>
<tr><td>Manufacturer</td><td>Klein</td></tr>
<tr><td>Model</td><td>5000</td></tr>
<tr><td>Description</td><td>High-speed, high-resolution side-scan sonar (SSS) system is a multibeamforming acoustic imagery device with an operating frequency of 455 kHz and vertical beam angle of 40°. The KLEIN 5000 system consists of a KLEIN 5500 towfish, a Transceiver/Processing Unit (TPU), and a computer for user interface. The towfish is towed via 3/8" armored coaxial cable connected to a DT marine electro-hydraulic winch (s/n 1271 302 OEHLW3R) equipped with a Klein slip ring (model: 14103033, s/n 1802003). The winch is controllable from the sonar operators station. Cable out is measured with a 3PS cable counter integrated with a General Oceanics model 4042 sheave. The sheave is mounted on the A-frame and is the tow point for offsets measurements. Cable counter accuracy was verified on 9/15/2011 using a known length of line.</td></tr>
<tr><td>Serial Numbers</td><td><table>
<tr><td>Vessel Installed On</td><td>S250</td></tr>
<tr><td>TPU s/n</td><td>138</td></tr>
<tr><td>Towfish s/n</td><td>292</td></tr>
</table></td></tr>
</table>

Specifications	*Frequency*		455 kilohertz
	Along Track Resolution	*Resolution*	10 centimeters
		Min Range	1 meters
		Max Range	
	Across Track Resolution		3.75 centimeters
	Max Range Scale		250 meters
Manufacturer Calibrations	*Vessel Installed On*		S250
	Calibration Date		2012-07-07

Figure 3: Klien 5500 configured for towing

A.2.2 Multibeam Echosounders

A.2.2.1 Reson 7125

Manufacturer	Reson
Model	7125
Description	Port system of a dual-head configuration. This sonar is mounted in the port hull with a 4.5 degrees outboard tilt. The sonar can be operated independently, but is typically operated in conjunction with the starboard system as a dual-head system. When operated as a dual-head system, the port unit acts as the master and controls the ping interval of the starboard system. Because the systems cannot ping simultaneously without interference, the system alternates pings between the two heads in a "ping-pong" configuration.

Serial Numbers	*Vessel Installed On*		S250
	Processor s/n		51180
	Transceiver s/n		56689
	Transducer s/n		n/a
	Receiver s/n		3906091
	Projector 1 s/n		506078
	Projector 2 s/n		None
Specifications	*Frequency*		396 kilohertz
	Beamwidth	*Along Track*	1.0 degrees
		Across Track	0.5 degrees
	Max Ping Rate		50 hertz
	Beam Spacing	*Beam Spacing Mode*	Equidistant
		Number of Beams	512
	Max Swath Width		128 degrees
	Depth Resolution		3 centimeters
	Depth Rating	*Manufacturer Specified*	400 meters
		Ship Usage	60 meters
Manufacturer Calibrations	Manufacturer calibration was not performed.		
System Accuracy Tests	*Vessel Installed On*		S250
	Methods		Reference surface comparison
	Results		A reference surface comparison was performed on May 18, 2011 (DN138). Tidally corrected surfaces were generated for the port and starboard 7125 systems and the surfaces differenced. The depths from the port 7125 were on average 0.04 meters shallower than the depths from the starboard 7125. The distribution of differences was close to normally distributed with a standard deviation of 0.03 meters. The accuracy of the starboard head was later verified with a lead line.
Snippets	Sonar has snippets logging capability.		

Figure 4: 7125 Housing flush mounted on hull

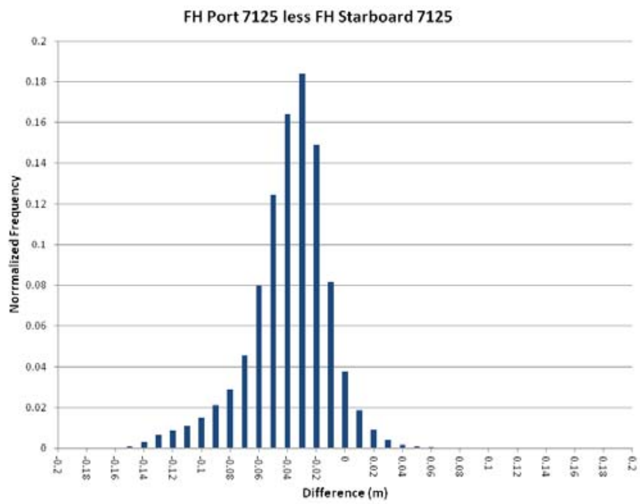


Figure 5: Histogram of depth differences from reference surface comparison between port and starboard 7125. Depths from port system average 0.04 meters shallower than starboard with a standard deviation of 0.03 meters.

A.2.2.2 Reson 7125

Manufacturer	Reson
Model	7125
Description	Starboard system of a dual-head configuration. This sonar is mounted in the starboard hull with a 4.5 degrees outboard tilt. The sonar can be operated independently, but is typically operated in conjunction with the port system as a dual-head system. When operated in dual-head mode, the port unit is configured as master.

Serial Numbers	*Vessel Installed On*		S250
	Processor s/n		1908005
	Transceiver s/n		51517
	Transducer s/n		n/a
	Receiver s/n		3205736
	Projector 1 s/n		107060030
	Projector 2 s/n		None
Specifications	*Frequency*		396 kilohertz
	Beamwidth	*Along Track*	1.0 degrees
		Across Track	0.5 degrees
	Max Ping Rate		50 hertz
	Beam Spacing	*Beam Spacing Mode*	Equidistant
		Number of Beams	512
	Max Swath Width		128 degrees
	Depth Resolution		3 centimeters
	Depth Rating	*Manufacturer Specified*	400 meters
		Ship Usage	60 meters
Manufacturer Calibrations	Manufacturer calibration was not performed.		
System Accuracy Tests	*Vessel Installed On*		S250
	Methods		Lead line comparison
	Results		On July 26, 2011 (DN207) a static lead line comparison was performed relative to the waterline. While the ship was alongside a pier, a leadline was lowered to the sea floor in the field of view of the sonar while logging sounding data. Because the leadline was visible in the water column display, the beams at the leadline measurement location could be identified. The logged data was processed through Caris using standard methods with zero-tides applied to yield a waterline referenced measurement. The leadline was marked at the water and measured with a fiberglass survey tape. The leadline agreed with the sonar derived measurement with a average difference of 0.00 m and a estimated error of 0.03 m. On July 27, 2011 (DN208) a static leadline comparison was performed relative to the ellipsoid using similar techniques as described above. A ellipsoid height was obtained on a fixed mark ashore using static GPS observations. The observed ellipsoid height was transfered to the suspended leadline using differential leveling. The logged sonar data was processed through Caris using standard ellipsoid methods to yield a ellipsoid referenced measurement. The ellipsoid referenced leadline measurement was shallower than the sonar data by an average of 0.07 m with an uncertainty of 0.06 m.

Snippets	Sonar has snippets logging capability.

A.2.2. Reson 7111

Manufacturer	Reson		
Model	7111		
Description	This sonar is mounted in a blister fairing forward on the starboard hull.		
Serial Numbers	*Vessel Installed On*	S250	
	Processor s/n	1908005	
	Transceiver s/n	n/a	
	Transducer s/n	n/a	
	Receiver s/n	1409098	
	Projector 1 s/n	4506285	
	Projector 2 s/n	None	
Specifications	*Frequency*	100 kilohertz	
	Beamwidth	*Along Track*	1.9 degrees
		Across Track	1.5 degrees
	Max Ping Rate	20 hertz	
	Beam Spacing	*Beam Spacing Mode*	Equidistant
		Number of Beams	301
	Max Swath Width	150 degrees	
	Depth Resolution	3 centimeters	
	Depth Rating	*Manufacturer Specified*	1000 meters
		Ship Usage	700 meters
Manufacturer Calibrations	Manufacturer calibration was not performed.		

System Accuracy Tests	*Vessel Installed On*	S250
	Methods	Lead line comparison and reference surface.
	Results	The 7111 was compared with both ellipsoid and waterline referenced lead line measurements as described above. The comparisons were done on August 5, 2011 (DN217). The depths from the 7111 were 0.44m deeper than the ellipsoid referenced lead line (0.08 uncertainty) and 0.33 m deeper than the waterline referenced lead line (0.08 uncertainty). On July 6, 2011 (DN187) a reference surface was acquired with both the dual head 7125 and the 7111. Both surfaces were referenced to the ellipsoid. The depths from the 7111 were 0.4 m deeper (0.4 standard deviation) than the 7125 depths. The apparent bottom detection bias of the 7111 has been acknowledged by Reson and verified in other systems. This offset has not been corrected for in the vessel configuration file. All 7111 data acquired in 2011 was in deep water.
Snippets	Sonar has snippets logging capability.	

Figure 5: 7111 mount and fairing. Sonar is located forward on staboard hull.

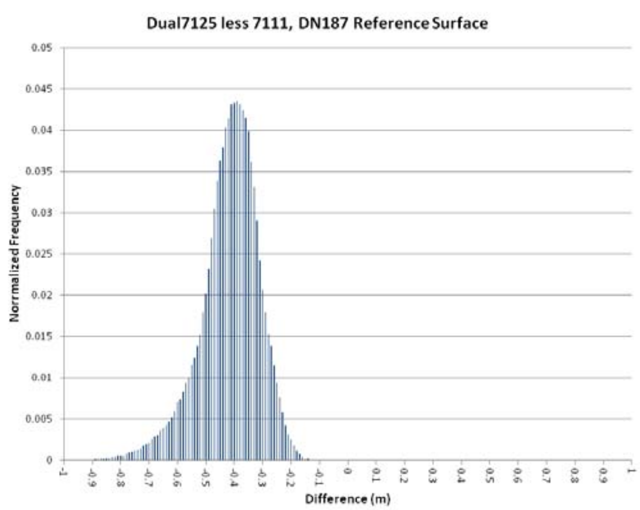


Figure 6: Histogram of depth differences from reference surface comparison with dual-head 7125. Depths from the 7111 are 0.4 meters deeper than the depths from the 7125s with a 0.4 meter standard deviation.

A.2.2 Single Beam Echosounders

A.2.2.1 Odom CV-200

<table>
<tr><td>Manufacturer</td><td colspan="5">Odom</td></tr>
<tr><td>Model</td><td colspan="5">CV-200</td></tr>
<tr><td>Description</td><td colspan="5">Dual-frequency digital recording echosounder system with a digital recorder on both hulls. The high frequency band is tunable from 100kHz to 1 MHz. The low band is tunable from 10-50 kHz. The installed Airmar M42 transducers are not broadband however and the sonar is tuned to the operating frequency of the dual-frequency transducers installed. Each transducer can be operated either at 24 or 200kHz. The system is configured with the low frequency signal to the port transducer and the high frequency signal to the starboard system to permit simultaneous, dual frequency acquisition. The starboard POS system is used for positioning of the singlebeam and the starboard POS serves as the reference point for both transducers.</td></tr>
<tr><td rowspan="3">Serial Numbers</td><td>Vessel</td><td colspan="4">S250</td></tr>
<tr><td>Processor s/n</td><td colspan="4">3038</td></tr>
<tr><td>Transducer s/n</td><td colspan="4">unknown</td></tr>
<tr><td rowspan="8">Specifications</td><td>Frequency</td><td colspan="2">200 kilohertz</td><td colspan="2">24 kilohertz</td></tr>
<tr><td rowspan="2">Beamwidth</td><td>Along Track</td><td>4 degrees</td><td>Along Track</td><td>20 degrees</td></tr>
<tr><td>Across Track</td><td>4 degrees</td><td>Across Track</td><td>20 degrees</td></tr>
<tr><td>Max Ping Rate</td><td colspan="2">100 kilohertz</td><td colspan="2">100 kilohertz</td></tr>
<tr><td>Depth Resolution</td><td colspan="2">0.01 meters</td><td colspan="2">0.01 meters</td></tr>
<tr><td rowspan="2">Depth Rating</td><td>Manufacturer Specified</td><td>200 meters</td><td>Manufacturer Specified</td><td>6000 meters</td></tr>
<tr><td>Ship Usage</td><td>50 meters</td><td>Ship Usage</td><td>700 meters</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Manufacturer Calibrations</td><td colspan="5">Manufacturer calibration was not performed.</td></tr>
<tr><td>System Accuracy Tests</td><td colspan="5">System accuracy test was not performed.</td></tr>
</table>

Figure 6: Hull mounted Odom Vertical Beam Echosounder

A.2.□□hase □ easuring □ath□metric Sonars

No phase measuring bathymetric sonars were utilized for data acquisition.

A.2.5 □ther Echosounders

No additional echosounders were utilized for data acquisition.

A.□□ anual Sounding Equipment

A.□.1 □i□er □epth □auges

No diver depth gauges were utilized for data acquisition.

A.□.2 □ead □ines

Manufacturer	Unknown
Model	Traditional
Description	Vessel is equipped with a hand lead line. The lead line is configured with a removable mud shoe to limit penetration in soft bottoms. Lead lines are used for

	system accuracy checks and measurements of depths in near shore or shallow areas that are impractical for other techniques. For all use in 2011, the leadline was marked with tape for each measurement and the measurements then determined with a fiberglass tape. The permanent markings on the leadline were neither calibrated nor used.
Serial Numbers	RA6S
Calibrations	No calibrations were performed.
Accuracy Checks	No accuracy checks were performed.
Correctors	Correctors were not determined.
Non-Standard Procedures	Non-standard procedures were not utilized.

Figure 7: Leadline with removable "mud-shoe"

A.□.□Sounding □oles

No sounding poles were utilized for data acquisition.

A.□.□□ther □ anual Sounding Equipment

No additional manual sounding equipment was utilized for data acquisition.

A.□□ositioning and Attitude Equipment

A.□1 Applani□ □□S□□ □

<table>
<tr><td>Manufacturer</td><td>Applanix</td></tr>
<tr><td>Model</td><td>POS/MV 320 V4</td></tr>
<tr><td>Description</td><td>Tightly coupled GPS and inertial positioning and attitude sensing system for port hull. Inertial motion unit (IMU) is located below water line close to the port side 7125 wet end. GPS antennae are located on flying bridge of S250. GPS antennae are used for position input as well as aiding the heading solution. The antennae pair for the port system is the aft pair of antennae. The separation distance between the antennae is approximately 8 meters. This distance is far above the recommended separation distance of 2 meters and some difficulties with the GPS aided heading (GAMS) solution were observed throughout 2011. The antennae configuration was changed in 2012.</td></tr>
<tr><td>PCS</td><td><table>
<tr><td>Manufacturer</td><td>Applanix</td></tr>
<tr><td>Model</td><td>POS/MV 320 V4</td></tr>
<tr><td>Description</td><td>Rack mounted POS control system located in charting lab.</td></tr>
<tr><td>Firmware Version</td><td>3.37</td></tr>
<tr><td>Software Version</td><td>5.1.0.2</td></tr>
<tr><td>Serial Numbers</td><td><table>
<tr><td>Vessel Installed On</td><td>S250 (port hull)</td></tr>
<tr><td>PCS s/n</td><td>3187</td></tr>
</table></td></tr>
</table></td></tr>
<tr><td>IMU</td><td><table>
<tr><td>Manufacturer</td><td>Applanix</td></tr>
<tr><td>Model</td><td>LN200</td></tr>
<tr><td>Description</td><td>Inertial measurement system consisting of three orthogonal accelerometers and three orthogonal fiber-optic gyroscopes. Located in port hull near 7125 wet end.</td></tr>
<tr><td>Serial Numbers</td><td><table>
<tr><td>Vessel Installed On</td><td>S250 (port hull)</td></tr>
<tr><td>IMU s/n</td><td>804</td></tr>
</table></td></tr>
<tr><td>Certification</td><td><table>
<tr><td>IMU s/n</td><td>804</td></tr>
<tr><td>Certification Date</td><td>2011-06-16</td></tr>
</table></td></tr>
</table></td></tr>
</table>

<table>
<tr><td rowspan="7">Antennas</td><td>Manufacturer</td><td colspan="3">Trimble</td></tr>
<tr><td>Model</td><td colspan="3">Zepher I</td></tr>
<tr><td>Description</td><td colspan="3"></td></tr>
<tr><td rowspan="4">Serial Numbers</td><td>Vessel Installed On</td><td>S250 (aft pair of antennae)</td><td>S250 (aft pair of antennae)</td></tr>
<tr><td>Antenna s/n</td><td>60244128</td><td>60243869</td></tr>
<tr><td>Port or Starboard</td><td>Port</td><td>Starboard</td></tr>
<tr><td>Primary or Secondary</td><td>Primary</td><td>Secondary</td></tr>
<tr><td rowspan="2">GAMS Calibration</td><td>Vessel</td><td colspan="3">S250</td></tr>
<tr><td>Calibration Date</td><td colspan="3">2011-05-31</td></tr>
<tr><td rowspan="2">Configuration Reports</td><td>Vessel</td><td colspan="3">S250</td></tr>
<tr><td>Report Date</td><td colspan="3">2011-06-16</td></tr>
</table>

Manufacturer	Applanix
Model	POS MV Version 4
Description	Tightly coupled GPS and inertial positioning and attitude sensing system for starboard hull. Inertial motion unit (IMU) is located below water line close to the starboard side 7125 wet end. GPS antennae are located on flying bridge of S250. GPS antennae are used for position input as well as aiding the heading solution. The antennae pair for the starboard system is the forward pair of antennae. The separation distance between the antennae is approximately 8 meters. This distance is far above the recommended separation distance of 2 meters and some difficulties with the GPS aided heading (GAMS) solution were observed throughout 2011. The antennae configuration was changed in 2012.

PCS	*Manufacturer*	Applanix		
	Model	POS MV Version 4		
	Description	Rack mounted POS control system located in charting lab.		
	Firmware Version	3.37		
	Software Version	5.1.0.2		
	Serial Numbers	*Vessel Installed On*	S250 (starboard hull)	
		PCS s/n	3189	
IMU	*Manufacturer*	Applanix		
	Model	LN200		
	Description	Inertial measurement system consisting of three orthogonal accelerometers and three orthogonal fiber-optic gyroscopes. Located in starboard hull near 7125 wet end.		
	Serial Numbers	*Vessel Installed On*	S250 (starboard hull)	
		IMU s/n	803	
	Certification	*IMU s/n*	803	
		Certification Date	2011-09-26	
Antennas	*Manufacturer*	Trimble		
	Model	Zepher I		
	Description			
	Serial Numbers	*Vessel Installed On*	S250 (forward pair of antennae)	S250 (forward pair of antennae)
		Antenna s/n	60240385	60243047
		Port or Starboard	Port	Starboard
		Primary or Secondary	Primary	Secondary
GAMS Calibration	*Vessel*	S250 Starboard		
	Calibration Date	2011-05-31		
Configuration Reports	*Vessel*	S250		
	Report Date	2011-09-26		

A.□.2 DGPS

Description	Hemisphere PGS MBX DGPS receiver. DGPS receiver feeds differential corrector to port and starboard POS-MV systems.		
Antennas	*Manufacturer*	Hemisphere	
	Model	MBX-4	
	Description		
	Serial Numbers	*Vessel Installed On*	S250
		Antenna s/n	1113139440044
Receivers	*Manufacturer*	Hemisphere	
	Model	MBX-4	
	Description		
	Firmware Version	1.0	
	Serial Numbers	*Vessel Installed On*	S250
		Antenna s/n	1118144550001

A.□.□ Trimble Backpacks

Trimble backpack equipment was not utilized for data acquisition.

A.□.□ Laser Rangefinders

No laser rangefinders were utilized for data acquisition.

A.□.5 Other Positioning and Attitude Equipment

No additional positioning and attitude equipment was utilized for data acquisition.

A.5 Sound Speed Equipment

A.5.1 Sound Speed Profiles

A.5.1.1 CTD Profilers

A.5.1.1.1 Sea-Bird SeaCat 19

Manufacturer	Sea-Bird	
Model	SeaCat 19	
Description	Internal logging conductivity, temperature, and depth measuring device.	
Serial Numbers	*Vessel Installed On*	S250
	CTD s/n	1060
Calibrations	*CTD s/n*	1060
	Date	2011-03-28
	Procedures	Routine Calibration Service

Figure 8: SBE 19 CTD cast in protective cage

A.5.1.2 Sound Speed Profilers

A.5.1.2.1 Brooke Ocean MVP-30

<table>
<tr><td>Manufacturer</td><td>Brooke Ocean</td></tr>
<tr><td>Model</td><td>MVP-30</td></tr>
<tr><td>Description</td><td>moving vessel profiler equipped with a AML Micro-CTD in a single sensor free fall fish.</td></tr>
<tr><td>Serial Numbers</td><td><table><tr><td>Vessel Installed On</td><td>S250</td></tr><tr><td>Sound Speed Profiler s/n</td><td>10796</td></tr></table></td></tr>
<tr><td>Calibrations</td><td><table><tr><td>Sound Speed Profiler s/n</td><td>007760</td></tr><tr><td>Date</td><td>2009-10-21</td></tr><tr><td>Procedures</td><td>Calibrated conductivity, pressure, and temperature.</td></tr></table></td></tr>
</table>

Figure 9: MVP control station & winch

Figure 10: MVP single sensor free fall fish

A.5.2 Surface Sound Speed

A.5.2.1 Sea-Bird 45 MicroTSG

Manufacturer	Sea-Bird
Model	45 MicroTSG
Description	Two SBE-45 thermosalinographs are installed to determine the sound velocity of the water at the sonar transducers. This data is used to aid beam steering of the multibeam sonar systems. One is located in the starboard engine room, the other in the port. Both units draw sampling water from the main cooling water line of the respective main engine. A SBE-38 remote temperature sensor is integrated with each device. However the SBE-38's are located in forward vent tubes that do not have water flow and so do not accurately reflect the ambient water temperature. The SBE-45 are configured to use their internal temperature sensors and disregard the data from the remote temperature sensors. The starboard SBE-45 is insulated with fiberglass and reflective aluminum insulation. This device calculates the sound speed from the measured salinity and temperature (using the Chen-Millero equation) of the sampled water. A serial broadcast device sends the sound speed message from the SBE-45 to the port and starboard 7125 systems and the 7111. The port SBE-45 is not insulated and is not used for data aquisition.
Serial Numbers	*Vessel Installed On*: S250 Port; S250 Stbd *Sound Speed Sensor s/n*: 4553332-0276; 4553332-0277
Calibrations	*Sound Speed Sensor s/n*: 4553332-0276; 4553332-0277 *Date*: 2009-02-15; 2009-02-15 *Procedures*: Standard calibration procedures; Standard calibration procedures

Serial Numbers:

Vessel Installed On	S250 Port	S250 Stbd
Sound Speed Sensor s/n	4553332-0276	4553332-0277

Calibrations:

Sound Speed Sensor s/n	4553332-0276	4553332-0277
Date	2009-02-15	2009-02-15
Procedures	Standard calibration procedures	Standard calibration procedures

A.6 Horizontal and Vertical Control Equipment

A.6.1 Horizontal Control Equipment

No horizontal control equipment was utilized for data acquisition.

A.6.2 Vertical Control Equipment

No vertical control equipment was utilized for data acquisition.

A.7 Computer Hardware and Software

A.□1 □omputer □ard□are

Manufacturer	Dell						
Model	T3400						
Description	Processing and Acquisition Computers						
Serial Numbers	*Computer s/n*	FH-PROC1 Service Tag # 1PKVTK1	FH-PROC2 Service Tag # 3PSUTK1	FH-PROC3 Service Tag # 4P5VTK1	FH-PROC4 Service Tag # 2P5VPK1	FH-ACQ1 Service Tag # 101WTK1	FH-ACQ2 Service Tag # 201WTK1
	Operating System	Windows XP	Windows XP	Windows XP	Windows XP	Windows XP	Windows XP
	Use	Processing	Processing	Processing	Processing	Acquisition	Acquisition

Manufacturer	Cybertron PC	
Model	Generic	
Description	Processing Computer	
Serial Numbers	*Computer s/n*	FH-PROC5 Service Tag # FQC-00765
	Operating System	Windows 7
	Use	Processing

A.□2 □omputer So□t□are

Manufacturer	CARIS
Software Name	HIPS/SIPS
Version	7.1
Service Pack	0
Hotfix	2
Installation Date	2011-07-06
Use	Processing
Description	Data conversion and processing

Manufacturer	CARIS
Software Name	HIPS/SIPS
Version	7.1
Service Pack	1
Hotfix	1

Installation Date	2012-04-02
Use	Processing
Description	Data processing

Manufacturer	CARIS
Software Name	Bathy Data Base Editor
Version	3.2
Service Pack	0
Hotfix	1
Installation Date	2011-09-23
Use	Processing
Description	Data analysis and feature management

Manufacturer	Applanix
Software Name	POSPac
Version	5.4
Service Pack	1
Hotfix	
Installation Date	2011-04-05
Use	Acquisition and Processing
Description	Position and Attitude processing software

Manufacturer	NOAA
Software Name	Pydro
Version	11.11
Service Pack	r3746
Hotfix	
Installation Date	2011-09-27
Use	Processing
Description	Feature management, correlation, and report generator

Manufacturer	Pitney Bowes
Software Name	MapInfo
Version	10.5
Service Pack	

Hotfix	
Installation Date	2011-08-24
Use	Acquisition and Processing
Description	GIS software

Manufacturer	QPS 3D
Software Name	Fledermaus
Version	7.3.2b - 64bit
Service Pack	Build 406
Hotfix	
Installation Date	2011-08-08
Use	Processing
Description	Data modeling, visualization, and backscatter processing

Manufacturer	Hypack
Software Name	Hypack/Hysweep
Version	11
Service Pack	
Hotfix	
Installation Date	2011-03-16
Use	Acquisition
Description	Data logging

Manufacturer	Klein
Software Name	SonarPro
Version	11.2
Service Pack	
Hotfix	
Installation Date	2011-07-11
Use	Acquisition
Description	Side Scan control

Manufacturer	Applanix
Software Name	POSView
Version	5.1.0.2

Service Pack	
Hotfix	
Installation Date	2011-04-05
Use	Acquisition
Description	Positioning

Manufacturer	Synergy
Software Name	Synergy
Version	1.3.6
Service Pack	
Hotfix	
Installation Date	2011-05-10
Use	Acquisition
Description	Shared mouse and keyboard between acquisition systems

Manufacturer	CARIS
Software Name	PlotComposer
Version	5.2
Service Pack	
Hotfix	
Installation Date	2012-06-06
Use	Processing
Description	Generation of plots and public relations deliverables.

A.□ Bottom Sampling Equipment

A.□.1 Bottom Samplers

A.□.1.1 Ponar Wildco 1728

Manufacturer	Ponar Wildco
Model	1728

Description	Grab sampler triggered by contact with sea floor.

Figure 11: Ponar Grab Sampler

□ □ualit□□ontrol

B.1 Data Acquisition

B.1.1 Bathymetry

B.1.1.1 Multibeam Echosounder

Multibeam data are acquired in through Hypack/Hysweep in HSX format for bathymetry. Multibeam data and are also logged locally on the Reson topside machines in s7k format. The HSX format includes sounding solutions, navigation, and attitude data. The s7k format includes sounding solutions, navigation, attitude and backscatter snippet data. This record included Reson datagrams: 1003, 1012, 1012, 7000, 7004, 7006, 7008, 7011, 7503. The Hypack logged .7k snippet backscatter record is not available for the dual head 7125 configuration. Ship navigation and survey line monitoring are performed with Hypack/ Hysweep.

The Reson units are interfaced with the acquisition machines through UDP LAN connections over a dedicated network switch (Netgear ProSafe Gigabit Switch). Position and attitude data is passed from the POS-MV to both the Reson machines and to the acquisition computers through dedicated network switches (NetGear ProSafe Gigabit switch). There is a decicated switch for the port and starbord POS systems. Time is passed from the POS to the Reson machines via a RS232 serial connection. The starboard POS is interfaced with the starboard 7125 and the 7111, which is located in the starboard hull. The port POS is interfaced to the port 7125.

Surface sound speed from the starboard TSG-45 is fed into all Reson machines via RS232 serial connections.

In the dual head 7125 configuration, the port 7125 is configured as the master and the starboard unit the slave. Pinging is alternated between the two heads to avoid interference. The Hypack logged HSX file in this configuration contains sounding data from both heads with the navigation and attitude data from the starboard POS-MV.

B.1.1.□□in□le Beam Echosounder

Single beam echosounder bathymetry was not acquired.

B.1.1.□□hase Measurin□Bathymetric □onar

Phase measuring bathymetric sonar bathymetry was not acquired.

B.1.□□ma□ery

B.1.□.1□ide □can □onar

The side scan fish is towed from a block suspended from the A-frame on the stern of the vessel . The height of the fish above the sea floor is actively managed through use of the remote winch control. Side scan imagery is monitored and logged using SonarPro. Tow cable offset values are entered into SonarPro to account for cable out in the docked tow position. This position has 12 m of cable between the tow point and the fish.

Survey lines are pre-planned to achieve coverage required by the project instruction. These lines are planned in MapInfo and exported to Hypack. Hypack is used for ship navigation and for survey line tracking.

B.1.□.□□hase Measurin□Bathymetric □onar

Phase measuring bathymetric sonar imagery was not acquired.

B.1.□□ound □□eed

B.1.□.1□ound □□eed □ro□iles

Seabird SBE 19 and MVP sound speed profilers are used regularly to collect sound speed data for ray tracing corrections for the multibeam sonar systems. In shallow water, the SBE 19 is hand deployed from the stern. In deeper water the oceanographic winch is used. Data is retrieved from the SBE 19 with a serial connection to an acquisition computer. Data from both the SBE 19 and MVP are processed through the NOAA in-house program Velocipy to give Caris .SVP formatted sound velocity profiles. All svp profiles for a survey sheet are concatenated to one master file for a survey.

Casts are taken at least every four hours. Cast frequency is increased in areas with strong sound speed gradients or anticipated sound speed variability. Cast locations are spread through the survey area to best capture the variability and are typically oversampled when using the MVP.

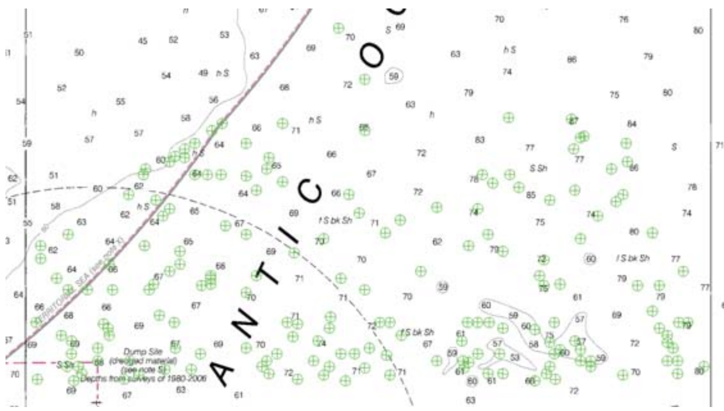


Figure 12: Example of sound speed samples taken in a survey area

B.1.□.□ur□ace □ound □□eed

The starboard Seabird TSG 45 thermosalinograph is used for determination of surface sound speed. This unit is located in the starboard main engine room and draws water from the raw water cooling line of the main engine. The port TSG-45 data is not used because the unit is uninsulated and reads erroneously high seawater temperatures. The starboard TSG and associated plumbing is insulated This device calculates the sound speed from the measured salinity and temperature (using the Chen-Millero equation) of the sampled water. A serial broadcast device sends the sound speed message from the SBE-45 to the port and starboard 7125 systems and the 7111. Other than the records in the logged multibeam data files, the surface sound speed is not logged.

B.1.□□ori□ontal and □ertical □ontrol

B.1.□.1□ori□ontal □ontrol

During acquisition, the port and starboard POS-MV units output position and attitude data through dedicated network switches (Netgear ProSafe Gigabit Switch) to both the acquisition computers and the sonar systems.

Applanix POS/MV .000 files are logged to the acquisition machine which contain attitude, heading, position and velocity data compliant with section 3.4.1 of the FPM. During acquisition, the navigation solution status status is constantly monitored by the acquisition watch stander.

Real-time USCG DGPS correctors are used for all acquisition. Specific DGPS stations are noted in the Descriptive Reports accompanying each survey.

B.1.□.□ertical □ontrol

Preliminary, observed and verified water levels are downloaded using FetchTides and applied to the data using CARIS HIPS Load Tide function. Refer to individual survey Descriptive Reports for detail.

B.1.□□eature □eri□ication

Feature verification followed guidelines set forth in section 3.5.5 of the FPM. Refer to individual sheet DRs for additional information if differing from previously stated.

B.1.□Bottom □am□lin□

Bottom Sampling followed guidelines set forth in sections 7.1 of the HSSD and 2.5.4.2.1 of the FPM. Refer to individual sheet DRs for additional information if differing from previously stated.

B.1.□Bac□scatter

Backscatter is acquired in the 7008 record logged in the .s7k files directly from the Reson 7125 processors. For processing, this record is paired with a GSF file exported from CARIS containing processed depth information. The paired files are imported into QPS Fledermaus Geocoder Toolbox for mosaic processing.

B.1.□□ther

No additional data were acquired.

Additional Discussion

Ferdinand Hassler maintains a continuous manned survey watch during all survey acquisition. The watch stander is in constant communication with the bridge and monitors the performance of all systems. Thresholds set in Hypack/Hysweep, POS view, Reson and Sonar Pro alert the watch stander by displaying alarm messages when error thresholds or tolerances are exceeded. Alarm conditions that may compromise survey data quality are corrected and then noted in acquisition log. Warning messages such as the temporary loss of differential GPS, excessive cross track error, or vessel speed approaching the maximum allowable survey speed are addressed by the watch stander and corrected before further data acquisition occurs.

B.□Data □rocessin□

B.□.1Bathymetry

B.□.1.1Multibeam Echosounder

Bathymetry processing followed section 4.2 of the FPM unless otherwise noted.

Raw .hsx multibeam data are converted to CARIS HIPS HDCS format. TrueHeave, sound speed and water level correctors are applied to all lines and the data is merged. Total Propagated Uncertainty (TPU) is computed using settings documented for each survey in the descriptive report.

The general resolution, depth ranges, and Combined Uncertainty and Bathymetric Estimator (CUBE) parameter settings outlined in section 5.2.2.2 of the HSSD and section 4.2.1.1.1.1 of the FPM are used for surface creation and analysis. A detailed listing of the resolutions and the actual depth ranges used during the processing of each survey, along with the corresponding fieldsheet(s), is provided in the Descriptive Report of each survey.

BASE surfaces are created using the CUBE algorithm and parameters contained in the NOAA CUBEParams_NOAA.xml file as provided in Appendix 4 of the FPM. The CUBEParams_NOAA.xml file will be included with the HIPS Vessel Files with the individual survey data. The NOAA parameter configurations for resolutions 0.5-32 meters are used.

Multibeam data are reviewed and edited in HIPS swath editor and in subset mode as necessary. The finalized BASE surfaces and CUBE hypotheses are used for directed data editing at the appropriate depth range in subset editor. The surfaces and subset editor view are also used to demonstrate coverage and to check for errors due to tides, sound speed, attitude and timing.

Vessel heading, attitude, and navigation data are reviewed in HIPS navigation editor and attitude editor if deemed necessary upon review of surfaces. Where necessary, fliers or gaps in heading, attitude, or navigation data are manually rejected or interpolated for small periods of time. Any such editing is detailed in the survey Descriptive Report.

The Density method for hypothesis disambiguation is used.

The surface filtering function in CARIS HIPS is not utilized routinely.

In depths less than 20 meters and deeper in areas of navigational significance where the BASE surface does not depict the desired depth for the given area, a designated sounding is selected. Designated soundings are selected as outlined in section 5.2.1.2 of the HSSD.

IHO child layers are created using the following two formulas for IHO_1 and IHO_2, respectively; -Uncertainty/((0.5^2 +((Depth*0.013)^2))^0.5) and -Uncertainty/((1.0^2 +((Depth*0.023)^2))^0.5). IHO_1 is created for all soundings less than 100 meters while IHO_2 is for 100 meters and deeper. This layer is then exported and run through an application which computes statistics. The results are reported and analyzed in each sheets individual DR.

Additionally, a combined surface is reviewed in 3-D mode using one of the following programs; CARIS HIPS, CARIS Base Editor or IVS Fledermaus, to ensure that the data are reasonable models of the sea floor and do not contain any fliers.

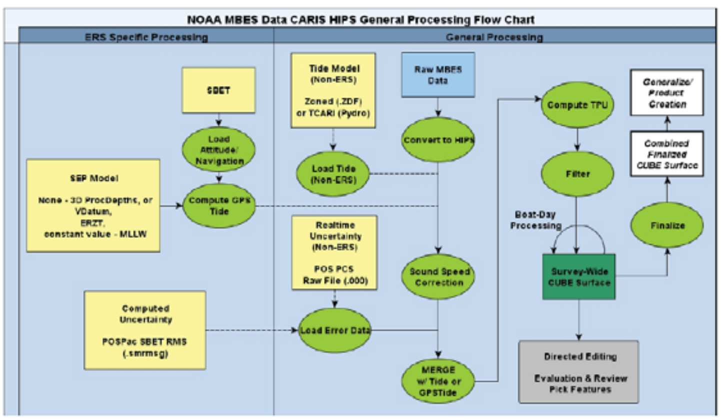


Figure 13: MBES flow diagram

B.□.1.□in□le Beam Echosounder

Single beam echosounders were not utilized during the 2011 field season other than for testing purposes.

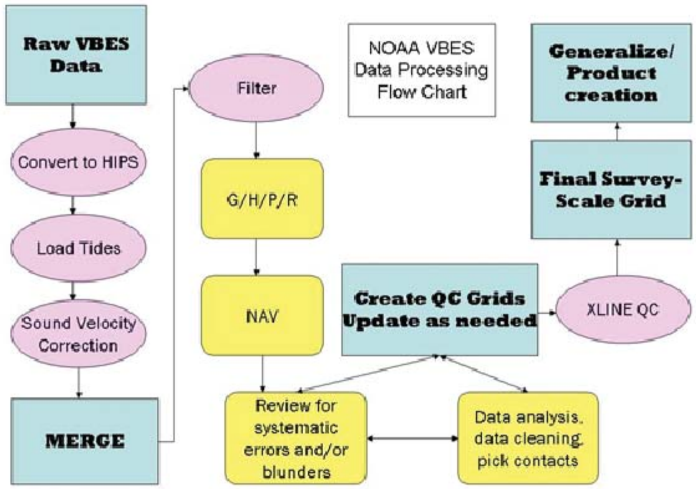


Figure 14: VBES flow diagram

B.□.1.□□hase Measurin□Bathymetric □onar

Phase measuring bathymetric sonar bathymetry was not processed.

B.□.1.□□□eci□ic Data □rocessin□Methods

B.□.1.□.Methods □sed to Maintain Data □nte□rity

The use of processing logs to record and communicate problems from acquisition to final processing.

B.□.1.□.Methods □sed to □enerate Bathymetric □rids

All methods used to generate final bathymetric grids are followed as put forth in section 4.2 and all relevant subsections of the FPM.

B.□.1.□.Methods □sed to Deri□e □inal De□ths

Methods Used	Cleaning Filters Gridding Parameters Surface Computation Algorithms
Description	Filters are used on a case by case basis as determined by the hydrographer, refer to individual sheet DRs for more information.

B.□.□ma□ery

B.□.□.1□ide □can □onar

Side scan sonar data are converted from .sdf (Sonarpro raw format) to CARIS HDCS lines. Fish height, vessel heading, and vessel navigation records are reviewed for each file and edited as necessary. Tow point offsets (A-Frame and cable out), fish depth, fish attitude and water depth are used to calculate horizontal lay back. Fish navigation is recalculated using CARIS SIPS.

After towfish navigation is recalculated, side scan imagery data are slant-range corrected and closely examined for targets. Targets are selected and saved as contacts to a contact file for each line of SSS data. Contact selection includes measuring apparent height and width, selecting contact position and creating a contact snapshot image. Targets are exported to Pydro for correlation and processing. Significant targets are surveyed with MBES to obtain least depths.

Side scan sonar coverage is determined by creating mosaics using Mosaic Editor in CARIS SIPS. This processed imagery data is stored in SIPS as Georeferenced Backscatter Rasters, or GeoBaRs. From GeoBaRs, mosaics are created which can be examined and edited in Mosaic Editor.

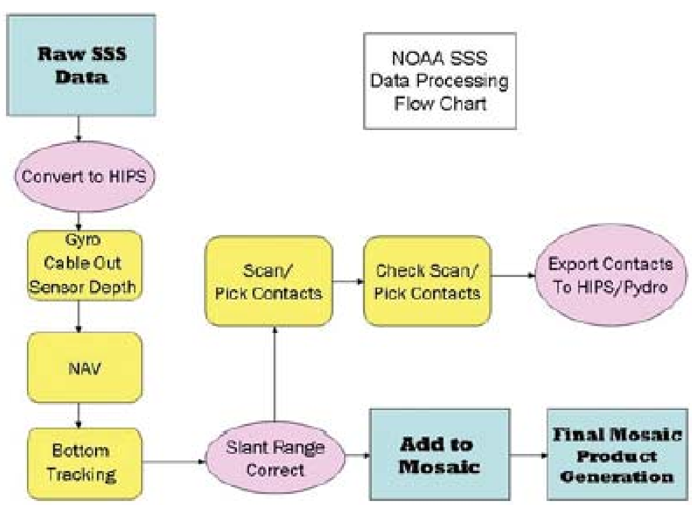


Figure 15: SSS flow diagram

B.□.□.□hase Measurin□Bathymetric □onar

Phase measuring bathymetric sonar imagery was not processed.

B.□.□.□□eci□ic Data □rocessin□Methods

B.□.□.□.Methods □sed to Maintain Data □nte□rity

The use of processing logs to record and communicate problems from acquisition to final processing.

B.□.□.□.Methods □sed to Achie□e □b□ect Detection and Accuracy □equirements

Range of the SSS, XTE, speed of vessel collecting data and repetitious processing examinations are all used to ensure that object detection and accuracy requirements are met.

B.□.□.□.Methods □sed to □eri□y □□ath □o□era□e

Swath coverage is verified through construction of side scan mosaics. During acquisition, the outer portions of the swath are monitored for refraction artifacts. If an apparent refraction artifact impacts objects detection ability and cannot be eliminated through adjustment of fish height, the range scale is reduced.

B.□.□.□.□riteria □sed □or □ontact □election

Contacts are selected it the apparent shadow measures greater than 1.0 meters or if the contact might otherwise be navigationally significant.

B.□.□.□.□om□ression Methods □sed □or □e□ie□in□ □ma□ery

No compression methods were used for reviewing imagery.

B.□.□□ound □□eed

B.□.□.1□ound □□eed □ro□iles

CTD profiles from both the Seabird SBE 19 and the AML Micro-CTD installed in the MVP system are processed using the NOAA developed program Velocipy. From each system, sound speed profiles are extracted and archived as both individual and concatenated Caris SVP files.

B.□.□.1.1□□eci□ic Data □rocessin□ Methods

B.□.□.1.1.1□aris □□□ □ile □oncatenation Methods

All sound speed profiles for a survey sheet are concatenated into one master file.

Figure 99: no figure

B.□.□.□ur□ace □ound □□eed

Surface sound speed data were not processed.

B.□.□□ori□ontal and □ertical □ontrol

B.□.□.1□ori□ontal □ontrol

Fixed USCG DGPS stations are used for all real time horizontal control. If post-processed GPS techniques are used to improve horizontal control, specific information is included in the Descriptive Report.

Figure 99: no figure

B.□.□.□ertical □ontrol

CO-OPS zoned water levels utilizing water level observations from fixed, continuously operating NOAA tide gages are used for reduction of data to MLLW. Predicted water levels are applied during preliminary processing. Before submission, verified water levels are applied to all tidally corrected data. If post-processed GPS techniques are used to improve horizontal control, specific information is included in the Descriptive Report.

Figure 99: no figure

B.□.□□eature □eri□ication

Features are processed using NOAA's Pydro software and are included with submitted processed data in the survey's final feature file (FFF). The FFF includes all features; buoys, rocks, wrecks, bottom samples, etc., addressed within the limits of each individual sheet.

Figure 99: no figure

B.□.□Bac□scatter

All backscatter was processed from acquired Reson .s7k files. Processed bathymetry is exported from Caris in GSF format, paired with the .s7k file in the raw data directory, and imported into QPS Fledermaus Geocoder Toolbox. A mosaic is processed with default processing parameters. Reson TVG plugins are used for all processing steps.

Figure 99: no figure

B.□.□□ther

No additional data were processed.

B.□□uality Mana□ement

Standard operating procedures (SOPs) and checklists are followed by personnel throughout the survey to ensure consistent high quality data and products.

Data is constantly reviewed for quality during acquisition and processing by all personnel. Before any data is to be submitted it is reviewed independently by at least three experienced persons who are signatories to the Descriptive Report.

B.□□ncertainty and Error Mana□ement

Error values for the multibeam and positioning systems were compiled from manufacturer specifications sheets for each sensor and from values set forth in section 4.2.3.8 and Appendix 4 - CARIS HVF Uncertainty Values of the 2011 FPM.

Regardless of this document stating that TPU was not calculated, TPU was calculated, but individual uncertainty values are not included here to reduce duplication. Refer to individually submitted HVF files for Uncertainty values used.

B.□.1□otal □ro□a□ated □ncertainty □□□□□

Total propagated uncertainty was not calculated.

B.□.□De□iations

There were no deviations from the requirement to compute total propagated uncertainty.

□ □orrections □o Echo □oundin□s

□.1 □essel □□sets and □aybac□

□.1.1 □essel □□sets

□.1.1.1 Descri□tion o□□orrectors

□.1.1.□Methods and □rocedures

Sensor offsets are measured with respect to the vessel's reference point. These offsets are derived from the full survey performed in the shipyard, a partial survey performed by NGS and measurements / verifications performed by Ferdinand R. Hassler personnel. All necessary offsets are tracked and updated as needed on a spreadsheet to be submitted with the appendices of this report.

The port IMU serves as the reference point for the port-only 7125 configuration and the side scan sonar. For all other vessel configurations the starboard IMU is the reference point.

□.1.1.□□essel □□set □orrectors

Vessel	S250 Port
Echosounder	Reson 7125 400 kilohertz
Date	2011-07-20

Offsets	*MRU to Transducer*	*x*	-1.244 meters
		y	0.362 meters
		z	1.486 meters
		x2	
		y2	
		z2	
	Nav to Transducer	*x*	-2.294 meters
		y	-1.033 meters
		z	14.234 meters
		x2	
		y2	
		z2	
	Transducer Roll	*Roll*	4.5 degrees
		Roll2	
Vessel	S250 Starboard		
Echosounder	Reson 7125 400 kilohertz		
Date	2011-07-26		
Offsets	*MRU to Transducer*	*x*	1.424 meters
		y	0.380 meters
		z	1.493 meters
		x2	
		y2	
		z2	
	Nav to Transducer	*x*	12.623 meters
		y	-1.549 meters
		z	14.233 meters
		x2	
		y2	
		z2	
	Transducer Roll	*Roll*	-4.5 degrees
		Roll2	
Vessel	S250 Dual		
Echosounder	Reson 7125 400 kilohertz		
Date	2011-09-09		

Offsets	*MRU to Transducer*	*x*	-13.490 meters
		y	0.338 meters
		z	1.485 meters
		x2	1.424 meters
		y2	0.380 meters
		z2	1.493 meters
	Nav to Transducer	*x*	-2.291 meters
		y	-1.591 meters
		z	14.225 meters
		x2	12.623 meters
		y2	-1.549 meters
		z2	14.233 meters
	Transducer Roll	*Roll*	4.5 degrees
		Roll2	-4.5 degrees
Vessel	S250		
Echosounder	Reson 7111 100 kilohertz		
Date	2011-07-20		
Offsets	*MRU to Transducer*	*x*	1.203 meters
		y	11.678 meters
		z	1.180 meters
		x2	
		y2	
		z2	
	Nav to Transducer	*x*	12.402 meters
		y	9.749 meters
		z	13.920 meters
		x2	
		y2	
		z2	
	Transducer Roll	*Roll*	0.000 degrees
		Roll2	
Vessel	S250		
Echosounder	Odom Echotrac CV200 24 kilohertz		
Date	2012-05-01		

Offsets	*MRU to Transducer*	*x*	-0.455 meters
		y	4.620 meters
		z	1.325 meters
		x2	-12.701 meters
		y2	4.62 meters
		z2	1.325 feet
	Nav to Transducer	*x*	12.623 meters
		y	-1.549 meters
		z	14.233 meters
		x2	
		y2	
		z2	
	Transducer Roll	*Roll*	0.000 degrees
		Roll2	

□.1.□□aybac□

□.1.□1 Descri□tion o□□orrectors

Layback is calculated in Caris from the cable-out and fish depth. Cable-out is output from a cable counter and recorded in the .sdf file. A 12 meter offset is applied in Sonar Pro to account for the amount of cable out when the towfish is in the docked position. The side scan cable is marked at 12 meters and is deployed to this position on launching. The cable counter is reset to zero at this position and the 12 meter offset applied in SonarPro. Thus the cable out value in the .sdf file is the correct value for the cable between the tow point and the towfish. The port POS system is used for positioning of the side scan. The port IMU is the reference point for offsets.

□.1.□.□Methods and □rocedures

Layback was calculated from the side scan calibration performed prior of obtaining data.

□.1.□.□□aybac□ □orrectors

Vessel	S250		
Echosounder	Klein 5000 455 kilohertz		
Date	2011-05-26		
Layback	*Towpoint*	*x*	7.161 meters
		y	-26.032 meters
		z	-9.347 meters
	Layback Error	0 meters	

□.□□tatic and Dynamic Dra□t

□.□.1 □tatic Dra□t

□.□.1.1 Descri□tion o□□orrectors

Because of her SWATH design HASSLER is particularly susceptible to loading and trim. While underway, the ballast is actively managed to maintain the draft at the design draft of 3.85 meters. During typical survey operations, HASSLER burns approximately 4,000 liters of diesel per day. At a density of 0.83 kilograms/ liter this is approximately 3.3 metric tons of fuel per day. At design draft of 3.85 meters, 1.3 metric tons is required to submerge an additional 0.01 meters of the hull in salt water. The daily fuel burn would thus account for 0.03 meters of variation in the draft. Ballast is adjusted daily to account for fuel burn and the levels in other tanks. Uncertainty is conservatively estimated at 0.05 meters.

□.□.1.□Methods and □rocedures

The waterline to reference point is calculated from the vessel offset survey and the vessel draft marks.

□.□.□Dynamic Dra□t

□.□.□.1 Descri□tion o□□orrectors

□.□.□.□Methods and □rocedures

An ellipsoidally referenced DDM was performed following guidelines put forth in the field procedures manual.

For a complete list of the dynamic draft please refer to attached ERDDM_Summary or appropriate HVF.

□.□.□.□Dynamic Dra□t □orrectors

<table>
<tr><td>Vessel</td><td>S250</td></tr>
<tr><td>Date</td><td>2011-05-01</td></tr>
<tr><td>Dynamic Draft Table</td><td><table><tr><td>Speed</td><td>0 meters/second</td></tr><tr><td>Draft</td><td>0 meters</td></tr></table></td></tr>
</table>

□.□□ystem Ali□nment

□.□1 Descri□tion o□□orrectors

□.□.□Methods and □rocedures

Methods and Procedures used follow recommendations given in section 1.5 of the 2011 FPM.

□.□.□□ystem Ali□nment □orrectors

Vessel	S250	
Echosounder	Reson 7125 Starboard 400 kilohertz	
Date	2011-07-07	
Patch Test Values	*Navigation Time Correction*	0.00 seconds
	Pitch	0.07 degrees
	Roll	-0.06 degrees
	Yaw	0.67 degrees
	Pitch Time Correction	0.00 seconds
	Roll Time Correction	0.00 seconds
	Yaw Time Correction	0.00 seconds
	Heave Time Correction	0.00 seconds
Vessel	S250	
Echosounder	Reson 7125 Port 400 kilohertz	
Date	2011-07-07	
Patch Test Values	*Navigation Time Correction*	0.00 seconds
	Pitch	0.27 degrees
	Roll	-0.08 degrees
	Yaw	-0.59 degrees
	Pitch Time Correction	0.00 seconds
	Roll Time Correction	0.00 seconds
	Yaw Time Correction	0.00 seconds
	Heave Time Correction	0.00 seconds
Vessel	S250	
Echosounder	Reson 7111 100 kilohertz	
Date	2011-06-07	

Patch Test Values	*Navigation Time Correction*	0.00 seconds
	Pitch	0.00 degrees
	Roll	-0.05 degrees
	Yaw	0.26 degrees
	Pitch Time Correction	0.00 seconds
	Roll Time Correction	0.00 seconds
	Yaw Time Correction	0.00 seconds
	Heave Time Correction	0.00 seconds

□.□□ositionin□and Attitude

□.□1 Descri□tion o□□orrectors

□.□.□Methods and □rocedures

Vessel attitude is measured by the POS/MV and recorded in the Hysweep .hsx file. The Reson 7111 is patch stabilized in real time, otherwise, attitude measurements not applied in real time are applied during post processing in CARIS HIPS using the raw POS/MV attitude data recorded in the Hysweep .hsx file. When available, post processed kinematic (PPK) position and attitude solutions from the POS/MV .000 file are applied to MBES data in CARIS HIPS in the form of SBET files.

The POS/MV TrueHeave data is logged within the POS/MV .000 files and applied in CARIS HIPS during post processing using the "Apply TrueHeave" function. TrueHeave is a forward-backward filtered heave corrector as opposed to the real time heave corrector, and is fully described in section 6 of the POS/MV V4 User Guide 2009.

PPK data in the form of Single Best Estimate of Trajectory (SBET) files are applied to soundings to increase the accuracy of the kinematic vessel corrections and to allow the ability to reference soundings to the ellipsoid. Standard daily data processing procedures include post processing of POS/MV kinematic .000 files using Applanix POSPac MMS and POSGNSS software using either IN-Fusion SmartBase or IN-Fusion SingleBase processing modes. After processing and quality control analysis of the post-processed SBET files is complete. the SBET and SMRMSG files are applied to the HDCS data in CARIS HIPS using the "Load Attitude/Navigation Data" and "Load Error Data" processing tools.

□.□□ides and □ ater □e□els

□.□1 Descri□tion o□□orrectors

□.□.□Methods and □rocedures

Unless otherwise noted in the survey Descriptive Report (DR) and/or project Horizontal and Vertical Control Report (HVCR), the vertical datum for all soundings and heights is Mean Lower Low Water (MLLW). Predicted, preliminary, and/or verified water level correctors from the primary tide station(s) listed in the Project Instructions may be downloaded from the CO-OPS website and used for water level corrections during the course of the project. These tide station files are collated to include the appropriate days of acquisition and then converted to CARIS .tid file format using FetchTides.

Water level data in the .tid files are applied to HDCS data in CARIS HIPS using the zone definition file (.zdf) or a Tidal Constituent and Residual Interpolation (TCARI) model supplied by CO-OPS. Upon receiving final approved water level data, all data are reduced to MLLW using the final approved water levels as noted in the individual surveys DR.

A complete description of vertical control utilized for a given project can be found in the project specific HVCR, submitted for each project under separate cover when necessary as outlined in section 5.2.3.2.3 of the FPM.

Newer methods for handling vertical control are being developed and, if utilized, will be explained in more detail in the project wide HVCR or survey descriptive report.

□.□ Sound Speed

□.□.1 Sound Speed Profiles

□.□.1.1 Description of Correctors

□.□.1.□ Methods and Procedures

Seabird .cnv and MVP .bot files are collected when necessary and converted to .svp files using Velocipy. These .svp files are concatenated into one vessel specific master file which is then applied to HDCS data using a specified method. This method of applying sound speed to data is listed in the processing log included in the Separates submitted with the individual survey.

□.□.□ Surface Sound Speed

□.□.□.1 Description of Correctors

Surface sound speed output by the starboard TSG is fed to all multibeam systems via serial connections.

□.□.□.□ Methods and Procedures

The sound speed is monitored by the acquisition watch stander and periodically compared with the CTD or MVP derived values.

D. APPROVAL SHEET

This Data Acquisition and Processing Report for project OPR-D304-FH-11, Approaches to Chesapeake Bay and M-H712-FH-11, Florida to North Carolina Trackline is respectfully submitted.

As Chief of Party, I have ensured that standard field surveying and processing procedures were adhered to during these projects in accordance with the Hydrographic Surveys Specifications and Deliverables (4/2011), Hydrographic Survey Technical Directive HTD 2010-2, and the Field Procedures Manual for Hydrographic Surveying (5/2011).

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

This DAPR applies to surveys F00607, H12346 which was completed in 2011 for Project D304 and survey D00158 which was completed in 2011 for Project H712.

Approved and Forwarded:

Samuel Greenaway Digitally signed by Samuel Greenaway DN: cn=Samuel Greenaway, o=NOAA Office of Marine and Aviation Operations, ou=Ferdinand R. Hassler, email=samuel.greenaway@noaa.gov, c=US Date: 2012.07.30 13:09:53 Z	Benjamin K. Evans 2012.07.30 09:20:37 -04'00'
LT Samuel F. Greenaway, NOAA Field Operations Officer	LCDR Benjamin K. Evans, NOAA Chief of Party

Appendix I

Vessel Reports

Final report

SURVEY REPORT

SHIP: M286 SWATH
FERDINAND R. HASSLER

LOCATION: PASCAGOULA, MS

DATE: 7/18-7/26, 2009
And **11/4, 2009**

PURPOSE:
Determine the ship's centerline, roll, and pitch. Install benchmarks, install the master reference plane in the same planes as the measured roll, pitch, and azimuth of the ship. Assist the shipyard to install the IMUs parallel to the centerline, and in the same plane as the ship's roll and pitch. Assist the shipyard in installing the transducers in the same plane as roll, pitch and azimuth of the ship. Measure and spot the draft marks.

PERSONNEL:
Eric Kostelak
Brian Kloter
Raymond Impastado
John Miskimmin

EQUIPMENT LIST:
WILD T2 THEODOLITE SN: 169786 Calibration Expiration Date; 12/19/09

WILD T2 THEODOLITE SN: 155062 Calibration Expiration Date; 12/19/09

WYLER CLINO 2000 CLINOMETER SN: M4416 Calibration Expiration Date; 07/10/10

TOPCON GTS-301 One Second Electronic Total Station, Serial number GU1193 Calibration Expiration Date; 07/12/09

WILD NA1 AUTO LEVEL: SN 472810 Calibration Expiration Date; 07/12/09

Procedures:

1. Establish a baseline in relation to the centerline of both pontoons.
   A. Locate points on each of the pontoons to determine centerline
   B. Measure the elevation differences of the points. Take the average of these to determine the pitch and roll of each pontoon.

2. Take the average of the measurements of the two pontoons for roll, pitch, and centerline. The result can then be used as the Master reference.

3. Create a traverse, in a level plane, around the ship using the established baseline as a reference. Set various points that will be used to locate the master reference block, IMUs, bench marks, transducers, and antennas.

4. Locate, set and secure the master reference block to within 9 arc seconds of the calculated roll, pitch, and centerline values.

5. Once the MRB has set for a day, confirm the measurements relative to the results of step 2. If the measurements are within the two values used in Step 2, these values will become the Final Master Reference, which all further measurements will be referenced to.

6. Locate IMU foundations, adjust to be level with roll and pitch, and aligned with centerline.

7. Establish bench marks that are aligned to the centerline in any areas that require future measurements.

8. For transducers, on the bottom of the hull, establish punch marks aligned to the centerline that can be used to align the transducers to the centerline.

9. Run a closed level loop from the master reference block to all bench marks, Transducers, antennas, and sensors to determine their elevation values relative to the reference. (Z axis).

10. Using established elevation points within the traverse, determine the correct locations for all draft marks.

11. Work with the shipyard to determine the correct alignment of the transducers.

METHODS

All angles at intersections were turned 4 times, 2 in regular, and 2 in inverted position. All other angles were turned 2 times, once in regular, and once in inverted position.

Slope distances were measured with a zenith angle in the regular and inverted Position.

The Traverse was closed and computed for accuracy.

Results

MRB

After the MRB has set up for 24 hours, it was found the chock fast had caused an 18 second movement in roll. As this small value was well within the average of the two pontoons, the final reference was shifted to the MRB values.

IMU

During measurements of the IMUs, we discovered it was impossible to meet the specification to be level to the roll and pitch within 90 arc seconds using the existing mounts. The shipyard manufactured a double plate separated by three threaded rods, which allowed fine adjustment in two planes (roll and pitch). The IMUs were aligned to zero measurable azimuth error, and to within 5 arc seconds in roll and pitch relative to the MRB.

TRANSDUCERS

7125

During measurements it became apparent that it was impossible to meet the roll and pitch specification on the multibeam transducer mounts. There was no measurable azimuth error on either 7125 transducer mount, when the welding was finished. The shipyard came up with the roll and pitch solution of machining the surfaces in place once the mounting plates were completely welded out. We attended for the machine work on 8/19/09. A portable milling machine was put in place, leveled to within 5 arc seconds of the MRB plus 4.5 degrees of roll to Give the transducer mounting surfaces the specified 4.5 degree outward roll angle. See attached photo. It was agreed by all that if the milling machine was positioned correctly, the surfaces had to be correct, but as a check to confirm the process, we measured the machined surface on the port unit, and found the pitch error was zero, and the roll error was 15 seconds. This was well within the required 90 seconds.

Milling machine set up on 7125 transducer housing

7111

Like the 7125s, it was impossible to meet the roll and pitch specification on this transducer mounting plate. It too, was machined by the portable milling machine.
The machine was set up to be within 5 seconds of the MRB Pitch and Roll values.

XYZ COORDINATES TABLE

POINT	X-AXIS	Y-AXIS	Z-AXIS	DESCRIPTION
5	9.264	-7.555	7.169	POINT FP
6	9.409	6.256	7.168	POINT FS
7	3.491	-7.478	7.176	POINT MP
8	3.872	6.168	7.178	POINT MS
9	-4.035	-7.561	7.168	POINT AP
10	-4.022	6.258	7.169	POINT AS
15	9.326	-0.652	7.168	CENTERLINE
18	-4.017	-0.652	7.168	CENTERLINE
19	16.343	2.530	-5.065	STARBOARD BENCH MARK TOP WHEEL HOUSE
20	16.343	-0.653	-5.064	MID BENCH MARK TOP WHEEL HOUSE
21	16.343	-3.836	-5.066	PORT BENCH MARK TOP WHEEL HOUSE
25	-1.336	0.001	0.160	AFT BENCH MARK MASTER REFERENCE PLATE
26	0.000	0.000	0.000	MASTER REFERENCE PLATE
27	-0.353	0.000	0.161	FWD BENCH MARK MASTER REFERENCE PLATE
28	13.428	-8.960	-2.496	PORT BENCH MARK BRIDGE WING
29	13.428	-5.592	-2.476	STARBOARD BENCH MARK BRIDGE WING
30	7.115	5.836	7.154	FWD PUNCH MARK ADCP
31	5.765	5.835	7.145	AFT PUNCH MARK ADCP
33	7.841	6.846	7.167	FWD PUNCH MARK RESON 7125 STARBOARD PONTOON
34	5.025	6.847	7.168	AFT PUNCH MARK RESON 7125 STARBOARD PONTOON
36	5.022	-8.169	7.157	AFT PUNCH MARK RESON 7125 PORT PONTOON
37	7.792	-8.169	7.154	FWD PUNCH MARK RESON 7125 PORT PONTOON
39	15.307	6.610	6.843	AFT PUNCH MARK RESON 7111
40	16.098	6.611	6.771	FWD PUNCH MARK RESON 7111
41	10.822	5.864	7.169	FWD PUNCH MARK MDS* STARBOARD PONTOON
42	9.818	5.863	7.172	AFT PUNCH MARK MDS* STARBOARD PONTOON
43	10.608	-7.081	7.177	FWD PUNCH MARK MDS* PORT PONTOON
44	9.762	-7.080	7.175	AFT PUNCH MARK MDS* PORT PONTOON
45	-13.926	-0.615	0.105	AFT MID BENCH MARK BACK DECK
46	-9.031	-0.615	0.125	FWD BENCH MARK BACK DECK

POINT	X-AXIS	Y-AXIS	Z-AXIS	DESCRIPTION
47	-13.926	6.471	0.114	STARBOARD BENCH MARK BACK DECK
48	-13.926	-7.697	0.093	PORT BENCH MARK BACK DECK
51	5.891	-6.878	5.839	IMU PORT PONTOON (OLD LOCATION)
52	5.923	5.428	5.840	IMU STARBOARD PONTOON (OLD LOCATION)
53	17.655	6.584	6.890	RESON 7111 CENTER OF PLATE
54	6.265	6.774	7.095	PORT EDGE RESON 7125 STARBOARD PONTOON
55	6.265	6.805	7.093	RESON 7125 STARBOARD PONTOON
56	6.223	-8.078	7.087	STARBOARD EDGE RESON 7125 PORT PONTOON
57	6.223	-8.109	7.085	RESON 7125 PORT PONTOON
58	16.039	5.417	2.563	INBOARD DRAFT MARK FRAME 4 STARBOARD
59	16.025	-6.711	2.567	INBOARD DRAFT MARK FRAME 4 PORT
60	-11.204	5.626	2.588	INBOARD DRAFT MARK FRAME 46 STARBOARD
61	-11.208	-6.870	2.562	INBOARD DRAFT MARK FRAME 46 PORT
62	16.040	7.458	2.565	OUTBOARD DRAFT MARK FRAME 4 STARBOARD
63	-11.208	7.462	2.588	OUTBOARD DRAFT MARK FRAME 46 STARBOARD
64	16.025	-8.735	2.570	OUTBOARD DRAFT MARK FRAME 4 PORT
65	-11.205	-8.711	2.555	OUTBOARD DRAFT MARK FRAME 46 PORT
66	6.273	-9.907	5.789	PORT BENCH MARK IMU PORT PONTOON
67	6.273	-5.007	5.861	STARBOARD BENCH MARK IMU PORT PONTOON
68	6.624	3.666	5.862	PORT BENCH MARK IMU STARBOARD PONTOON
69	6.624	8.571	5.798	STARBOARD BENCH MARK IMU STARBOARD PONTOON
70	5.861	-6.865	5.767	IMU PORT PONTOON
71	5.885	5.381	5.768	IMU STARBOARD PONTOON
72	-20.247	-0.609	-4.327	BOTTOM OF CENTER BLOCK "A" FRAME
73	11.205	-1.904	-7.782	BOTTOM OF GPS ANTENNAE PORT LOWER
74	10.488	-1.896	-9.774	BOTTOM OF GPS ANTENNAE PORT UPPER
75	11.180	0.594	-7.776	BOTTOM OF GPS ANTENNAE STARBOARD LOWER
76	10.455	0.589	-9.776	BOTTOM OF GPS ANTENNAE STARBOARD UPPER

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

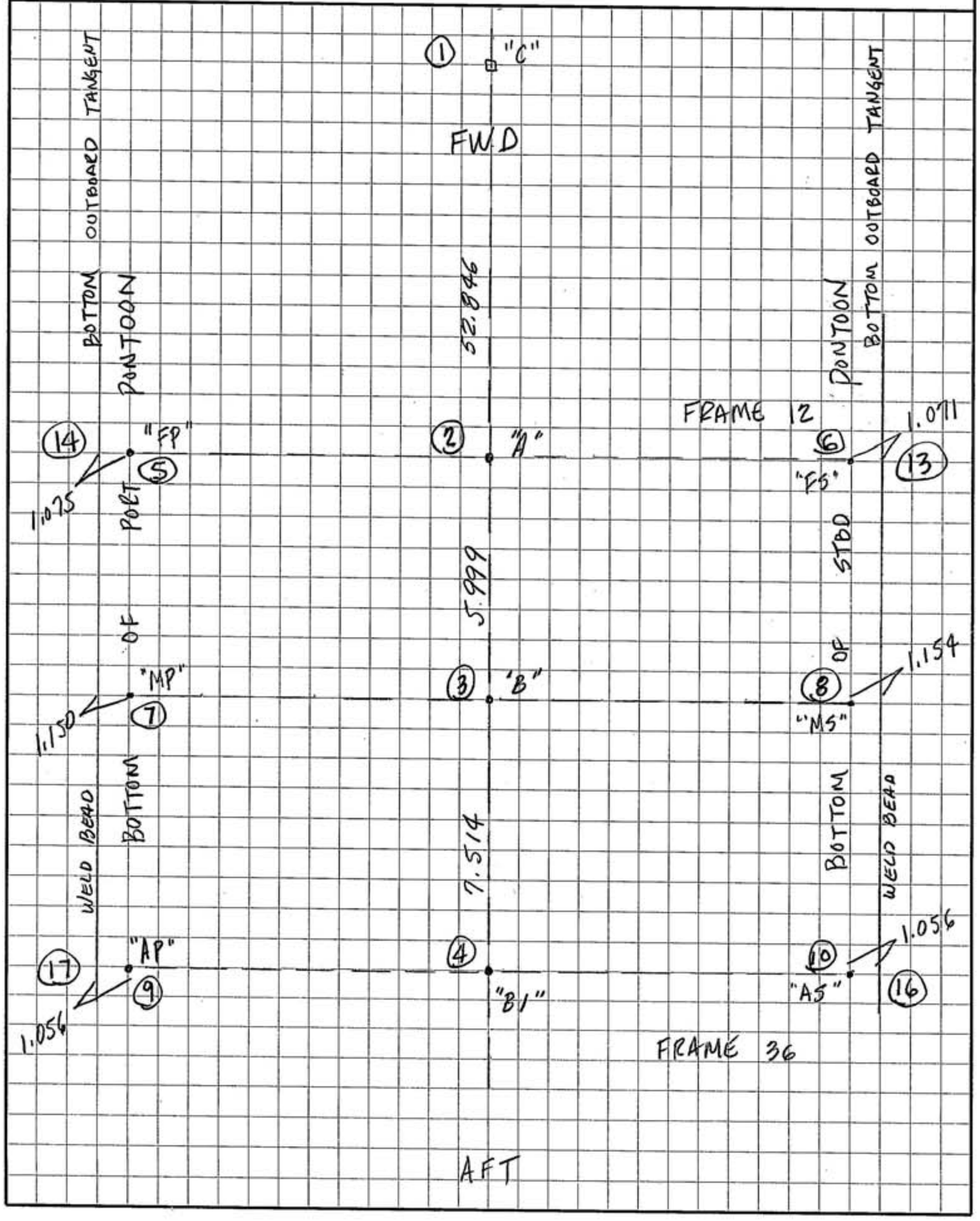
SCALE: 1" = **NONE**

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 1



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PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 SHEET NO.: 1A

INST. ON PT "A" - B.S. @ PT "C"

∡1	∡2	AVG.	Z∡1	Z∡2	AVG.	DIST.	PT.
89°20'25"	89°20'30"	89°20'28"	87°41'56"	272°17'59"	87°41'59"	6.779	"FS"
268°11'37"	268°11'42	268°11'40"	87°54'43"	272°05'12"	87°54'45"	7.044	"FP"

INST. ON PT "B" - B.S. @ PT "C"

∡1	∡2	AVG.	Z∡1	Z∡2	AVG.	DIST.	PT.
85°25'42"	85°25'46"	85°25'44	88°45'06"	271°14'57"	88°45'05"	6.770	"MS"
270°02'26"	270°02'28"	270°02'27"	88°53'12"	271°07'02"	88°53'05"	6.895	"MP"

INST. ON PT "B1" - B.S @ PT "C"

∡1	∡2	AVG.	Z∡1	Z∡2	AVG.	DIST.	PT.
88°39'43"	88°39'43"	88°39'43	87°52'44"	272°07'20"	87°52'42"	6.932	"AS"
269°56'40"	269°56'48"	269°56'44"	87°54'20"	272°05'48"	87°54"16"	6.897	"AP"

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" - NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.
CALCULATED BY: R. IMPASTATO
DATE: 7-18-09 SHEET NO.: 2

STA	BS	HI	FS	ELEV	DESCRIPTION	
				0.000	(ASSUMED ELEVATION) PT. "B1"	-8.526
	0.780	0.780				
			-0.564	1.344	"AP"	-7.182
			-0.578	1.358	"AS"	-7.168
			0.812	-0.032	PT "B"	-8.558
	1.017	0.985				
			-0.363	1.348	"MP"	-7.178
			-0.376	1.361	"MS"	-7.~~176~~ 165
			-0.379	1.364	"FP"	-7.162
			-0.395	1.380	"FS"	-7.146
	-0.416	0.964				
			-0.400	1.364	"FP"	-7.162
			-0.385	1.349	"MP"	
			-0.397	1.361	"MS"	
			0.996	-0.032	"PT" B"	
	0.807	0.775				
			-0.583	1.358	"AS"	
			-0.569	1.344	"AP"	
			0.775	0.000	✓ PT "B1"	

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PASCAGOULA, MISSISSIPPI

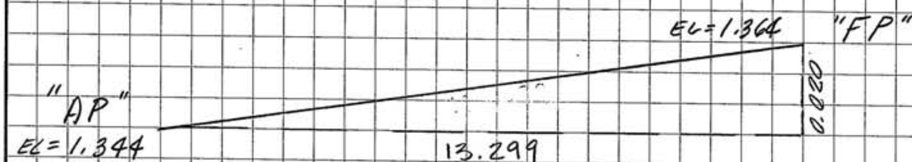
FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09
7-26-09

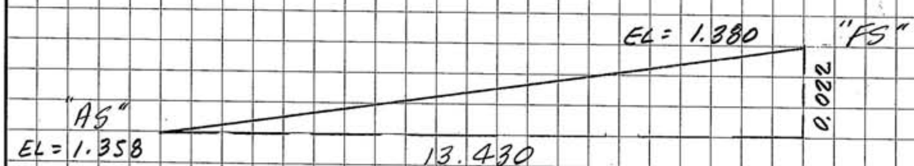
SHEET NO.: 3

BOTTOM OF PORT PONTOON



PITCH = 0°05' 10"

BOTTOM OF STARBOARD PONTOON



PITCH = 0°05' 38"

PITCH AVERAGE = 0°05' 24"
BOW HIGH

RAYMOND C. IMPASTATO
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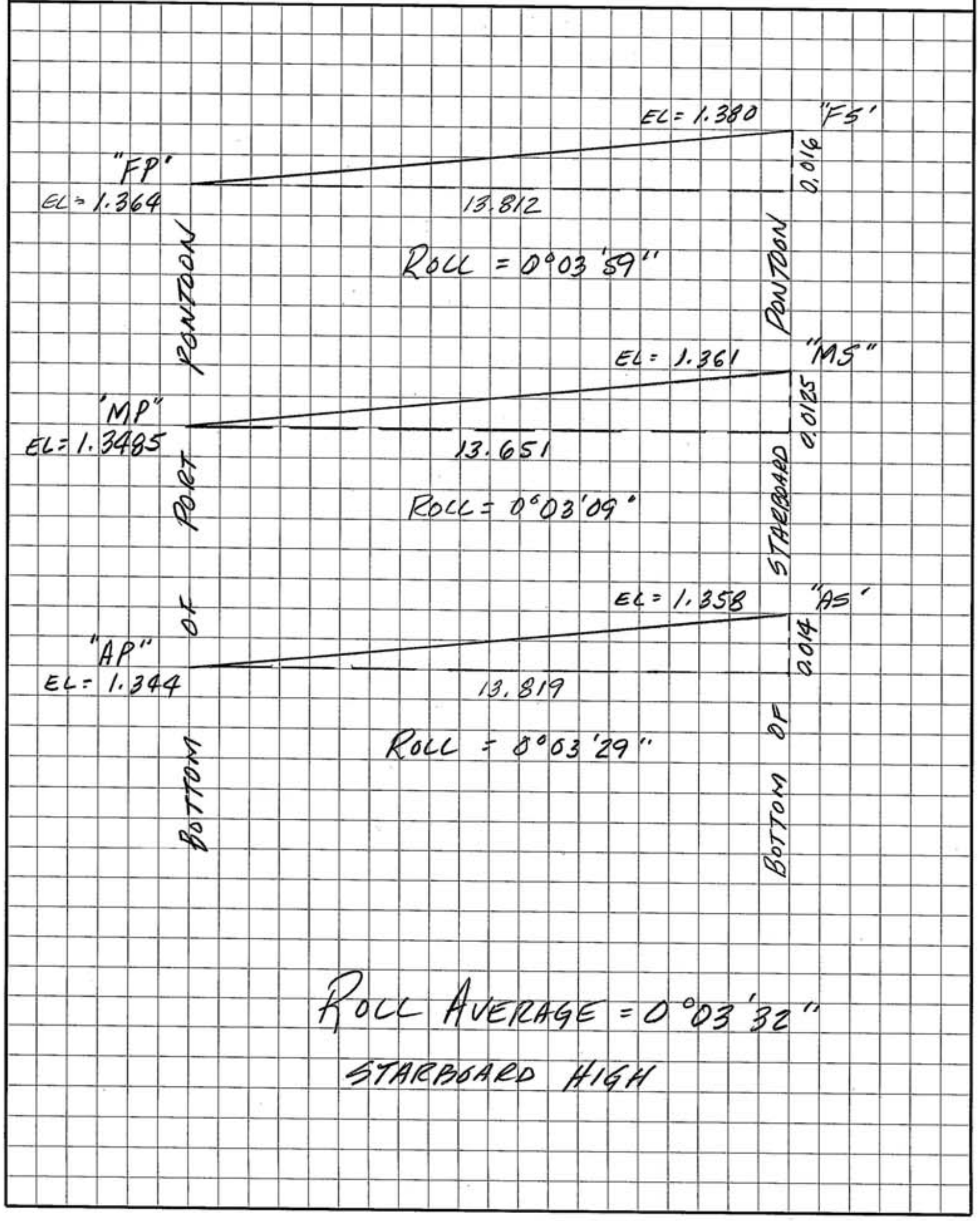
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 4



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JOB: FERDINAND R. HASSLER
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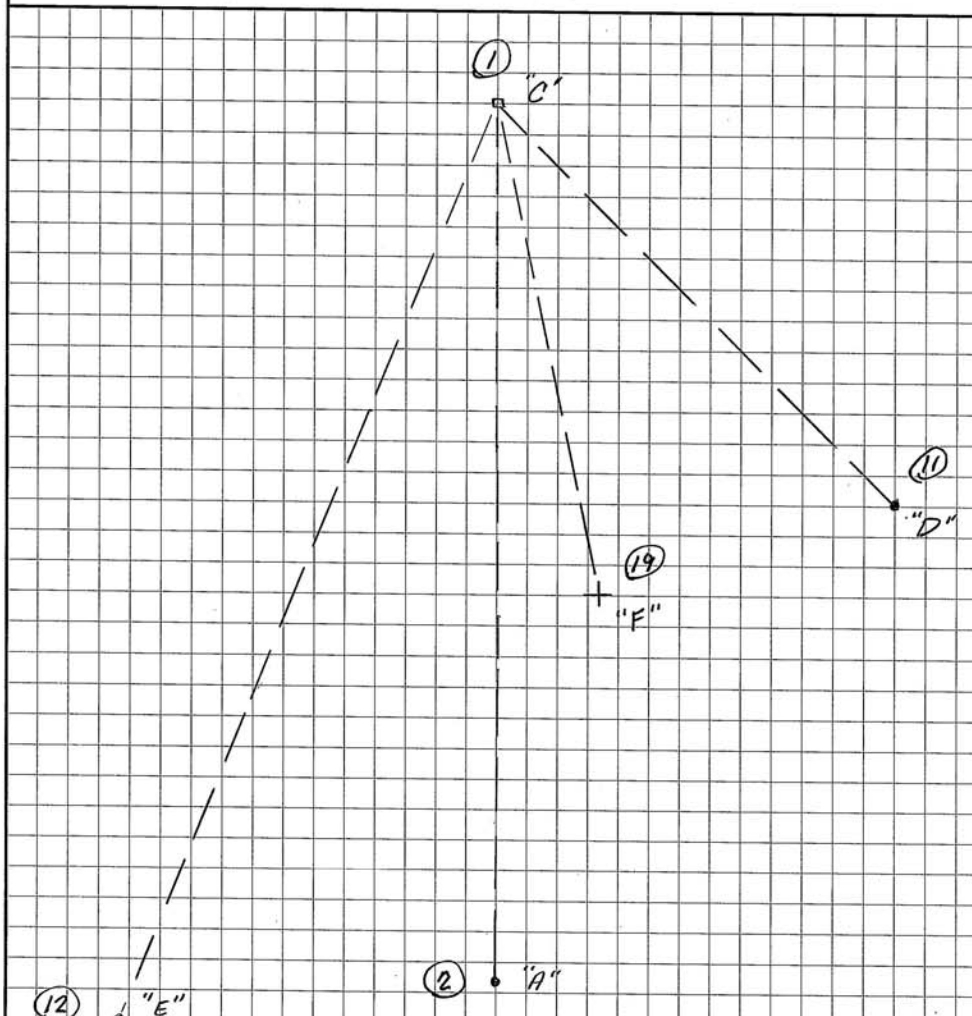
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09
7-26-09

SHEET NO.: 5



INST. ON PT "C" - B.S. @ PT "A"

∡. 1	∡ 2	AVG	Z ∡1	Z ∡2	AVG	DIST.	PT.
327°52'02"	327°52'05"	327°52'03"	90°02'07	269°57'50"	90°02'09"	50.572	"D"
24°59'01"	24°59'07"	24°59'04"	81°38'44	278°21'12"	81°38'46"	66.533	"E"
356°18'52"	356°18'56"	356°18'54	73°44'26"	286°15'37"	73°44'25"	47.908	"F"

RAYMOND C. IMPASTATO
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PHONE NO: (985) 774-1955

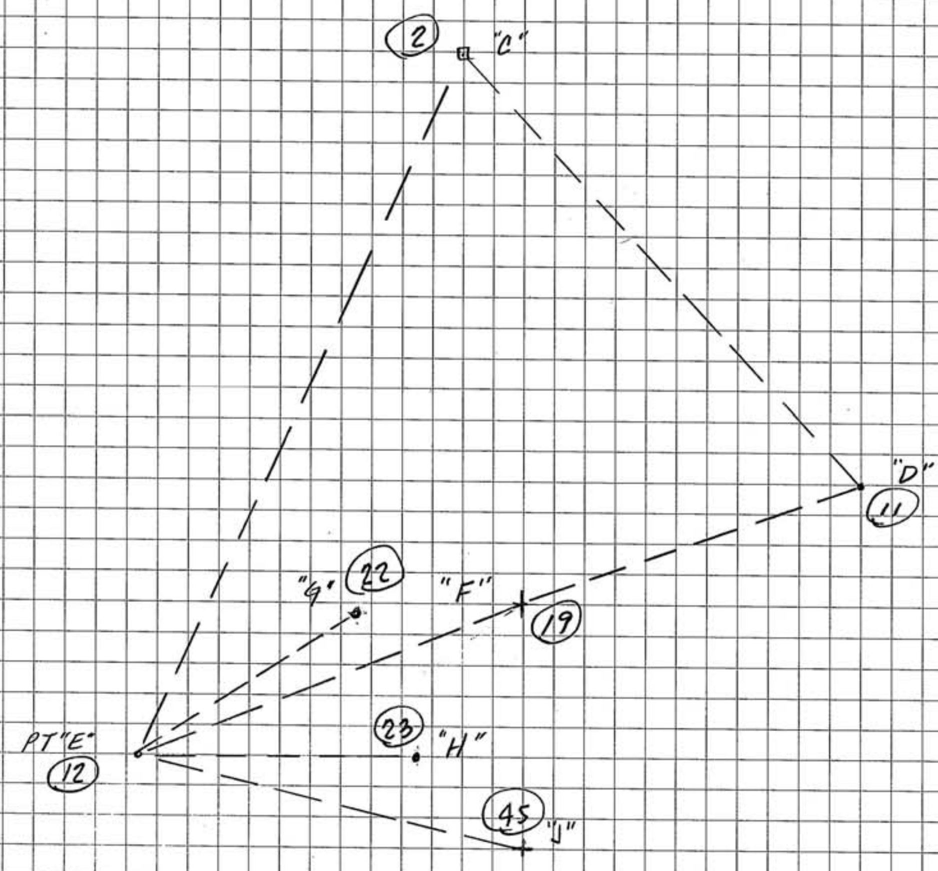
SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 6



INST. ON POINT "E" - B.S. @ PT "C"

∢1	∢2	AVG	Z∢1	Z∢2	AVG	DIST.	PT.
40°53'50"	40°53'44"	40°53'47"	83°41'57"	276°18'12"	83°41'53"	33.906	"F"
37°40'49"	37°40'52	37°40'51"	87°24'16"	272°35'54"	87°24'11"	23.410	"G"
59°49'14"	59°49'17"	59°49'16"	93°09'48"	266°50'20"	93°09'44"	23.114	"H"
95°35'50"	95°35'46"	95°35'48"	92°05'16"	267°54'37"	92°05'20"	32.496	"J"
INST ON PT "D" - B.S. @ PT "C"							
294°49'26"	294°49'27"	294°49'27"	61°04'08"	298°55'49"	61°04'10"	27.580	"F"

RAYMOND C. IMPASTATO PROFESSIONAL LAND SURVEYOR 139 RANCH ROAD SLIDELL, LOUISIANA 70460 PHONE NO: (985) 774-1955 SCALE: 1" = NONE	JOB: FERDINAND R. HASSLER M286 SWATH PASCAGOULA, MISSISSIPPI FIELD CREW: R.I., E.K., J. M. & B. K. CALCULATED BY: R. IMPASTATO DATE: 7-18-09 SHEET NO.: 7 7-26-09

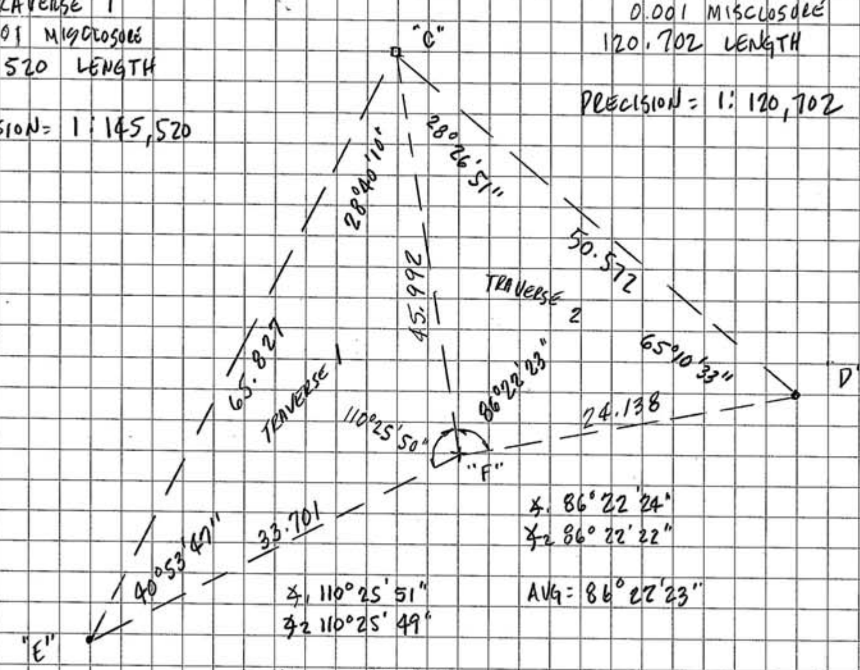
CLOSING ANGLES

TRAVERSE 1
0.001 MISCLOSURE
145.520 LENGTH

PRECISION = 1 : 145,520

TRAVERSE 2
0.001 MISCLOSURE
120.702 LENGTH

PRECISION = 1 : 120,702



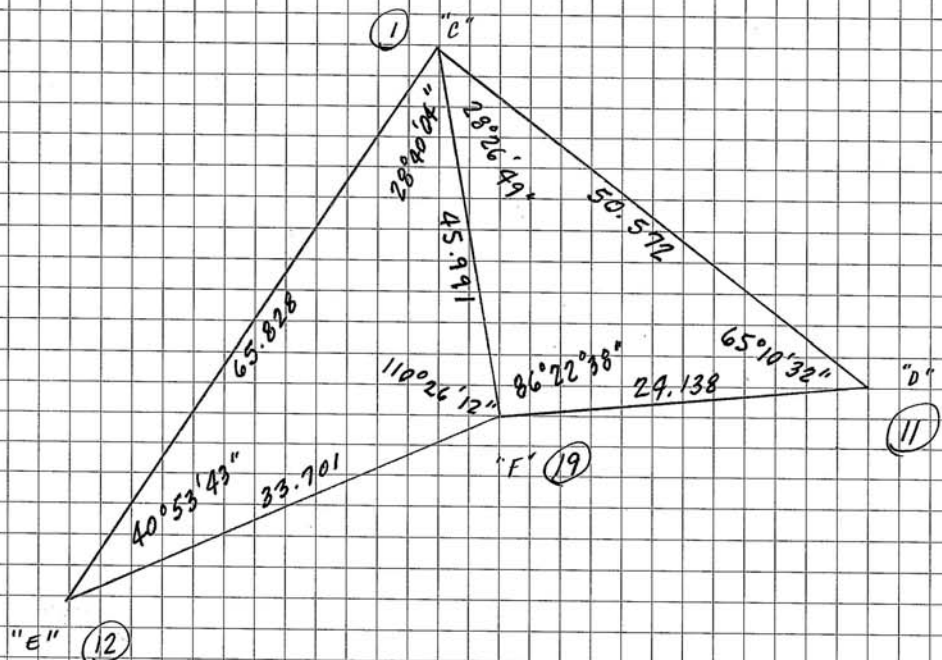
	ADJUSTED ∢'S
40°53'47"	40°53'51"
28 40'10"	28°40'14"
110 25'50"	110°25'55"
179°59'47"	180°00'00"

13 SECOND MISCLOSURE

	ADJUSTED ∢'S
28°26'51"	28°26'55"
86°22'23	86°22'28"
65'10 33'	65°10'37"
179°59'47	180°00'00"

13 SECOND MISCLOSURE

RAYMOND C. IMPASTATO PROFESSIONAL LAND SURVEYOR 139 RANCH ROAD SLIDELL, LOUISIANA 70460 PHONE NO: (985) 774-1955 SCALE: 1" = NONE	JOB: FERDINAND R. HASSLER M286 SWATH PASCAGOULA, MISSISSIPPI FIELD CREW: R.I., E.K., J. M. & B. K. CALCULATED BY: R. IMPASTATO DATE: 7-18-09 SHEET NO.: 8 7-26-09



ANGLES AND DISTANCES
AFTER ADJUSTMENTS

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

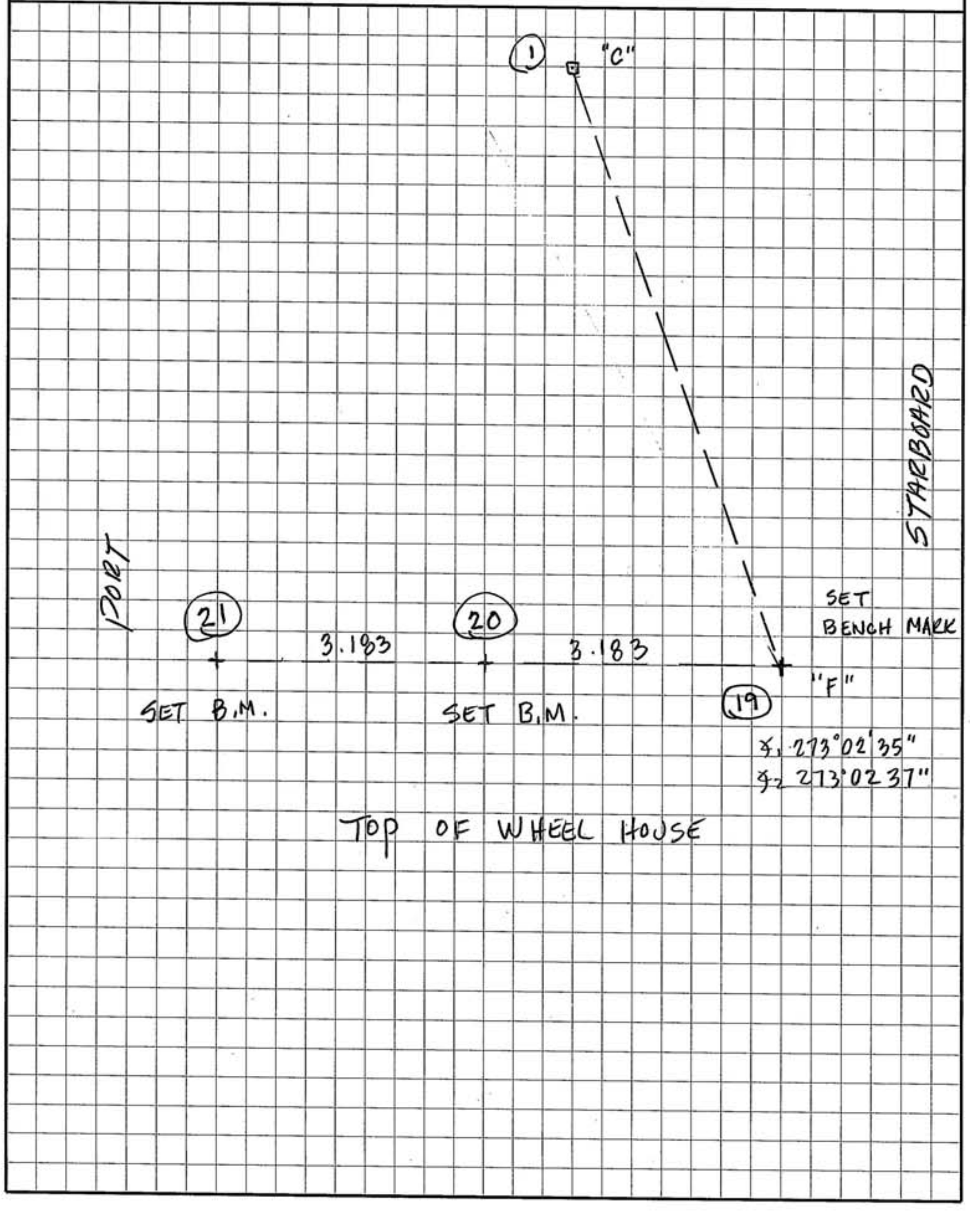
SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

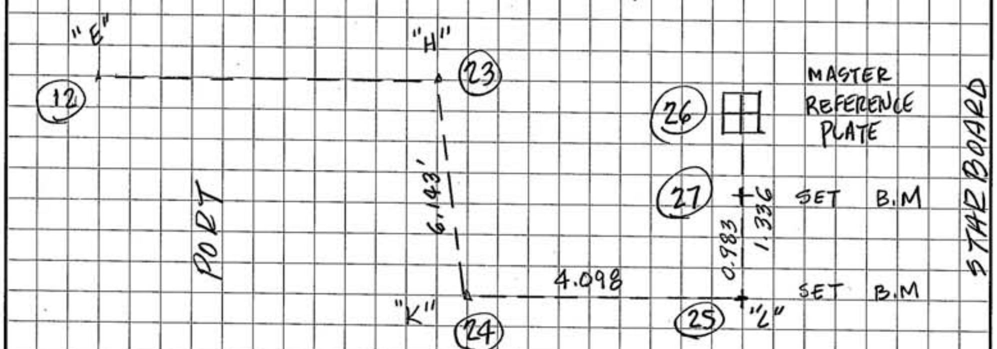
CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 9



RAYMOND C. IMPASTATO PROFESSIONAL LAND SURVEYOR 139 RANCH ROAD SLIDELL, LOUISIANA 70460 PHONE NO: (985) 774-1955 SCALE: 1" = NONE	JOB: FERDINAND R. HASSLER M286 SWATH PASCAGOULA, MISSISSIPPI FIELD CREW: R.I., E.K., J. M. & B. K. CALCULATED BY: R. IMPASTATO DATE: 7-18-09 7-26-09 SHEET NO.: 10

MASTER REFERENCE PLATE ROOM



INST. ON PT "H" - B.S @ PT. "E"

∢1	∢2	AVG.	Z∢1	Z∢2	AVG.	DIST.	POINT
262°24'48"	262°24'50	262°24'49"	92°09'18"	267°50'37"	92°09'21"	6.143	"K"
INST. ON PT "K" - B.S. @ PT "H"							
103°10'42"	103°10'41"	103°10'42"	93°29'07"	266°30'33"	93°29'17"	4.098	"L" AFT B.M
INST. ON PT "L" - B.S @ PT "K"							
88°52'34	88°52'30'	88°52'32"	—	—	—	0.983	FWD. B.M
88°54'52"	88°54'48	88°54'50'	-	-	-	1.336	MRP

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI
FIELD CREW: R.I., E.K., J. M. & B. K.
CALCULATED BY: R. IMPASTATO
DATE: 7-18-09 7-26-09 SHEET NO.: 11

STA	BS	HI	FS	ELEV	DESCRIPTION
				0.000	MASTER REFERENCE PLATE
	1.300	1.300			
			1.461	-0.161	FWD B.M -0.162
			1.461	-0.161	AFT B.M -0.162
			1.429	-0.129	PT "H" -0.130
			1.432	-0.132	T.P. 1
	1.467	1.335			
			0.440	0.895	T.P. 2
	0.414	1.309			
			0.392	0.917	T.P. 3 TOP OF RAIL
	-8.118	-7.201			
			1.357	-8.558	PT "B"
	1.352	-7.206			
			-8.122	0.916	T.P. 3
	0.365	1.281			
			0.387	0.894	T.P. 2
	0.429	1.323			
			1.456	-0.133	T.P. 1
	1.429	1.296			
			1.427	-0.131	PT "H"
			1.459	-0.163	AFT B.M.
			1.459	-0.163	FWD B.M.
			1.297	-0.001	M.R.P.

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JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09
7-26-09

SHEET NO.: 12

STA	BS	HI	FS	ELEV	DESCRIPTION
				0.917	T.P. 3 TOP OF RAIL
	0.427	1.344			
			-1.207	2.551	T.P. 4 EDGE OF DECK (BRIDGE WING)
	3.980	6.531			
			1.437	5.094	STBD B.M, TOP OF WHEEL HOUSE
			1.442	5.089	MID B.M. " " " "
			1.443	5.088	PORT B.M. " " " "
	1.387	6.475			
			1.386	5.089	MID B.M
			1.381	5.094	STBD. B.M
			3.923	2.552	T.P. 4
	-1.228	1.324			
			0.406	0.918	(0.001) T.P. 3

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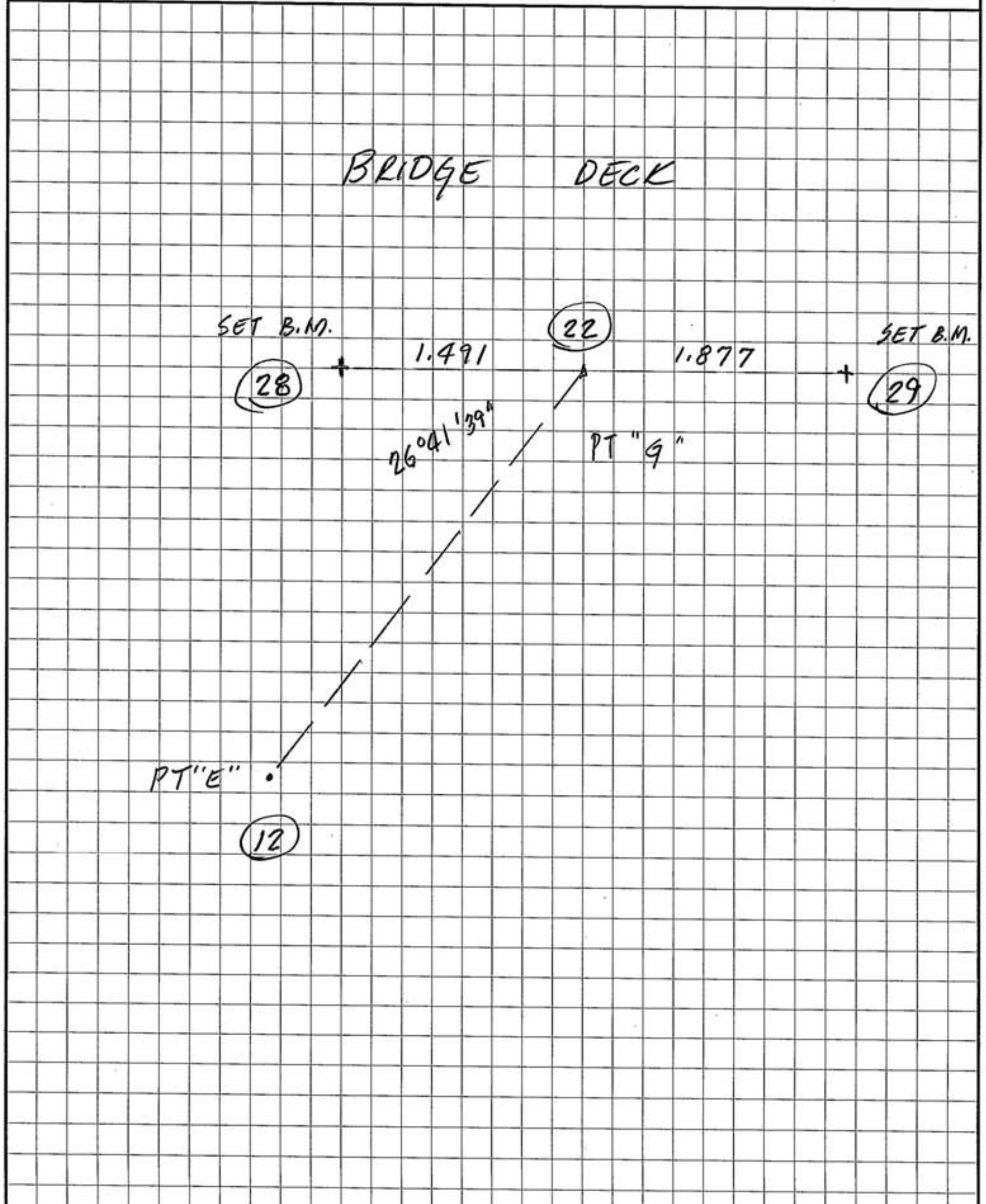
SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09
7-26-09
SHEET NO.: 13



RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

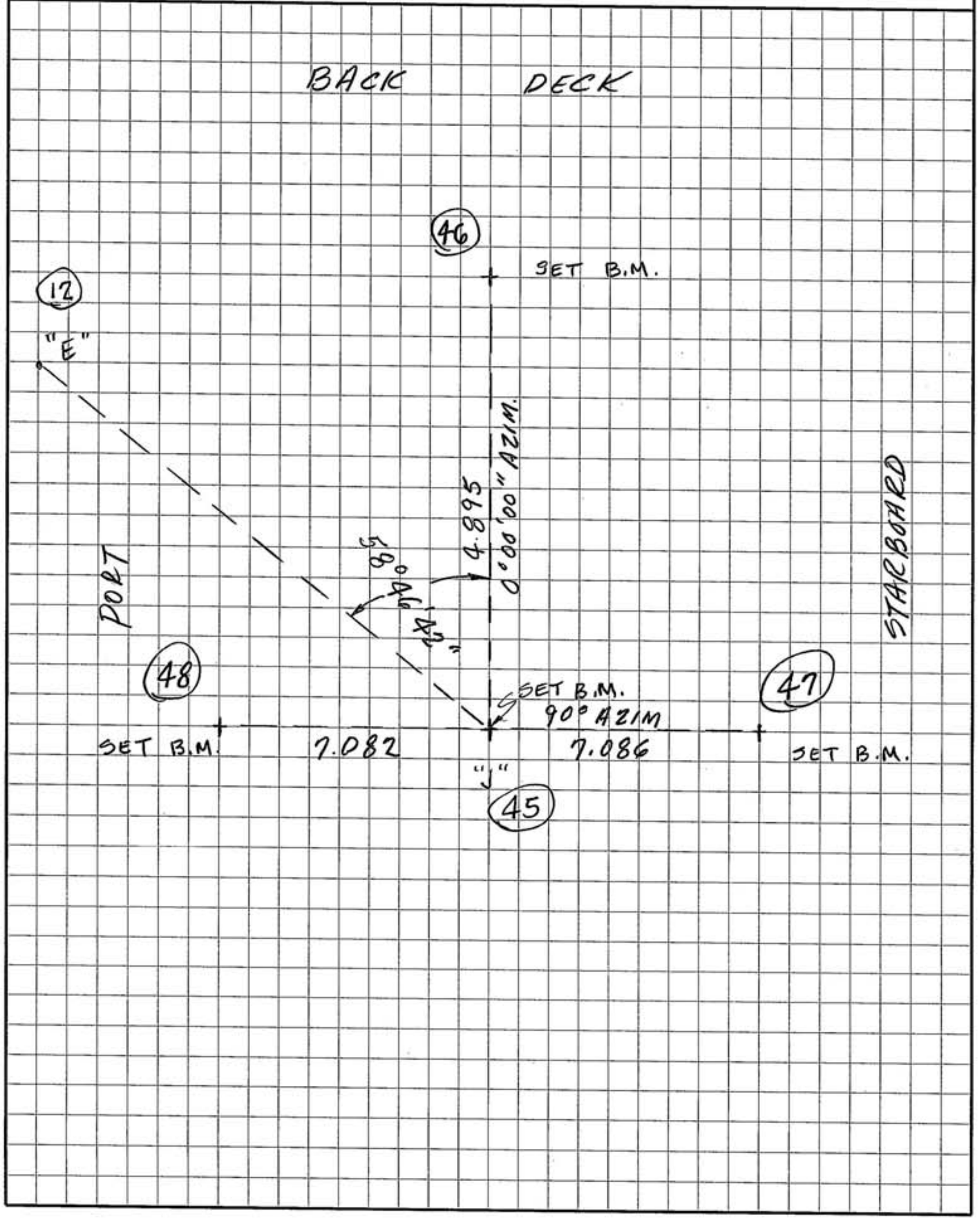
SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 14



RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 15

STA	BS	HI	FS	ELEV	DESCRIPTION
				2.551	T.P. 4 EDGE OF DECK (BRIDGE WING)
	1.385	3.936			
			1.445	2.491	STARBOARD B.M. BRIDGE WING (PORT SIDE)
			1.429	2.507	PORT B.M. (BRIDGE WING (PORT SIDE)
	1.411	3.918			
			1.427	2.491	STARBOARD B.M.
			1.367	2.551	T.P. 4
				0.000	MASTER REFERENCE PLATE
	1.344	1.344			
			1.375	-0.031	T. P. 5
	1.399	1.368			
			1.508	-0.140	FWD. B.M BACK DECK
			1.496	-0.128	AFT MID B.M. BACK DECK
			1.497	-0.129	STARBOARD B.M. BACK DECK
			1.492	-0.124	PORT B.M. BACK DECK
	1.466	1.342			
			1.471	-0.129	ST. B.M.
			1.470	-0.128	AFT MID B.M.
			1.482	-0.140	FWD. B.M.
			1.373	-0.031	T.P. 5
	1.383	1.352			
			1.352	0.000	MASTER REFERENCE PLATE

RAYMOND C. IMPASTATO
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PHONE NO: (985) 774-1955

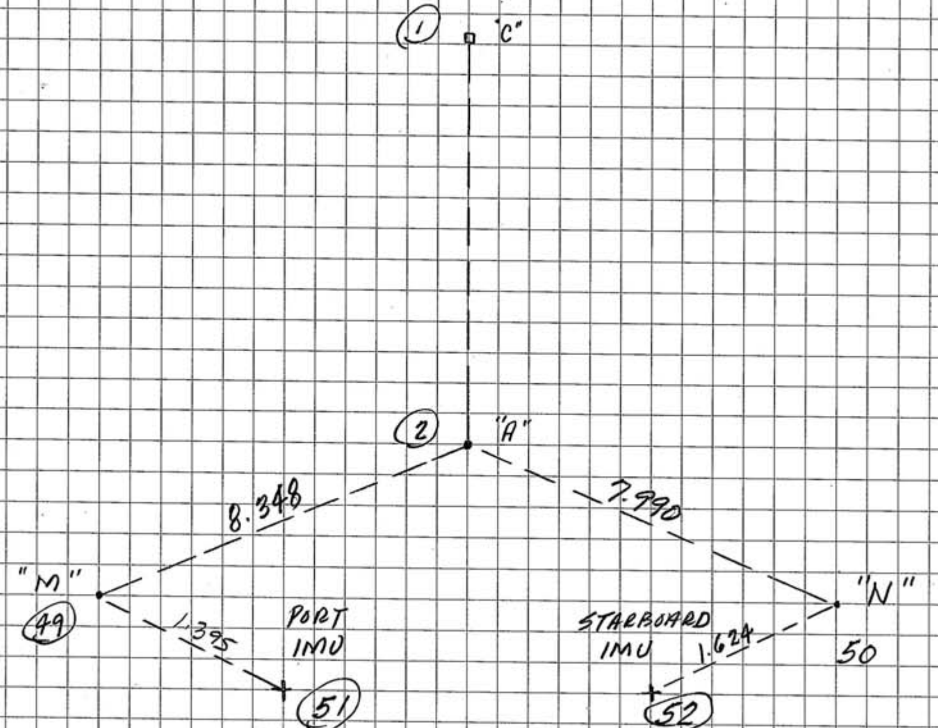
SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 / 7-26-09 SHEET NO.: 16



∡ 1	∡ 2	AVG	Z∡ 1	Z∡ 2	AVG	DIST.	PT.
INST ON PT "A" - B.S. @ PT "C"							
246°56'46	246°56'42"	246°56'44"	91°15'05	268°44'45	91°15'10"	8.348	"M"
110°36'30"	110°36'38"	110°36'34"	90°16'21"	269°43'51"	90°16'15"	7.990'	"N"
INST. ON PT. "M" - B.S. @ PT "A"							
36°21'23"	36°21'27"	36°21'25"	91°19'18"	268°40'45"	91°19'17"	1.395	IMU PORT
INST. ON PT "N" - B.S. @ PT "A"							
317°19'00	317°18'54"	317°18'57"	96°08'50"	263°50'58"	96°08'56"	1.624	IMU STARBORD

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JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09
7-26-09

SHEET NO.: 17

STA	BS	HI	FS	ELEV	DESCRIPTION
				-8.558	PT "B"
	1.092	-7.466			
			-0.357	-7.109	T.P. 6 PORT SIDE
	-0.349	-7.458			
			1.100	-8.558	PT "B"
	1.100	-7.458			
			-0.361	-7.097	T. P. 7 STARBOARD SIDE
	-0.346	7.443			
			1.116	-8.559	(0.001) PT "B"
				-7.097	T.P. 7
	1.377	-5.720			
			0.104	-5.824	IMU STARBOARD (OLD)
	0.103	-5.721			
			1.376	-7.097	T.P. 7
				-7.109	T.P. 6
	1.341	-5.768			
			0.070	-5.838	IMU PORT (OLD)
	0.087	-5.751			
			1.358	-7.109	T. P. 6

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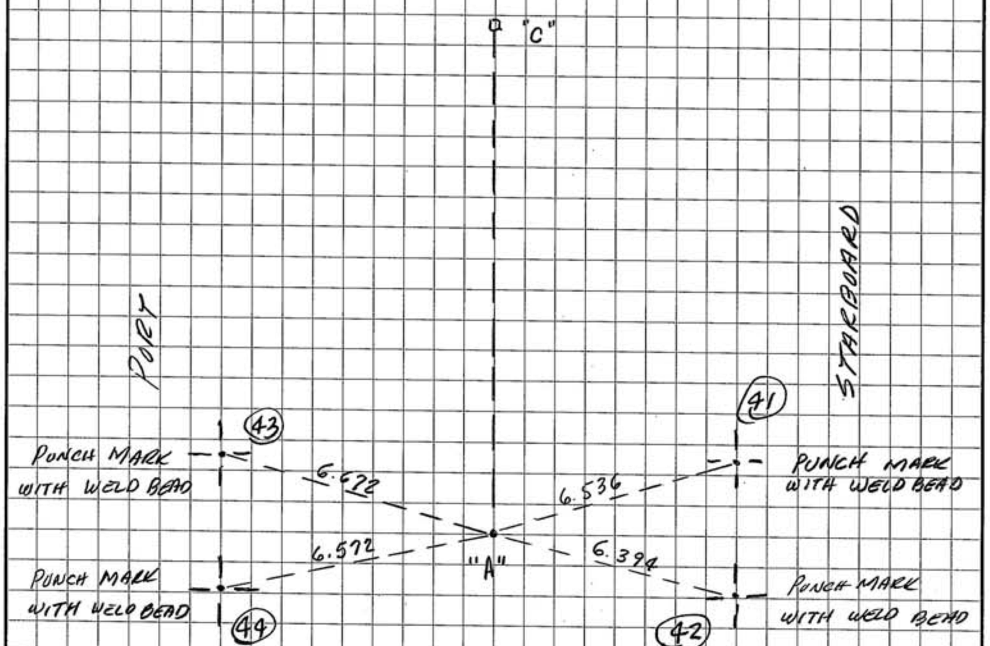
SCALE: 1" = **NONE**

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 18



INSTRUMENT OF PT "A" - B.S. @ PT "C"

∢1	∢2	AVG.	Z∢1	Z∢2	AVG	DIST.	POINT
76°51'22"	76°51'28"	76°51'25"	89°41'15"	270°18'38"	89°41'19"	6.536	41
85°40'36"	85°40'32"	85°40'34"	89°44'20"	270°15'48"	89°44'16"	6.394	42
279°43'20"	279°43'21"	279°43'21"	89°58'54"	270°00'50"	89°59'02"	6.672	43
272°26'53"	272°27'01"	272°26'57"	90°00'48"	269°59'21"	90°00'43"	6.572	44

RAYMOND C. IMPASTATO
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139 RANCH ROAD
SLIDELL, LOUISIANA 70460
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SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

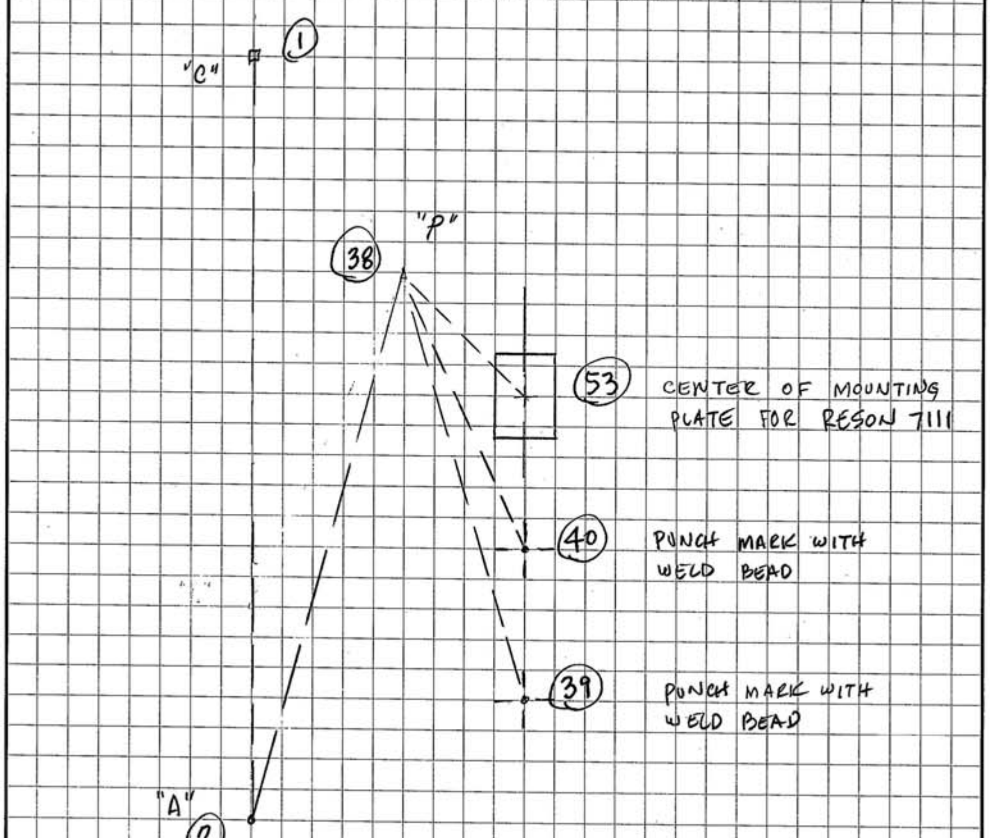
FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 19

INST. ON PT "A" - BS @ PT "C"

∡1	∡2	AVG	Z∡1	Z∡2	AVG	DIST.	POINT
19°03'19	19°03'21"	19°03'20"	92°05'28"	267°54'30	92°05'28	10.455	"P"



INST ON PT "P" - B.S. @ PT. "A"

∡1	∡2	AVG	Z∡1	Z∡2	AVG.	DIST	POINT
274°14'00"	274°13'51"	274°13'56"	82°48'55"	277°11'02"	82°48'57"	3.947	RESON 7111
291°24'44"	291°24'49"	291°24'46"	83°00'01"	276°59'44"	83°00'09"	4.820	PUNCH MARK
297°48'51"	297°49'01"	297°48'56"	84°29'45	275°30'01"	84°29'52"	5.363	PUNCH MARK

RAYMOND C. IMPASTATO
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PHONE NO: (985) 774-1955

SCALE: 1" = NONE

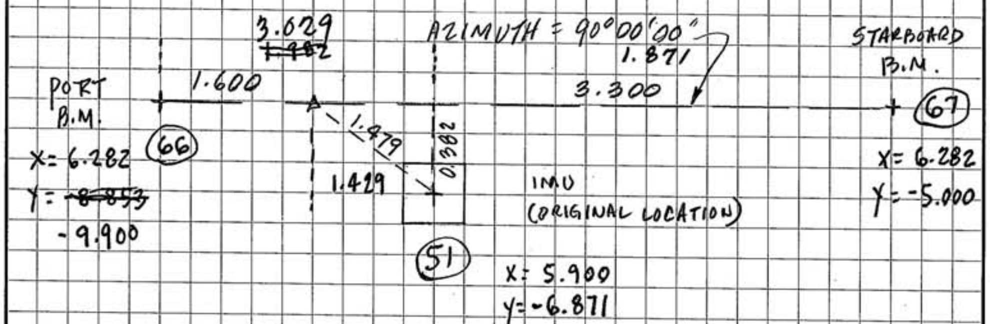
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 20

BENCH MARKS IMU ROOM
PORT SIDE PONTOON



RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

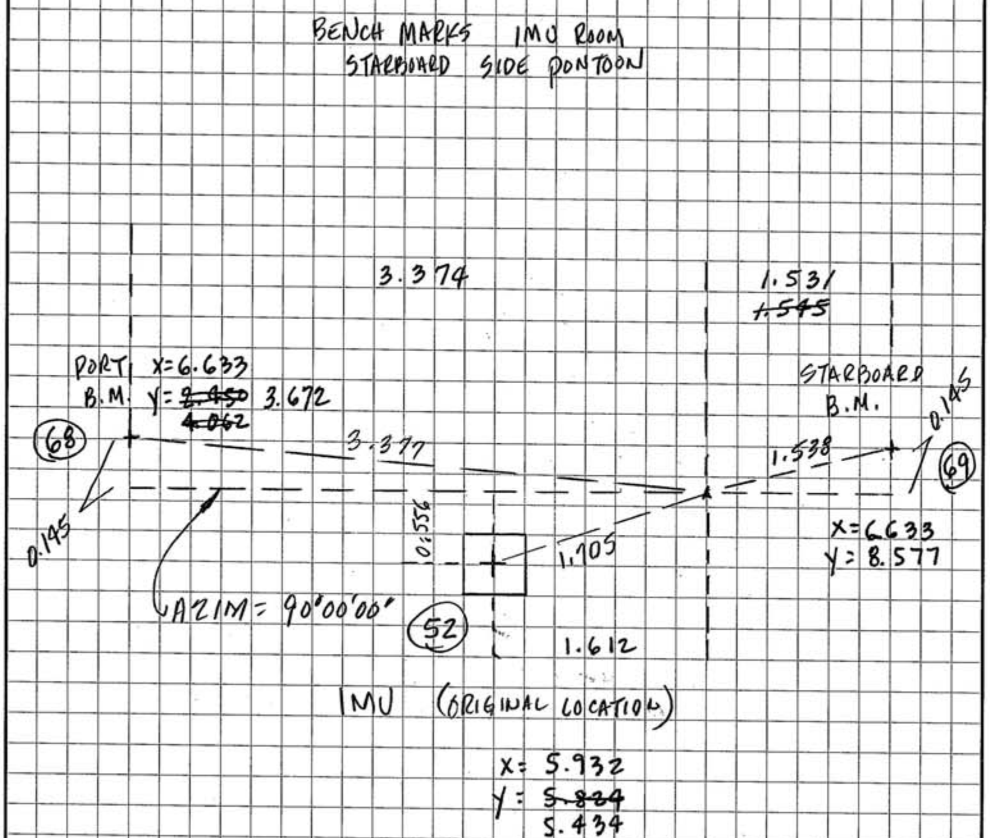
SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 / 7-26-09 SHEET NO.: 21



RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 22

STA	BS	HI	FS	ELEV	DESCRIPTION
					(ORIGINAL LOCATION)
				-5.838	IMU PORT SIDE PONTOON
	0.268	-5.570			
			0.220	-5.790	PORT B.M.
			0.289	-5.859	STARBOARD B.M
	0.296	-5.560			
			0.227	-5.790	PORT B.M.
			0.275	-5.838	IMU
					(ORIGINAL LOCATION)
				-5.824	IMU STARBOARD SIDE B.M.
	0.227	-5.597			
			0.250	-5.847	PORT B.M
			0.200	-5.797	STARBOARD B.M.
	0.215	-5.582			
			0.266	-5.848	PORT B.M.
			0.242	-5.824	IMU

RAYMOND C. IMPASTATO
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139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = **NONE**

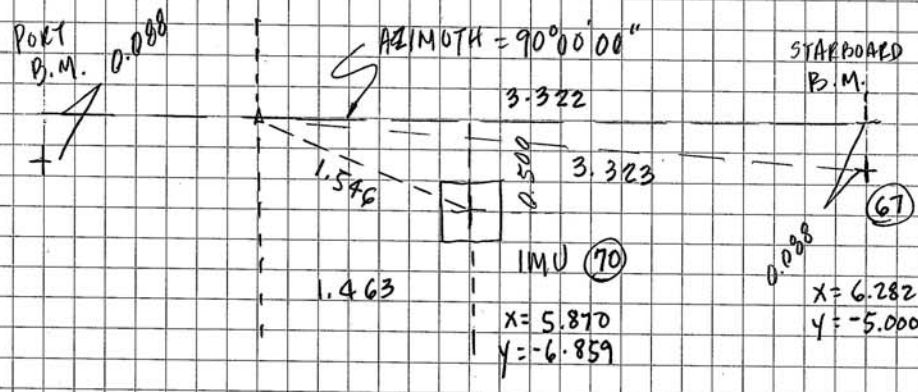
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 23

PRESENT LOCATION OF IMU
PORT SIDE PONTOON



RAYMOND C. IMPASTATO
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139 RANCH ROAD
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PHONE NO: (985) 774-1955

SCALE: 1" = NONE

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PASCAGOULA, MISSISSIPPI

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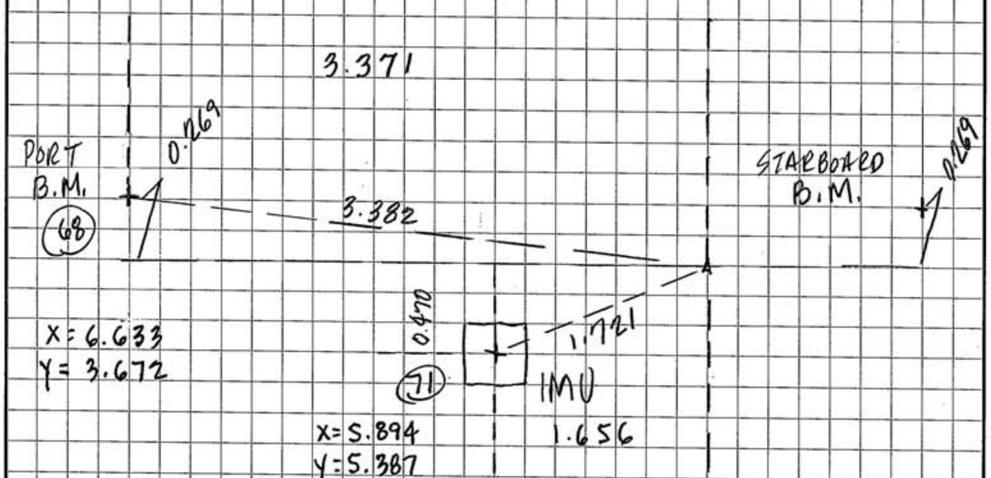
CALCULATED BY: R. IMPASTATO

DATE: 7-18-09
7-26-09

SHEET NO.: 24

PRESENT LOCATION OF IMU

STARBOARD SIDE PONTOON



RAYMOND C. IMPASTATO
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139 RANCH ROAD
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PHONE NO: (985) 774-1955

SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 SHEET NO.: 25
7-26-09

STA	BS	HI	FS	ELEV	DESCRIPTION
					PRESENT LOCATION
					PORT SIDE PONTOON IMU
				-5.859	STARBOARD B.M.
	0.184	-5.675			
			0.091	-5.766	IMU
	0.103	-5.663			
			0.196	-5.859	STARBOARD B.M
					PRESENT LOCATION
					STARBOARD SIDE PONTOON IMU
				-5.847	PORT B.M.
	0.236	-5.611			
			0.142	-5.753	IMU
	0.158	-5.595			
			0.252	-5.847	PORT B.M.

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JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

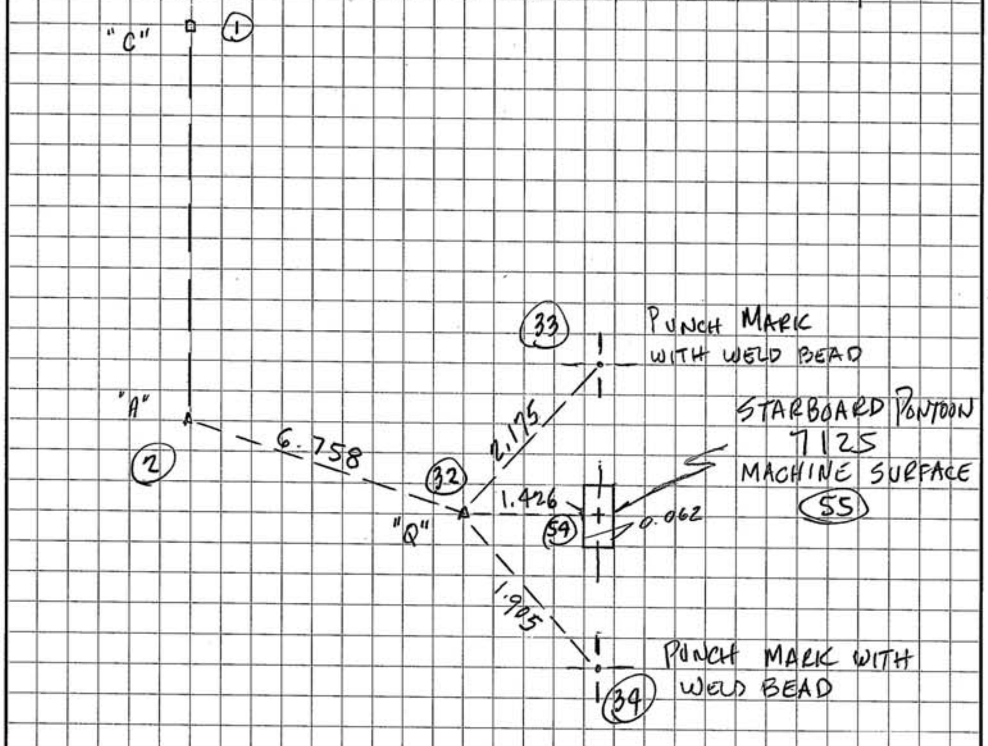
CALCULATED BY: R. IMPASTATO

DATE: 7-18-09
7-26-09

SHEET NO.: 26

INST. ON PT. "A" - B.S. @ PT "C"

∡1	∡2	AVG	Z∡1	Z∡2	AVG.	DIST	POINT
117°20'06"	117°20'10"	117°20'08	90°54'43"	269°05'11"	90°54'46"	6.758	"Q"



INST. ON PT. "Q" - B.S. @ PT. "A"

∡1	∡2	AVG	Z∡1	Z∡2	AVG	DIST	POINT
150°50'00"	150°50'18"	150°50'09	68°11'10"	291°48'44"	68°11'13"	1.426	PORT SIDE OF 7125
103°03'47"	103°04'00"	103°03'54"	77°48'15"	282°11'54	77°48'11"	2.175	PUNCH MARK
192°58'26"	192°58'41"	192°58'34"	76°10'56"	283°49'00"	76°10'58	1.905	PUNCH MARK

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

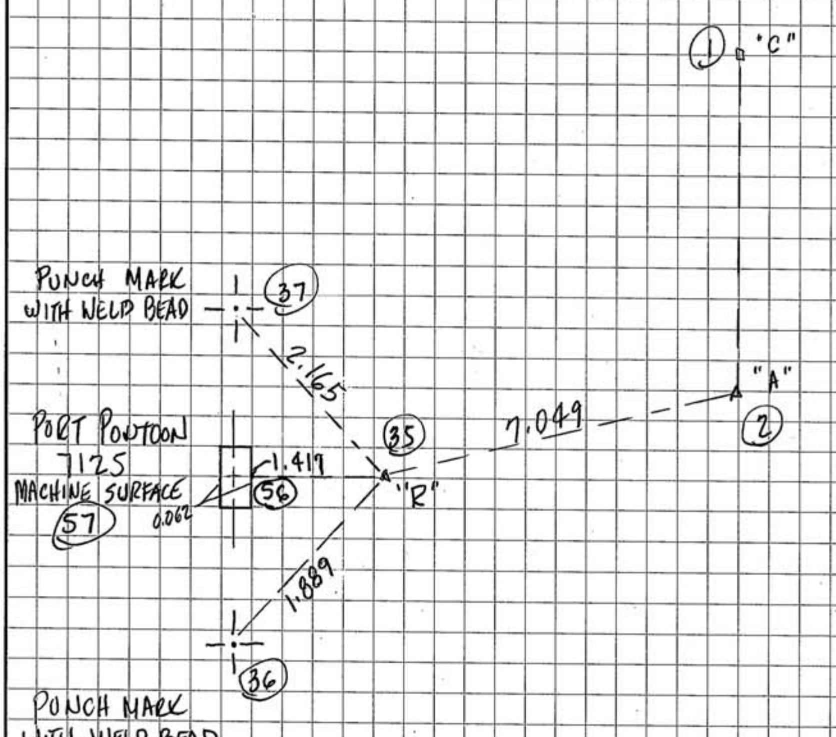
FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 SHEET NO.: 27
7-26-09

INST. ON PT "A" - B.S. @ PT "C"

∡1	∡2	AVG	Z ∡1	Z ∡2	AVG	DIST	POINT
242°20'59	242°20'59"	242°20'59"	91°17'11"	268°42'49	91°17'11"	7.049	"R"



INST. ON PT "R" - B.S. @ PT "A"

∡1	∡2	AVG	Z ∡1	Z ∡2	AVG	DIST	POINT
207°41'09"	207°44'21"	207°44'15"	64°49'01"	295°10'23"	64°49'19"	1.417	STARB. SIDE 7125
256°06'39"	256°06'49"	256°06'44"	75°35'51"	284°23'58"	75°35'57"	2.165	PUNCH MARK
166°12'22"	166°12'21"	166°12'22"	73°41'25"	286°18'14"	73°41'36"	1.889	PUNCH MARK

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 SHEET NO.: 28
7-26-09

STA	BS	HI	FS	ELEV	DESCRIPTION		
				-8.558	PT "B"		
	1.234	-7.324					
			-0.166	-7.158	AFT P.M. 7125	PORT	PONTOON
			-0.239	-7.085	7125 PORT SIDE	"	"
			-0.242	-7.082	7125 STARB. SIDE	"	"
			-0.174	-7.150	FWD P.M. 7125	"	"
			-0.158	-7.166	AFT P.M. (-7.167)	"	"
			-0.157	-7.167	FWD P.M (-7.168)	"	"
			-0.494	-6.830	RESON 7111	STARBOARD	PONTOON
			-0.586	-6.738	FWD. P.M. 7111	"	"
			-0.513	-6.811	AFT P.M. 7111	"	"
			-0.179	-7.145	FWD P.M FB	"	"
			-0.175	-7.149	AFT P.M. FB	"	"
			-0.178	-7.146	FWD P.M. 7125	"	"
			-0.247	-7.077	7125 PORT SIDE	"	"
			-0.251	-7.073	7125 STARB. SIDE	"	"
			-0.172	-7.152	AFT P.M. 7125	"	"
	-0.186	-7.330					
			-0.265	-7.073	7125 STARB. SIDE	"	"
			-0.261	-7.077	7125 PORT SIDE	"	"
			-0.191	-7.147	FWD P.M 7125	"	"
			-0.188	-7.150	AFT P.M. FB	"	"
			-0.192	-7.146	FWD P.M. FB	"	"
			-0.526	-6.812	AFT P.M. 7111	"	"
			-0.600	-6.738	FWD P.M. 7111	"	"
			-0.507	-6.831	RESON 7111	"	"
			-0.169	-7.169	FWD P.M. FB	PORT	PONTOON
			-0.170	-7.168	AFT P.M. FB	"	"
			-0.187	-7.151	FWD P.M. 7125	"	"
			-0.256	-7.082	7125 STARB. SIDE	"	"
			-0.252	-7.086	7125 PORT SIDE	"	"
			-0.179	-7.159	AFT P.M. 7125	"	"
			1.220	-8.558	PT "B"		

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = NONE

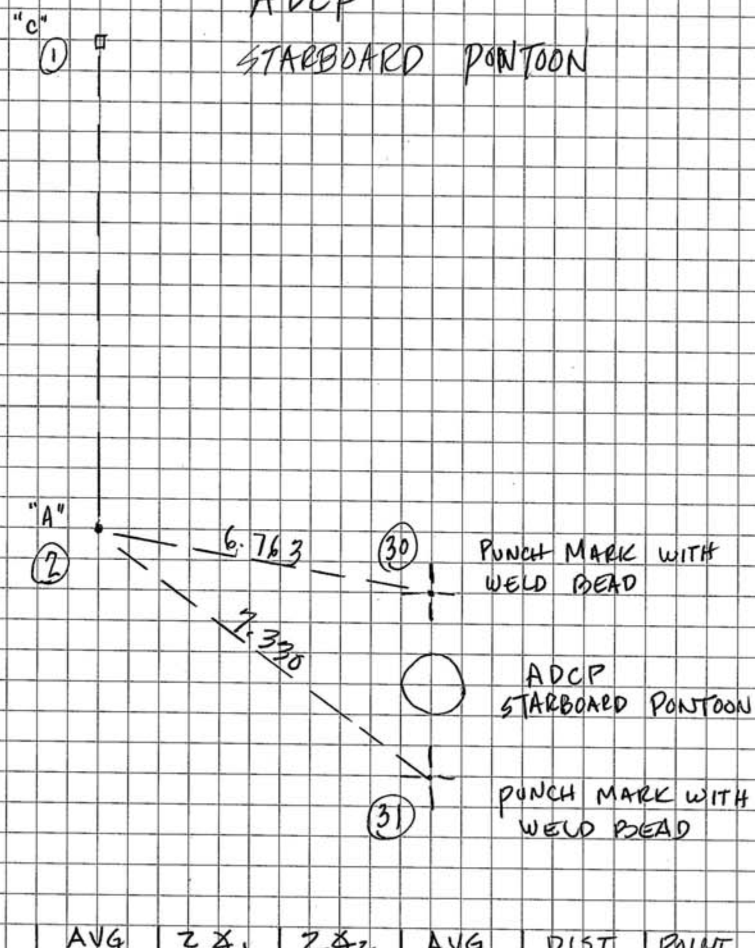
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 29

ADCP
STARBOARD PONTOON



∡1	∡2	AVG	Z∡1	Z∡2	AVG	DIST	POINT
109°11'49"	109°11'57"	109°11'53"	87°03'07"	272°56'52"	87°03'07"	6.763	FWD PUNCH MARK
119°11'11"	119°11'14"	119°11'13"	87°20'24"	272°39'40"	87°20'22"	7.336	AFT PUNCH MARK

RAYMOND C. IMPASTATO
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LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
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PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 38

STA	BS	HI	FS	ELEV	DESCRIPTION
				-7.152	AFT P.M. 7125 STARBOARD PONTOON
	0.279	-6873			
			0.256	-7.129	AFT PUNCH MARK ADCP
			0.263	-7.136	FWD PUNCH MARK ADCP
	0.297	-6.839			
			0.290	-7.129	AFT PUNCH MARK ADCP
			0.313	-7.152	AFT P.M. 7125 STARBOARD PONTOON

RAYMOND C. IMPASTATO
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139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

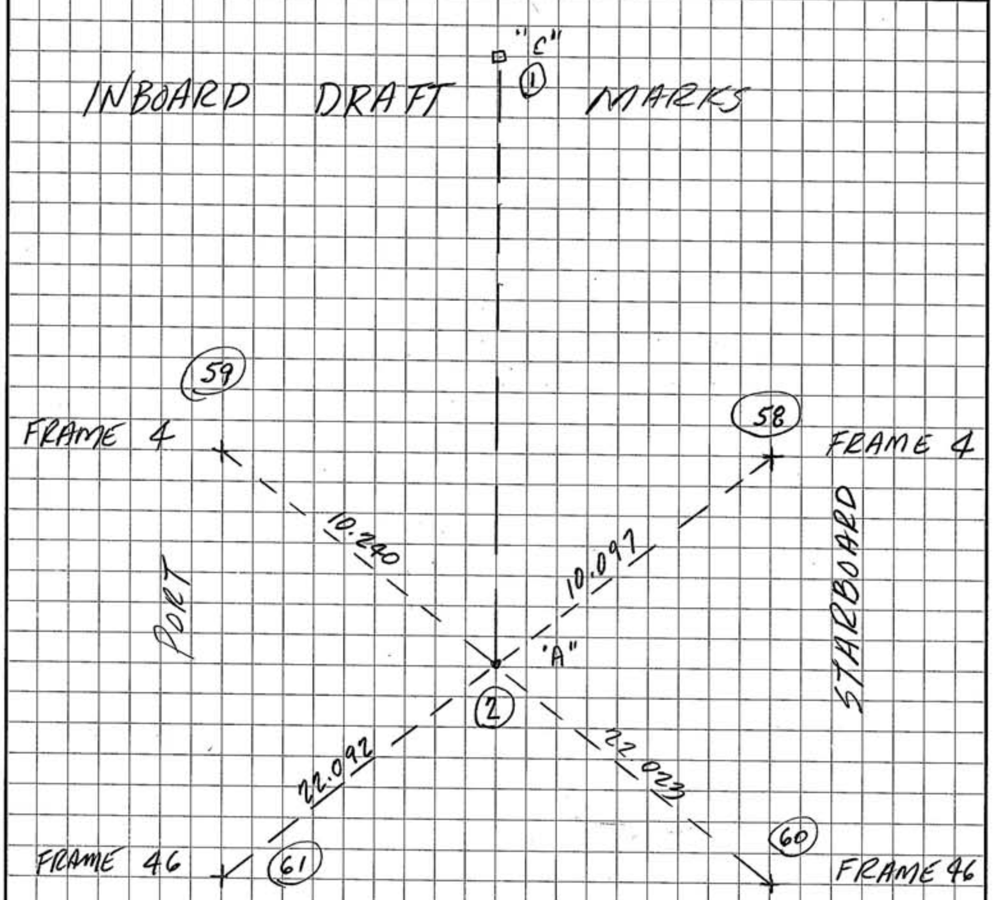
SCALE: 1" = NONE

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I., E.K., J. M. & B. K.

CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 31



INST. ON PT "A" - B.S. @ PT "C"

∢1	∢2	AVG	Z∢1	Z∢2	AVG	DIST	POINT
41°11'21"	41°11'05"	41°11'13"	61°42'40"	298°17'23"	61°42'39"	10.097	FRAME 4
316°12'03"	316°12'10"	316°12'07"	62°15'00	297°45'04	62°14'58	10.240	FRAME 4
162°46'43	162°46'44"	162°46'44"	77°38'18"	282°21'40"	77°38'19"	22.023	FRAME 46
196°29'33"	196°29'37"	196°29'30"	77°38'32"	282°21'26"	77°38'33"	22.092	FRAME 46

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = NONE

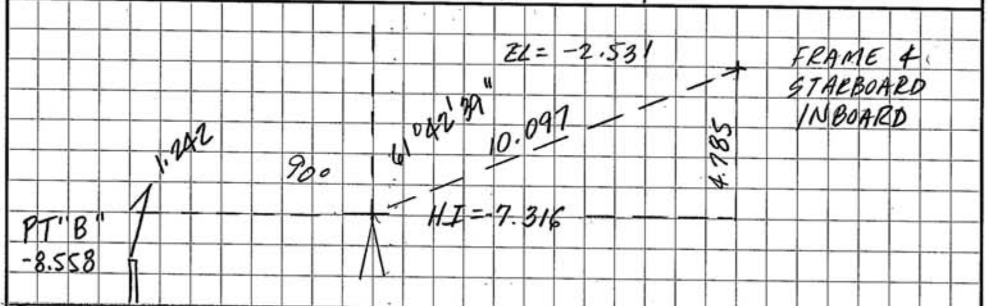
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

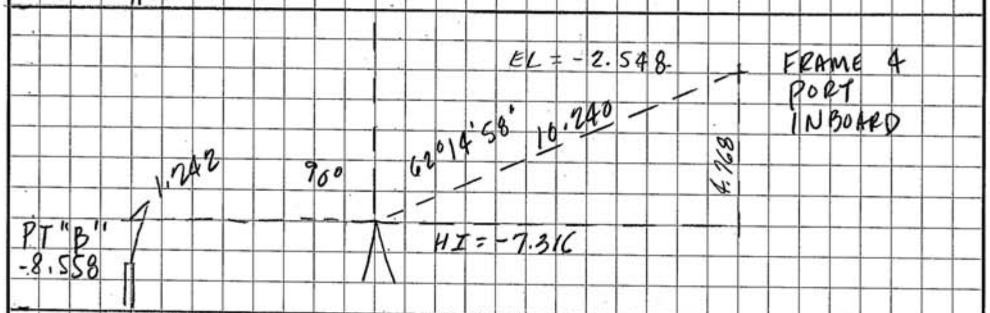
FIELD CREW: R.I., E.K., J. M. & B. K.

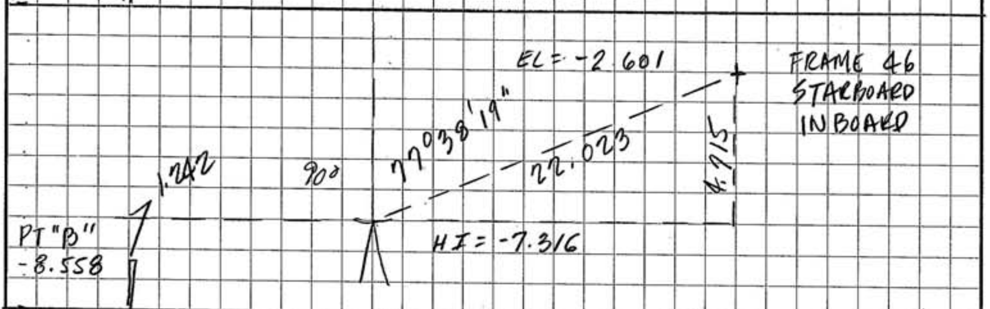
CALCULATED BY: R. IMPASTATO

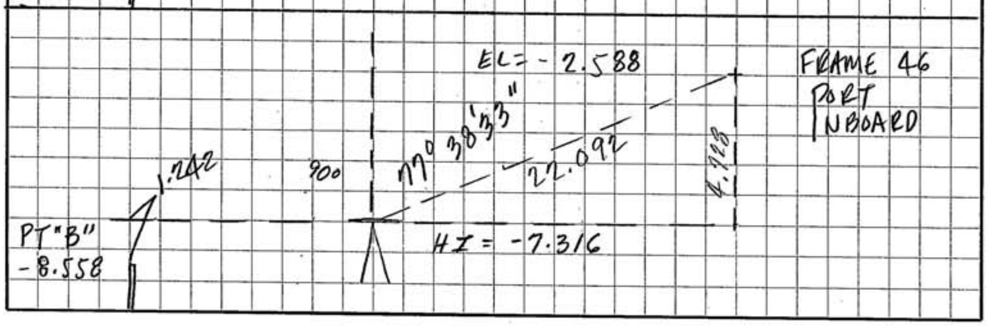
DATE: 7-18-09
7-26-09

SHEET NO.: 32

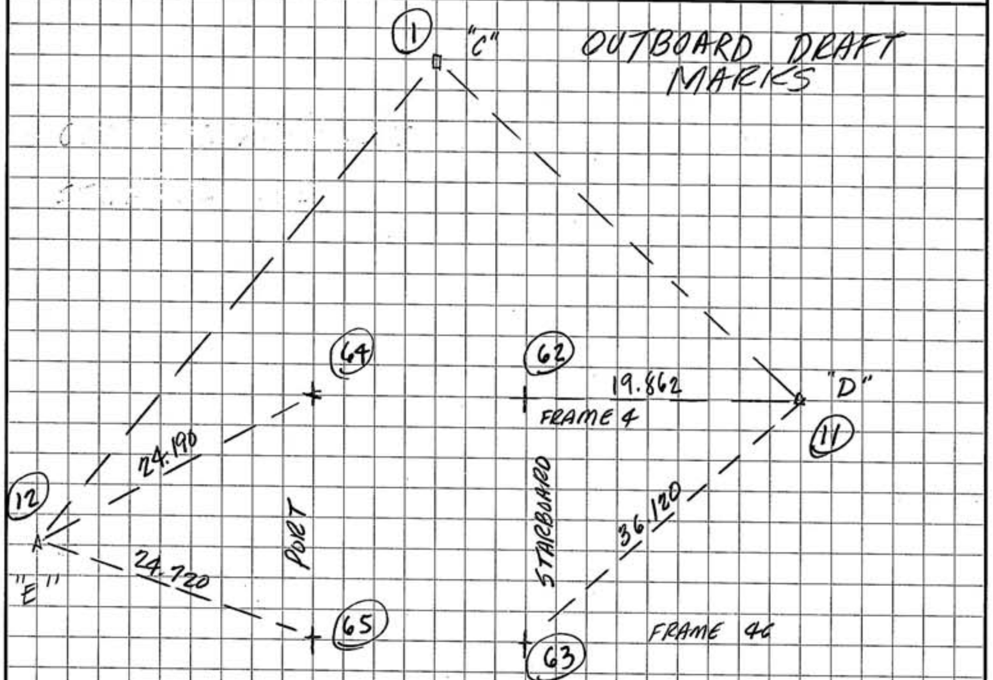








RAYMOND C. IMPASTATO PROFESSIONAL LAND SURVEYOR 139 RANCH ROAD SLIDELL, LOUISIANA 70460 PHONE NO: (985) 774-1955 SCALE: 1" = NONE	JOB: FERDINAND R. HASSLER M286 SWATH PASCAGOULA, MISSISSIPPI FIELD CREW: R.I., E.K., J. M. & B. K. CALCULATED BY: R. IMPASTATO DATE: 7-18-09 / 7-26-09 SHEET NO.: 33



INSTRUMENT ON PT "D" - B.S @ PT "C"

∡1	∡2	AVG	Z ∡1	Z ∡2	AVG	DIST	POINT
292°15'44	292°15'53"	292°15'49"	76°11'28"	283°48'34'	76°11'27"	19,862	FRAME 4 STARBOARD
243°35'26"	243°35'34"	243°35'30"	82°33'53"	277°26'07"	82°33'53"	36.126	FRAME 46 STARBOARD
INST. @ PT "E" - B.S. @ PT "C"							
30°38'48"	30°38'49"	30°38'49"	101°49'55"	258°10'01"	101°49'57"	24.145	FRAME 4 PORT
100°00'48"	100°00'49	100°00'49	101°37'22"	258°22'42"	101°37'20"	24.720	FRAME 46 PORT

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

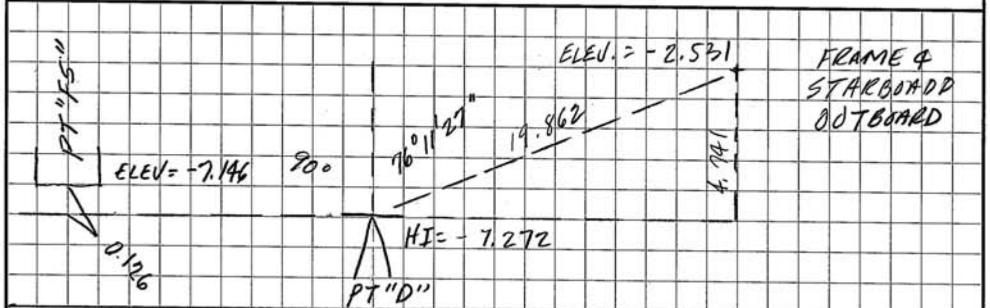
SCALE: 1" = NONE

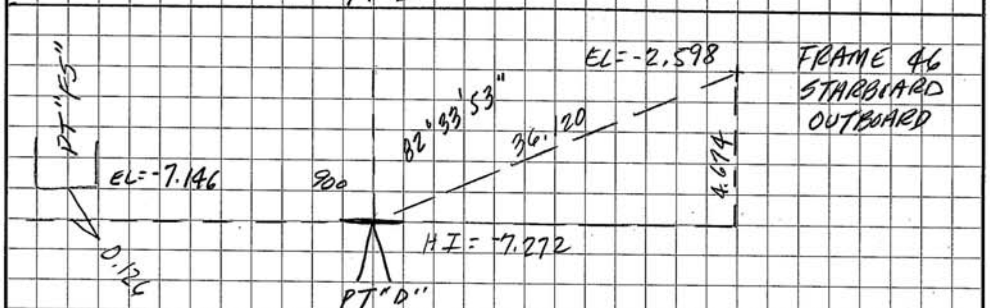
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

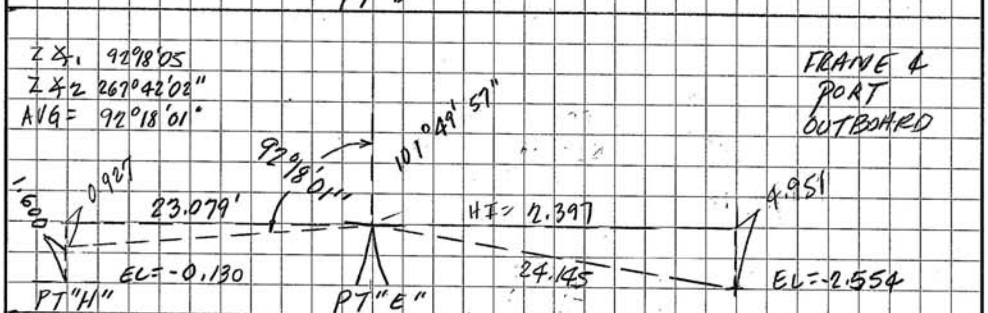
FIELD CREW: R.I., E.K., J. M. & B. K.

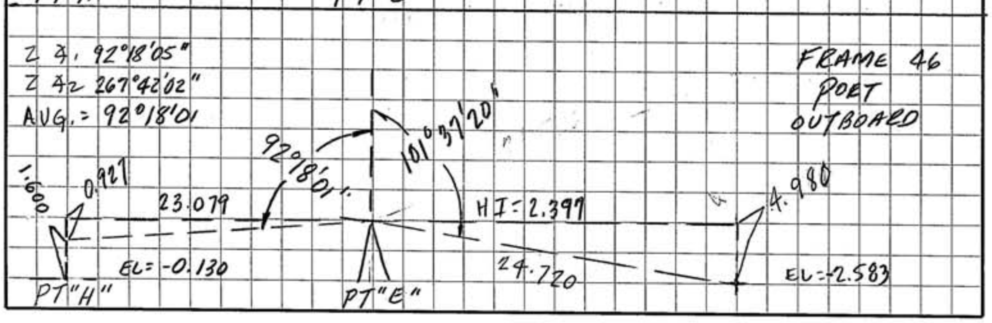
CALCULATED BY: R. IMPASTATO

DATE: 7-18-09 7-26-09 SHEET NO.: 34









RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = NONE

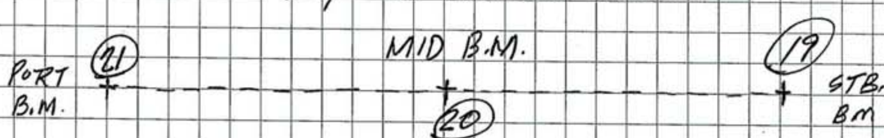
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I. & E.K.

CALCULATED BY: R. IMPASTATO

DATE: 11-4-09 SHEET NO.: 1

TOP OF WHEEL HOUSE



INSTRUMENT ON STB. B.M - B.S @ PORT B.M. ZA = 103°44'50"

	HOR. ∡	AZIMUTH
BOLT ℄ LOWER GPS ANTENNAE	310° 52' 34"	
	310° 52' 42"	
AVG	310° 52' 38"	220° 52' 38
BOLT ℄ UPPER GPS ANTENNAE	307° 14' 02"	
	307° 14' 23	
AVG	307° 14' 13"	217° 14' 13"

INSTRUMENT ON MID B.M. - B.S @ PORT B.M. ZA = 115° 58' 30"

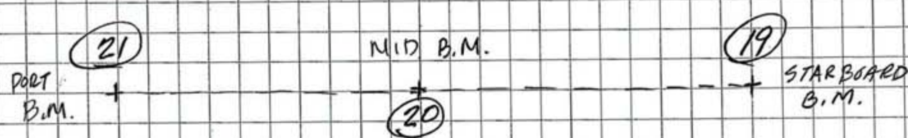
	HORIZ ∡	AZIMUTH	ZENITH ∡
BOLT ℄ LOWER GPS ANTENNAE	283°53'38"		77°53'50"
	283°53'48"		282°06'40"
AVG	283°53'43	193°53'43"	77°53'35"
BOLT ℄ UPPER GPS ANTENNAE	282°18'38"		62°31'34"
	282°18'40"		297°28'25"
AVG	282°18'39	192°18'39"	62°31'35"

PORT GPS ANTENNAES

NOTE: 0.022m FROM BOTTOM OF BOLT TO BOTTOM OF ANTENNAE

RAYMOND C. IMPASTATO PROFESSIONAL LAND SURVEYOR 139 RANCH ROAD SLIDELL, LOUISIANA 70460 PHONE NO: (985) 774-1955 SCALE: 1" = **NONE**	JOB: FERDINAND R. HASSLER M286 SWATH PASCAGOULA, MISSISSIPPI FIELD CREW: R.I. & E.K. CALCULATED BY: R. IMPASTATO DATE: 11-4-09 SHEET NO.: 2

TOP OF WHEEL HOUSE



INSTRUMENT ON PORT B.M. - B.S. @ STARBOARD B.M.

	HORIZ ∡	AZIMUTH
BOLT ℄ LOWER GPS ANTENNAE	49°34'47"	
	49°34'43"	
AVG.	49°34'45"	139°34'45
BOLT ℄ UPPER GPS ANTENNAE	53°24'46"	
	53°24'50"	
AVG.	53°24'48"	143°24'48

INSTRUMENT ON MID B.M. B.S @ PORT B.M. Z.A = 115°58'30"

	HORIZ. ∡	AZIMUTH	ZENITH ∡
BOLT ℄ LOWER GPS ANTENNAE	256°41'23"		77°46'38"
	256°41'18"		282°14'00"
AVG	256°41'21"	166°41'21"	77°46'19"
	258°30'00"		62°24 45"
BOLT ℄ UPPER GPS ANTENNAE	258°29'42"		297°35'00"
AVG.	258°29'51"	168°29'51"	62°24'53"

STARBOARD GPS
ANTENNAES

RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

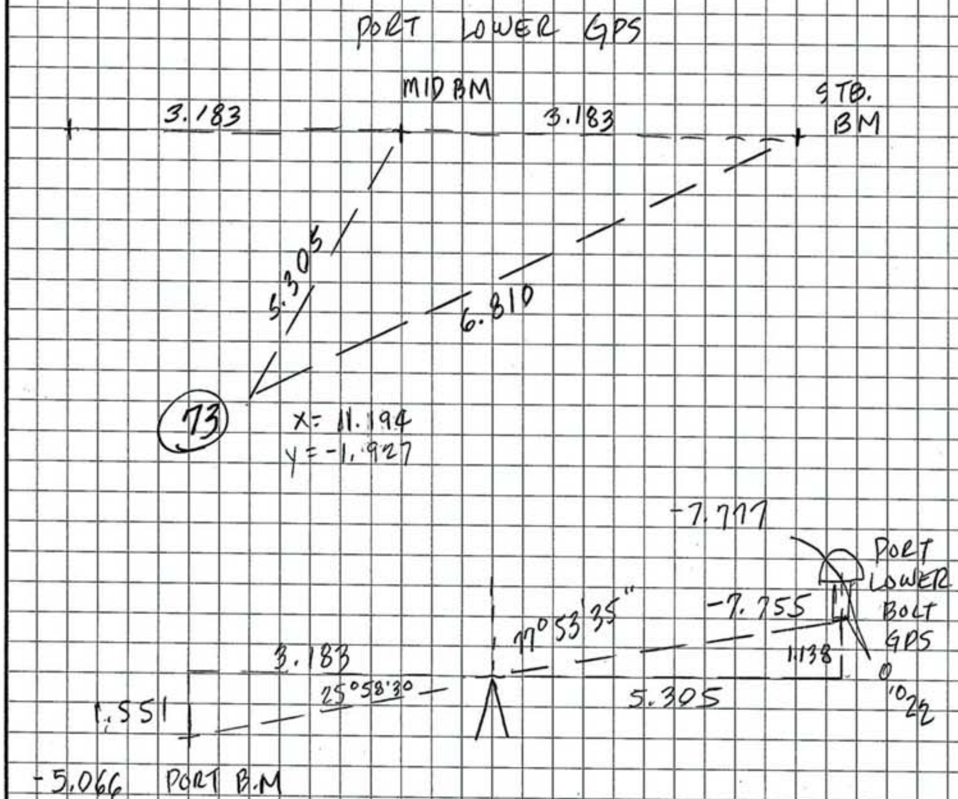
SCALE: 1" = **NONE**

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I. & E.K.

CALCULATED BY: R. IMPASTATO

DATE: 11-4-09 SHEET NO.: 3



RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

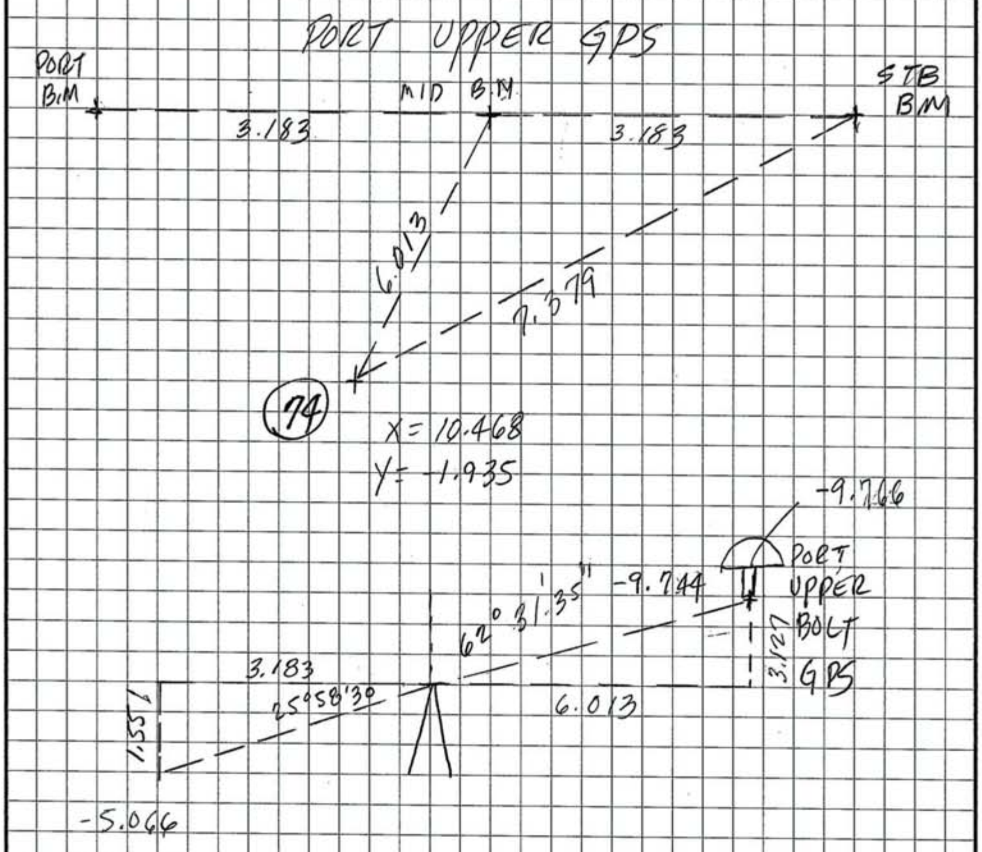
SCALE: 1" = **NONE**

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I. & E.K.

CALCULATED BY: R. IMPASTATO

DATE: 11-4-09 SHEET NO.: 4



RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = **NONE**

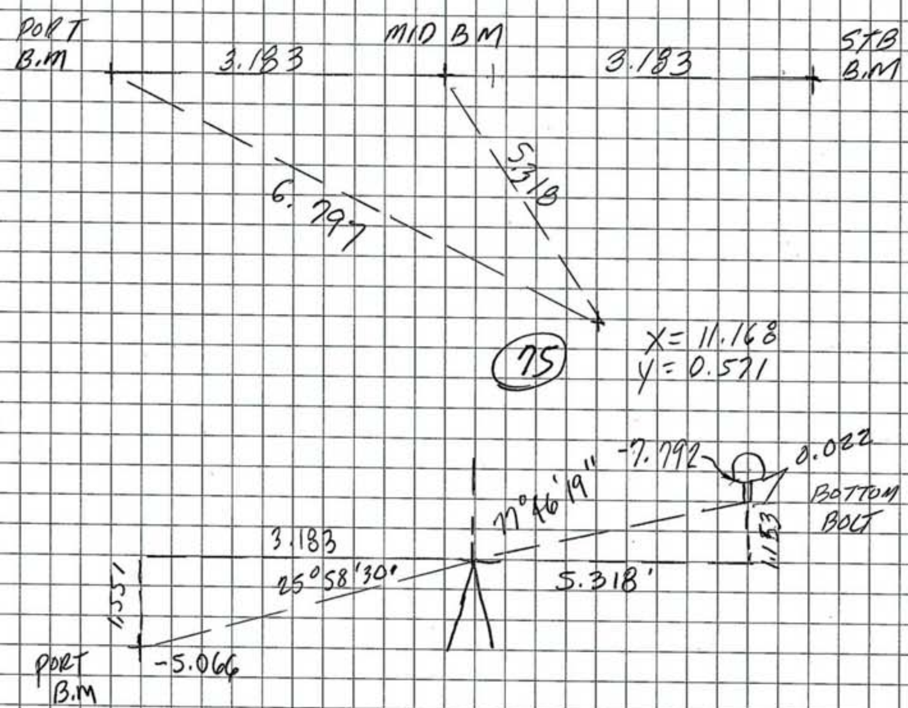
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I. & E.K.

CALCULATED BY: R. IMPASTATO

DATE: 11-4-09 SHEET NO.: 5

STARBOARD LOWER GPS



RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

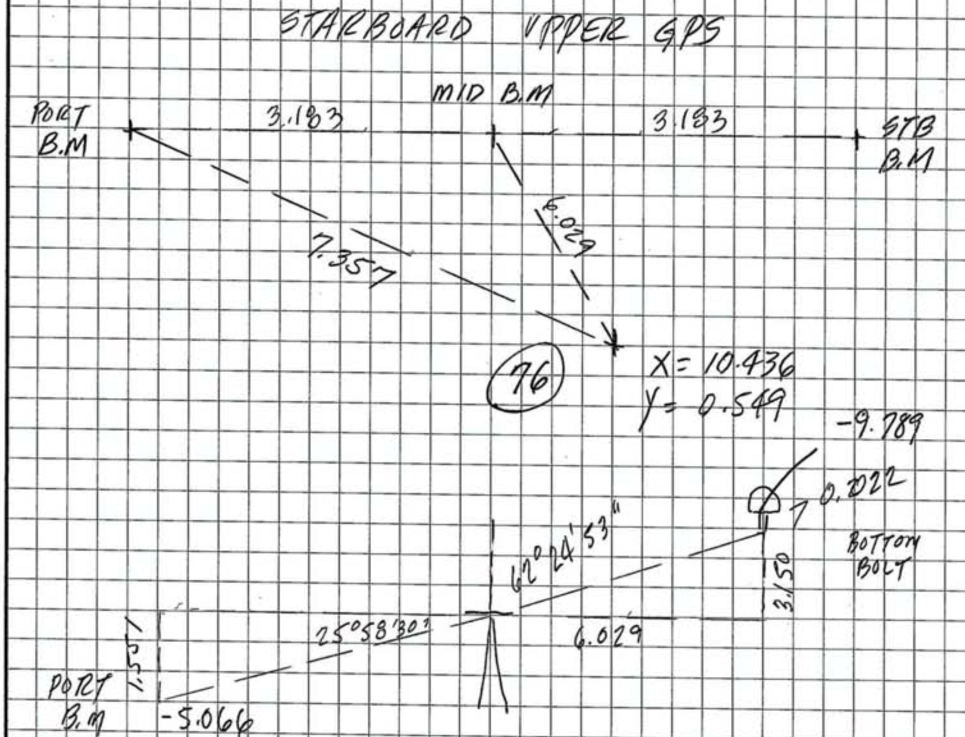
SCALE: 1" = **NONE**

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I. & E.K.

CALCULATED BY: R. IMPASTATO

DATE: 11-4-09 SHEET NO.: 6



RAYMOND C. IMPASTATO
PROFESSIONAL
LAND SURVEYOR

139 RANCH ROAD
SLIDELL, LOUISIANA 70460
PHONE NO: (985) 774-1955

SCALE: 1" = **NONE**

JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I. & E.K.

CALCULATED BY: R. IMPASTATO

DATE: 11-4-09 SHEET NO.: 7

BACK DECK

PORT B.M. (48) — — — — — — — — — — — — (47) STARBOARD B.M.

INSTRUMENT ON STARBOARD B.M. B.S. @ PORT B.M.
Z.A = 96°53'06"

	HORIZ. ∡	AZIMUTH	ZENITH ∡
℄ BOTTOM OF CENTER BLOCK	318°17'00"		73°49'25"
	318°16'48"		286°10'30"
AVG	318°16'54"	228°16'54"	73°49'28"

INSTRUMENT ON PORT B.M. - B.S. STARBOARD B.M.

	HORIZ. ∡	AZIMUTH	ZENITH ∡
℄ BOTTOM OF CENTER BLOCK	41°58'22"		
	41°58'06"		
AVG.	41°58 14"	131°58'14	

"A" FRAME
CENTER BLOCK (BOTTOM)

RAYMOND C. IMPASTATO
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SLIDELL, LOUISIANA 70460
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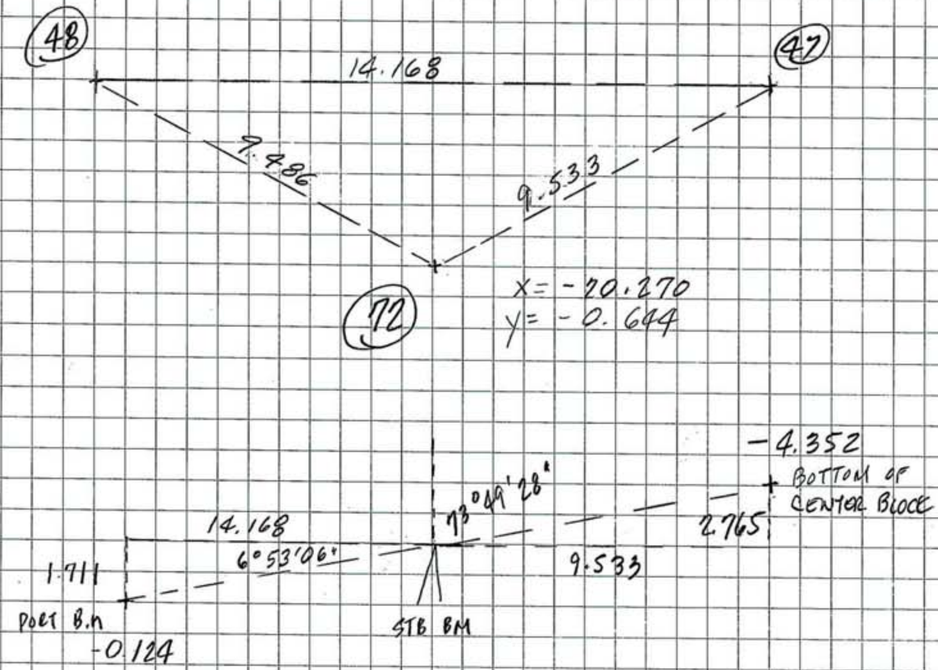
JOB: FERDINAND R. HASSLER
M286 SWATH
PASCAGOULA, MISSISSIPPI

FIELD CREW: R.I. & E.K.

CALCULATED BY: R. IMPASTATO

DATE: 11-4-09 SHEET NO.: 8



"A" FRAME - CENTER BLOCK

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Ocean Service
National Geodetic Survey
Field Operations Branch

NOAA SHIP HASSLER
POS ANTENNA and Component Spatial Relationship Survey
Field Report

Kevin Jordan
March, 2011

NOAA Ship Hassler
POS Antenna and Spatial Relationship Survey

PURPOSE

The intention of this survey was to accurately position the relocated POS Antennas and Side Scan Sonar tow point.

PROJECT DETAILS

This survey was conducted on March 29, 2011 on Spring River Island in Pascagoula, MS. NGS was provided data from a previous survey that contained a complete point listing of all components as well as recoverable bench mark stations. The NOAA Ferdinand Hassler was in water causing some instability of the instrument and target reflectors. The tilt compensator had to be bypassed in order to take measurements.

INSTRUMENTATION

The TOPCON GPT 3000 Series Total Station was used to make all measurements.

A SECO 25 mm Mini Prism System configured to have a zero mm offset was used as target sighting and distance measurements.

SOFTWARE AND DATA COLLECTION

TDS Survey Pro Ver. 4.7.1

ForeSight DXM Ver. 3.2.2 was used for post processing.

PERSONNEL

Kevin Jordan NOAA/NOS/NGS/Field Operations Branch 757-441-5478

Doug Adams NOAA/NOS/NGS/Field Operations Branch 757-441-5480

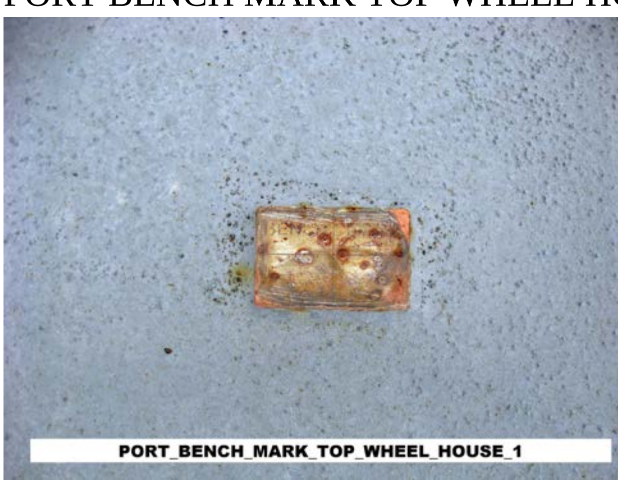
NOAA Ship Hassler
POS Antenna and Spatial Relationship Survey

SURVEY PROCEDURES

RECOVERED STATIONS

MID BENCH MARK TOP WHEEL HOUSE

PORT BENCH MARK TOP WHEEL HOUSE

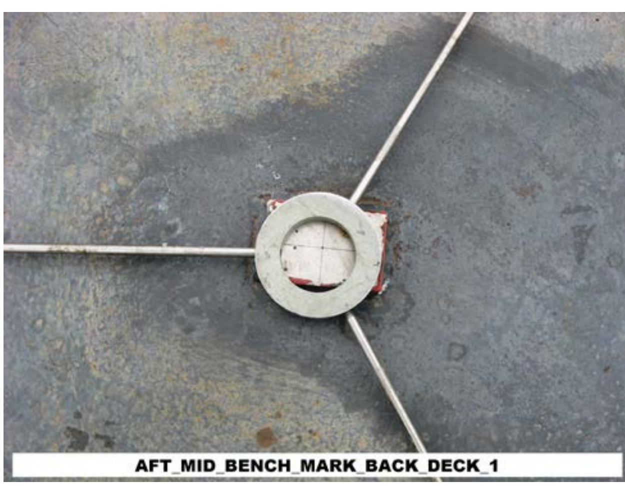


STARBOARD BENCH MARK TOP WHEEL HOUSE

STARBOARD_BENCH_MARK_TOP_WHEEL_HOUSE_1

STARBOARD_BENCH_MARK_TOP_WHEEL_HOUSE_2

AFT MID BENCH MARK BACK DECK



AFT_MID_BENCH_MARK_BACK_DECK_1

AFT_MID_BENCH_MARK_BACK_DECK_2

PORT BENCH MARK BACK DECK

PORT_BENCH_MARK_BACK_DECK_1

PORT_BENCH_MARK_BACK_DECK_2

STARBOARD BENCH MARK BACK DECK

STARBOARD_BENCH_MARK_BACK_DECK_1

STARBOARD_BENCH_MARK_BACK_DECK_2

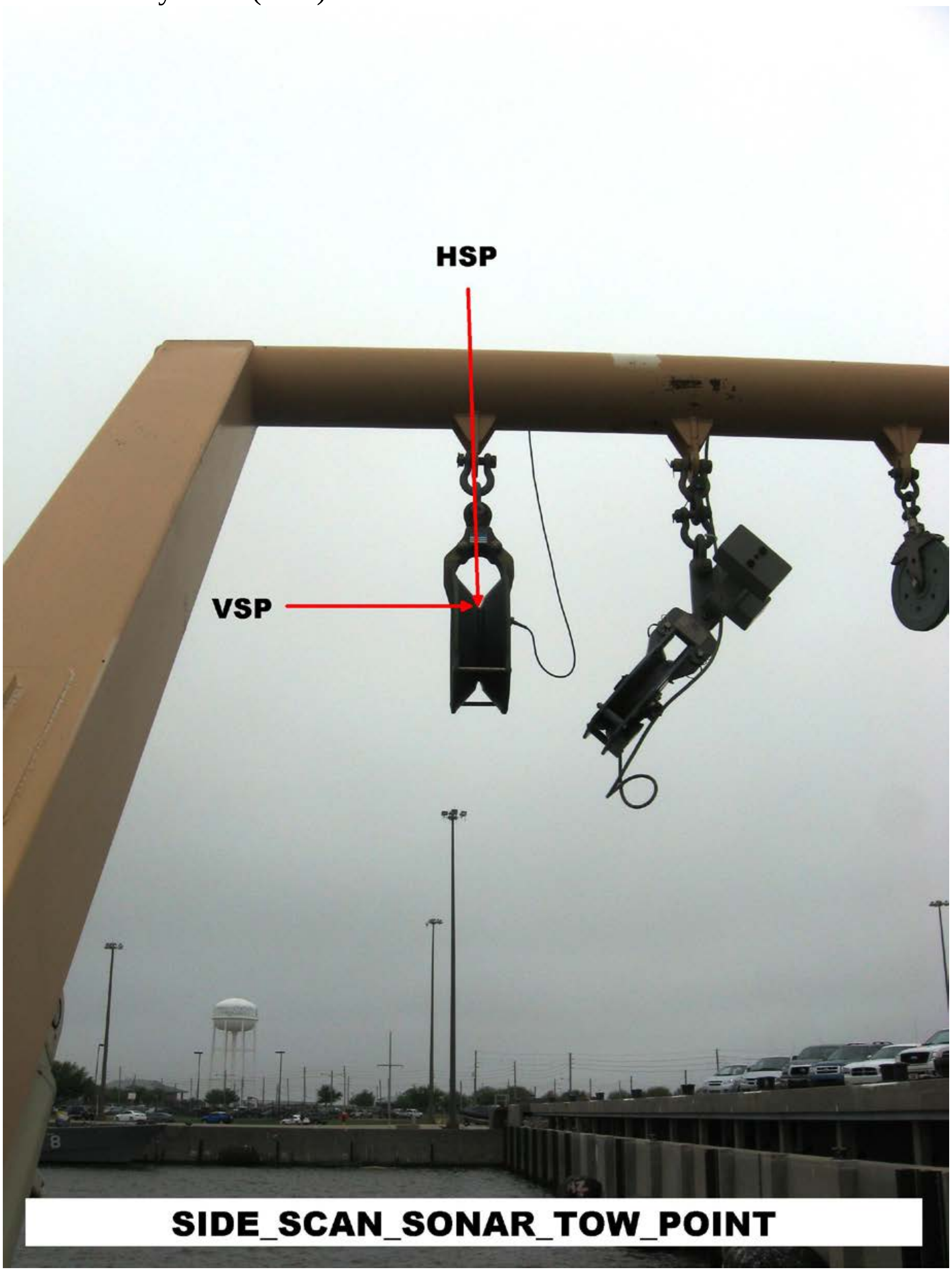
PORT BENCH MARK BRIDGE WING
-NO PHOTOS OF THIS STATION

NEW FEATURES

PORT POS ANTENNA MOUNT

STARBOARD POS ANTENNA MOUNT

SIDE SCAN SONAR TOW POINT
-Horizontal Survey Point (HSP)
-Vertical Survey Point (VSP)



Setup #1

Using the coordinates from the previous survey, the field crew setup the theodolite on the MID BENCH MARK TOP WHEEL HOUSE and initialized on PORT BENCH MARK BRIDGE WING to obtain a starting azimuth. From this setup, we collected the four POS antenna mount locations:

PORT FWD ANTENNA
PORT AFT ANTENNA
STARBOARD FWD ANTENNA
STARBOARD AFT ANTENNA

Positional checks were made to bench mark stations (see attached comparison report):

PORT BENCH MARK TOP WHEEL HOUSE
STARBOARD BENCH MARK TOP WHEEL HOUSE
PORT BENCH MARK BRIDGE WING

A temporary point (TP1) was established on the flying bridge near the stairs in order to collect the location of the SIDE SCAN SONAR TOW POINT.

Setup #2

The field crew setup on TP1 and initialized on the MID BENCH MARK TOP WHEEL HOUSE. From this setup, we collected:

SIDE SCAN SONAR TOW POINT

Positional checks were made to bench mark stations (see attached comparison report):

MID BENCH MARK TOP WHEEL HOUSE
AFT MID BENCH MARK BACK DECK

Setup #3

The field crew setup on AFT MID BENCH MARK BACK DECK and initialized on TP1. Positional checks were made to bench mark stations (see attached comparison report):

PORT BENCH MARK BACK DECK
STARBOARD BENCH MARK BACK DECK

DISCUSSION

All sensor/benchmark coordinates are contained in spreadsheets “NOAA SHIP HASSLER.xls”

The following table includes stations that were observed from more than one setup and for each, an inverse was computed to identify possible setup errors. Each station checked with favorable results.

OBSERVED to PUBLISHED COMPARISON (Units in Meters)			
NAME	**Δ Northing**	**Δ Easting**	**Δ Elevation**
PORT BENCH MARK BRIDGE WING	-0.003	-0.008	0
PORT BENCH MARK TOP WHEEL HOUSE	0.030	-0.015	-0.003
STARBOARD BENCH MARK TOP WHEEL HOUSE	-0.026	0.010	-0.006
MID BENCH MARK TOP WHEEL HOUSE	0.015	0.002	-0.007
AFT MID BENCH MARK BACK DECK	-0.020	-0.030	0.011
PORT BENCH MARK BACK DECK	0.027	-0.002	-0.005
STARBOARD BENCH MARK BACK DECK	-0.015	0.018	-0.011

Measurement	Stbd IMU to Fwd Port Ant		Port IMU to Aft Port Ant		Stbd IMU to Heave		Stbd IMU to Heave	
Coord. Sys.	Caris	POSMV	Caris	POSMV	Caris	POSMV	Caris	POSMV
x	-11.199	1.929	1.050	1.395	NA	NA	NA	NA
y	1.929	-11.199	1.395	1.050	NA	NA	NA	NA
z	-12.741	-12.741	-12.749	-12.749	NA	NA	NA	NA

Fwd Port Ant to Fwd Stbd Ant	
(from NGS survey)	
Scaler Distance	8.143

Aft Port Ant to Aft Stbd Ant	
(from NGS survey)	
Scaler Distance	8.138

Fwd Port Ant to Fwd Stbd Ant	
(from GAMS Cal)	
Scaler Distance	8.120

Fwd Port Ant to Fwd Stbd Ant	
(from GAMS Cal)	
Scaler Distance	8.104

POSMV offsets are derived from Impasato Centerline Survey (2010) and NGS POS Antenna Survey (April 2011), and measurements by FH personnel.

Calculations

Stbd IMU to Fwd Port Ant		
Center of IMU Plate to top of IMU	x	0
	y	0.000
	z	0.1675
(from POSMV V4 User Guide)		(in POSMV)
Center of Stbd IMU Plate to Fwd Port Antenna Base	x	1.929
	y	-11.199
	z	-12.862
(from Impastato)		(in POSMV)
Antenna base to phase center	x	0.000
	y	0.000
	z	-0.046
(from antenna)		(in POSMV)

Port IMU to Aft Port Ant		
Center of IMU Plate to top of IMU	x	0
	y	0.000
	z	0.1675
(from POSMV V4 User Guide)		(in POSMV)
Center of Port IMU Plate to Aft Port Antenna Base	x	1.395
	y	1.050
	z	-12.870
(from Impastato)		(in POSMV)
Antenna base to phase center	x	0.000
	y	0.000
	z	-0.046
(from antenna)		(in POSMV)

Top of Stbd IMU to Fwd Port Ant		
Top of Stbd IMU to fwd port ant phase center	x	1.929
	y	-11.199
	z	-12.741
		(in POSMV)

Top of Port IMU to Aft Port Ant		
Top of Port IMU to aft port ant phase center	x	1.395
	y	1.050
	z	-12.749
		(in POSMV)

PosPac Offsets

Port IMU to Fwd Port Ant	
(from NGS survey)	
x	1.395
y	1.05
z	-12.749

Stbd IMU to Fwd Port Ant	
(from NGS survey)	
x	1.929
y	-11.199
z	-12.741

Port IMU to Fwd Port Ant		
(from PosPac calibration)		
	DN152	DN194-A
x	1.395	1.424
y	1.008	1.008
z	-12.895	-12.895
	use this	

Stbd IMU to Fwd Port Ant		
(from PosPac calibration)		
	DN152	DN194-A
x	2.010	2.002
y	-11.189	-11.206
z	-12.906	-12.892
	use this	

Measurement Coord. Sys.	IMU to 7111 (MRU to Trans) Caris	Fwd Port Ant to 7111 (Nav to Trans) Caris	Hysweep Offsets		Hypack
x	1.203	12.402	Stbd IMU to 7111 RP	Stbd	1.203
y	11.678	9.749		Fwd	11.678
z	1.180	13.920		Vertical	3.460

*Top of IMU is RP (Reference Pt)

(Hypack vertical is positive down from waterline.)

Vessel Offsets for S250 7111 are derived from Impasato Centerline Survey (2010) and NGS POS Antenna Survey (April 2011), and measurements by FH personnel.

Calculations

Stbd IMU to 7111

Top of IMU to Center of IMU Plate	x	0
	y	0.000
	z	0.1675
(from POSMV V4 User Guide)		(in CARIS)
IMU Plate to 7111 Center of Plate	x	1.203
	y	11.770
	z	1.122
(from Impastato)		(in CARIS)
7111 Center of Plate to 7111 Acoustic RP	x	0.000
	y	-0.092
	z	-0.110
(from Reson diagram)		(in CARIS)

Fwd Port Ant to 7111 RP

Antenna Phase Center to Port Ant	x	0
	y	0.000
	z	0.046
(from Trimble diagram)		(in CARIS)
Fwd Port Ant to IMU Plate	x	11.199
	y	-1.929
	z	12.862
(from Impastato)		(in CARIS)
IMU Plate to 7111 Center of Plate	x	1.203
	y	11.770
	z	1.122
(from Impastato)		(in CARIS)
7111 Center of Plate to 7111 Acoustic RP	x	0.000
	y	-0.092
	z	-0.110
		(in CARIS)

Waterline to 7111 RP

Top Stbd IMU to 7111 RP	x	1.203
	y	11.678
	z	1.180
(from calculcations)		(in CARIS)
Top Stbd IMU to Waterline	x	0
	y	0.000
	z	2.280
(from waterline spreadsheet)		(in Hypack)

	Top of Stbd IMU to 7111 RP	Fwd Port Ant RP to 7111 RP	Waterline to 7111 RP
x	1.203	12.402	
y	11.678	9.749	
z	1.180	13.920	3.460
	(in CARIS)	(in CARIS)	(in Hypack)

Measurement Coord. Sys.	Stbd IMU to Stbd 7125 (MRU to Trans)		Fwd Port Ant to Stbd 7125 (Nav to Trans)		Reson Projector to Receiver		Hysweep Offsets		
		Caris		Caris		Reson			Hypack
x		1.424		12.623		0.000	Stbd IMU to Stbd 7125	Stbd	1.424
y		0.380		-1.549		0.000		Fwd	0.380
z		1.493		14.233		0.031		Vertical	3.773

TILTED 4.5 degrees up to stbd
*Top of IMU is RP (Reference Pt)

(from Reson diagram, entered in Reson Hardware configuration)

TILTED 4.5 degrees up to stbd
(Hypack vertical is positive down from waterline.)

Vessel Offsets for S250 Stbd 7125 are derived from Impasato Centerline Survey (2010) and NGS POS Antenna Survey (April 2011), and measurements by FH personnel

Calculations

Stbd IMU to Stbd 7125		
Center of IMU Plate to top of IMU	x	0
	y	0.000
	z	0.1675
(from POSMV V4 User Guide)		(in POSMV)
IMU Plate to Stbd 7125	x	1.424
	y	0.380
	z	1.325
(from Impastato)		(in CARIS)

Fwd Port Ant to Stbd 7125		
Antenna Phase Center to Port Ant	x	0
	y	0.000
	z	0.046
(from Trimble diagram)		(in CARIS)
Fwd Port Ant to IMU Plate	x	11.199
	y	-1.929
	z	12.862
(from Impastato)		(in CARIS)
Stbd IMU Plate to Stbd 7125	x	1.424
	y	0.380
	z	1.325
(from Impastato)		(in CARIS)

Waterline to Stbd 7125 RP		
Top Stbd IMU to Stbd 7125 RP	x	1.424
	y	0.380
	z	1.493
(from calculcations)		(in CARIS)
Top Stbd IMU to Waterline	x	0
	y	0.000
	z	2.280
(from waterline spreadsheet)		(in Hypack)

Stbd IMU to Stbd 7125 RP	
x	1.424
y	0.380
z	1.493
	(in CARIS)

Fwd Port Ant to Stbd 7125 RP	
x	12.623
y	-1.549
z	14.233
	(in CARIS)

Waterline to Stbd 7125 RP	
x	
y	
z	3.773
	(in Hypack)

Measurement Coord. Sys.	Port IMU to Port 7125 (MRU to Trans) Caris	Aft Port Ant to Port 7125 (Nav to Trans) Caris	Projector to Receiver Reson	Hysweep Offsets		Hypack
x	-1.244	-2.294	0.000	Port IMU to Port 7125	Stbd	-1.244
y	0.362	-1.033	0.000		Fwd	0.362
z	1.486	14.234	0.031		Vertical	3.756

TILTED 4.5 degrees up to port
*Top of IMU is RP (Reference Pt)

Hysweep Offsets: TILTED 4.5 degrees up to port
(Hypack vertical is positive down from waterline.)

Vessel Offsets for S250 Stbd 7125 are derived from Impasato Centerline Survey (2010) and NGS POS Antenna Survey (April 2011), and measurements by FH personnel

Calculations

Port IMU to Port 7125

Center of IMU Plate to top of IMU	x	0
	y	0.000
	z	0.1675
(from POSMV V4 User Guide)		(in CARIS)
Port IMU Plate to Port 7125	x	-1.244
	y	0.362
	z	1.318
(from Impastato)		(in CARIS)

Aft Port Ant to Port 7125

Antenna Phase Center to Port Ant	x	0
	y	0.000
	z	0.046
(from Trimble diagram)		(in CARIS)
Aft Port Ant to Port IMU Plate	x	-1.05
	y	-1.395
	z	12.870
(from Impastato)		(in CARIS)
Port IMU Plate to Port 7125	x	-1.244
	y	0.362
	z	1.318
(from Impastato)		(in CARIS)

Waterline to Stbd 7125 RP

Top Port IMU to Port 7125 RP	x	-1.244
	y	0.362
	z	1.486
(from calculcations)		(in CARIS)
Top Port IMU to Waterline	x	0
	y	0.000
	z	2.270
(from waterline spreadsheet)		(in Hypack)

Port IMU to Port 7125

IMU to Port 7125	x	-1.244
	y	0.362
	z	1.486

Aft Port Ant to Port 7125

x	-2.294
y	-1.033
z	14.234

Waterline to Stbd 7125 RP

x	
y	
z	3.756
	(in Hypack)

Measurement Coord. Sys.	Stbd IMU to Port 7125 (MRU to Trans) - Swath 1		Stbd IMU to Stbd 7125 (MRU to Trans) - Swath 2		Fwd Port Ant to Port 7125 (Nav to Trans)		Fwd Port Ant to Stbd 7125 (Nav to Trans)	
		Caris		Caris		Caris		Caris
x		-13.490		1.424		-2.291		12.623
y		0.338		0.380		-1.591		-1.549
z		1.485		1.493		14.225		14.233

*Top of Stbd IMU is RP (Reference Pt)
Tilted up 4.5 degrees up on both sides

Port 7125 Hysweep Offsets			Stbd 7125 Hysweep Offsets		
		Hypack			Hypack
Stbd IMU to Port 7125	Stbd	-13.490	Stbd IMU to Stbd 7125	Stbd	1.424
	Fwd	0.338		Fwd	0.380
	Vertical	3.765		Vertical	3.773

TILTED 4.5 degrees up to port
(Hypack vertical is positive down from waterline.)

TILTED 4.5 degrees up to stbd

Vessel Offsets for dual 7125 are derived from Impasato Centerline Survey (2010) and NGS POS Antenna Survey (April 2011), and measurements by FH personnel.

Calculations

Stbd IMU to Port 7125			Stbd IMU to Stbd 7125		
Center of Stbd IMU Plate to top of IMU	x	0	Center of IMU Plate to top of IMU	x	0
	y	0		y	0.000
	z	0.1675		z	0.1675
(from POSMV V4 User Guide)		(in CARIS)	(from POSMV V4 User Guide)		(in CARIS)
Stbd IMU Plate to Port 7125	x	-13.490	IMU Plate to Stbd 7125	x	1.424
	y	0.338		y	0.38
	z	1.317		z	1.325
(from Impastato)		(in CARIS)	(from Impastato)		(in CARIS)

Fwd Port Ant to Port 7125			Fwd Port Ant to Stbd 7125		
Antenna Phase Center to Port Ant	x	0	Antenna Phase Center to Port Ant	x	0
	y	0.000		y	0.000
	z	0.046		z	0.046
(from Trimble diagram)		(in CARIS)	(from Trimble diagram)		(in CARIS)
Fwd Port Ant to Stbd IMU Plate	x	11.199	Fwd Port Ant to Stbd IMU Plate	x	11.199
	y	-1.929		y	-1.929
	z	12.862		z	12.862
(from Impastato)		(in CARIS)	(from Impastato)		(in CARIS)
Stbd IMU Plate to Port 7125	x	-13.49	Stbd IMU Plate to Stbd 7125	x	1.424
	y	0.338		y	0.380
	z	1.317		z	1.325
(from Impastato)		(in CARIS)	(from Impastato)		(in CARIS)

Waterline to Stbd 7125 RP			Waterline to Stbd 7125 RP		
Top Stbd IMU to Port 7125 RP	x	-13.490	Top Stbd IMU to Stbd 7125 RP	x	1.424
	y	0.338		y	0.380
	z	1.485		z	1.493
(from calculcations)		(in CARIS)	(from calculcations)		(in CARIS)
Top Stbd IMU to Waterline	x	0	Top Stbd IMU to Waterline	x	0
	y	0.000		y	0.000
	z	2.280		z	2.280
(from waterline spreadsheet)		(in Hypack)	(from waterline spreadsheet)		(in Hypack)

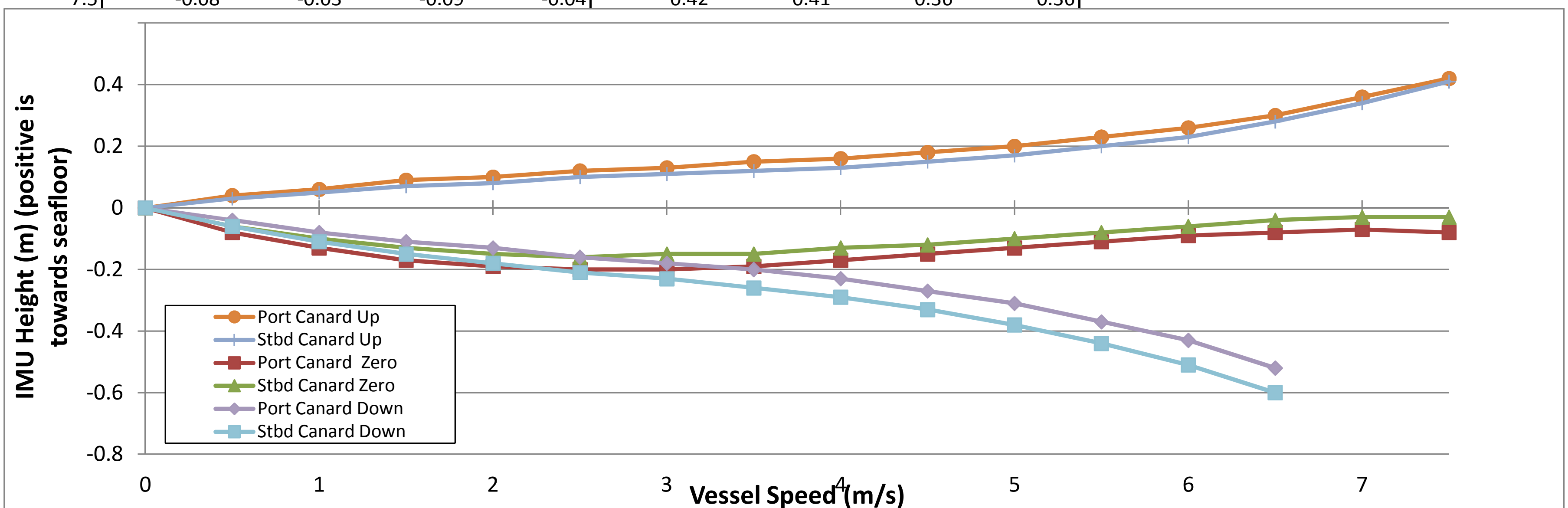
Stbd IMU to Port 7125 RP		Stbd IMU to Stbd 7125 RP		Fwd Port Ant to Port 7125 RP		Fwd Port Ant to Stbd 7125 RP		Waterline to Stbd 7125 RP		Waterline to Stbd 7125 RP	
x	-13.490	x	1.424	x	-2.291	x	12.623	x		x	
y	0.338	y	0.380	y	-1.591	y	-1.549	y		y	
z	1.485	z	1.493	z	14.225	z	14.233	z	3.765	z	3.773
	(in CARIS)		(in CARIS)				(in CARIS)		(in Hypack)		(in Hypack)

Note: For dual acquisition 7125, the HSX file contains data from both 7125s but only POSMV data from the stbd POSMV. The port 7125 is swath 1 (beams 1-512) and the stbd 7125 is swath 2 (beams 513 to 1024).

Measurement	Port IMU to TowPoint	
Coord. Sys.		Caris
x		-26.032
y		7.161
z		-9.347
		(in CARIS)

Measurement	Stbd IMU to Stbd SB		Stbd IMU to Port SB	
Coord. Sys.		Caris		Caris
x		-0.455		
y		4.62		
z		1.325		

	Canards Zero				Canards Up 15 deg				Canards Down 25 deg			
Speed (m/s)	Port Canard Zero - 3rd Order	Stbd Canard Zero - 3rd Order	Port 4th Order	Stbd 4th Order	Port Canard Up - 3rd Order	Stbd Canard Up - 3rd Order	Port 4th Order	Stbd 4th Order	Port Canard Down - 3rd Order	Stbd Canard Down - 3rd Order	Port 4th Order	Stbd 4th Order
0	0	0	0	0	0	0	0	0	0	0	0	0
0.5	-0.08	-0.06	0.04	0.06	0.04	0.03	0.18	0.15	-0.04	-0.06	-0.21	-0.21
1	-0.13	-0.1	0.04	0.08	0.06	0.05	0.27	0.23	-0.08	-0.11	-0.33	-0.34
1.5	-0.17	-0.13	0.01	0.07	0.09	0.07	0.3	0.25	-0.11	-0.15	-0.39	-0.41
2	-0.19	-0.15	-0.01	0.04	0.1	0.08	0.3	0.24	-0.13	-0.18	-0.41	-0.44
2.5	-0.2	-0.16	-0.04	0.02	0.12	0.1	0.29	0.23	-0.16	-0.21	-0.42	-0.46
3	-0.2	-0.15	-0.06	0	0.13	0.11	0.28	0.23	-0.18	-0.23	-0.43	-0.47
3.5	-0.19	-0.15	-0.06	0	0.15	0.12	0.28	0.23	-0.2	-0.26	-0.45	-0.5
4	-0.17	-0.13	-0.04	0.01	0.16	0.13	0.3	0.25	-0.23	-0.29	-0.49	-0.54
4.5	-0.15	-0.12	-0.02	0.03	0.18	0.15	0.34	0.28	-0.27	-0.33	-0.54	-0.59
5	-0.13	-0.1	0.02	0.07	0.2	0.17	0.39	0.33	-0.31	-0.38	-0.6	-0.65
5.5	-0.11	-0.08	0.05	0.1	0.23	0.2	0.45	0.38	-0.37	-0.44	-0.66	-0.72
6	-0.09	-0.06	0.08	0.12	0.26	0.23	0.49	0.43	-0.43	-0.51	-0.7	-0.77
6.5	-0.08	-0.04	0.07	0.12	0.3	0.28	0.51	0.46	-0.52	-0.6	-0.71	-0.78
7	-0.07	-0.03	0.02	0.08	0.36	0.34	0.48	0.44				
7.5	-0.08	-0.03	-0.09	-0.04	0.42	0.41	0.36	0.36				



Date: NA **Personnel:** NA

DESIGN DRAFT OF 3.85 METERS

PORT PONTOON Draft Readings

Fwd Outboard	3.85	Fwd Inboard	3.85
Aft Outboard	3.85	Aft Inboard	3.85

Port Ave **3.85**

STBD PONTOON Draft Readings

Fwd Inboard	3.85	Fwd Outboard	3.85
Aft Inboard	3.85	Aft Outboard	3.85

Stbd Ave **3.85**

Port

Center of IMU Plate to top of IMU	x				
	y				
	z	-0.1675			
IMU Plate to Fwd Outboard 4.6 Draft Mark	x		**IMU Plate to Fwd Inboard 4.6 Draft Mark**	x	
	y			y	
	z	-3.197		z	-3.200
		(in CARIS)			(in CARIS)
IMU Plate to Aft Outboard 4.6 M Draft Mark	x		**IMU Plate to Aft Inboard 4.6 Draft Mark**	x	
	y			y	
	z	-3.212		z	-3.205
		(in CARIS)			(in CARIS)

From Impastato Survey Ave -3.204

Fwd Outboard Draft Mark to Waterline	x		**Fwd Inboard Draft Mark to Waterline**	x	
	y			y	
	z	0.750		z	0.750
		(in CARIS)			(in CARIS)
Aft Outboard Draft Mark to Waterline	x		**Aft Inboard Draft Mark to Waterline**	x	
	y			y	
	z	0.750		z	0.750
		(in CARIS)			(in CARIS)

4.6

Calculated from draft mark 4.6 to draft readings Ave 0.750

IMU to Fwd Outboard Waterline	x		IMU to Fwd Inboard Waterline	x	
	y			y	
	z	-2.280		z	-2.283
		(in CARIS)			(in CARIS)
IMU to Aft Outboard Waterline	x		IMU to Aft Inboard Waterline	x	
	y			y	
	z	-2.295		z	-2.288
		(in CARIS)			(in CARIS)

Ave -2.621

Stbd

Center of IMU Plate to top of IMU	x				
	y				
	z	-0.1675			
IMU plate to Fwd Inboard 4.6 Draft Mark	x		**IMU plate to Fwd Outboard 4.6 Draft Mark**	x	
	y			y	
	z	-3.205		z	-3.203
		(in CARIS)			(in CARIS)
IMU plate to Aft Inboard 4.6 Draft Mark	x		**IMU plate to Aft Outboard 4.6 Draft Mark**	x	
	y			y	
	z	-3.180		z	-3.180
		(in CARIS)			(in CARIS)

From Impastato Survey Ave -3.192

Fwd Inboard Draft Mark to Waterline	x		**Fwd Outboard Draft Mark to Waterline**	x	
	y			y	
	z	0.750		z	0.750
		(in CARIS)			(in CARIS)
Aft Inboard Draft Mark to Waterline	x		**Aft Outboard Draft Mark to Waterline**	x	
	y			y	
	z	0.750		z	0.750
		(in CARIS)			(in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.750

IMU to Fwd Inboard Waterline	x		IMU to Fwd Outboard Waterline	x	
	y			y	
	z	-2.288		z	-2.286
		(in CARIS)			(in CARIS)
IMU to Aft Inboard Waterline	x		IMU to Aft Outboard Waterline	x	
	y			y	
	z	-2.263		z	-2.263
		(in CARIS)			(in CARIS)

Ave -2.442

PORT Waterline to Port IMU

Fwd Outboard	2.2795	Fwd Inboard	2.2825	-1
Aft Outboard	2.2945	Fwd Inboard	2.2875	

Port Ave **2.286**

Port Waterline to Port IMU

	x	
Waterline	y	
to IMU (m)	z	2.286
	(In CARIS)	

STBD Waterline to Stbd IMU

Fwd Inboard	2.2875	Fwd Outboard	2.2855	-1
Fwd Inboard	2.2625	Aft Outboard	2.2625	

Stbd Ave **2.2745**

Stbd Waterline to Stbd IMU

	x	
Waterline	y	
to IMU (m)	z	2.275
	(In CARIS)	

Date: 5/3/2011 **Personnel:** Welton (inboard marks assumed to be same as outboard marks)

Location: Sing River Island Pier, Pascagoula, MS

PORT PONTOON Draft Readings

Fwd Outboard	3.97	Fwd Inboard	3.97
Aft Outboard	3.85	Aft Inboard	3.85

Port Ave 3.91

STBD PONTOON Draft Readings

Fwd Inboard	3.9	Fwd Outboard	3.9
Aft Inboard	3.85	Aft Outboard	3.85

Stbd Ave 3.875

Port

Center of IMU Plate to top of IMU	
x	
y	
z	-0.1675

IMU Plate to Fwd Outboard 4.6 Draft Mark		IMU Plate to Fwd Inboard 4.6 Draft Mark	
x		x	
y		y	
z	-3.197 (in CARIS)	z	-3.200 (in CARIS)

IMU Plate to Aft Outboard 4.6 M Draft Mark		IMU Plate to Aft Inboard 4.6 Draft Mark	
x		x	
y		y	
z	-3.212 (in CARIS)	z	-3.205 (in CARIS)

From Impastato Survey Ave -3.204

4.6

Fwd Outboard Draft Mark to Waterline		Fwd Inboard Draft Mark to Waterline	
x		x	
y		y	
z	0.630 (in CARIS)	z	0.630 (in CARIS)

Aft Outboard Draft Mark to Waterline		Aft Inboard Draft Mark to Waterline	
x		x	
y		y	
z	0.750 (in CARIS)	z	0.750 (in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.690

IMU to Fwd Outboard Waterline		IMU to Fwd Inboard Waterline	
x		x	
y		y	
z	-2.400 (in CARIS)	z	-2.403 (in CARIS)

IMU to Aft Outboard Waterline		IMU to Aft Inboard Waterline	
x		x	
y		y	
z	-2.295 (in CARIS)	z	-2.288 (in CARIS)

Ave -2.681

Stbd

Center of IMU Plate to top of IMU	
x	
y	
z	-0.1675

IMU plate to Fwd Inboard 4.6 Draft Mark		IMU plate to Fwd Outboard 4.6 Draft Mark	
x		x	
y		y	
z	-3.205 (in CARIS)	z	-3.203 (in CARIS)

IMU plate to Aft Inboard 4.6 Draft Mark		IMU plate to Aft Outboard 4.6 Draft Mark	
x		x	
y		y	
z	-3.180 (in CARIS)	z	-3.180 (in CARIS)

From Impastato Survey Ave -3.192

Fwd Inboard Draft Mark to Waterline		Fwd Outboard Draft Mark to Waterline	
x		x	
y		y	
z	0.700 (in CARIS)	z	0.700 (in CARIS)

Aft Inboard Draft Mark to Waterline		Aft Outboard Draft Mark to Waterline	
x		x	
y		y	
z	0.750 (in CARIS)	z	0.750 (in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.725

IMU to Fwd Inboard Waterline		IMU to Fwd Outboard Waterline	
x		x	
y		y	
z	-2.338 (in CARIS)	z	-2.336 (in CARIS)

IMU to Aft Inboard Waterline		IMU to Aft Outboard Waterline	
x		x	
y		y	
z	-2.263 (in CARIS)	z	-2.263 (in CARIS)

Ave -2.467

PORT Waterline to Port IMU

Fwd Outboard	2.3995	Fwd Inboard	2.4025	-1
Aft Outboard	2.2945	Fwd Inboard	2.2875	

Port Ave 2.346

STBD Waterline to Stbd IMU

Fwd Inboard	2.3375	Fwd Outboard	2.3355	-1
Fwd Inboard	2.2625	Aft Outboard	2.2625	

Stbd Ave 2.2995

Port Waterline to Port IMU

Waterline to IMU (m)		
	x	
	y	
	z	2.346
	(In CARIS)	

Stbd Waterline to Stbd IMU

Waterline to IMU (m)		
	x	
	y	
	z	2.300
	(In CARIS)	

Date: 5/5/2011 **Personnel:** Cousins, Welton (draft marks read by Kayak)
Location: Sing River Island Pier, Pascagoula, MS

PORT PONTOON Draft Readings

Fwd Outboard	3.825	Fwd Inboard	3.8
Aft Outboard	3.85	Aft Inboard	3.9

Port Ave **3.84375**

STBD PONTOON Draft Readings

Fwd Inboard	3.75	Fwd Outboard	3.75
Aft Inboard	3.82	Aft Outboard	3.82

Stbd Ave **3.785**

Center of IMU Plate to top of IMU (Port)

x	
y	
z	-0.1675

Center of IMU Plate to top of IMU (Stbd)

x	
y	
z	-0.1675

Port						Stbd					
IMU Plate to Fwd Outboard 4.6 Draft Mark	x		IMU Plate to Fwd Inboard 4.6 Draft Mark	x		IMU plate to Fwd Inboard 4.6 Draft Mark	x		IMU plate to Fwd Outboard 4.6 Draft Mark	x	
	y			y			y			y	
	z	-3.197		z	-3.200		z	-3.205		z	-3.203
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
IMU Plate to Aft Outboard 4.6 M Draft Mark	x		IMU Plate to Aft Inboard 4.6 Draft Mark	x		IMU plate to Aft Inboard 4.6 Draft Mark	x		IMU plate to Aft Outboard 4.6 Draft Mark	x	
	y			y			y			y	
	z	-3.212		z	-3.205		z	-3.180		z	-3.180
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)

From Impastato Survey Ave -3.204 | *From Impastato Survey* Ave -3.192

4.6

Port						Stbd					
Fwd Outboard Draft Mark to Waterline	x		Fwd Inboard Draft Mark to Waterline	x		Fwd Inboard Draft Mark to Waterline	x		Fwd Outboard Draft Mark to Waterline	x	
	y			y			y			y	
	z	0.775		z	0.800		z	0.850		z	0.850
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
Aft Outboard Draft Mark to Waterline	x		Aft Inboard Draft Mark to Waterline	x		Aft Inboard Draft Mark to Waterline	x		Aft Outboard Draft Mark to Waterline	x	
	y			y			y			y	
	z	0.750		z	0.700		z	0.780		z	0.780
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.756 | *Calculated from draft mark 4.6 to draft readings* Ave 0.815

Port						Stbd					
IMU to Fwd Outboard Waterline	x		IMU to Fwd Inboard Waterline	x		IMU to Fwd Inboard Waterline	x		IMU to Fwd Outboard Waterline	x	
	y			y			y			y	
	z	-2.255		z	-2.233		z	-2.188		z	-2.186
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
IMU to Aft Outboard Waterline	x		IMU to Aft Inboard Waterline	x		IMU to Aft Inboard Waterline	x		IMU to Aft Outboard Waterline	x	
	y			y			y			y	
	z	-2.295		z	-2.338		z	-2.233		z	-2.233
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)

Ave -2.615 | Ave -2.377

PORT Waterline to Port IMU

Fwd Outboard	2.2545	Fwd Inboard	2.2325	-1
Aft Outboard	2.2945	Fwd Inboard	2.3375	

Port Ave **2.27975**

STBD Waterline to Stbd IMU

Fwd Inboard	2.1875	Fwd Outboard	2.1855	-1
Fwd Inboard	2.2325	Aft Outboard	2.2325	

Stbd Ave **2.2095**

Port Waterline to Port IMU

	x	
Waterline	y	
to IMU (m)	z	2.280
	(In CARIS)	

Stbd Waterline to Stbd IMU

	x	
Waterline	y	
to IMU (m)	z	2.210
	(In CARIS)	

Date: 5/12/2011 **Personnel:** Cousins (inboard marks assumed to be same as outboard marks)
Location: Sing River Island Pier, Pascagoula, MS

PORT PONTOON Draft Readings

Fwd Outboard	3.78	Fwd Inboard	3.78
Aft Outboard	3.8	Aft Inboard	3.8

Port Ave 3.79

STBD PONTOON Draft Readings

Fwd Inboard	3.8	Fwd Outboard	3.8
Aft Inboard	3.9	Aft Outboard	3.9

Stbd Ave 3.85

Center of IMU Plate to top of IMU (Port)			Center of IMU Plate to top of IMU (Stbd)		
	x			x	
	y			y	
	z	-0.1675		z	-0.1675

IMU Plate to Fwd Outboard 4.6 Draft Mark	x / y / z	-3.197 (in CARIS)	IMU Plate to Fwd Inboard 4.6 Draft Mark	x / y / z	-3.200 (in CARIS)	IMU plate to Fwd Inboard 4.6 Draft Mark	x / y / z	-3.205 (in CARIS)	IMU plate to Fwd Outboard 4.6 Draft Mark	x / y / z	-3.203 (in CARIS)
IMU Plate to Aft Outboard 4.6 M Draft Mark	x / y / z	-3.212 (in CARIS)	IMU Plate to Aft Inboard 4.6 Draft Mark	x / y / z	-3.205 (in CARIS)	IMU plate to Aft Inboard 4.6 Draft Mark	x / y / z	-3.180 (in CARIS)	IMU plate to Aft Outboard 4.6 Draft Mark	x / y / z	-3.180 (in CARIS)

From Impastato Survey Ave -3.204 | *From Impastato Survey* Ave -3.192

4.6

Fwd Outboard Draft Mark to Waterline	x / y / z	0.820 (in CARIS)	Fwd Inboard Draft Mark to Waterline	x / y / z	0.820 (in CARIS)	Fwd Inboard Draft Mark to Waterline	x / y / z	0.800 (in CARIS)	Fwd Outboard Draft Mark to Waterline	x / y / z	0.800 (in CARIS)
Aft Outboard Draft Mark to Waterline	x / y / z	0.800 (in CARIS)	Aft Inboard Draft Mark to Waterline	x / y / z	0.800 (in CARIS)	Aft Inboard Draft Mark to Waterline	x / y / z	0.700 (in CARIS)	Aft Outboard Draft Mark to Waterline	x / y / z	0.700 (in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.810 | *Calculated from draft mark 4.6 to draft readings* Ave 0.750

IMU to Fwd Outboard Waterline	x / y / z	-2.210 (in CARIS)	IMU to Fwd Inboard Waterline	x / y / z	-2.213 (in CARIS)	IMU to Fwd Inboard Waterline	x / y / z	-2.238 (in CARIS)	IMU to Fwd Outboard Waterline	x / y / z	-2.236 (in CARIS)
IMU to Aft Outboard Waterline	x / y / z	-2.245 (in CARIS)	IMU to Aft Inboard Waterline	x / y / z	-2.238 (in CARIS)	IMU to Aft Inboard Waterline	x / y / z	-2.313 (in CARIS)	IMU to Aft Outboard Waterline	x / y / z	-2.313 (in CARIS)

Ave -2.561 | Ave -2.442

PORT Waterline to Port IMU

Fwd Outboard	2.2095	Fwd Inboard	2.2125	-1
Aft Outboard	2.2445	Fwd Inboard	2.2375	

Port Ave 2.226

STBD Waterline to Stbd IMU

Fwd Inboard	2.2375	Fwd Outboard	2.2355	-1
Fwd Inboard	2.3125	Aft Outboard	2.3125	

Stbd Ave 2.2745

Port Waterline to Port IMU

	x	
Waterline	y	
to IMU (m)	z	2.226
	(In CARIS)	

Stbd Waterline to Stbd IMU

	x	
Waterline	y	
to IMU (m)	z	2.275
	(In CARIS)	

Date: 5/17/2011 **Personnel:** VanWaes (inboard marks assumed to be same as outboard marks)

Location: Sing River Island Pier, Pascagoula, MS

PORT PONTOON Draft Readings

Fwd Outboard	3.78	Fwd Inboard	3.78
Aft Outboard	3.85	Aft Inboard	3.85

Port Ave **3.815**

STBD PONTOON Draft Readings

Fwd Inboard	3.9	Fwd Outboard	3.9
Aft Inboard	3.95	Aft Outboard	3.95

Stbd Ave **3.925**

Port

Center of IMU Plate to top of IMU	
x	
y	
z	-0.1675

IMU Plate to Fwd Outboard 4.6 Draft Mark		IMU Plate to Fwd Inboard 4.6 Draft Mark	
x		x	
y		y	
z	-3.197 (in CARIS)	z	-3.200 (in CARIS)

IMU Plate to Aft Outboard 4.6 M Draft Mark		IMU Plate to Aft Inboard 4.6 Draft Mark	
x		x	
y		y	
z	-3.212 (in CARIS)	z	-3.205 (in CARIS)

From Impastato Survey Ave -3.204

4.6

Fwd Outboard Draft Mark to Waterline		Fwd Inboard Draft Mark to Waterline	
x		x	
y		y	
z	0.820 (in CARIS)	z	0.820 (in CARIS)

Aft Outboard Draft Mark to Waterline		Aft Inboard Draft Mark to Waterline	
x		x	
y		y	
z	0.750 (in CARIS)	z	0.750 (in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.785

IMU to Fwd Outboard Waterline		IMU to Fwd Inboard Waterline	
x		x	
y		y	
z	-2.210 (in CARIS)	z	-2.213 (in CARIS)

IMU to Aft Outboard Waterline		IMU to Aft Inboard Waterline	
x		x	
y		y	
z	-2.295 (in CARIS)	z	-2.288 (in CARIS)

Ave -2.586

Stbd

Center of IMU Plate to top of IMU	
x	
y	
z	-0.1675

IMU plate to Fwd Inboard 4.6 Draft Mark		IMU plate to Fwd Outboard 4.6 Draft Mark	
x		x	
y		y	
z	-3.205 (in CARIS)	z	-3.203 (in CARIS)

IMU plate to Aft Inboard 4.6 Draft Mark		IMU plate to Aft Outboard 4.6 Draft Mark	
x		x	
y		y	
z	-3.180 (in CARIS)	z	-3.180 (in CARIS)

From Impastato Survey Ave -3.192

Fwd Inboard Draft Mark to Waterline		Fwd Outboard Draft Mark to Waterline	
x		x	
y		y	
z	0.700 (in CARIS)	z	0.700 (in CARIS)

Aft Inboard Draft Mark to Waterline		Aft Outboard Draft Mark to Waterline	
x		x	
y		y	
z	0.650 (in CARIS)	z	0.650 (in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.675

IMU to Fwd Inboard Waterline		IMU to Fwd Outboard Waterline	
x		x	
y		y	
z	-2.338 (in CARIS)	z	-2.336 (in CARIS)

IMU to Aft Inboard Waterline		IMU to Aft Outboard Waterline	
x		x	
y		y	
z	-2.363 (in CARIS)	z	-2.363 (in CARIS)

Ave -2.517

PORT Waterline to Port IMU

Fwd Outboard	2.2095	Fwd Inboard	2.2125	-1
Aft Outboard	2.2945	Fwd Inboard	2.2875	

Port Ave **2.251**

Port Waterline to Port IMU

Waterline to IMU (m)	
x	
y	
z	2.251
(In CARIS)	

STBD Waterline to Stbd IMU

Fwd Inboard	2.3375	Fwd Outboard	2.3355	-1
Fwd Inboard	2.3625	Aft Outboard	2.3625	

Stbd Ave **2.3495**

Stbd Waterline to Stbd IMU

Waterline to IMU (m)	
x	
y	
z	2.350
(In CARIS)	

Date: NA **Personnel:** NA

DESIGN DRAFT OF 3.85 METERS

PORT PONTOON Draft Readings

Fwd Outboard	3.8	Fwd Inboard	3.8
Aft Outboard	3.85	Aft Inboard	3.85

Port Ave 3.825

STBD PONTOON Draft Readings

Fwd Inboard	3.75	Fwd Outboard	3.75
Aft Inboard	3.85	Aft Outboard	3.85

Stbd Ave 3.8

PORT

Center of IMU Plate to top of IMU	x				
	y				
	z	-0.1675			
IMU Plate to Fwd Outboard 4.6 Draft Mark	x		IMU Plate to Fwd Inboard 4.6 Draft Mark	x	
	y			y	
	z	-3.197 (in CARIS)		z	-3.200 (in CARIS)
IMU Plate to Aft Outboard 4.6 M Draft Mark	x		IMU Plate to Aft Inboard 4.6 Draft Mark	x	
	y			y	
	z	-3.212 (in CARIS)		z	-3.205 (in CARIS)

From Impastato Survey Ave -3.204

Fwd Outboard Draft Mark to Waterline	x		Fwd Inboard Draft Mark to Waterline	x	
	y			y	
	z	0.800 (in CARIS)		z	0.800 (in CARIS)
Aft Outboard Draft Mark to Waterline	x		Aft Inboard Draft Mark to Waterline	x	
	y			y	
	z	0.750 (in CARIS)		z	0.750 (in CARIS)

4.6

Calculated from draft mark 4.6 to draft readings Ave 0.775

IMU to Fwd Outboard Waterline	x		IMU to Fwd Inboard Waterline	x	
	y			y	
	z	-2.230 (in CARIS)		z	-2.233 (in CARIS)
IMU to Aft Outboard Waterline	x		IMU to Aft Inboard Waterline	x	
	y			y	
	z	-2.295 (in CARIS)		z	-2.288 (in CARIS)

Ave -2.596

PORT Waterline to Port IMU

Fwd Outboard	2.2295	Fwd Inboard	2.2325	-1
Aft Outboard	2.2945	Fwd Inboard	2.2875	

Port Ave 2.261

Port Waterline to Port IMU

Waterline to IMU (m)	x	
	y	
	z (In CARIS)	2.261

STBD

Center of IMU Plate to top of IMU	x				
	y				
	z	-0.1675			
IMU plate to Fwd Inboard 4.6 Draft Mark	x		IMU plate to Fwd Outboard 4.6 Draft Mark	x	
	y			y	
	z	-3.205 (in CARIS)		z	-3.203 (in CARIS)
IMU plate to Aft Inboard 4.6 Draft Mark	x		IMU plate to Aft Outboard 4.6 Draft Mark	x	
	y			y	
	z	-3.180 (in CARIS)		z	-3.180 (in CARIS)

From Impastato Survey Ave -3.192

Fwd Inboard Draft Mark to Waterline	x		Fwd Outboard Draft Mark to Waterline	x	
	y			y	
	z	0.850 (in CARIS)		z	0.850 (in CARIS)
Aft Inboard Draft Mark to Waterline	x		Aft Outboard Draft Mark to Waterline	x	
	y			y	
	z	0.750 (in CARIS)		z	0.750 (in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.800

IMU to Fwd Inboard Waterline	x		IMU to Fwd Outboard Waterline	x	
	y			y	
	z	-2.188 (in CARIS)		z	-2.186 (in CARIS)
IMU to Aft Inboard Waterline	x		IMU to Aft Outboard Waterline	x	
	y			y	
	z	-2.263 (in CARIS)		z	-2.263 (in CARIS)

Ave -2.392

STBD Waterline to Stbd IMU

Fwd Inboard	2.1875	Fwd Outboard	2.1855	-1
Fwd Inboard	2.2625	Aft Outboard	2.2625	

Stbd Ave 2.2245

Stbd Waterline to Stbd IMU

Waterline to IMU (m)	x	
	y	
	z (In CARIS)	2.225

Date: NA **Personnel:** NA

DESIGN DRAFT OF 3.85 METERS

PORT PONTOON Draft Readings				**STBD PONTOON Draft Readings**			
Fwd Outboard	3.9	Fwd Inboard	3.85	Fwd Inboard	3.9	Fwd Outboard	3.9
Aft Outboard	3.75	Aft Inboard	3.75	Aft Inboard	3.85	Aft Outboard	3.85
Port Ave	**3.8125**			**Stbd Ave**	**3.875**		

Center of IMU Plate to top of IMU (Port)			Center of IMU Plate to top of IMU (Stbd)		
	x			x	
	y			y	
	z	-0.1675		z	-0.1675

IMU Plate to Fwd Outboard 4.6 Draft Mark	x		IMU Plate to Fwd Inboard 4.6 Draft Mark	x		IMU plate to Fwd Inboard 4.6 Draft Mark	x		IMU plate to Fwd Outboard 4.6 Draft Mark	x	
	y			y			y			y	
	z	-3.197		z	-3.200		z	-3.205		z	-3.203
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
IMU Plate to Aft Outboard 4.6 M Draft Mark	x		IMU Plate to Aft Inboard 4.6 Draft Mark	x		IMU plate to Aft Inboard 4.6 Draft Mark	x		IMU plate to Aft Outboard 4.6 Draft Mark	x	
	y			y			y			y	
	z	-3.212		z	-3.205		z	-3.180		z	-3.180
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
From Impastato Survey				Ave	-3.204	*From Impastato Survey*				Ave	-3.192

4.6

Fwd Outboard Draft Mark to Waterline	x		Fwd Inboard Draft Mark to Waterline	x		Fwd Inboard Draft Mark to Waterline	x		Fwd Outboard Draft Mark to Waterline	x	
	y			y			y			y	
	z	0.700		z	0.750		z	0.700		z	0.700
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
Aft Outboard Draft Mark to Waterline	x		Aft Inboard Draft Mark to Waterline	x		Aft Inboard Draft Mark to Waterline	x		Aft Outboard Draft Mark to Waterline	x	
	y			y			y			y	
	z	0.850		z	0.850		z	0.750		z	0.750
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
Calculated from draft mark 4.6 to draft readings				Ave	0.788	*Calculated from draft mark 4.6 to draft readings*				Ave	0.725

IMU to Fwd Outboard Waterline	x		IMU to Fwd Inboard Waterline	x		IMU to Fwd Inboard Waterline	x		IMU to Fwd Outboard Waterline	x	
	y			y			y			y	
	z	-2.330		z	-2.283		z	-2.338		z	-2.336
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
IMU to Aft Outboard Waterline	x		IMU to Aft Inboard Waterline	x		IMU to Aft Inboard Waterline	x		IMU to Aft Outboard Waterline	x	
	y			y			y			y	
	z	-2.195		z	-2.188		z	-2.263		z	-2.263
		(in CARIS)			(in CARIS)			(in CARIS)			(in CARIS)
				Ave	-2.584					Ave	-2.467

PORT Waterline to Port IMU					STBD Waterline to Stbd IMU				
Fwd Outboard	2.3295	Fwd Inboard	2.2825	-1	Fwd Inboard	2.3375	Fwd Outboard	2.3355	-1
Aft Outboard	2.1945	Fwd Inboard	2.1875		Fwd Inboard	2.2625	Aft Outboard	2.2625	
Port Ave	**2.2485**				**Stbd Ave**	**2.2995**			

Port Waterline to Port IMU			**Stbd Waterline to Stbd IMU**		
	x			x	
Waterline	y		Waterline	y	
to IMU (m)	z	2.249	to IMU (m)	z	2.300
	(In CARIS)			(In CARIS)	

Date: NA **Personnel:** NA

DESIGN DRAFT OF 3.85 METERS

PORT PONTOON Draft Readings

Fwd Outboard	3.95	Fwd Inboard	3.85
Aft Outboard	3.85	Aft Inboard	3.85

Port Ave 3.875

Center of IMU Plate to top of IMU	x	
	y	
	z	-0.1675

IMU Plate to Fwd Outboard 4.6 Draft Mark	x		IMU Plate to Fwd Inboard 4.6 Draft Mark	x	
	y			y	
	z	-3.197		z	-3.200
		(in CARIS)			(in CARIS)
IMU Plate to Aft Outboard 4.6 M Draft Mark	x		IMU Plate to Aft Inboard 4.6 Draft Mark	x	
	y			y	
	z	-3.212		z	-3.205
		(in CARIS)			(in CARIS)

From Impastato Survey Ave -3.204

4.6

Fwd Outboard Draft Mark to Waterline	x		Fwd Inboard Draft Mark to Waterline	x	
	y			y	
	z	0.650		z	0.750
		(in CARIS)			(in CARIS)
Aft Outboard Draft Mark to Waterline	x		Aft Inboard Draft Mark to Waterline	x	
	y			y	
	z	0.750		z	0.750
		(in CARIS)			(in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.725

IMU to Fwd Outboard Waterline	x		IMU to Fwd Inboard Waterline	x	
	y			y	
	z	-2.380		z	-2.283
		(in CARIS)			(in CARIS)
IMU to Aft Outboard Waterline	x		IMU to Aft Inboard Waterline	x	
	y			y	
	z	-2.295		z	-2.288
		(in CARIS)			(in CARIS)

Ave -2.646

PORT Waterline to Port IMU

Fwd Outboard	2.3795	Fwd Inboard	2.2825	-1
Aft Outboard	2.2945	Fwd Inboard	2.2875	

Port Ave 2.311

Port Waterline to Port IMU

Waterline to IMU (m)	x	
	y	
	z	2.311
	(In CARIS)	

STBD PONTOON Draft Readings

Fwd Inboard	3.85	Fwd Outboard	3.85
Aft Inboard	3.85	Aft Outboard	3.85

Stbd Ave 3.85

Center of IMU Plate to top of IMU	x	
	y	
	z	-0.1675

IMU plate to Fwd Inboard 4.6 Draft Mark	x		IMU plate to Fwd Outboard 4.6 Draft Mark	x	
	y			y	
	z	-3.205		z	-3.203
		(in CARIS)			(in CARIS)
IMU plate to Aft Inboard 4.6 Draft Mark	x		IMU plate to Aft Outboard 4.6 Draft Mark	x	
	y			y	
	z	-3.180		z	-3.180
		(in CARIS)			(in CARIS)

From Impastato Survey Ave -3.192

Fwd Inboard Draft Mark to Waterline	x		Fwd Outboard Draft Mark to Waterline	x	
	y			y	
	z	0.750		z	0.750
		(in CARIS)			(in CARIS)
Aft Inboard Draft Mark to Waterline	x		Aft Outboard Draft Mark to Waterline	x	
	y			y	
	z	0.750		z	0.750
		(in CARIS)			(in CARIS)

Calculated from draft mark 4.6 to draft readings Ave 0.750

IMU to Fwd Inboard Waterline	x		IMU to Fwd Outboard Waterline	x	
	y			y	
	z	-2.288		z	-2.286
		(in CARIS)			(in CARIS)
IMU to Aft Inboard Waterline	x		IMU to Aft Outboard Waterline	x	
	y			y	
	z	-2.263		z	-2.263
		(in CARIS)			(in CARIS)

Ave -2.442

STBD Waterline to Stbd IMU

Fwd Inboard	2.2875	Fwd Outboard	2.2855	-1
Fwd Inboard	2.2625	Aft Outboard	2.2625	

Stbd Ave 2.2745

Stbd Waterline to Stbd IMU

Waterline to IMU (m)	x	
	y	
	z	2.275
	(In CARIS)	

	PORT	STBD	Notes
Average	2.27475	2.286643	Waterline
SD	0.0413	0.042215	Loading Uncertainty

Appendix II

Echosounder Reports

Hassler

Multibeam Echosounder Calibration

Date	Dn	Local Area
7/7/2011	188	Norfolk Canyon Wreck PA provided by OE

Calibrating Hydrographer(s)
Welton, Van Waes, Wilson

MBES System	MBES System Location	Date of most recent EED/Factory Check
Reson 7111	Stbd	UK

Sonar Serial Number	Processing Unit Serial Number

Sonar Mounting Configuration	Date of current offset measurement/verification
Stbd fwd pontoon	

Description of Positioning System	Date of most recent positioning system calibration
Stbd side POSMV	none

Acquisition Log

Date	Dn	Local Area	Wx
7/7/2011	188	Norfolk Canyon Wreck PA provided by OE	

Bottom Type	Approximate Water Depth
unknown	80 meters

Personnel on board

Comments

TrueHeave filename
2011_188_S250_Port_NorfolkCanyonA.000

	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #1 filename: MVP Files All Day					
SV Cast #2 filename:					

NAV TIME LATENCY

view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
MVP	2011_1881244	165	8.9	
	2011_1881253	347	4.5	

PITCH

view parallel to track, same line (at nadir) [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks

MVP	2011_1881224	165	7.5	On west side of target
	2011_1881236	345	7.5	

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
MVP	2011S_1881303	163	8.0	
	2011S_1881311	344	8.0	
	2011S_1881319	164	8.0	

ROLL view across track, same line [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
MVP				

Processing Log

Date	Dn	Personnel
6/7/2011	188	MJW

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** 2011_188_S250_Port_NorfolkCanyon_A.000

☑ **SVP applied** Concatenated, processed MVP file

☑ **Tide applied** zero tide

Zone file

Lines merged ☑ **Computed TPU** ☑

Data cleaned to remove gross fliers ☐ **Applied SBETs and Error Files** ☑

Compute correctors in this order			
1. Precise Timing	**2. Pitch bias**	**3. Heading bias**	**4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency (sec)	Pitch (deg)	Roll (deg)	Yaw (deg)
PS Wilson	0.00	0.20	-0.05	0.40
LT Greenaway	0.00	-0.21	-0.05	0.12
Averages	0.00	0.00	-0.05	0.26
Standard Deviation	0.00	0.29	0.00	0.20
FINAL VALUES	0.00	0.00	-0.05	0.26

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro	0.26	Value from standard deviation of Heading offset values
MRU Align StdDev Roll/Pitch	0.14	Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

Both HSX and S7K processed with SBETs and Error Files from POSPAC.

☐ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: **Date:**

FERDINAND R. HASSLER

Multibeam Echosounder Calibration

Please choose a vessel
Vessel

7/7/2011	188	Norfolk Canyon Wreck PA
Date	Dn	Local Area

Welton, PS Wilson, Higgs (Reson)
Calibrating Hydrographer(s)

Reson 7125	Port Pontoon	
MBES System	MBES System Location	Date of most recent EED/Factory Check

Sonar Serial Number	Processing Unit Serial Number
Sonar Mounting Configuration	Date of current offset measurement/verification
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

Date	Dn	Local Area	Wx
7/7/2011	188	Norfolk Canyon Wreck PA	2-4 ft swells, 1-2 ft seas, 10 kt winds

Bottom Type:

Approximate Water Depth: 10 meters

Personnel on board: FOO, Parker, Wilson, Higgs

Comments:

TrueHeave filename:

Concatenated MVP files

SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY

view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
MVP	2011_1881537	345	4.6	
	2011_1881547	165	9.6	

PITCH

view parallel to track, same line (at nadir) [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
MVP	2011_1881504	165	7.4	
	2011_1881515	345	7.0	

HEADING/YAW

view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
MVP	2011_1881556	345	8.4	
	2011_1881604	165		
	2011_1881611	345	8.0	

	2011_1881618	165	8.0	

ROLL view across track, same line [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
				Use Pitch

Processing Log

7/7/2011	189	PS Wilson
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied**

☑ **SVP applied** S250_ResonSAT_NorfolkCanyonWrk.svp

☑ **Tide applied** zerotide

Zone file n/a

Lines merged ☑ **Computed TPU** ☑

Data cleaned to remove gross fliers ☐ **Applied SBETs and Error Files** ☑

Compute correctors in this order			
1. Precise Timing	**2. Pitch bias**	**3. Heading bias**	**4. Roll bias**
Do not enter/apply correctors until all evaluations are complete and analyzed.			

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency (sec)	Pitch (deg)	Roll (deg)	Yaw (deg)
PS Wilson	-0.10	0.40	0.10	-1.20
Welton (remove)	0.00	0.15	0.07	-0.40
LT Greenaway	0.03	-0.09	0.05	-1.41
PS Wilson (2)	0.00	0.40	-0.08	-0.35
LT Greenaway(2)	0.00	0.14	-0.08	-0.82
Averages	0.00	0.27	-0.08	-0.59
Standard Deviation	0.00	0.18	0.00	0.33
FINAL VALUES	0.00	0.27	-0.08	-0.59

Final Values based on Averageof second trails- first discarded.

Resulting HVF File Name

MRU Align StdDev gyro	0.15	Value from standard deviation of Heading offset values
MRU Align StdDev Roll/Pitch	0.09	Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

PS Wilson values (2nd attempt): latency and pitch were both no change. Roll value -0.08, yaw value -0.35
LT Greenaway, 2nd attemp - roll -0.08

Not sure the casue.

☐ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: ____________________ **Date:** __________

FERDINAND R. HASSLER

Multibeam Echosounder Calibration

Please choose a vessel
Vessel

7/7/2011	188	Norfolk Canyon
Date	Dn	Local Area

Calibrating Hydrographer(s)

Reson 7125	Stbd Pontoon	
MBES System	MBES System Location	Date of most recent EED/Factory Check

Sonar Serial Number	Processing Unit Serial Number
Sonar Mounting Configuration	Date of current offset measurement/verification
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

7/7/2011	188	Norfolk Canyon	West, 8 kts, 1-2 ft seas, 2-4 ft swell
Date	Dn	Local Area	Wx

	80 meters
Bottom Type	Approximate Water Depth

Welton, Van Waes, Wilson, Higgs
Personnel on board

Comments

2011_188_S250_Stbd_NorfolkCanyon_A
TrueHeave filename

MVP					
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY

view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
MVP	2011S_1881355	345	5.2	
	2011S_1881406	163	8.0	

PITCH

view parallel to track, same line (at nadir) [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
MVP	2011S_1881335	345	7.3	
	2011S_1881346	163	7.0	

HEADING/YAW

view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks

MVP	2011S_1881417	345	7.0	
	2011S_1881424	165	7.0	
	2011S_1881432	345	7.0	
	2011S_1881442	165	7.0	
	2011S_1881450	345	7.0	

ROLL view across track, same line [opposite direction, same speed]

SV Cast #	Line Filename	Heading	Speed (kts)	Remarks
	use pitch lines			

Processing Log

7/7/2011	188	PS Wilson
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** 2011_188_S250_Stbd_NorfolkCanyon_A.000

☑ **SVP applied** S250_ResonSAT_NorfolkCanyonWrk.svp

☑ **Tide applied** zerotide

Zone file n/a

Lines merged ☑ **Computed TPU** ☑

Data cleaned to remove gross fliers ☑ **Applied SBETs and Error Files** ☑

Compute correctors in this order			
1. Precise Timing	**2. Pitch bias**	**3. Heading bias**	**4. Roll bias**
Do not enter/apply correctors until all evaluations are complete and analyzed.			

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency (sec)	Pitch (deg)	Roll (deg)	Yaw (deg)
Wilson	0.00	-0.13	-0.07	0.72
Van Waes	-0.14	0.40	-0.05	0.80
Welton	0.00	0.13	-0.05	0.60
LT Greenaway	0.00	-0.11	-0.05	0.56
Averages	-0.04	0.07	-0.06	0.67
Standard Deviation	0.07	0.25	0.01	0.11
FINAL VALUES	0.00	0.07	-0.06	0.67

Final Values based on ______________________

Resulting HVF File Name ______________________

MRU Align StdDev gyro	0.11	Value from standard deviation of Heading offset values
MRU Align StdDev Roll/Pitch	0.13	Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

Both HSX and S7K processed and SBETs and Error Files applied from POSPAC.

☐ **HVF Hydrographic Vessel File created or updated with current offsets**

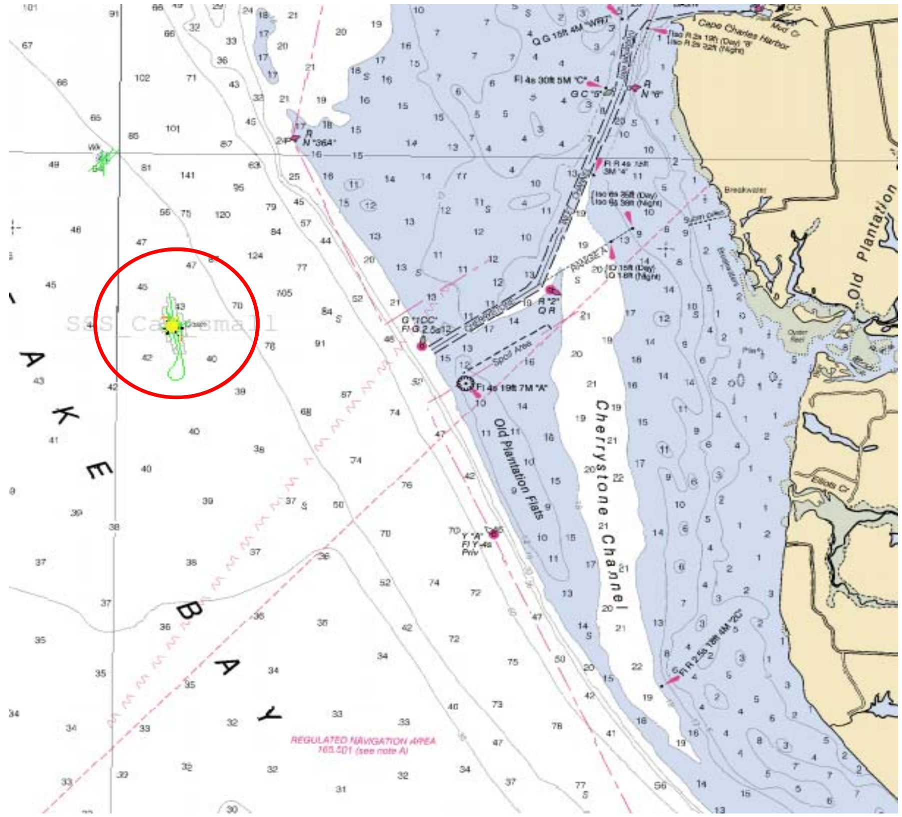
Name: ______________________ **Date:** __________

S250-Dual Head Worksheet

IMU Difference - From POS PAC
(stbd - port in IMU coordinate system, right hand, posx fwd, pos y stbd, pos z down.)
arc-minutes

file	Heading	uncert	Pitch	uncert	Roll	uncert	notes
2011_194_StbdA	-85	2	2	0.3	-10.3	0.5	
2011_194_StdbB	-86	2	1.8	0.4	-9	2	trend - tidal? In roll difference
2011_193_S250_Stbd_Canards_Up	-85	1	1.8	0.5	-8.6	1	
188_Stbd_norfolkCanyon_B	-85	3	1.8	0.5	-8.3	1.2	
average	-85.25	2	1.85	0.425	-9.05	1.175	
PORT to STBD IMU (in POS - DEG)	-1.42	0.03	0.03	0.01	-0.15	0.02	
PORT to STBD IMU (in CARIS - DEG)	-1.42		-0.03		0.15		pitch and roll have opposite sign in POS and CARIS
PORT 7125 Patch Test Values (in CARIS)	-0.59		0.27		-0.08		
PORT 7125 to STBD IMU	-2.01		0.24		0.07		

FH 2011 Sidescan Calibration
Side Scan run on Dn279, 2011. MBES run on Dn277, 2011
Contact is conspicuous point on debris field off Cape Charles City



MBES Position of Contact

Lat (DD)	Long (DD)
37.2338	-76.0775

SSS Contacts			Lat Diff (m)	Long Diff (m)	Distance (m)	All x,y Diff
1	37.2337	-76.0774	-6.0	2.8	6.6	
2	37.2337	-76.0775	-4.7	1.5	4.9	
3	37.2338	-76.0775	-0.8	-3.2	3.3	
4	37.2338	-76.0774	1.2	3.5	3.7	
5	37.2338	-76.0775	-0.6	-2.2	2.2	
6	37.2338	-76.0774	0.0	3.9	3.9	
7	37.2337	-76.0774	-7.7	2.6	8.2	
8	37.2338	-76.0774	-0.5	2.0	2.1	
9	37.2338	-76.0774	-3.0	2.1	3.6	
10	37.2338	-76.0775	-0.5	-0.8	0.9	
11	37.2338	-76.0774	-0.8	3.8	3.9	
12	37.2338	-76.0775	-1.7	-3.7	4.1	
N 12		Average	-2.1	1.0	3.9	-0.5
DOF: 2N-1 23		StDev	2.7	2.8		3.1

Criteria: 95% Confidence that any future measurement will not give a positional error greater than 10 meters.

Assuming x and y errors are goverened by the same normal distribution, the square of the distance error is governed by Chi-squared statistics.

So:

$$P\left[d^2 > \frac{\sigma^2 \chi^2_{n;\alpha}}{n} \right] = \alpha$$

Setting the distance error equal to 10 meters and using the Chi-squared value for one degree of freedom and alpha = 0.05, solve for the maximum value for the standard deviation of the x or y error.

Distance Error Limit (meters)	10
Max. x,y Std Deviation	5.1

The sample estimate of the standard deviation will also be Chi-squared distributed

At a 95% confidence interval the standard deviation range is:

	low	best est.	high	
x,y StDev	2.4	3.1	4.4	**PASS**

Appendix III

Positioning and Attitude System Reports

POSMV 320
INSTALLATION REPORT

Prepared for NOAA
Ferdinand Hassler
S250 SWATH
May, 2011
By

Bruce A. Francis
Applanix
Houston, TX

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Company:	**Oak Management**
Attention of:	**Steve Laverty**
Email:	steve.laverty@oakmanagement.com
From:	Bruce A. Francis
Date:	18 May, 2011
Ref.:	**POSMV Installation aboard** ***Ferdinand Hassler-SWATH***

During the period of May16th to May 18th, 2011 two POSMV systems were commissioned aboard NOAA vessel *Ferdinand Hassler*. The following is a summary of the events and final observations.

Chronology:

May 16th-

Travel from Houston TX to New Orleans LA. Overnight in Gulfport MS with the intention of meeting the ship in the morning to conduct dockside testing in the morning before the ship sets sail in the afternoon. Informed by Steve Laverty there has been a change in plan and the CO wants to depart the dock at 0900 tomorrow instead.

May 17th-

Arrive ship 0730. Brief review of POSMV installation with Briana Welton followed by cursory inspection. Both POSMV systems are up and running with no errors. Collected a set of dockside POSMV data from both systems for processing in POSPAC later today. Plan is to meet at the NOAA facility in Pascagoula at 0630 and transit out to ship in small boat.

May 18th- 0630- Depart Pascagoula for Ferdinand Hassler. Upon arrival commenced system inspection and diagnostics. No faults found. Conducted two GAMS calibrations on both POSMV systems and completed system acceptance testing.

Calibration and testing results:

1. The GAMS calibration was completed on May 18th and checked against the calculations derived from the survey report. Further comparisons are required but it appears that the survey calculations differ somewhat from the GAMS measured values.

Notes:

As a result of post processing the data set collected during commissioning, it was discovered that the POSMV IMU's were actually reversed at the back of the POSMV PCS units. Because of the symmetry in the two systems, these errors were not immediately obvious during the trials; however the lever arm errors were apparent in the data set. After physically changing the IMU inputs the processed calibration data was now reasonable when compared to the measured survey results. A new GAMS calibration was performed by the NOAA personnel after the IMU cables were returned to the correct orientation and the information below is based upon the correct orientation.

Recommendations:

While the large separation between the GPS antennas across decks will improve heading accuracy, there is a possibility that flexure in the ship will cause poor GAMS performance as the baseline vectors may become unstable. We were unable to fully test this configuration in a calm sea but if this turns out to be the case after the ship experiences a modest increase in sea state, the solution might be to extend the separation between the antennas on the individual mounts and switch the antenna input to the POS from cross decks to using the pairs from each side to their corresponding POS unit. The minimum separation should be 1 meter whereas now the distance is only about 0.6m and slightly too short to expect normal GAMS performance.

Submitted By:
Bruce A. Francis
Customer Support Engineer
Marine Products
713-896-9900
bfrancis@applanix.com

Vessel Name	Ferdinand R. Hassler
Year Built	2010
POSMV Location	**Port Side**
PCS Serial Number	3187
IMU Serial Number Top Hat	804 (Cable S/N 105)
Hardware Version	3.3-7
Firmware Version	5.03
POS IP Address Subnet Mask	129.100.2.231 255.255.0.0
POS PC Address Subnet Mask	129.100.2.234 255.255.255.0
Survey Software	Hypack 11.0.8.0
Multibeam System	Reson 7125

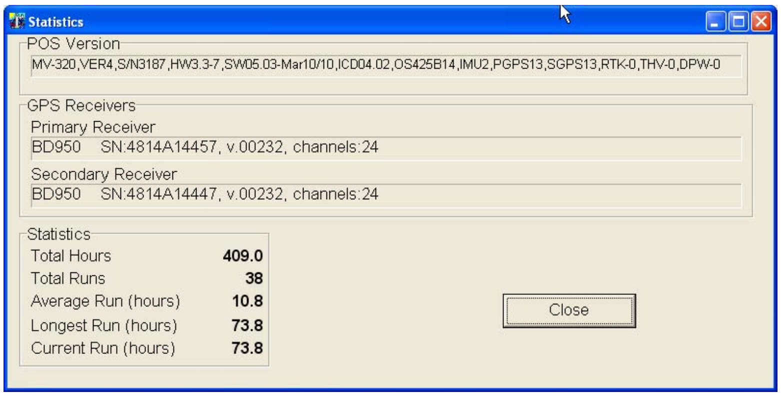
Port System Lever Arms: (Units are in Meters)

Point	**X Axis**	**Y Axis**	**Z Axis**	**Notes**
Reference point	0.0	0.0	0.0	PORT IMU
Ref to IMU	0.0	0.0	0.0	PORT IMU
Ref to Primary GPS	1.395	1.05	-13.084	Port Aft antenna
Ref to Secondary GPS	1.418	9.188	-13.080	Strb Aft antenna
Ref to AUX GPS	N/A	N/A	N/A	Not surveyed
Ref to Vessel	0.0	0.0	0.0	POS NMEA, message point of validity at target on IMU.
IMU frame w.r.t Ref frame	0.0	0.0	0.0	Rotation of IMU frame in comparison to ships frame.
Ref to Heave (COR)	0.0	0.0	0.0	Center of gravity (rotation) Information not available.
Ref to Sensor 1	0.0	0.0	0.0	Point of validity of HPR +Posn-Valid at IMU
Ref to Sensor 2	0.0	0.0	0.0	Point of validity-HPR +Posn-Valid at IMU

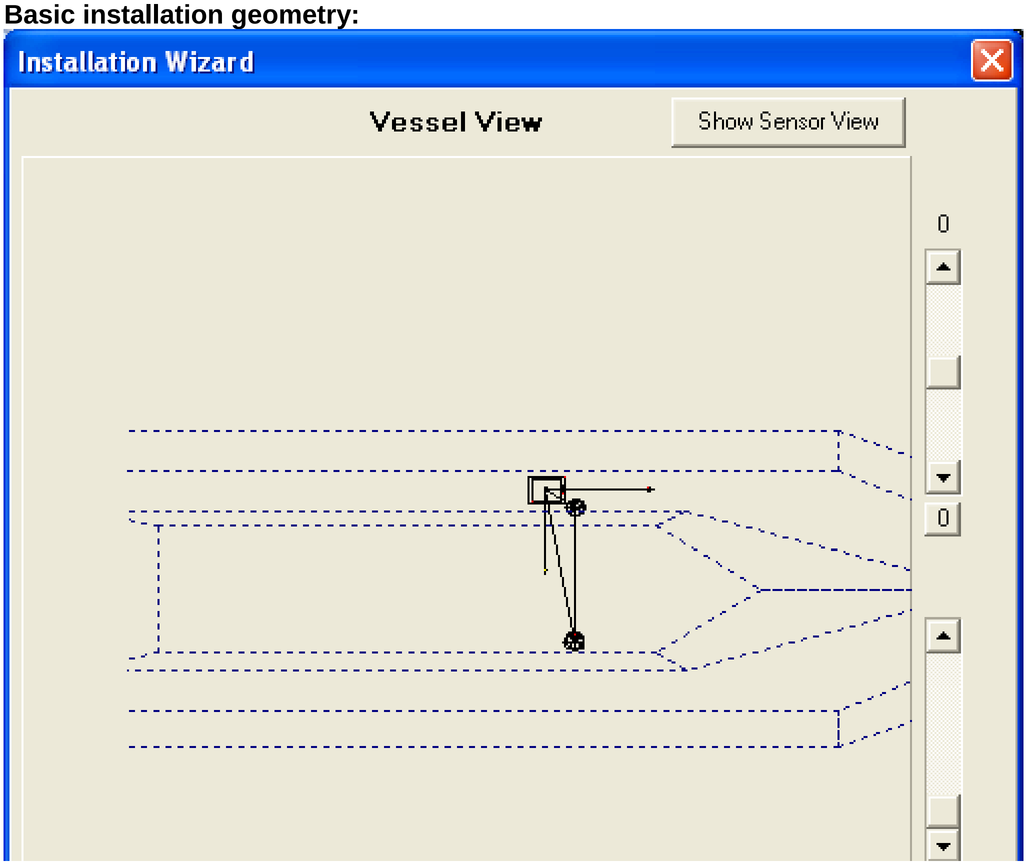
General System information:

Options included- RTK (RTK-0); True Heave (THV-0); (DPW-0) Password protection Disabled

Port POSMV



Basic installation geometry:

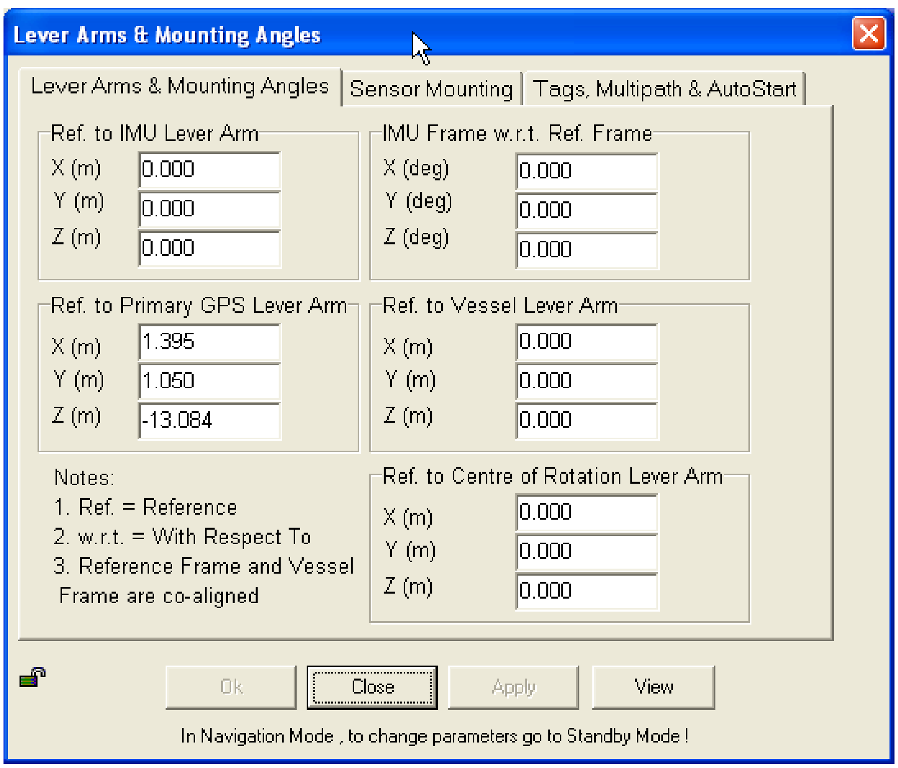


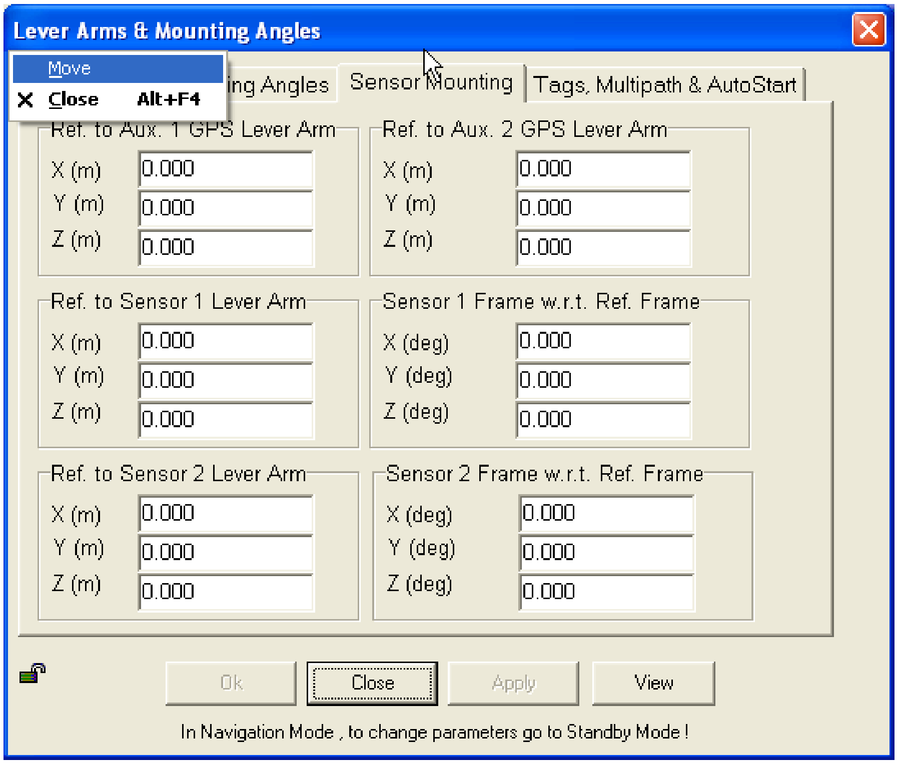
```
POSRT Data Extraction Utility [Jun 15 2011]
Copyright (c) 2008-2011 Applanix Corporation.  All rights reserved.
Date : 07/25/11    Time : 15:12:36
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
First POS file      : E:\Clients config, IP, & test results\NOAA\NOAA
Swath\Final_Data_IMUcorrect\For Bruce Frances\2011_152_S250_Port_A_GAMS.000
Last POS file       : E:\Clients config, IP, & test results\NOAA\NOAA
Swath\Final_Data_IMUcorrect\For Bruce Frances\2011_152_S250_Port_A_GAMS.000
Output path         : C:\Documents and Settings\bfrancis\My Documents\POSPac
MMS\Unnamed(1)\Swath Port IMU\Extract
Output kernel       : Swath Port IMU
Start time          : 0.000
End time            : 999999.000
VNAV output modulus : 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307750.275 : The First Group 99: Versions & Statistics
   System Version:
     Product-Model: MV-320; Version: VER4; Serial Number: S/N3187;
     Hardware Version: HW3.3-7;
     Software Release Version-Date: SW05.03-Mar10/10;
     ICD release version: ICD04.02;
     Operating System Version: OS425B14;
     IMU Type: IMU2; Primary GPS Type: PGPS13; Secondary GPS Type: SGPS13;
     Option mnemonic-Expiry Time: DMI0;
     Option mnemonic-Expiry Time: GIM0;
     Option mnemonic-Expiry Time: RTK-0;
     Option mnemonic-Expiry Time: THV-0;
     Option mnemonic-Expiry Time: DPW-0;
   Primary GPS Version: BD950        SN:4814A14457, v.00232, channels:24;
   Secondary GPS Version: BD950      SN:4814A14447, v.00232, channels:24;
   Total Hours          :    561.4; Number of Runs:     53
   Average Length of Run:   10.6; Longest Run:  126.2; Current Run:   12.1;
--------------------------------------------------------------------------------
307750.275 : Diffcorr2 time1 gap: start 0.0, end 307750.2749
307750.280 : IMU type: IMU2  Data rate = 200 Hz
307750.280 : Extracting Group 4 : Time-tag data
307750.290 : SNV status changed to 0  (Full Nav)
307751.070 : Primary GNSS receiver type is GNSS13.
307751.090 : Secondary GNSS receiver type is GNSS13.
307755.275 : GenB( 9):  GAMS solution in use CLEARED.
307756.275 : GenB( 9):  GAMS solution in use SET.
307758.275 : GenB( 9):  GAMS solution in use CLEARED.
--------------------------------------------------------------------------------
307759.275 : Message 50: Transition to NAVIGATE mode.
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 37: Base 1 setup
   Input data type expected: RTCM 1 or 9
   Datum Type: NAD83
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 38: Base 2 setup
   Input data type expected: RTCM 1 or 9
   Datum Type: WGS84
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 20: General parameters
   Time and distance tag types:          2  1
   Autostart selection:                   ENABLED
   Reference-IMU lever arm:              -0.008  -0.031  0.130
   Reference-primary GPS lever arm:      1.395  1.050  -13.084
   Reference-auxiliary 1 GPS lever arm:  0.000  0.000  0.000
```

```
   Reference-auxiliary 2 GPS lever arm:  0.000  0.000  0.000
   Reference-IMU mounting angles:        0.000  0.000  0.000
   Reference-vehicle mounting angles:    0.000  0.000  0.000
   Multipath environment:                 LOW
--------------------------------------------------------------------------------


--------------------------------------------------------------------------------
307759.275 : Message 22: Aiding sensor install parameters
   DMI scale factor:                    0.00
   Reference-DMI lever arm:             0.00    0.00    0.00
   DVS scale factor correction:         1.00
   Reference-DVS lever arm:             0.00    0.00    0.00
   Reference-DVS attitude:              0.00    0.00    0.00
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 24: User accuracy parameters
   User position accuracy:       2.00
   User velocity accuracy:       0.50
   User attitude accuracy:       0.05
   User heading accuracy:        0.05
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 106: Heave ratios
   Heave Bandwidth (sec):  12.000
   Heave Damping Ratio:  0.707
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 120: Heave and sensor 1&2 install parameters
   Reference->Sensor1 alignment angles (R,P,Y) in degrees:  0.00  0.00  0.00
   Reference->Sensor2 alignment angles (R,P,Y) in degrees:  0.00  0.00  0.00
   Reference->Sensor1 lever arm in meters:                  0.00  0.00  0.00
   Reference->Sensor2 lever arm in meters:                  0.00  0.00  0.00
   Reference->Center of Rotation in meters:                    0.00  0.00  0.00
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 121: Vessel Installation Parameters
   Reference-Vessel in meters:                             0.00  0.00  0.00
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 32: PCS IP address
   IP Address (Network part 1): 129
   IP Address (Network part 2): 100
   IP Address (Host part 1):    1
   IP Address (Host part 2):    232
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 56: General data
   Initial status:     COARSE_LEVEL
   Initial position:   30.339734242 -88.576108929 -24.927
   Initial distance:   0.00
   Initial attitude:   0.000 0.000 0.000
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307759.275 : Message 21: GAMS install parameters
   A-B antenna separation:        8.112
   A-B baseline vector:           -0.060 8.112 0.021
   Heading error for calibration: 0.50
   A-B azimuth correction:        0.000
--------------------------------------------------------------------------------
Available subsystems                   :  IMU
                                       :  Primary GNSS
                                       :  Secondary GNSS
                                       :  Differential Corrections
Vehicle to reference alignment angles :  0.000  0.000  0.000
Multipath setting                      :  LOW
Reference to IMU lever arm             : -0.008 -0.031  0.130
Reference to IMU alignment angles      :  0.000  0.000  0.000
Reference to primary GNSS lever arm    :  1.395  1.050 -13.084
GAMS antenna separation                :  8.104
GAMS baseline vector                   :  0.152  8.103 -0.004
```

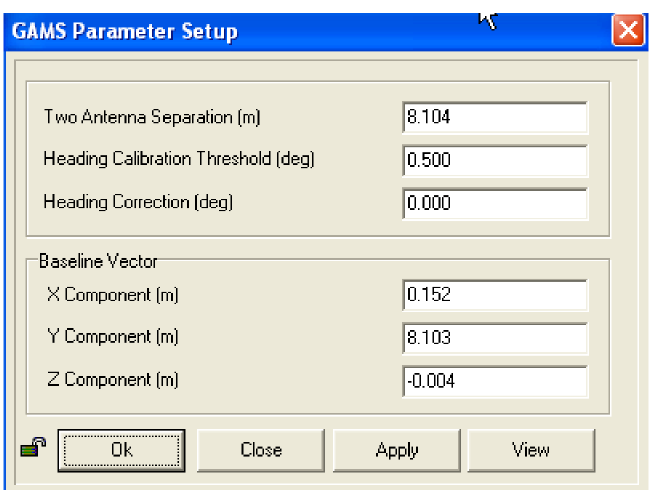
```
GAMS heading calibration threshold     :  0.500
GAMS heading correction                :  0.000
```



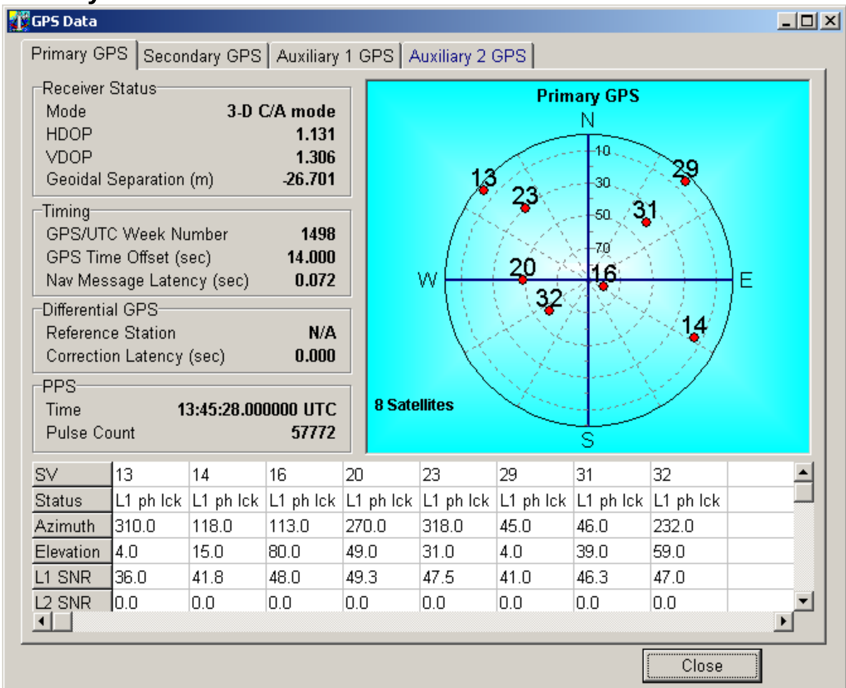


Observed GAMS values derived from the field calibration:

Port GAMS Cal #1

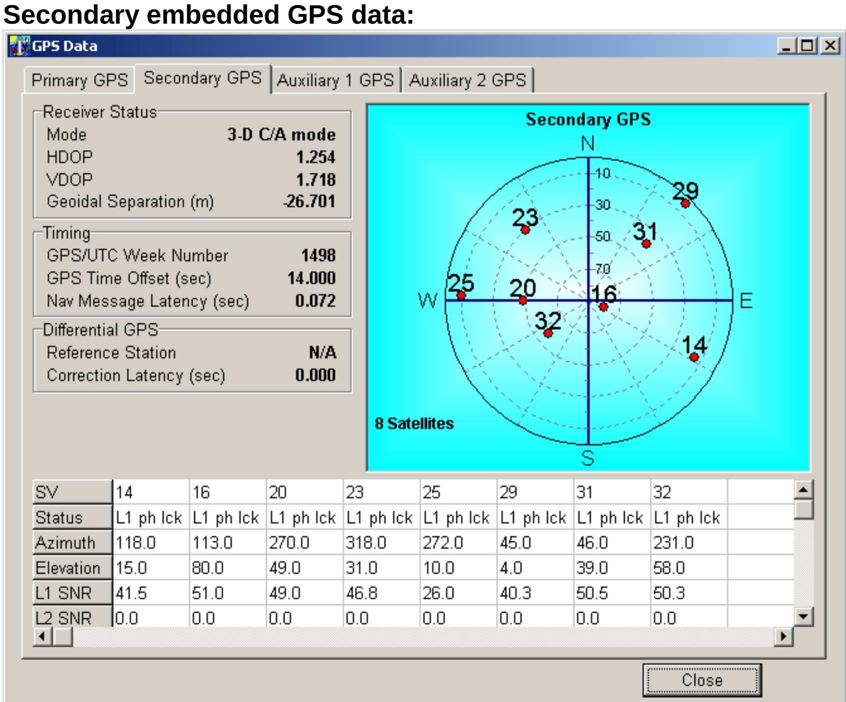


Primary GPS data observed from internal Trimble BD950 receivers.



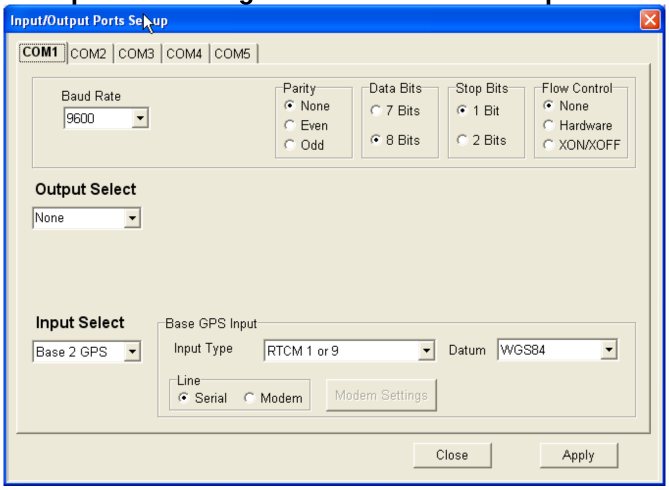
SV	13	14	16	20	23	29	31	32
Status	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck
Azimuth	310.0	118.0	113.0	270.0	318.0	45.0	46.0	232.0
Elevation	4.0	15.0	80.0	49.0	31.0	4.0	39.0	59.0
L1 SNR	36.0	41.8	48.0	49.3	47.5	41.0	46.3	47.0
L2 SNR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Secondary embedded GPS data:

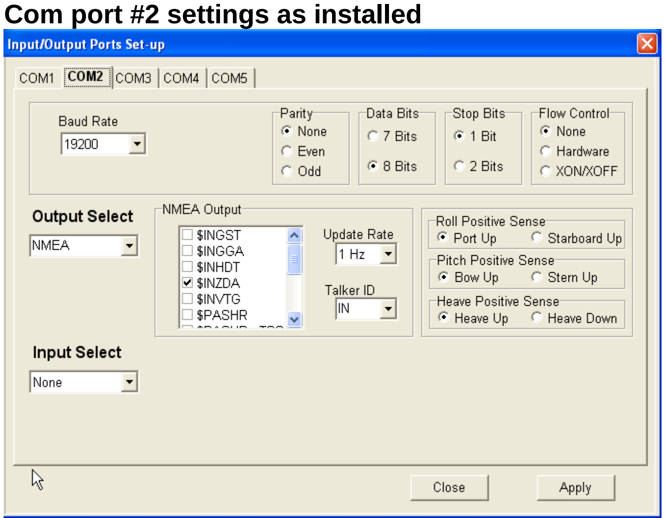


SV	14	16	20	23	25	29	31	32
Status	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck	L1 ph lck
Azimuth	118.0	113.0	270.0	318.0	272.0	45.0	46.0	231.0
Elevation	15.0	80.0	49.0	31.0	10.0	4.0	39.0	58.0
L1 SNR	41.5	51.0	49.0	46.8	26.0	40.3	50.5	50.3
L2 SNR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

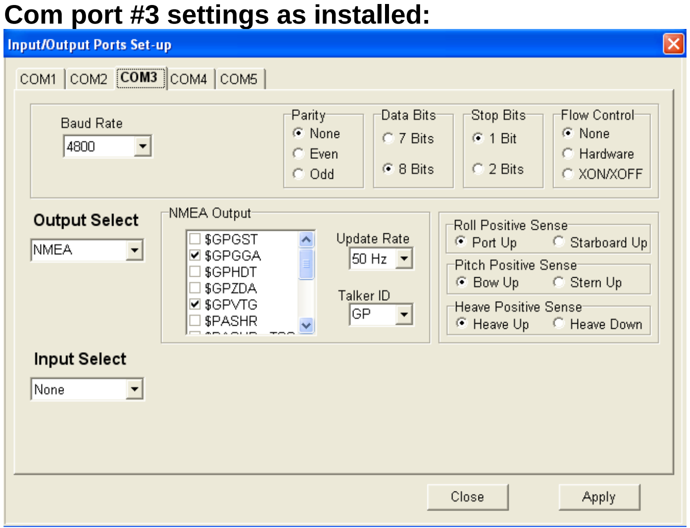
Com port #1 settings as installed: DGPS input from Trimble SPS Receiver.



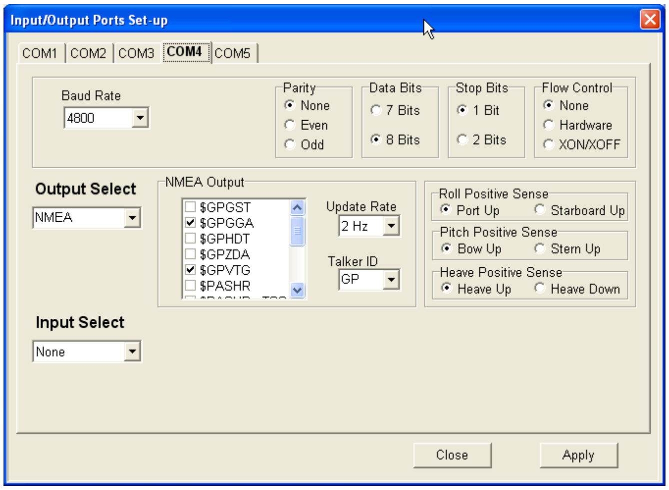
Com port #2 settings as installed



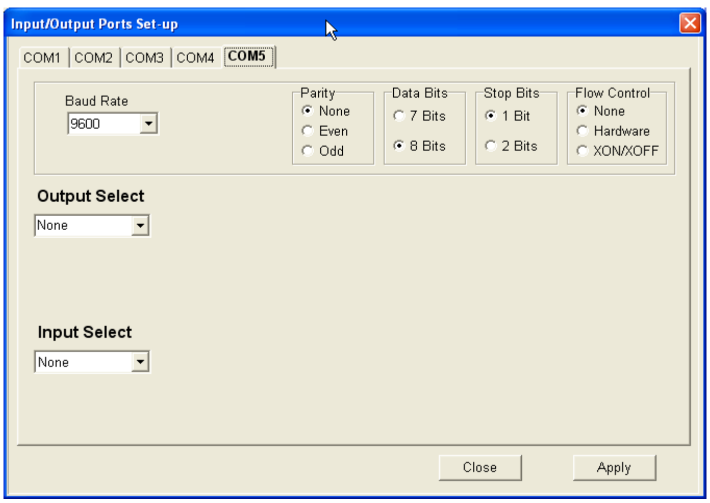
Com port #3 settings as installed:



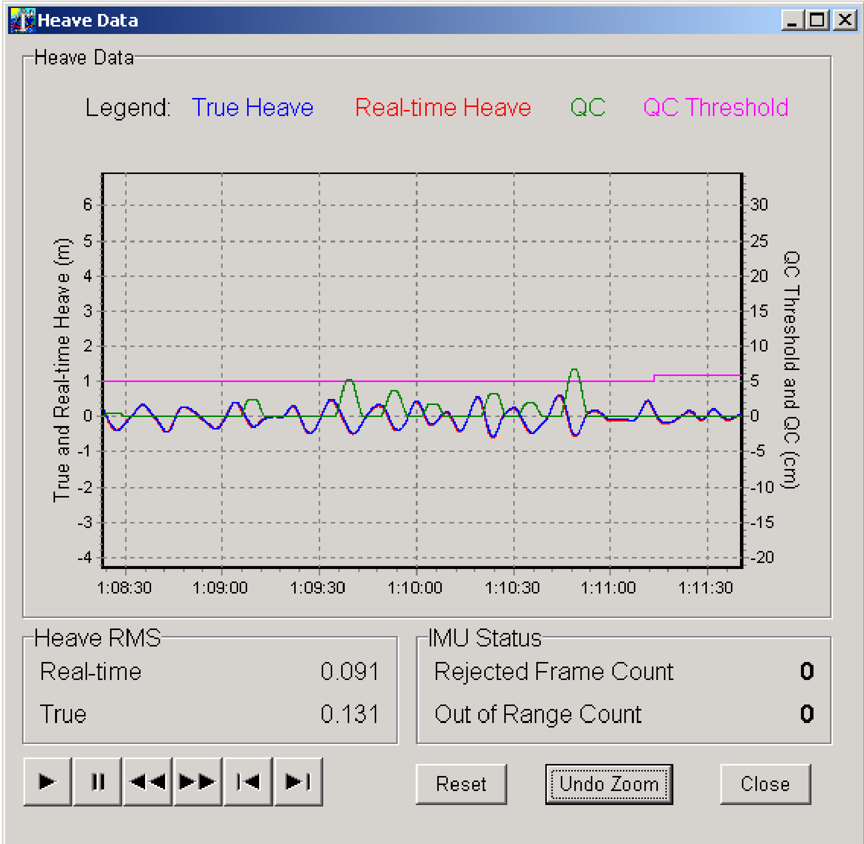
Com port #4 settings as installed:



Com port #5 settings as installed

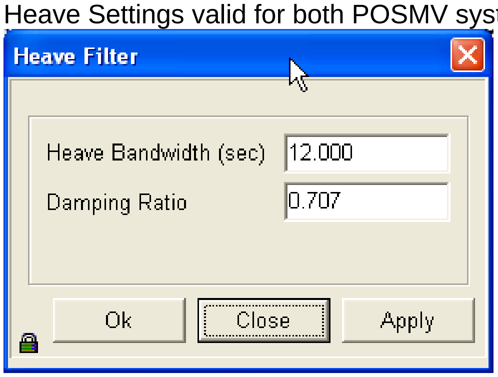


Heave data plot:

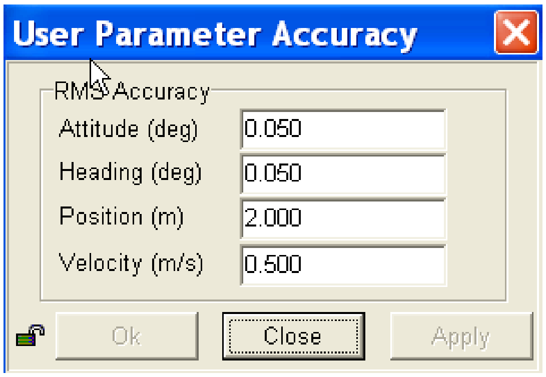


The heave plot above shows the relationship between the Real-time (RT) heave and the True (or delayed TH) heave measurements. The green line relates to quality control (QC) and represents the difference between the two values. When the delta between the RT and TH exceeds 5cm or 5% of total heave (pink line) then the radio light on the main controller screen will turn from green to red but <u>does not affect the real-time heave data being collected</u>. Quite often this occurs after the vessel makes a turn or an abrupt change in speed and is not necessarily cause for alarm. The heave filter has a 105 second buffer so the event which may have caused the impulse happened in the past. A red light merely calls the users attention to the difference and may also suggest that the filter settings need to be refined if the QC value is continually out of bounds.

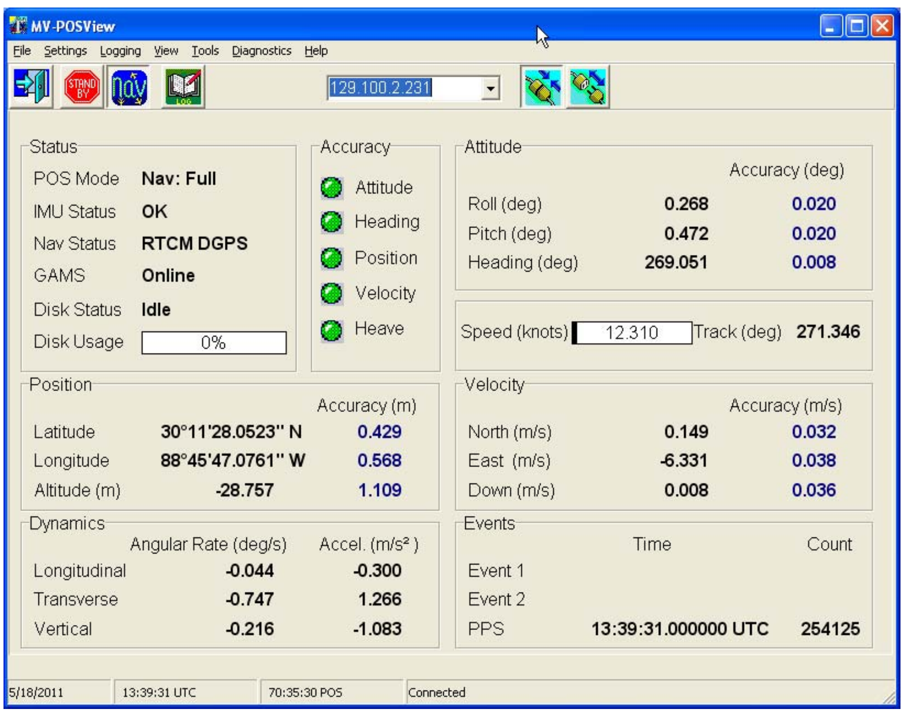
Note: The TrueHeave data filter is delayed about 3 minutes from the TH value. <u>Also, Group 111 & 113 must be enabled in the Ethernet Real-time logging page.</u> In addition, this filter should be adjusted as required for changes in the local swell conditions.
Heave Settings valid for both POSMV systems.



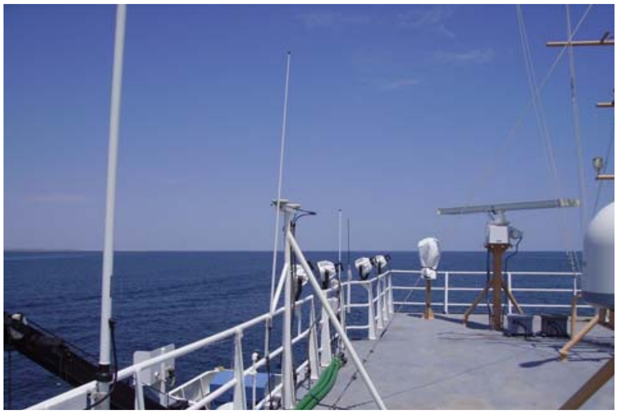
The main controller screens below shows normal POSMV operation. POS Mode is FULL indicating that all user accuracy settings have been satisfied. Note, when using RTK the position threshold should be set to a smaller value i.e. 0.100m or whatever is specified in the survey parameters. Exceeding any of the limits below will cause one of the radio lights to turn red and the POS mode will no longer report "Full Navigation" This however only affects the flag in the GGA or GGK message and not the performance.



Port POSMV Final Navigation



Port side antenna and IMU mounting:

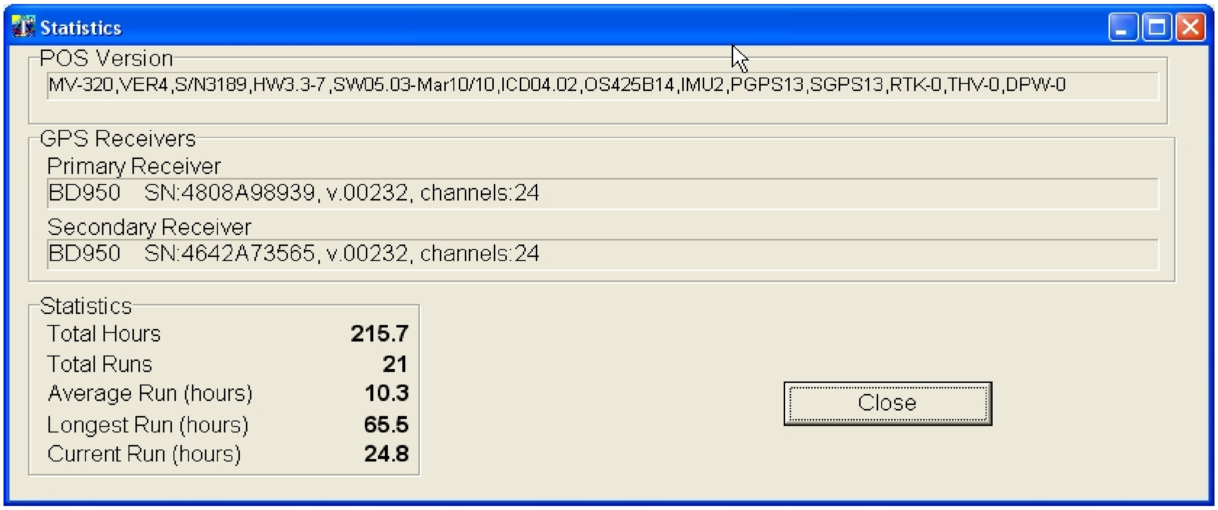


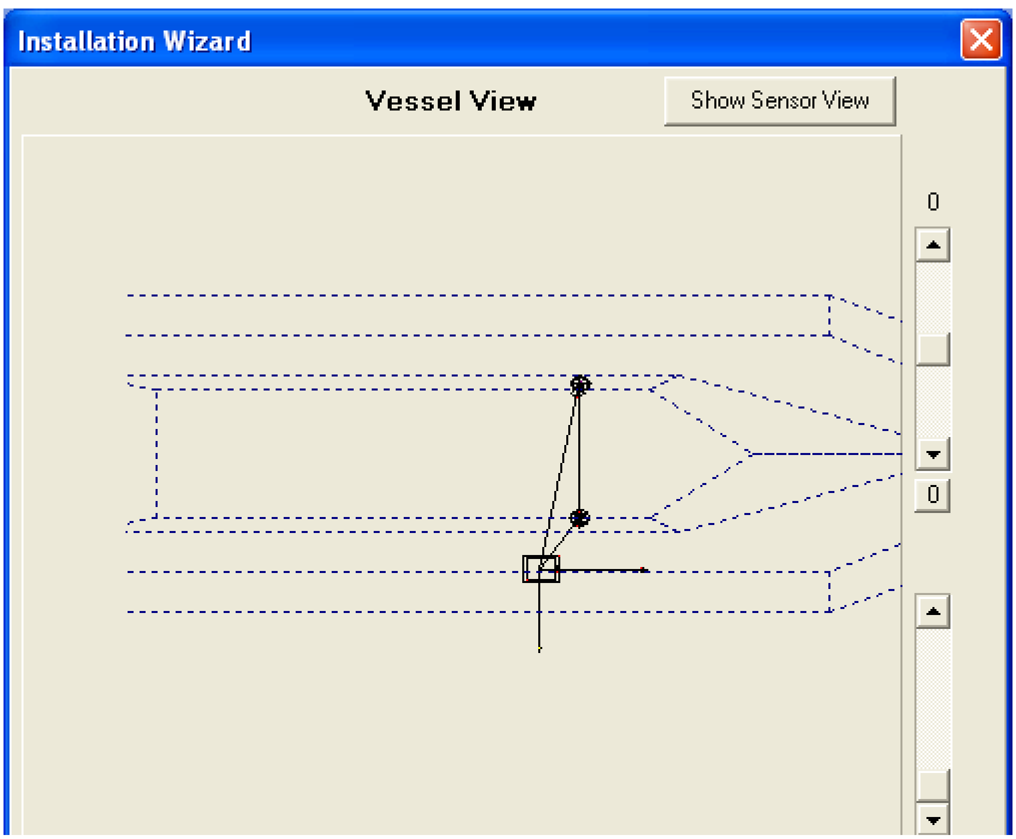
Vessel Name	Ferdinand R. Hassler	
Year Built	2010	
POSMV Location	**STRB Side**	
PCS Serial Number	3189	
IMU Serial Number Top Hat	803 (Cable S/N 104)	
Hardware Version	3.3-7	
Firmware Version	5.03	
POS IP Address Subnet Mask	129.100.1.231 255.255.0.0	
POS PC Address Subnet Mask	129.100.1.234 255.255.255.0	
Survey Software	Hypack 11.0.8.0	
Multibeam System	Reson 7125	

Port System Lever Arms: (Units are in Meters)

Point	**X Axis**	**Y Axis**	**Z Axis**	**Notes**
Reference point	0.0	0.0	0.0	STRB IMU
Ref to IMU	0.0	0.0	0.0	STRB IMU
Ref to Primary GPS	1.929	-11.199	-13.084	Port FWD antenna
Ref to Secondary GPS	1.953	-3.056	-13.083	Strb FWD antenna
Ref to AUX GPS	N/A	N/A	N/A	Not surveyed
Ref to Vessel	0.0	0.0	0.0	POS NMEA, message point of validity at target on IMU.
IMU frame w.r.t Ref frame	0.0	0.0	0.0	Rotation of IMU frame in comparison to ships frame.
Ref to Heave (COR)	0.0	0.0	0.0	Center of gravity (rotation) Information not available.
Ref to Sensor 1	0.0	0.0	0.0	Point of validity of HPR +Posn-Valid at IMU
Ref to Sensor 2	0.0	0.0	0.0	Point of validity-HPR +Posn-Valid at IMU

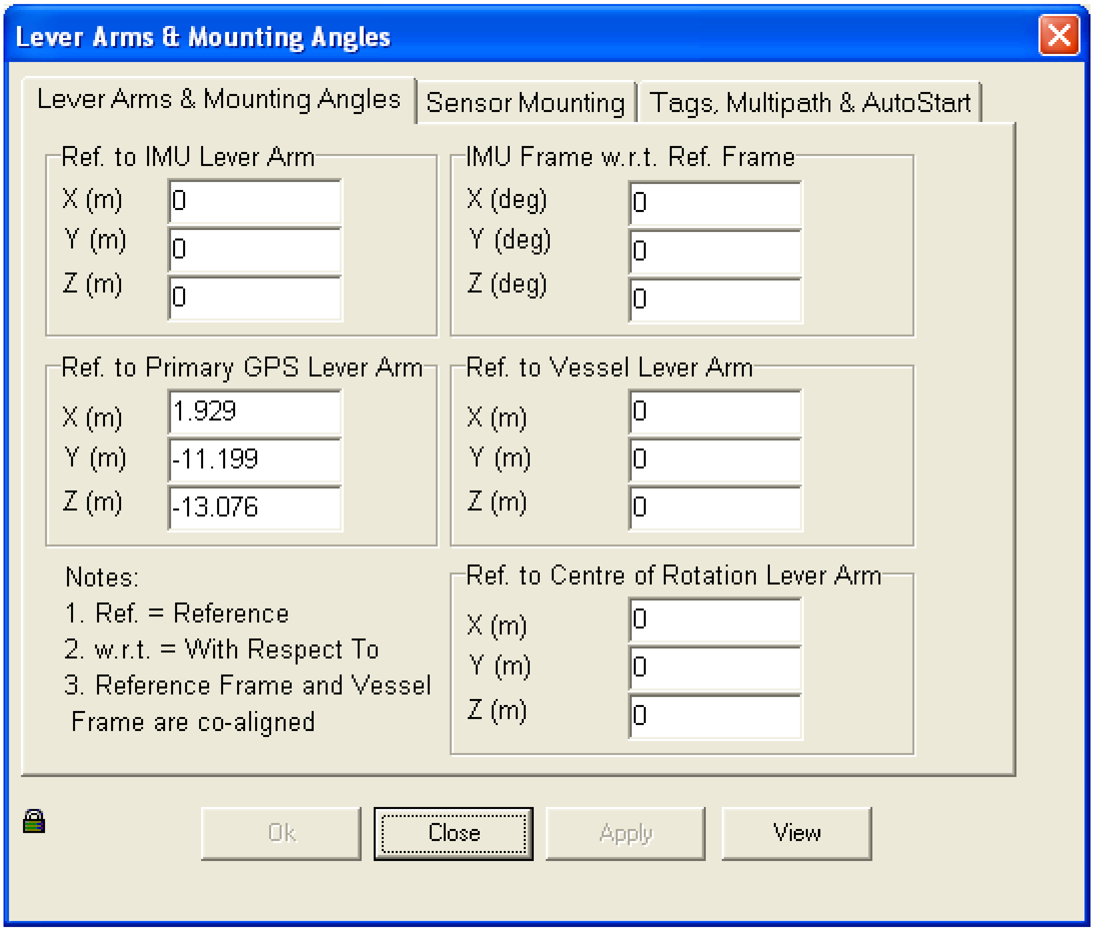
STRB POSMV

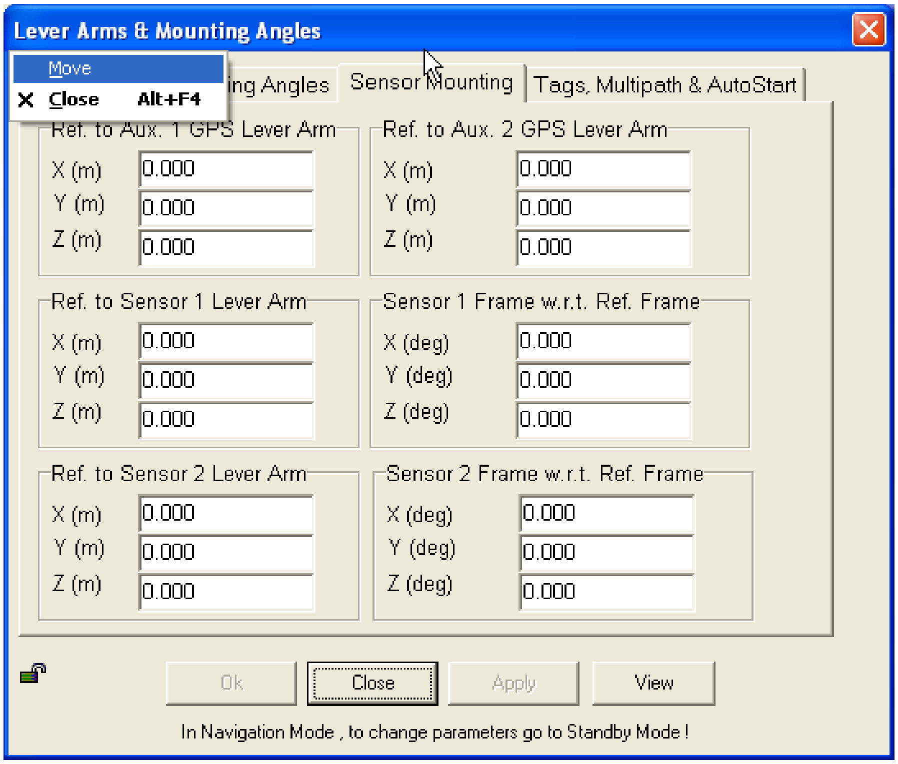

Statistics
POS Version
MV-320,VER4,S/N3189,HW3.3-7,SW05.03-Mar10/10,ICD04.02,OS425B14,IMU2,PGPS13,SGPS13,RTK-0,THV-0,DPW-0
GPS Receivers
Primary Receiver
BD950 SN:4808A98939, v.00232, channels:24
Secondary Receiver
BD950 SN:4642A73565, v.00232, channels:24
Statistics
Total Hours 215.7
Total Runs 21
Average Run (hours) 10.3
Longest Run (hours) 65.5
Current Run (hours) 24.8
Close


Installation Wizard
Vessel View
Show Sensor View
0
0

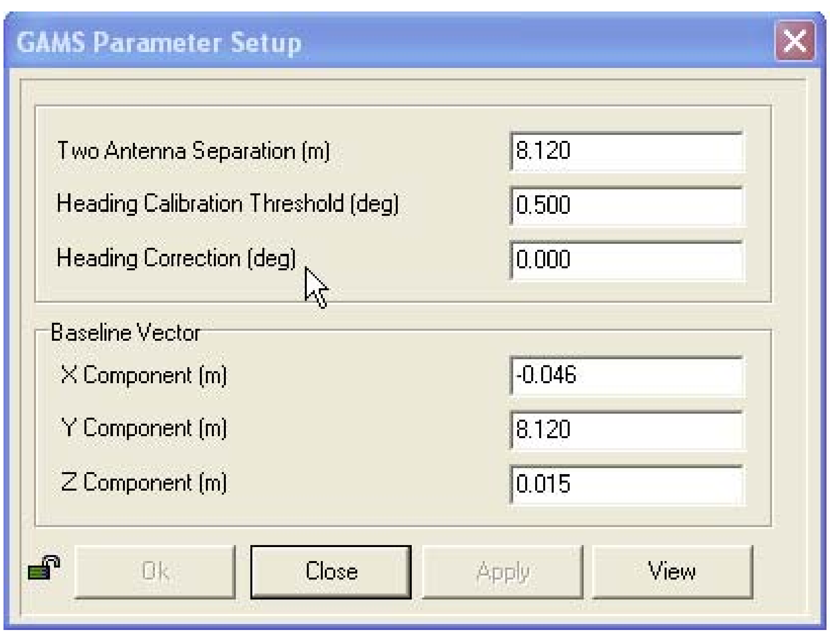
```
POSRT Data Extraction Utility [Jun 15 2011]
Copyright (c) 2008-2011 Applanix Corporation.  All rights reserved.
Date : 07/25/11    Time : 15:12:36
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
First POS file      : E:\Clients config, IP, & test results\Swath 250 Testing\Final
Report Files\Final_Data_IMUcorrect\For Bruce Frances\2011_152_S250_Stbd_GAMS.000
Last POS file       : E:\Clients config, IP, & test results\Swath 250 Testing\Final
Report Files\Final_Data_IMUcorrect\For Bruce Frances\2011_152_S250_Stbd_GAMS.003
Output path         : C:\Documents and Settings\bfrancis\My Documents\POSPac
MMS\Unnamed(2)\Mission 1\Extract
Output kernel       : Mission 1
Start time          : 0.000
End time            : 999999.000
VNAV output modulus : 1
--------------------------------------------------------------------------------
Opening file: E:\Clients config, IP, & test results\Swath 250 Testing\Final Report
Files\Final_Data_IMUcorrect\For Bruce Frances\2011_152_S250_Stbd_GAMS.000
307625.639 : Output time 1 is in UTC time
307625.639 : Output time 2 is in POS time
307625.639 : Output distances are in POS distance
307625.639 : IMU type: IMU2  Data rate = 200 Hz
307625.639 : Extracting Group 4 : Time-tag data
307625.649 : SNV status changed to 0  (Full Nav)
307626.069 : Primary GPS receiver type is GPS13.
307626.094 : Secondary GPS receiver type is GPS13.
307626.144 : Extracting Group 10: The General Status & FDIR data.
307626.144 : GenA( 2):  IIN quadrant resolved SET.
307626.144 : GenA( 3):  IIN fine align active SET.
307626.144 : GenA( 4):  IIN navigator initialized SET.
307626.144 : GenA( 5):  IIN navigator alignment active SET.
307626.144 : GenA( 7):  IIN full navigation solution SET.
307626.144 : GenA( 8):  IIN initial position valid SET.
307626.144 : GenA(16):  RAM config != NVM SET.
307626.144 : GenB( 0):  IIN user attitude performance SET.
307626.144 : GenB( 1):  IIN user heading performance SET.
307626.144 : GenB( 2):  IIN user position performance SET.
307626.144 : GenB( 3):  IIN user velocity performance SET.
307626.144 : GenB( 8):  GAMS installation parameters valid SET.
307626.144 : GenB( 9):  GAMS solution in use SET.
307626.144 : GenB(10):  GAMS solution OK SET.
307626.144 : GenB(16):  Primary GPS configuration file sent SET.
307626.144 : GenB(18):  Primary GPS in CA mode SET.
307626.144 : GenB(23):  Primary GPS observables in use SET.
307626.144 : GenB(24):  GAMS secondary GPS observables in use SET.
307626.144 : GenC( 6):  RTCM Type 1 or 9 in use SET.
307626.144 : GenC(13):  IIN in RTCM DGPS aided mode SET.
307626.144 : FDIR1(13): Ephemeris missing SET.
--------------------------------------------------------------------------------
307626.144 : The First Group 99: Versions & Statistics
   System Version:
     Product-Model: MV-320; Version: VER4; Serial Number: S/N3189;
     Hardware Version: HW3.3-7;
     Software Release Version-Date: SW05.03-Mar10/10;
     ICD release version: ICD04.02;
     Operating System Version: OS425B14;
     IMU Type: IMU2; Primary GPS Type: PGPS13; Secondary GPS Type: SGPS13;
     Option mnemonic-Expiry Time: DMI0;
     Option mnemonic-Expiry Time: GIM0;
     Option mnemonic-Expiry Time: RTK-0;
     Option mnemonic-Expiry Time: THV-0;
     Option mnemonic-Expiry Time: DPW-0;
   Primary GPS Version: BD950    SN:4808A98939, v.00232, channels:24;
   Secondary GPS Version: BD950  SN:4642A73565, v.00232, channels:24;
   Total Hours          :    789.9; Number of Runs:     66
   Average Length of Run:   12.0; Longest Run:   84.0; Current Run:   12.2;
--------------------------------------------------------------------------------
307626.144 : Diffcorr2 time1 gap: start 0.0, end 307626.1439
```

```
--------------------------------------------------------------------------------
307633.139 : Message 50: Transition to NAVIGATE mode.
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 37: Base 1 setup
   Input data type expected: RTCM 1 or 9
   Datum Type: NAD83
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 38: Base 2 setup
   Input data type expected: RTCM 1 or 9
   Datum Type: WGS84
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 20: General parameters
   Time and distance tag types:          2  1
   Autostart selection:                   ENABLED
   Reference-IMU lever arm:              -0.008  -0.031  0.130
   Reference-primary GPS lever arm:      1.929  -11.199  -13.076
   Reference-auxiliary 1 GPS lever arm:  0.000  0.000  0.000
   Reference-auxiliary 2 GPS lever arm:  0.000  0.000  0.000
   Reference-IMU mounting angles:        0.000  0.000  0.000
   Reference-vehicle mounting angles:    0.000  0.000  0.000
   Multipath environment:                 LOW
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 24: User accuracy parameters
   User position accuracy:       2.00
   User velocity accuracy:       0.50
   User attitude accuracy:       0.05
   User heading accuracy:        0.05
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 106: Heave ratios
   Heave Bandwidth (sec):  12.000
   Heave Damping Ratio:  0.707
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 120: Heave and sensor 1&2 install parameters
   Reference-Sensor1 alignment angles (R,P,Y) in degrees:  0.000  0.000  0.000
   Reference-Sensor2 alignment angles (R,P,Y) in degrees:  0.000  0.000  0.000
   Reference-Sensor1 lever arm in meters:                  0.000  0.000  0.000
   Reference-Sensor2 lever arm in meters:                  0.000  0.000  0.000
   Reference-Centre of Rotation in meters:                 0.000  0.000  0.000
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 121: Vessel Installation Parameters
   Reference-Vessel in meters:                             0.00  0.00  0.00
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 32: PCS IP address
   IP Address (Network part 1): 129
   IP Address (Network part 2): 100
   IP Address (Host part 1):    1
   IP Address (Host part 2):    231
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 56: General data
   Initial status:     COARSE_LEVEL
   Initial position:   30.339738973 -88.576114608 -17.526
   Initial distance:   0.00
   Initial attitude:   0.000 0.000 0.000
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
307633.139 : Message 21: GAMS install parameters
   A-B antenna separation:        8.122
   A-B baseline vector:           0.170 8.120 -0.003
   Heading error for calibration: 0.50
   A-B azimuth correction:        0.000
--------------------------------------------------------------------------------
```

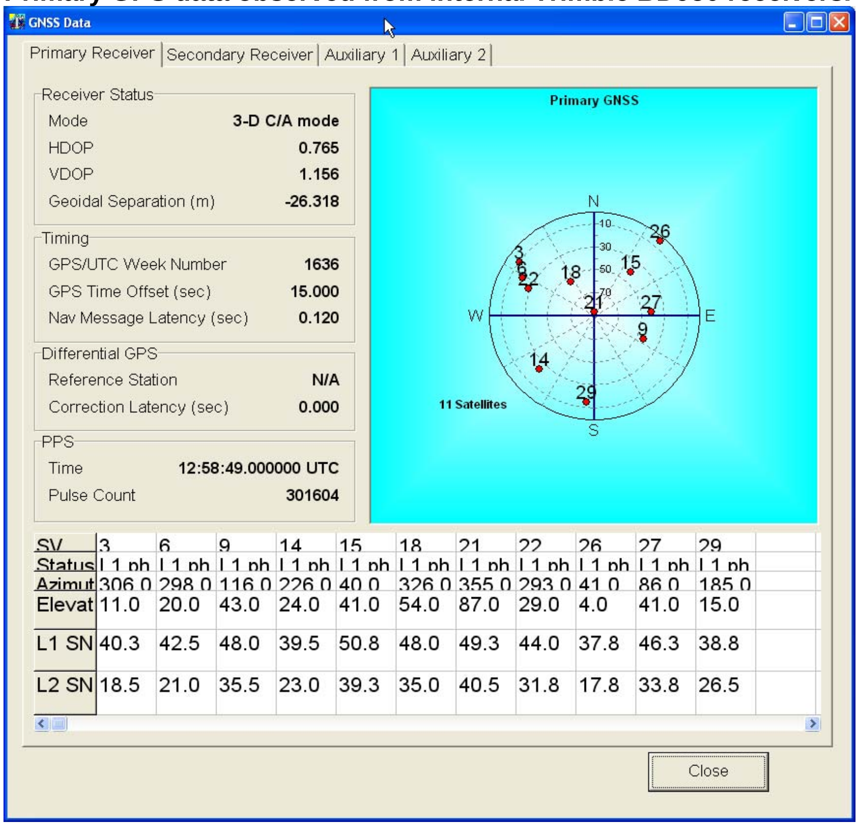

Lever Arms & Mounting Angles
Lever Arms & Mounting Angles
Sensor Mounting
Tags, Multipath & AutoStart
Ref. to IMU Lever Arm
X (m) 0
Y (m) 0
Z (m) 0
IMU Frame w.r.t. Ref. Frame
X (deg) 0
Y (deg) 0
Z (deg) 0
Ref. to Primary GPS Lever Arm
X (m) 1.929
Y (m) -11.199
Z (m) -13.076
Ref. to Vessel Lever Arm
X (m) 0
Y (m) 0
Z (m) 0
Notes:
1. Ref. = Reference
2. w.r.t. = With Respect To
3. Reference Frame and Vessel Frame are co-aligned
Ref. to Centre of Rotation Lever Arm
X (m) 0
Y (m) 0
Z (m) 0
Ok
Close
Apply
View



Observed GAMS values derived from the field calibration:
STRB GAMS Cal #1

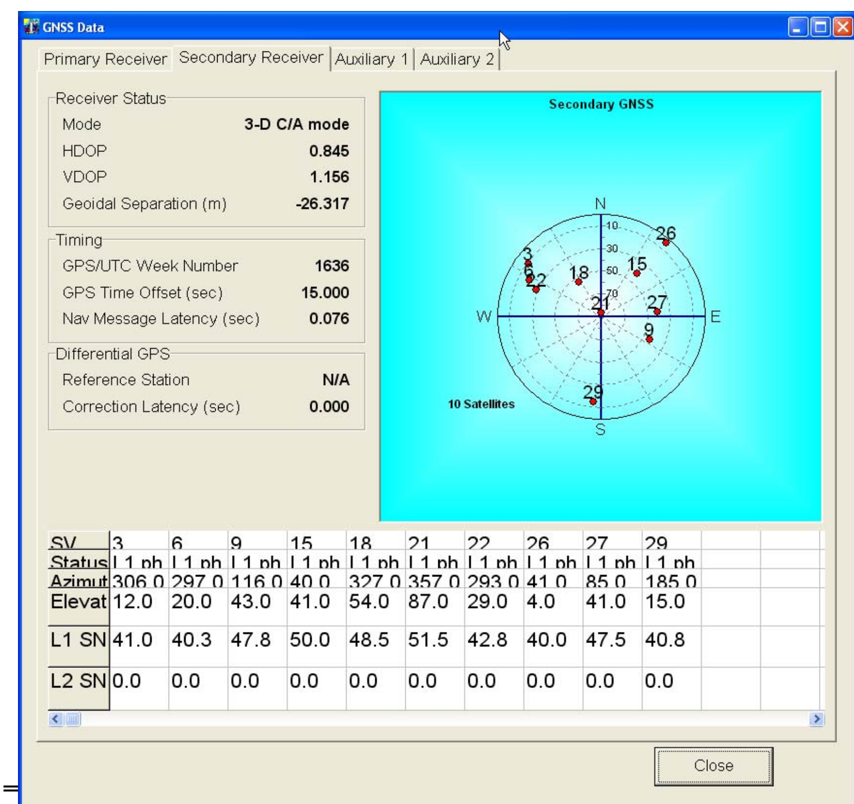


Primary GPS data observed from internal Trimble BD950 receivers.



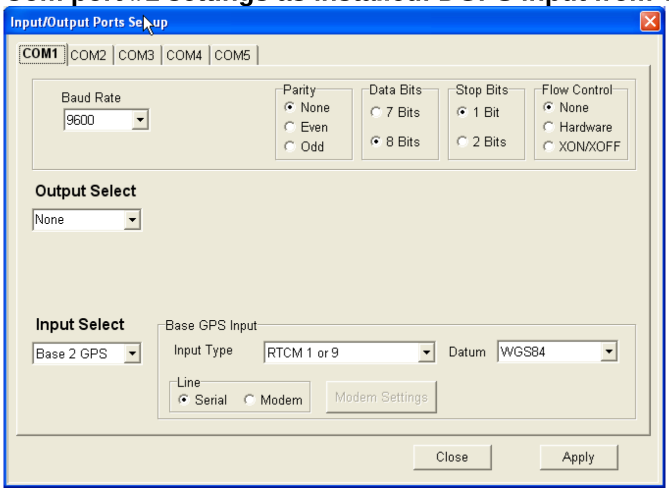
SV	3	6	9	14	15	18	21	22	26	27	29
Status	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph
Azimut	306.0	298.0	116.0	226.0	40.0	326.0	355.0	293.0	41.0	86.0	185.0
Elevat	11.0	20.0	43.0	24.0	41.0	54.0	87.0	29.0	4.0	41.0	15.0
L1 SN	40.3	42.5	48.0	39.5	50.8	48.0	49.3	44.0	37.8	46.3	38.8
L2 SN	18.5	21.0	35.5	23.0	39.3	35.0	40.5	31.8	17.8	33.8	26.5

Secondary embedded GPS data:

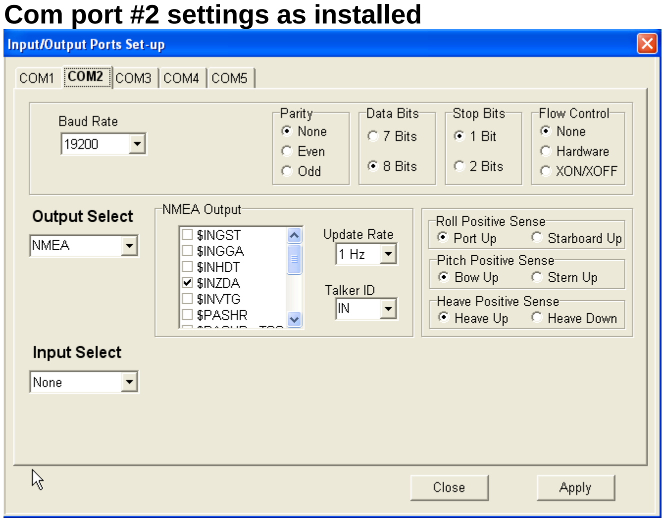


SV	3	6	9	15	18	21	22	26	27	29
Status	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph	L1 ph
Azimut	306.0	297.0	116.0	40.0	327.0	357.0	293.0	41.0	85.0	185.0
Elevat	12.0	20.0	43.0	41.0	54.0	87.0	29.0	4.0	41.0	15.0
L1 SN	41.0	40.3	47.8	50.0	48.5	51.5	42.8	40.0	47.5	40.8
L2 SN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

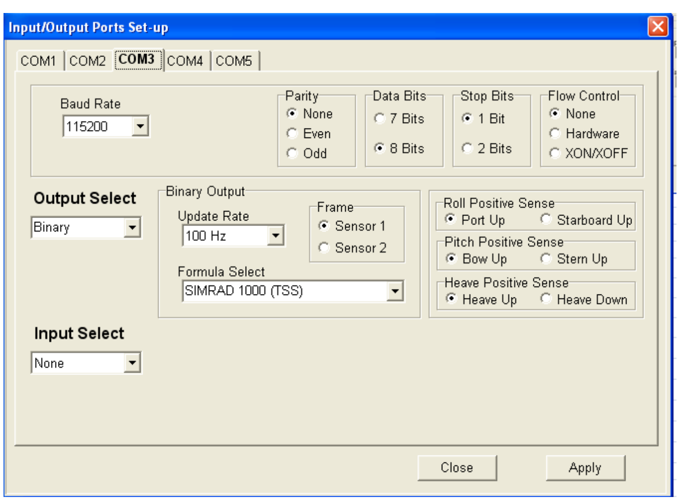
Com port #1 settings as installed: DGPS input from Trimble SPS Receiver.



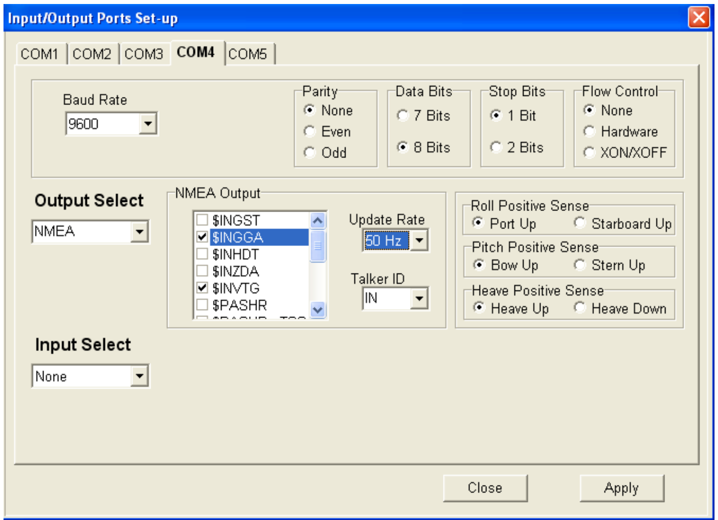
Com port #2 settings as installed



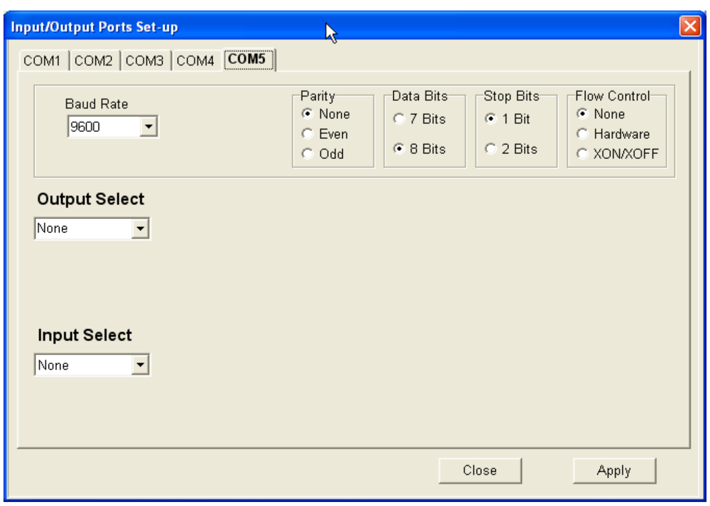
Com port #3 settings as installed:



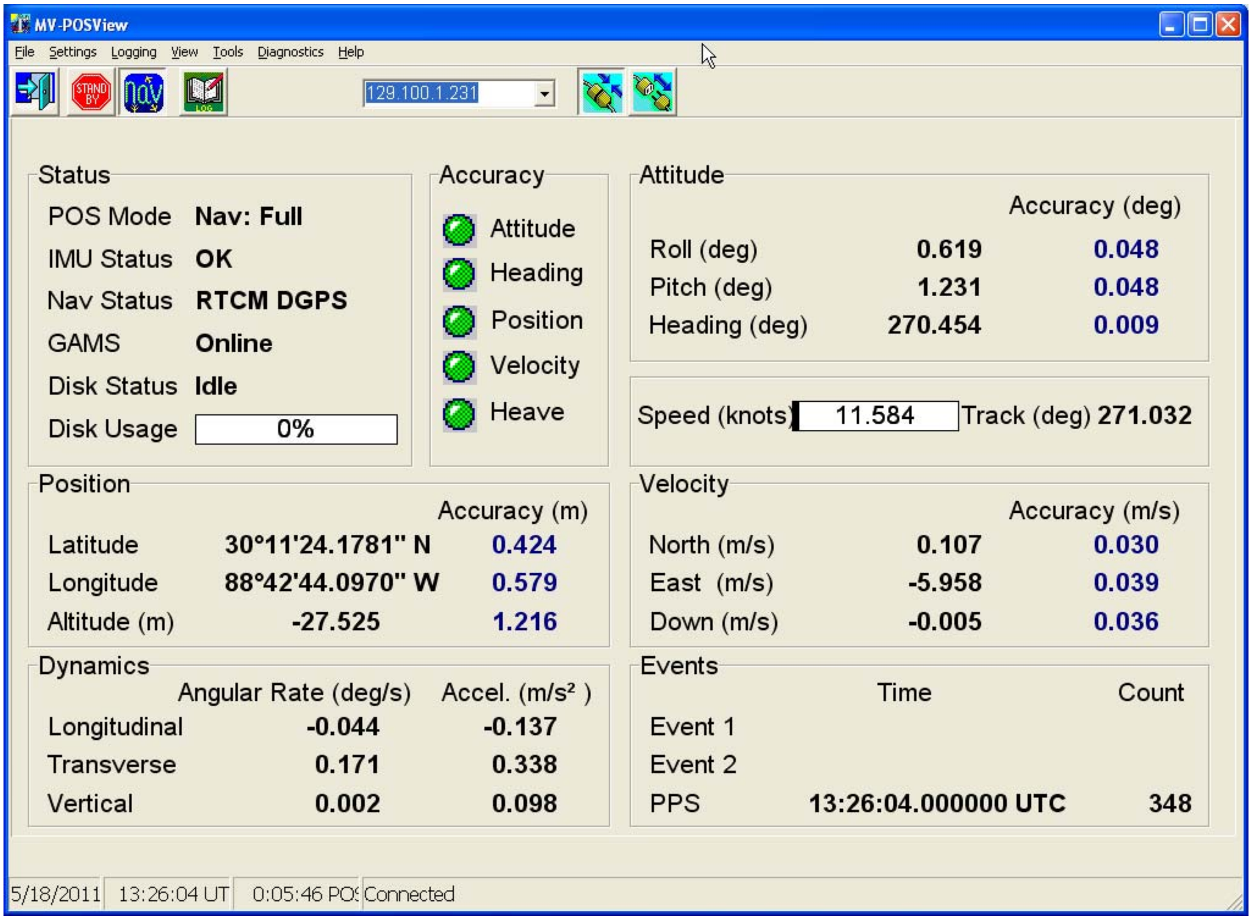
Com port #4 settings as installed:



Com port #5 settings as installed



STRB POSMV Final Navigation



STRB side antenna and IMU mounting:

STRB IMU Mount

NOAA POS/MV Calibration Report

Fill out all fields! See previous years as an example.

Yellow areas require screen grabs!

Ship: HASSLER

Vessel: S250

Date: 5/31/2011

Dn: 151

Personnel: Welton, Cousins

PCS Serial # 3187

IMU Serial # 804

IP Address: 129.100.1.232

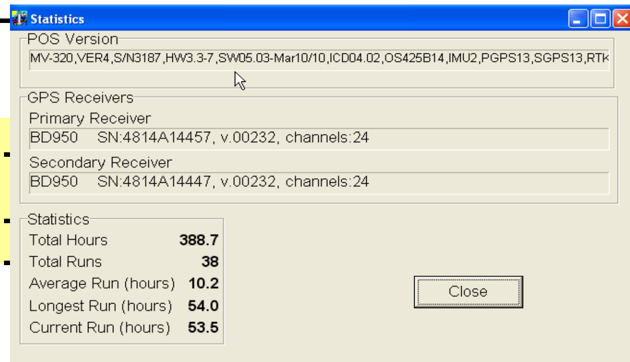
POS controller Version (Use Menu Help > About)

POS Version (Use Menu View > Statistics)

GPS Receivers

Primary Receiver Serial #:

Secondary Receiver Serial #:



Calibration area

Location: East of Pascagoula Ship Channel

Approximate Position:

Lat	30	10	17
Lon	88	27	5

DGPS Beacon Station: unknown

DGPS Receiver Serial#: 220227632

Frequency: uk

Satellite Constellation

(Use View> GPS Data)

Primary GPS

Insert screen grabs

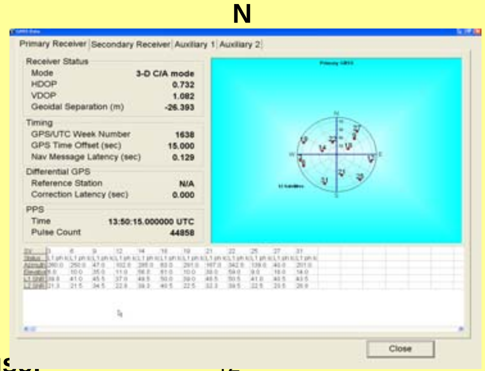
N

HDOP

0.732

VDOP

1.082



Sattelites in us

L1 SNR > **30** **35** **40**

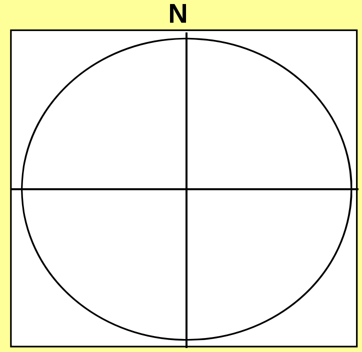
Secondary GPS

Note any differences from Primary GPS Receiver

N

HDOP

VDOP



Sattelites in use:

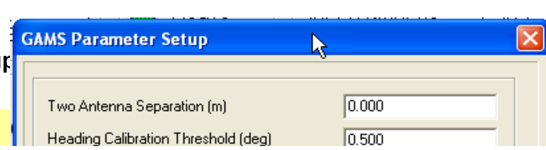
L1 SNR > **30** **35** **40**

PDOP (Use View> GAMS Solution)

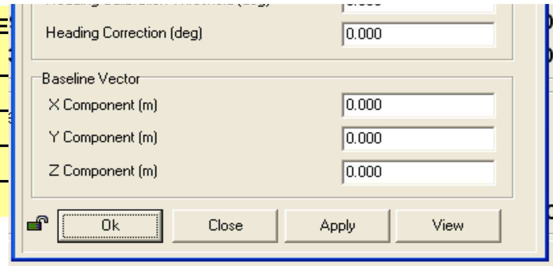
POS/MV Configuration

Settings

Gams Parameter Setup ...tallation)



User E



ine Vector

0	X Component (m)
0	YComponent (m)
0	Z Component (m)

Configuration Notes:

POS/MV Calibration

Calibration Procedure:

(Refer to POS MV V4 Installation and Operation Guide, 4-25)

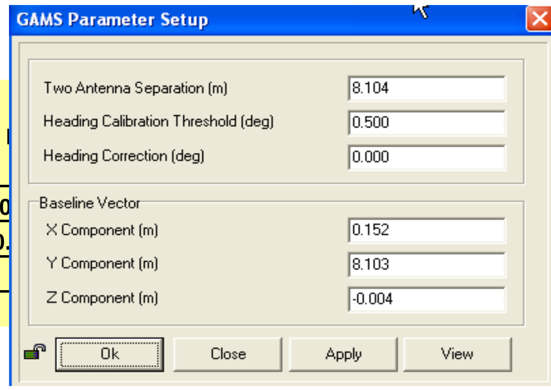
Start time: ______________________

End time: ______________________

Heading accuracy achieved for calibration: 0.26

Calibration Results:

Gams Parameter Setup lation)



POS/MV

8.10	
0.	

e Vector

).152	X Component (m)
3.103	YComponent (m)
).004	Z Component (m)

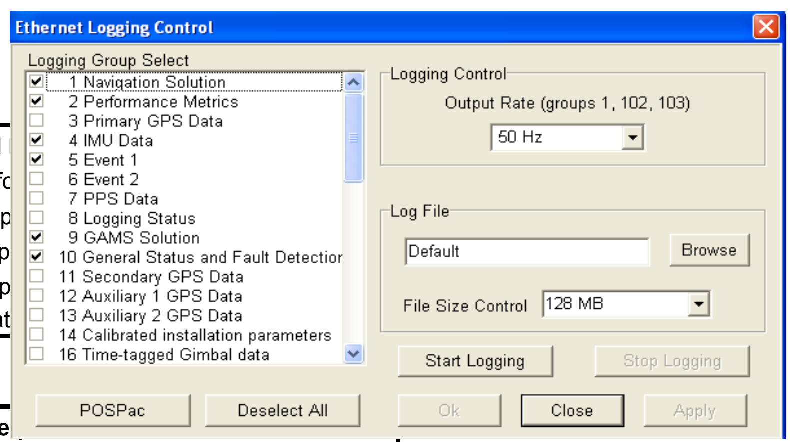
GAMS Status Online yes

Save Settings yes

Calibration Notes:

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

File Name: POSConfig_DATE (saved in GNSS folder on C drive)



General Notes:

The POS/MV uses a Right-Hand Orthogonal

The right-handed orthogonal system defines the fo

• The x-axis is in the fore-aft direction in the app

• The y-axis is perpendicular to the x-axis and p
right (starboard) side in the approp

• The z-axis points downwards in the appropriat

The POS/MV uses a Tate-Bryant Rotation Se

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.

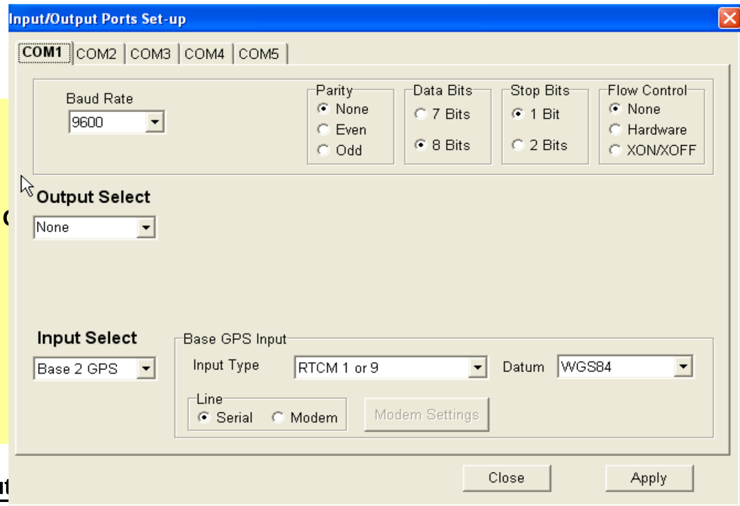
b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

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

SETTINGS

Input/Output Ports

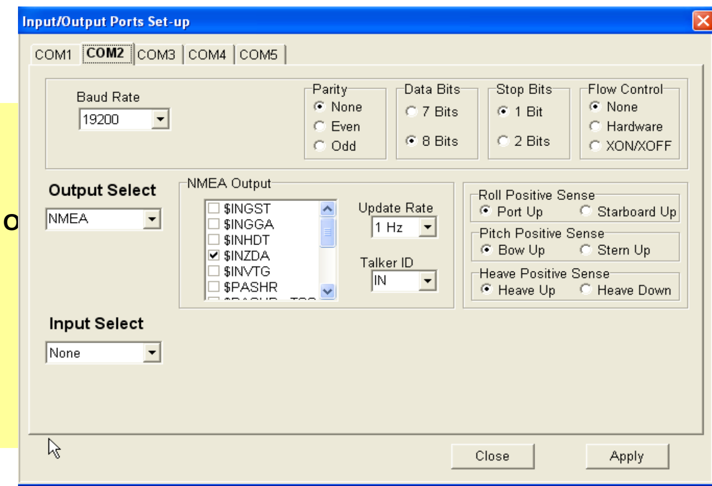
COM1



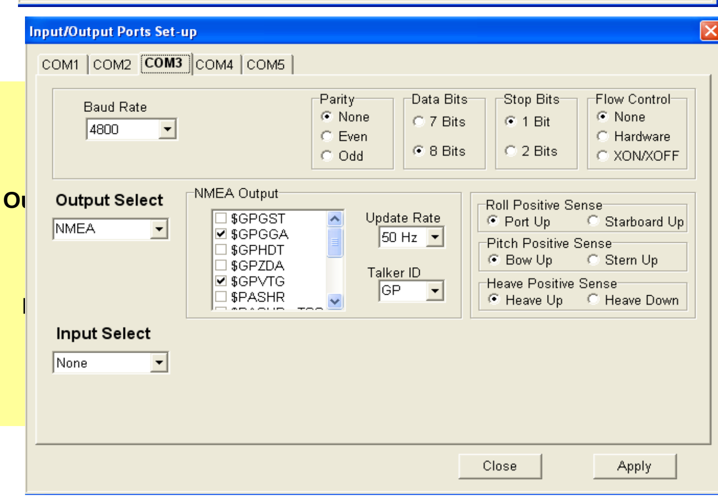
NMEA Output

	$INVTG		$PASHR TB		$INZDA
	$INGST		$PASHR TSS		$INGGK
	$INGGA		$PRDID TB		$UTC
	$INHDT		$PRDID TSS		

COM2



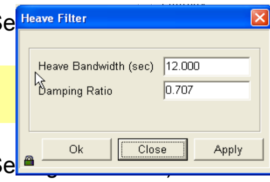
COM3



SETTINGS Continued

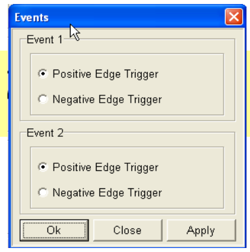
Heave Filter (Use Se

ndwidth
Ratio



Events (Use Se

1
Positive, Negative Edge Trigger
2



INSTALLATION (Use Settings > Installation)

Lever Arms and Mounting Angles (Use Settings > Installation > Lever Arms and Offsets)

Reference to IMU

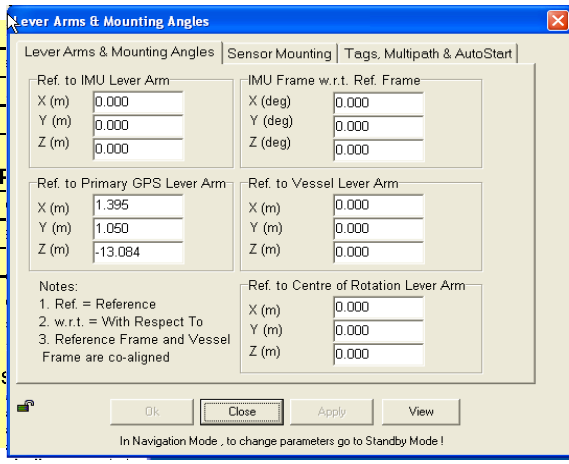
me w.r.t Reference Frame
X (deg)
Y (deg)
Z (deg)

Reference to Primary GP

ce to Primary Vessel Lever Arm
X (m)
Y (m)
Z (m)

ce to Centre of Rotation Lever Arm
X (m)
Y (m)
Z (m)

Reference frame and vess



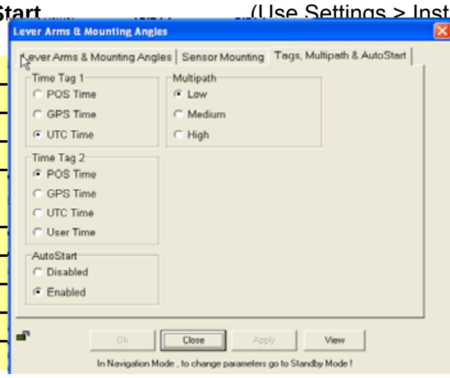
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)

Time Tag 1

Time Tag 2

Multi Path
Low
Medium
High

Auto Start
Disabled
Enabled



Sensor Mounting (Use Settings > Installation > Sensor Mounting)

Reference to Aux. 1 GPS Lever Arm
X (m)
Y (m)
Z (m)

Reference to Aux. 2 GPS Lever Arm
X (m)
Y (m)
Z (m)

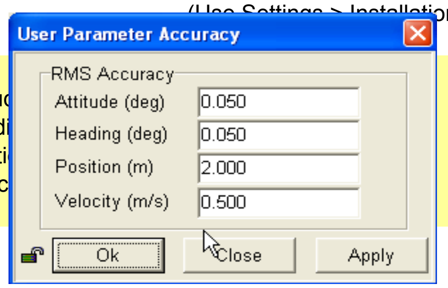
Reference to Sensor 1 Lever Arm
X (m)
Y (m)
Z (m)

Sensor 1 Frame w.r.t. Reference Frame
X (deg)
Y (deg)
Z (deg)

Reference to Sensor 2 Lever Arm
X (m)
Y (m)
Z (m)

Sensor 2 Frame w.r.t. Reference Frame
X (deg)
Y (deg)
Z (deg)

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



RMS Accuracy

	Attitu
	Headi
	Positi
	Veloc

Frame Control (Use Tools > Config)

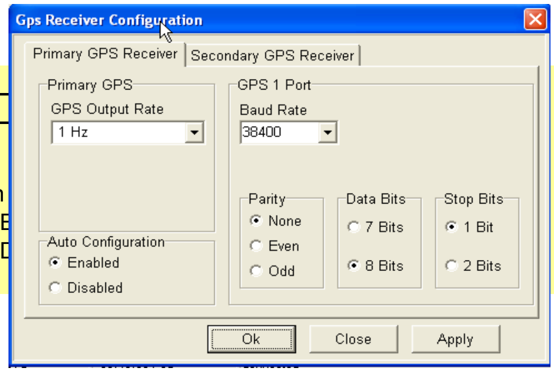
	User Frame	Primary GPS Measurement	
	IMU Frame	Auxiliary GPS Measurement	

Use GAMS enabled

GPS Receiver Configuration

(Use Settings> Installation> GPS Receiver Configuration)

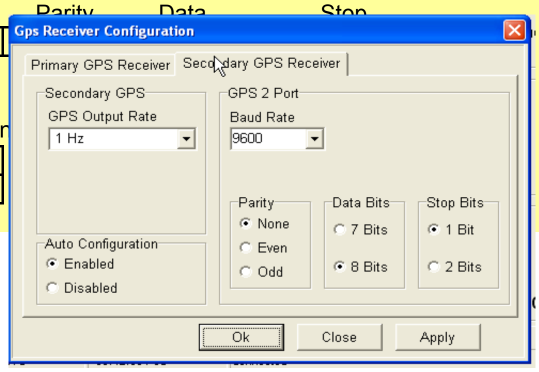
Primary GPS Receiver



Baud Rate

Auto Configuration

Secondary GPS Receiver



Baud Rate Parity Data Stop

Auto Configuration

NOAA POS/MV Calibration Report

Fill out all fields! See previous years as an example.

Yellow areas require screen grabs!

Ship: Hassler **Vessel:** S250 Stbd

Date: 5/31/2011 **Dn:** 151

Personnel: Welton, Cousins

PCS Serial # 3189 **IMU Serial #** 803

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About)

POS Version (Use Menu View > Statistics)
GPS Receivers

Primary Receiver Serial #:

Secondary Receiver Serial #:

Calibration area

Location: East of Pascagoula Ship Channel

Approximate Position:

Lat	30	10	17
Lon	88	27	5

DGPS Beacon Station: unkown **DGPS Receiver Serial#:** 220227632

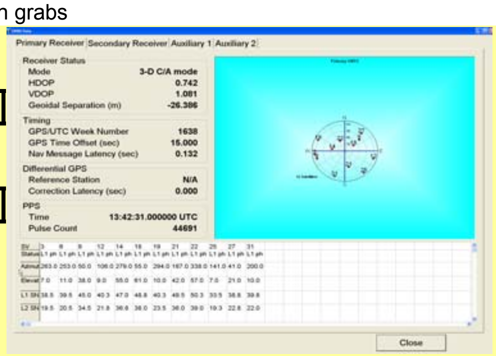
Frequency: uk

Satellite Constellation

(Use View> GPS Data)

Primary GPS

Insert screen grabs



HDOP 0.742

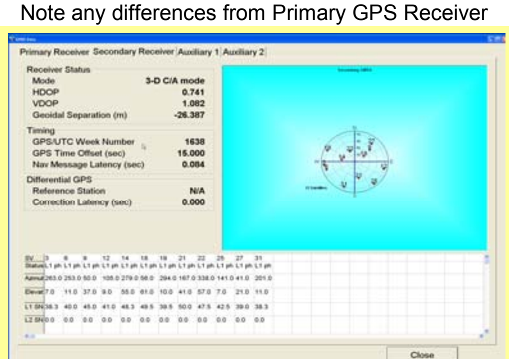
VDOP 1.081

Sattelites in use: 12

L1 SNR > 30

Secondary GPS

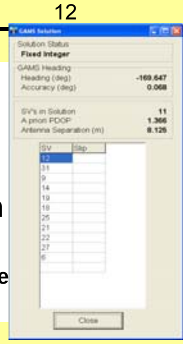
Note any differences from Primary GPS Receiver



Sattelites in use: 12

L1 SNR > 30 35 40

PDOP 1.366

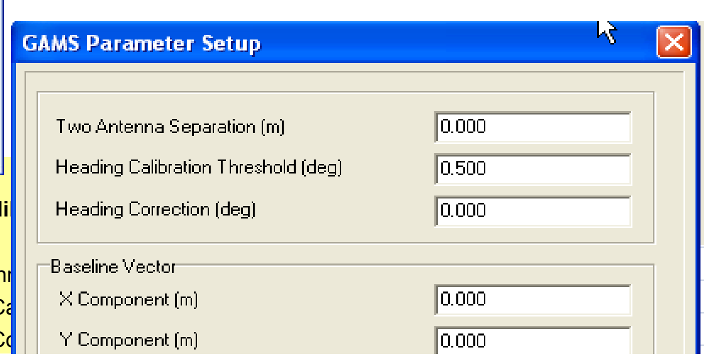


> GAMS Solution)

POS/MV Configuration

Settings

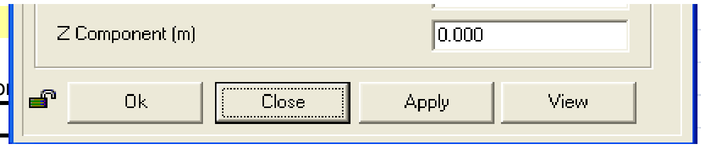
Gams Parameter Se



User Entries, Pre-Cali

0	Two Antenn
0.5	Heading Ca
0	Heading Co

Configuration Notes: Used manual calibratio



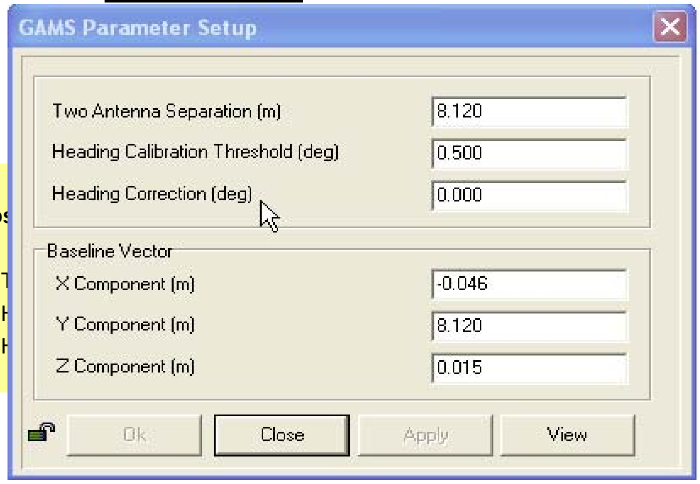
POS/MV Calibration

Calibration Procedure: (Refer to POS MV V4 Installation and Operation Guide, 4-25)

Start time: ____________________
End time: ____________________
Heading accuracy achieved for calibration: 0.26

Calibration Results:

Gams Parameter Setup



POS/MV Pos

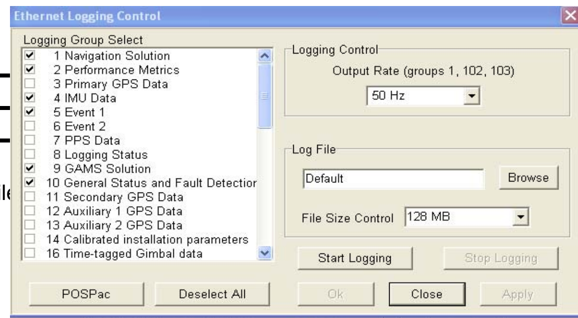
8.12	T	m)
0.5	H	n)
0	H	m)

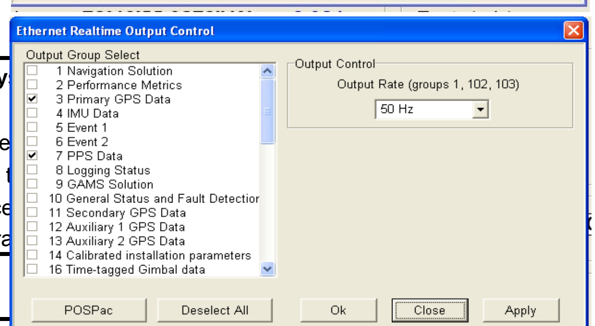
GAMS Status Online yes
Save Settings yes

Calibration Notes:

Save POS Settings on PC (Use File

File Name: POSConfig (saved under c:\GNSSData)





General Notes:

The POS/MV uses a Right-Hand Orthogonal Reference Sy
The right-hand orthogonal system defines the following:
• The x-axis is in the fore-aft direction in the appropriate refere
• The y-axis is perpendicular to the x-axis and points towards t
right (starboard) side in the appropriate reference
• The z-axis points downwards in the appropriate reference fra

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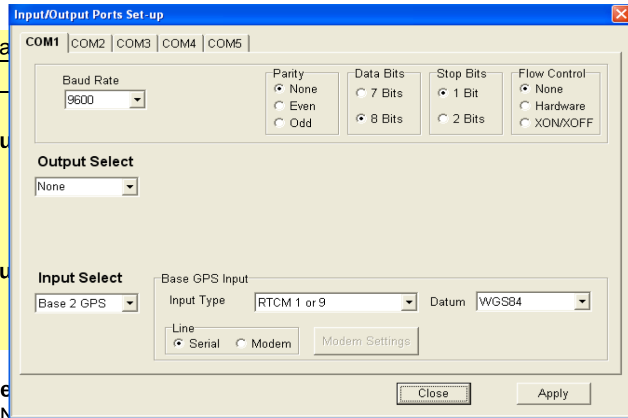
c) Roll rotation - apply a right-hand screw rotation θx about the twice-rotated x-axis to align one frame with the other.

SETTINGS

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

COM1 DGPS Corrector



Ba

Outpu

Inpu

Sense

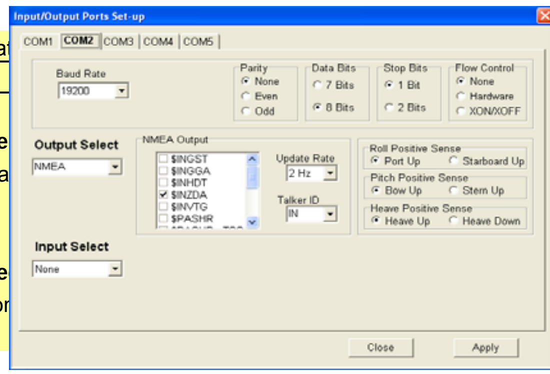
e Sense

ive Sense

NMEA Output (sele

	$IN				
	$INGST		$PASHR TSS		$INGGK
	$INGGA		$PRDID TB		$UTC
	$INHDT		$PRDID TSS		

COM2 ZDA and PPS for Reson 7125 and 7111



Baud Rat

Output Sele

Bina

Input Sele

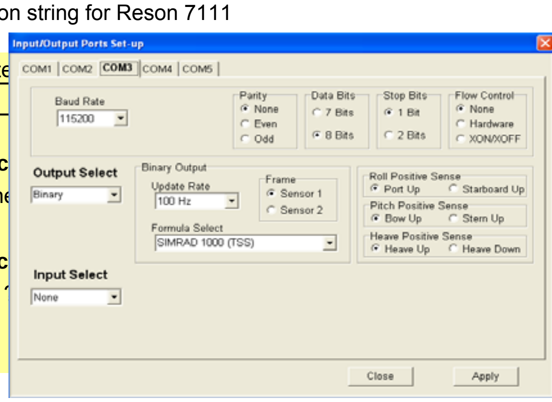
Nor

ve Sense

tive Sense

sitive Sense

COM3 TSS motion string for Reson 7111



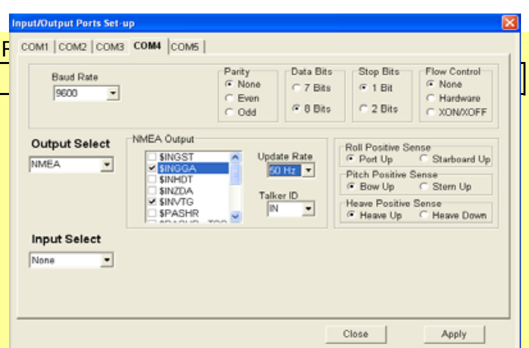
Baud Rate

Output Selec

None

Input Selec

COM4 GGA and VTG for Side Scan



Baud Rate

Output Select

None

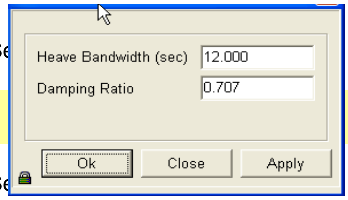
Input Select

?

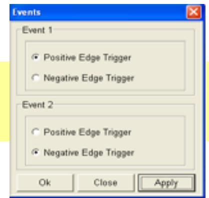

Heave Filter

SETTINGS Continued

Heave Filter (Use Se



Events (Use Se



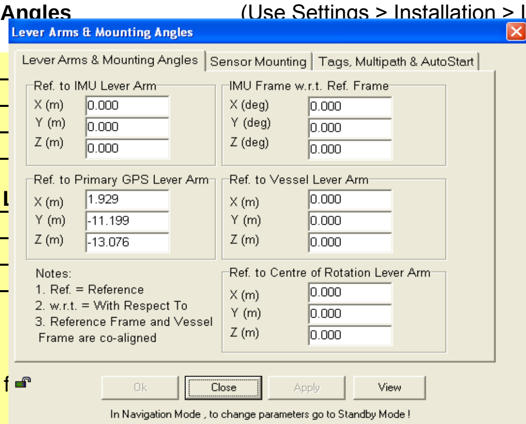
1

Positive, Negative Edge Trigger

2

INSTALLATION (Use Settings > Installation)

Lever Arms and Mounting Angles (Use Settings > Installation > Lever Arms and Offsets)



Reference to IMU — **e w.r.t Reference Frame**

	X (deg)
	Y (deg)
	Z (deg)

Reference to Primary GPS L — **e to Primary Vessel Lever Arm**

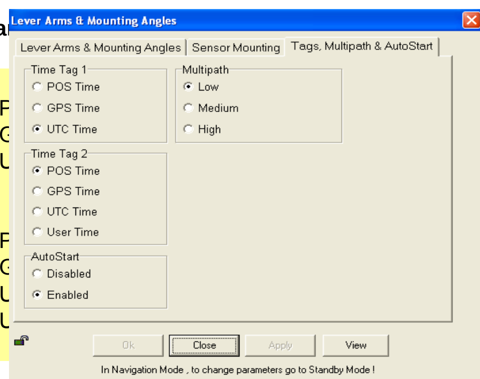
	X (m)
	Y (m)
	Z (m)

e to Centre of Rotation Lever Arm

Reference frame and vessel f

	X (m)
	Y (m)
	Z (m)

Tags, Multipath and Auto Sta > Tags, Multipath and Auto Start)



Time Tag 1 — **ath**

	F	Low
	G	Medium
	U	High

Time Tag 2 — **tart**

	F	Disabled
	G	Enabled
	U	
	U	

Sensor Mounting (Use Settings > Installation > Sensor Mounting)

Reference to Aux. 1 GPS Lever Arm

	X (m)
	Y (m)
	Z (m)

Reference to Aux. 2 GPS Lever Arm

	X (m)
	Y (m)
	Z (m)

Reference to Sensor 1 Lever Arm

	X (m)
	Y (m)
	Z (m)

Sensor 1 Frame w.r.t. Reference Frame

	X (deg)
	Y (deg)
	Z (deg)

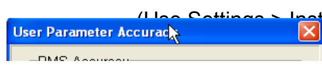
Reference to Sensor 2 Lever Arm

	X (m)
	Y (m)
	Z (m)

Sensor 2 Frame w.r.t. Reference Frame

	X (deg)
	Y (deg)
	Z (deg)

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



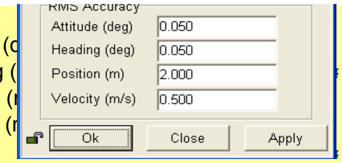
RMS Accuracy

Attitude (d

Heading (

Position (r

Velocity (r



Frame Control (Use Tools > Config)

User Frame

IMU Frame

Primary GPS Measurement

Auxiliary GPS Measurement

Use GAMS enabled

GPS Receiver Configuration

(Use Settings> Installation> GPS Receiver Configuration)

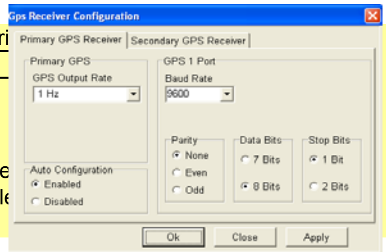
Primary GPS Receiver

Baud Rate   Pari

Auto Configuration

Enable

Disable



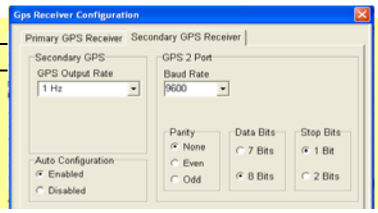
Secondary GPS Receiver

Baud Rate   Parity

Auto Configuration

Enabled

Disabled



Appendix IV

Sound Speed Sensor Reports

SBE 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 63283

Customer Information:

Company	Atlantic Marine Center
Date	3/28/2011
Contact	Robert J. Yates
PO Number	TBD

Serial Number	196093-1060
Model Number	SBE 19-02

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: 1060
CALIBRATION DATE: 26-Feb-11

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

GHIJ COEFFICIENTS

```
g = -4.01267099e+000
h =  4.78535152e-001
i =  1.32327755e-003
j = -3.89517066e-005
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  4.50284488e-002
b =  4.31069500e-001
c = -4.00398956e+000
d = -1.50222338e-004
m =  2.1
CPcor = -9.5700e-008 (nominal)
```

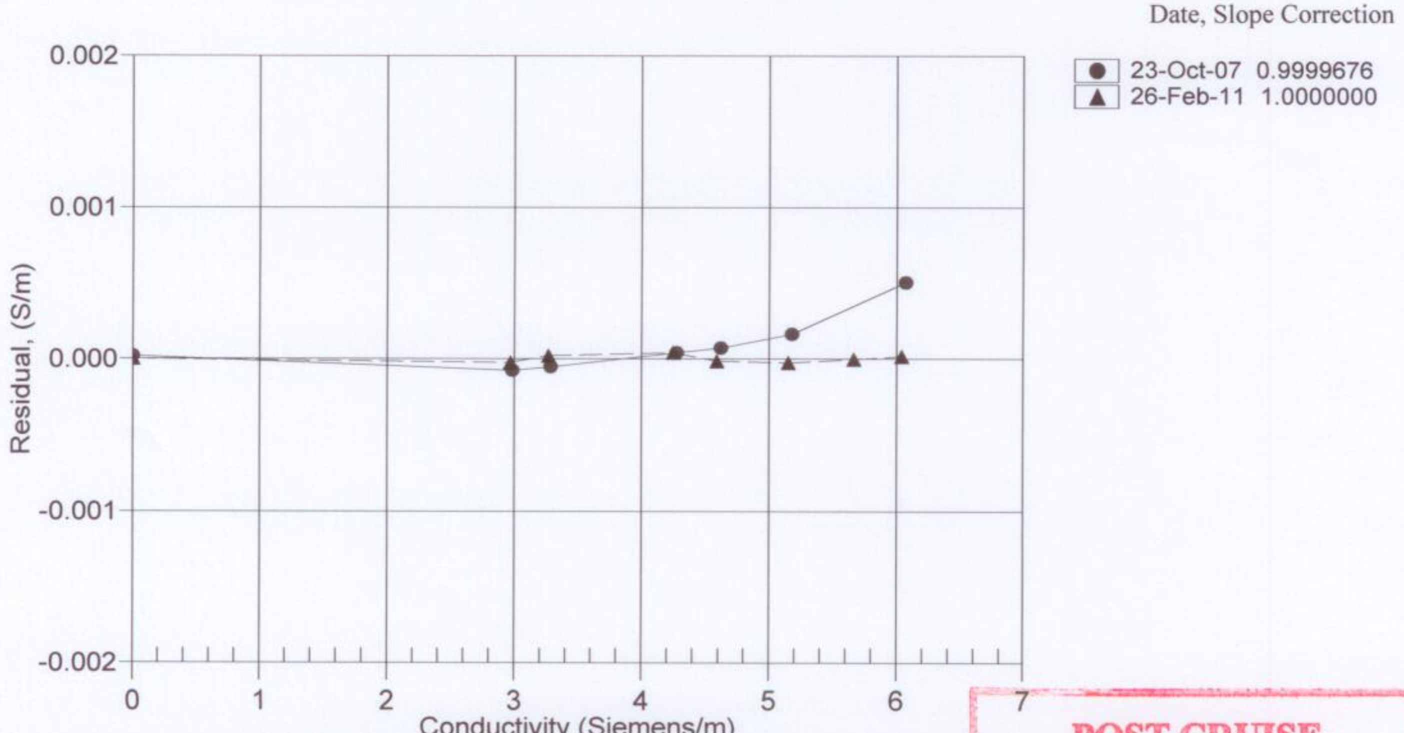
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88523	0.00000	0.00000
1.0000	34.6531	2.96334	8.31326	2.96332	-0.00003
4.5000	34.6328	3.26911	8.68073	3.26913	0.00002
15.0000	34.5893	4.24670	9.76222	4.24674	0.00004
18.5000	34.5790	4.59027	10.11458	4.59026	-0.00002
24.0000	34.5665	5.14556	10.65937	5.14553	-0.00003
29.0000	34.5569	5.66459	11.14442	5.66459	-0.00000
32.5000	34.5479	6.03446	11.47751	6.03447	0.00001

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

SBE 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:	Atlantic Marine Center		
Job Number:	63283	**Date of Report:**	3/1/2011
Model Number	SBE 19-02	**Serial Number:**	196093-1060

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: 2/26/2011 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: 1060
CALIBRATION DATE: 26-Feb-11

SBE19 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.16424767e-003
h = 5.89400433e-004
i = 3.49874302e-006
j = -1.86583315e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS

a = 3.64763503e-003
b = 5.78989975e-004
c = 8.46714574e-006
d = -1.86545663e-006
f0 = 2418.901

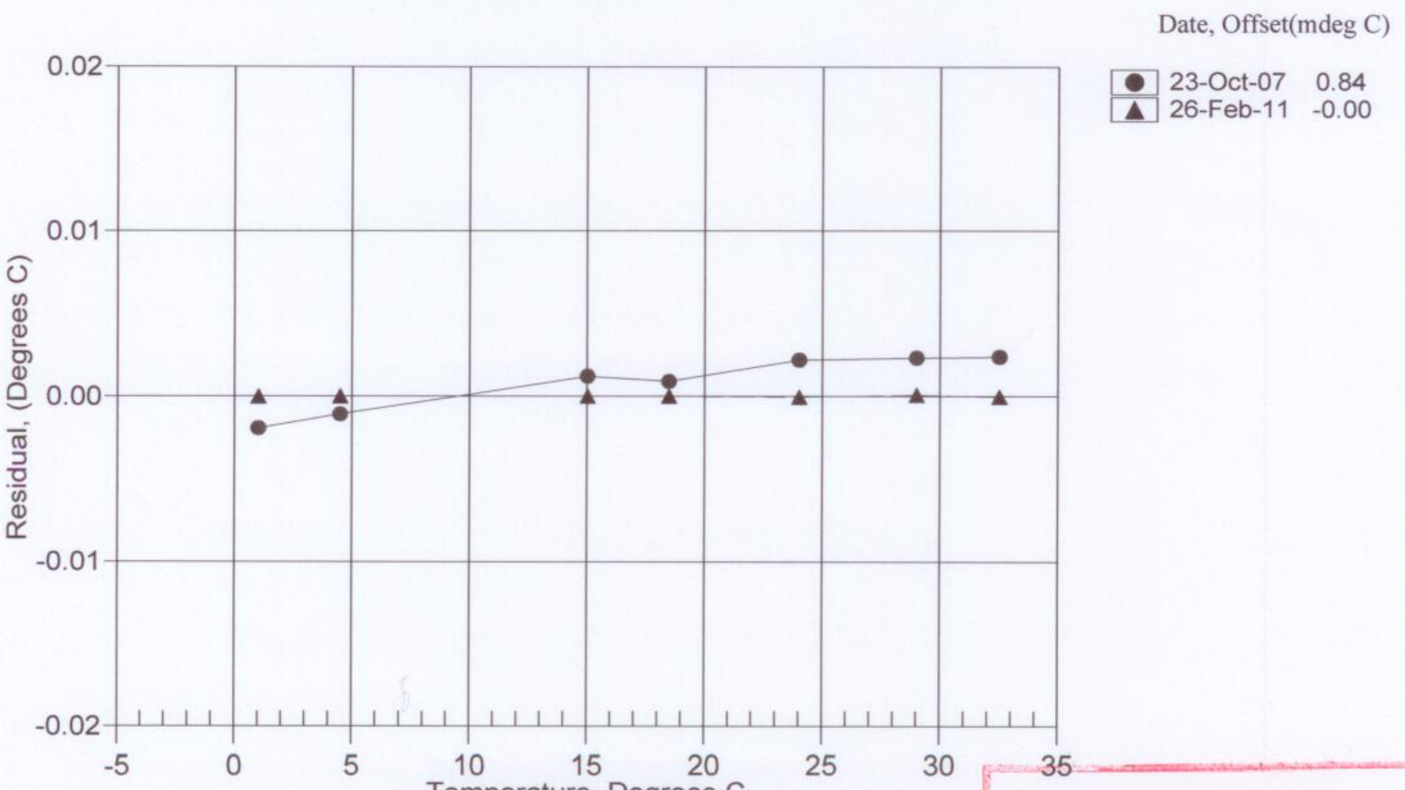
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2418.901	1.0000	-0.00001
4.5000	2619.132	4.5000	0.00001
15.0000	3290.210	15.0000	0.00000
18.5000	3538.537	18.5000	0.00000
24.0000	3954.959	24.0000	-0.00005
29.0000	4362.316	29.0001	0.00007
32.5000	4664.316	32.5000	-0.00003

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



POST CRUISE CALIBRATION

SBE 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:	Atlantic Marine Center		
Job Number:	63283	Date of Report:	3/1/2011
Model Number	SBE 19-02	Serial Number:	196093-1060

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: 2/26/2011 Drift since last cal: -0.00025 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

1060

63283

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

SENSOR SERIAL NUMBER: 1060
CALIBRATION DATE: 09-Mar-11

SBE19 PRESSURE CALIBRATION DATA
300 psia S/N 195086 TCV: 218

QUADRATIC COEFFICIENTS:

PA0 = 1.499811e+002
PA1 = -3.953348e-002
PA2 = 3.468983e-008

STRAIGHT LINE FIT:

M = -3.952748e-002
B = 1.501715e+002

PRESSURE PSIA	INST OUTPUT(N)	COMPUTED PSIA	ERROR %FS	LINEAR PSIA	ERROR %FS
14.55	3438.0	14.48	-0.03	14.28	-0.09
59.77	2293.0	59.51	-0.08	59.54	-0.08
119.78	771.0	119.52	-0.08	119.70	-0.03
179.81	-750.0	179.65	-0.05	179.82	0.00
239.80	-2267.0	239.78	-0.00	239.78	-0.01
299.80	-3775.0	299.71	-0.03	299.39	-0.14
239.79	-2271.0	239.94	0.05	239.94	0.05
179.82	-760.0	180.05	0.08	180.21	0.13
119.79	761.0	119.92	0.04	120.09	0.10
59.84	2280.0	60.03	0.06	60.05	0.07
14.55	3432.0	14.71	0.05	14.51	-0.01

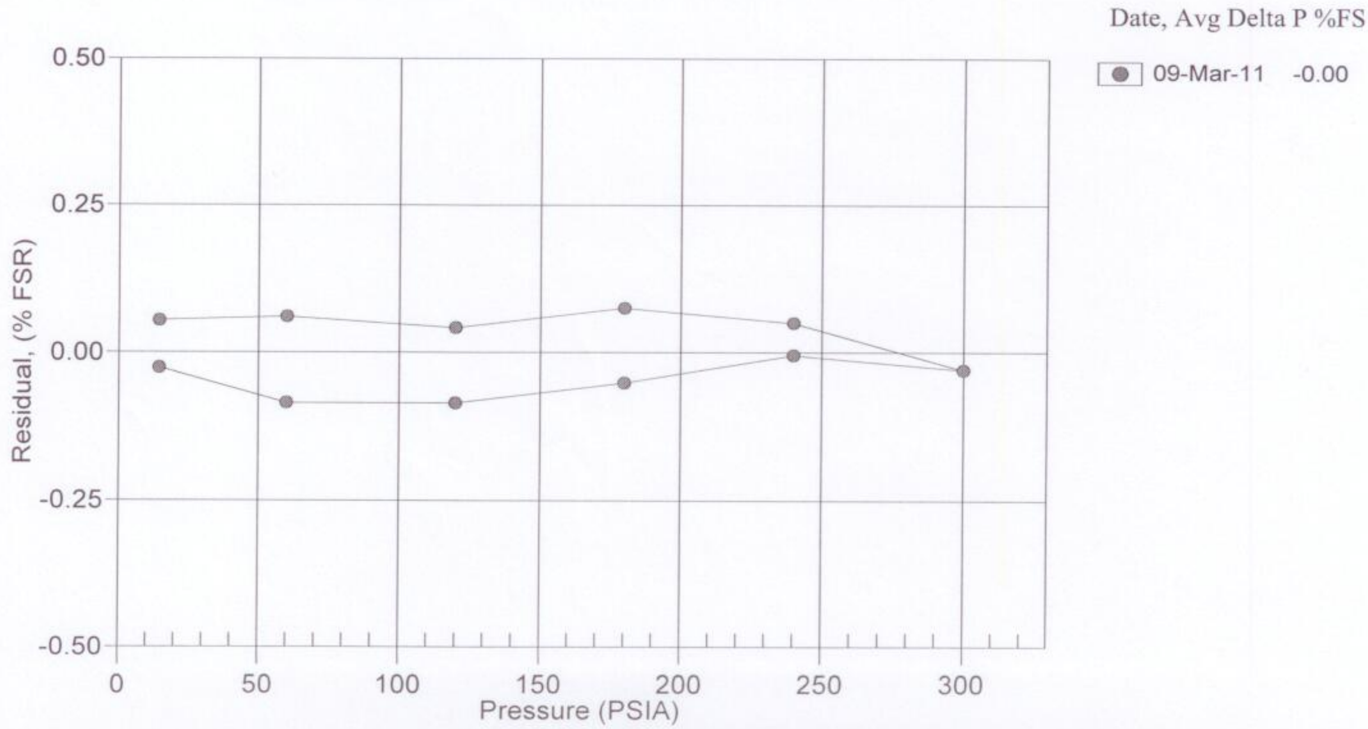
Straight Line Fit:

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



AML Calibration Equipment

Temperature Calibrations

Performed using either of two Hart Scientific "Black Stack" Model 1560 Power Bases with attached Hart Scientific Model 2563 Thermistor Modules connected to a Thermometrics AS125 4 Wire Thermistor Standard

1: Hart Scientfic Power Base 1560 S/N 79263 / Thermistor Module 2563 S/N 79039 / Thermometrics AS125 4 Wire Thermistor Standard S/N 2131
2: Hart Scientfic power Base 1560 S/N A05690 / Thermistor Module 2563 S/N A05693 / Thermometrics AS125 4 Wire Thermistor Standard S/N 2128

Temperature calibration equipment is calibrated yearly and verified bi-monthly as per Applied Microsystems Ltd. Calibration Schedule T11.2 utilizing a Hart Scientific Model 5901 Triple Point of Water Cell. All temperature calibrations and verifications are ITS-90 and NIST traceable

Pressure Calibrations

Performed using a Budenburg Model 380D S/N 18564 Range 0-8000 psi Deadweight Tester. Calibrations and verifications are implemented as per Applied Microsystems Ltd. Calibration Schedule T11.2. All pressure calibrations and verifications are NIST traceable.

Conductivity Calibrations

Performed using either of two Guildline 8400B S/N 59251 or Guildline 8400 S/N 43385 Autosals. Both Conductivity Calibrators are calibrated and verified using Ocean Scientific International IAPSO Standard Seawater as per Applied Microsystems ltd. Calibration Schedule T11.2. All Conductivity Calibrations and verifications are NIST traceable

Battery Channel Calibrations

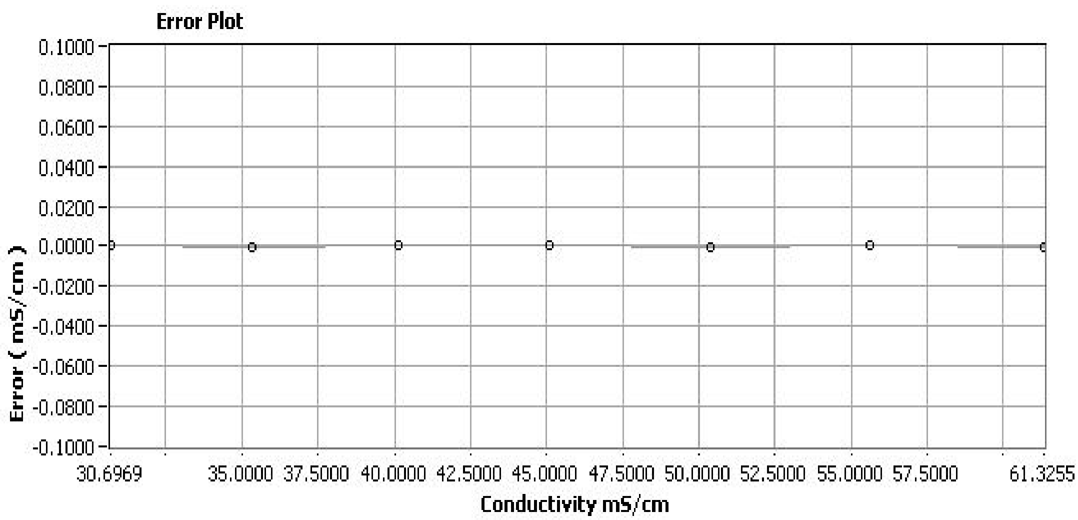
Performed using a Precision Fluke Model 45 Multimeter S/N 4720162. Calibrations and verifications are implemented as per Applied Microsystems Ltd. Calibration Schedule T11.2 All calibrations and verifications are NIST traceable.

Sound Velocity Calibrations

Performed using an Applied Microsystems Ltd Temperature Standard S/N 9998 in distilled water, <5 ppm TDS, and sound velocity reference is Del Grosso and Mader's Pure Water Equation. Calibrations and verifications are implemented as per Applied Microsystems Ltd. Calibration Schedule T11.2 All temperature calibrations and verifications are ITS-90 and NIST traceable.

Conductivity Calibration

Date	10/16/09
S/N	007760
Calibrator	Wanda Turple
RMS Error	0.0002
Range	0 to 7 S/m



mS/cm=A+B*Nte+C*Nte^2+D*Nte^3+(E+F*Nte+G*Nte^2+H*Nte^2)*Raw

A=-1.152428E-2	G=1.893281E-11
B=9.157882E-7	H=-5.385734E-14
C=-8.103243E-9	I=0.000000E+00
D=2.305094E-11	J=0.000000E+00
E=2.692588E-5	K=0.000000E+00
F=-2.139692E-9	L=0.000000E+00

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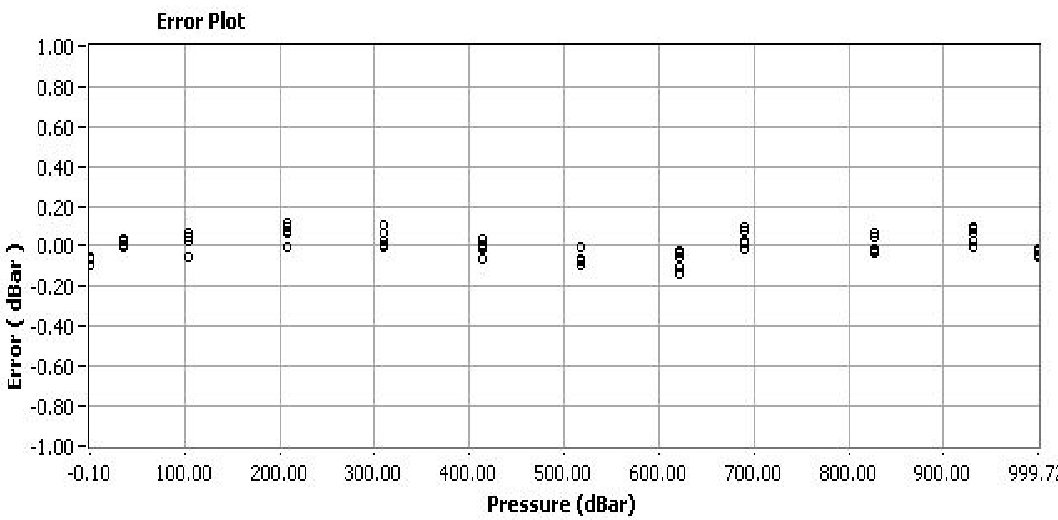
Phone: (250) 656-0771 Fax: (250) 655-3655
Canada & USA: 800-663-8721
Email: info@amloceanographic.com Web: http://www.amloceanographic.com

Pressure Calibration

Date	10/08/09
S/N	007760
Calibrator	Wanda Turple
RMS Error	0.058
Range	1000 dBar



dBar=A+B*T+C*T^2+D*T^3+(E+F*T+G*T^2+H*T^3)*Raw+(I+J*T+K*T^2+L*T^3)*Raw^2

A=1.169427E+2	G=-2.518083E-9
B=2.159378E-2	H=1.881585E-14
C=-1.091023E-6	I=1.829127E-5
D=1.027632E-11	J=-1.261447E-9
E=-1.650542E+0	K=2.899260E-14
F=1.123778E-4	L=-2.220854E-19

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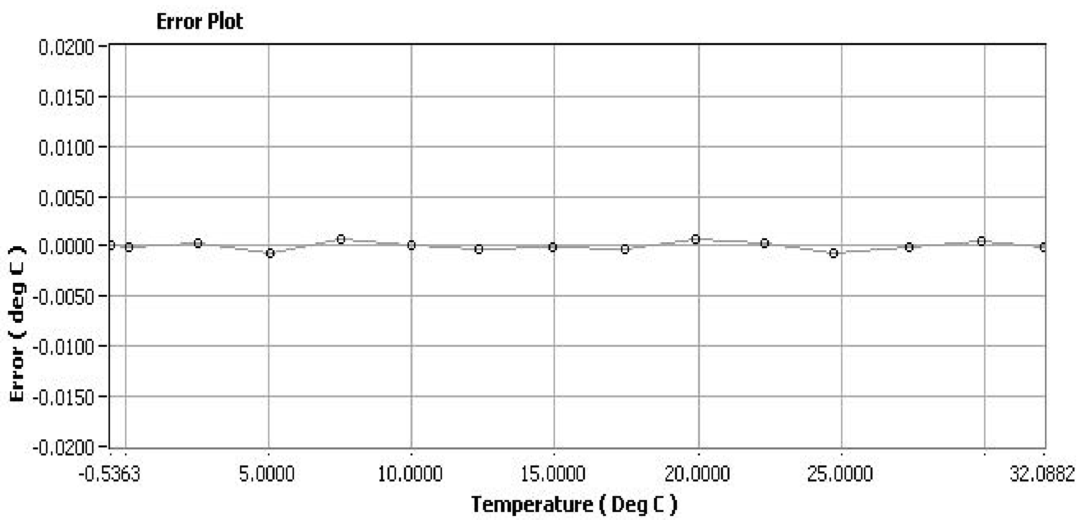
Email: info@amloceanographic.com Web: http://www.amloceanographic.com

Temperature Calibration

Date	10/16/09
S/N	007760
Calibrator	Wanda Turple
RMS Error	0.0004
Range	-2 to +32 Deg C



Deg C=A+B*Raw+C*Raw^2+D*Raw^3+E*Raw^4+F*Raw^5+G*Raw^6

A=-9.720103E+0	G=-2.749893E-29
B=8.715852E-4	H=0.000000E+00
C=-8.615532E-9	I=0.000000E+00
D=1.629973E-13	J=0.000000E+00
E=-1.785860E-18	K=0.000000E+00
F=1.317008E-23	L=0.000000E+00

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SEA-BIRD ELECTRONICS, INC.

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

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

SENSOR SERIAL NUMBER: 0276
CALIBRATION DATE: 15-Feb-09

SBE 45 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

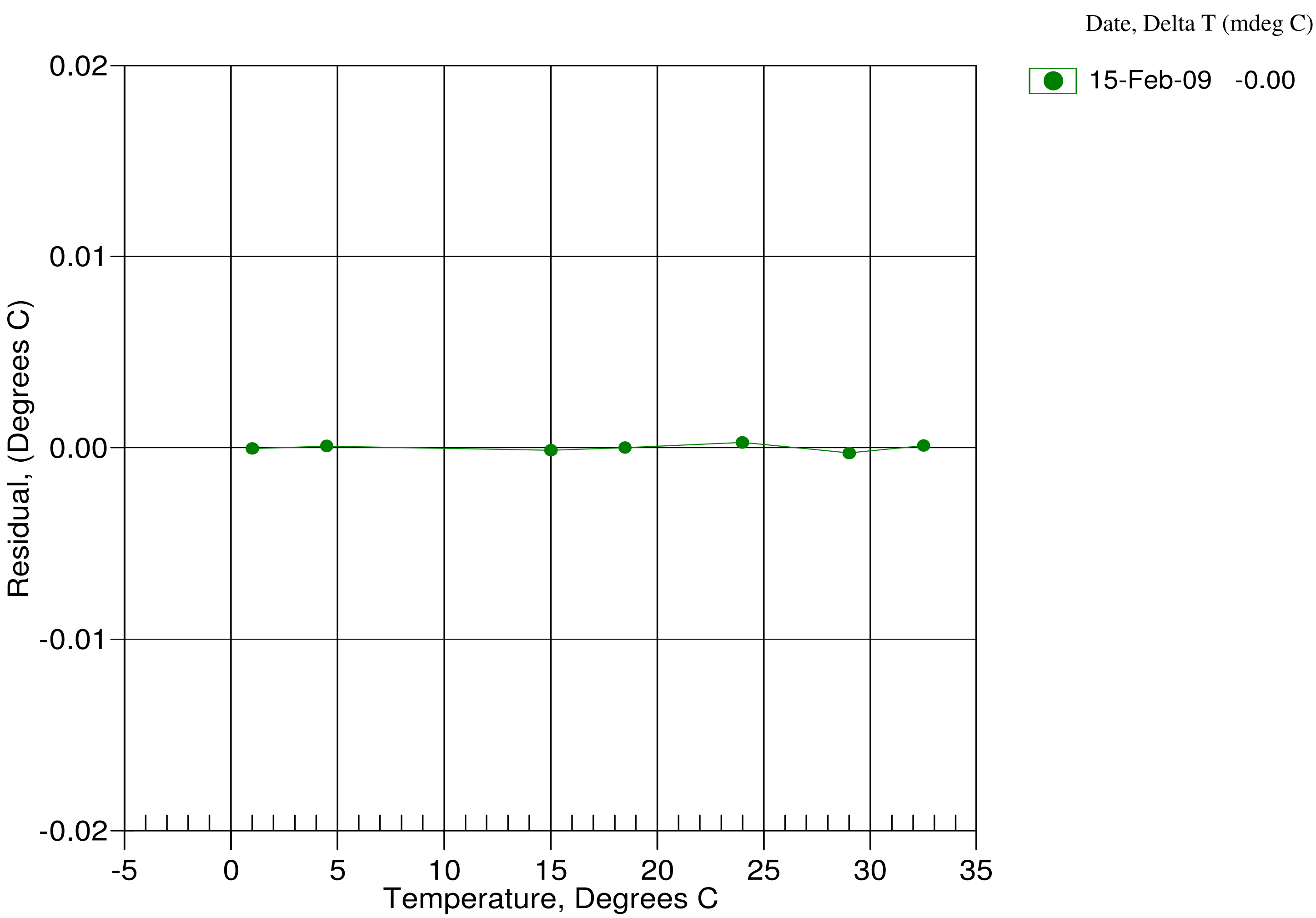
ITS-90 COEFFICIENTS

a0 = 4.876460e-006
a1 = 2.820307e-004
a2 = -3.073148e-006
a3 = 1.663229e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	695526.7	1.0000	-0.0000
4.5000	593239.1	4.5001	0.0001
15.0000	375466.3	14.9999	-0.0001
18.4999	324396.7	18.4999	-0.0000
23.9998	259363.7	24.0001	0.0003
29.0001	212937.1	28.9998	-0.0003
32.5000	186097.5	32.5001	0.0001

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

Residual = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 0276
CALIBRATION DATE: 15-Feb-09

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -1.000413e+000
h =  1.568807e-001
i = -2.349823e-004
j =  4.488494e-005
```

```
CPcor = -9.5700e-008
CTcor =  3.2500e-006
WBOTC =  4.2855e-007
```

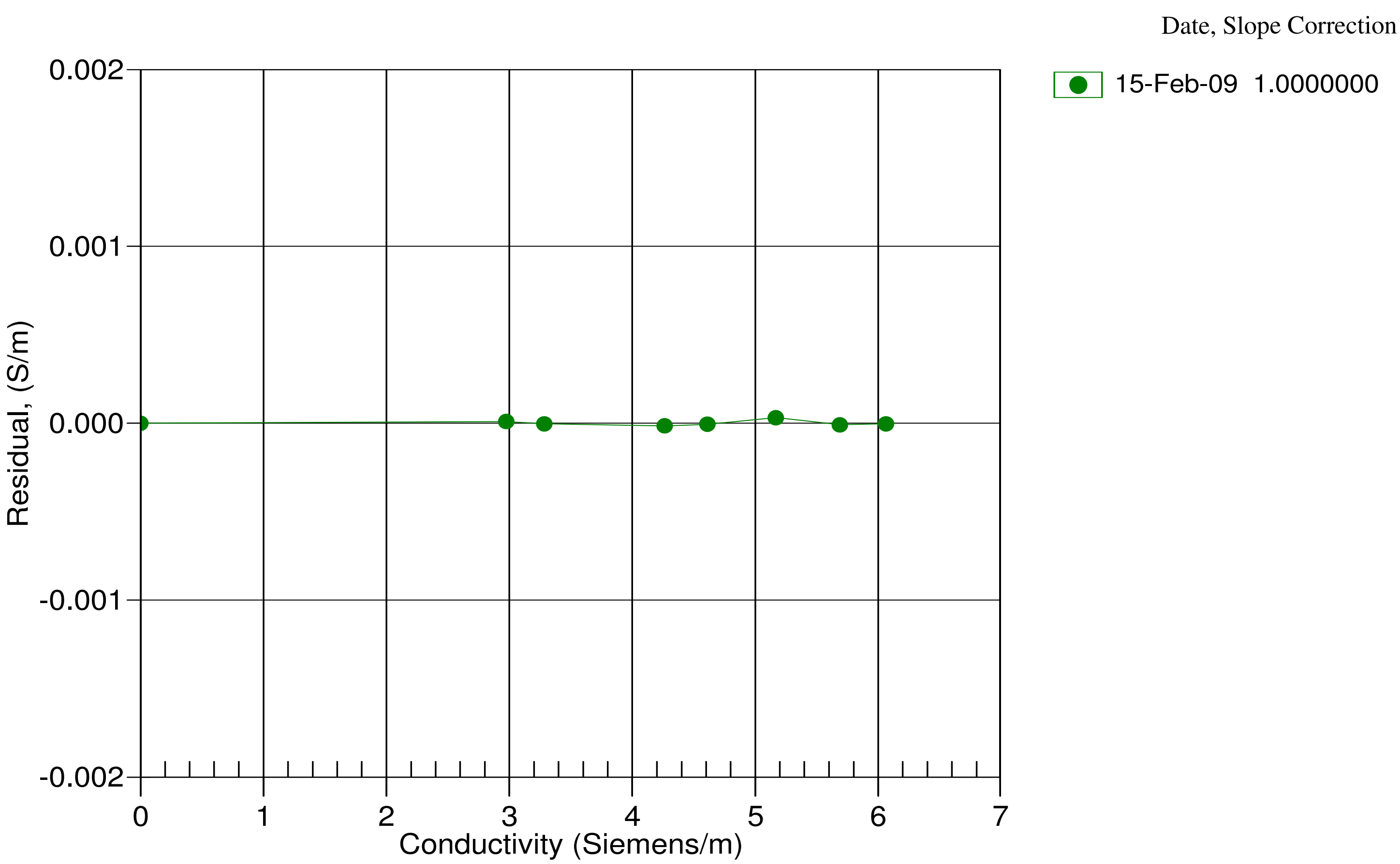
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2527.72	0.00000	0.00000
1.0000	34.8168	2.97600	5035.29	2.97601	0.00001
4.5000	34.7972	3.28310	5225.41	3.28310	-0.00000
15.0000	34.7546	4.26484	5790.71	4.26483	-0.00002
18.4999	34.7451	4.60993	5976.45	4.60993	-0.00001
23.9998	34.7341	5.16773	6264.77	5.16776	0.00003
29.0001	34.7263	5.68925	6522.45	5.68924	-0.00001
32.5000	34.7200	6.06109	6699.95	6.06109	-0.00000

f = INST FREQ * sqrt(1.0 + WBOTC * t) / 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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SENSOR SERIAL NUMBER: 0277
CALIBRATION DATE: 15-Feb-09

SBE 45 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

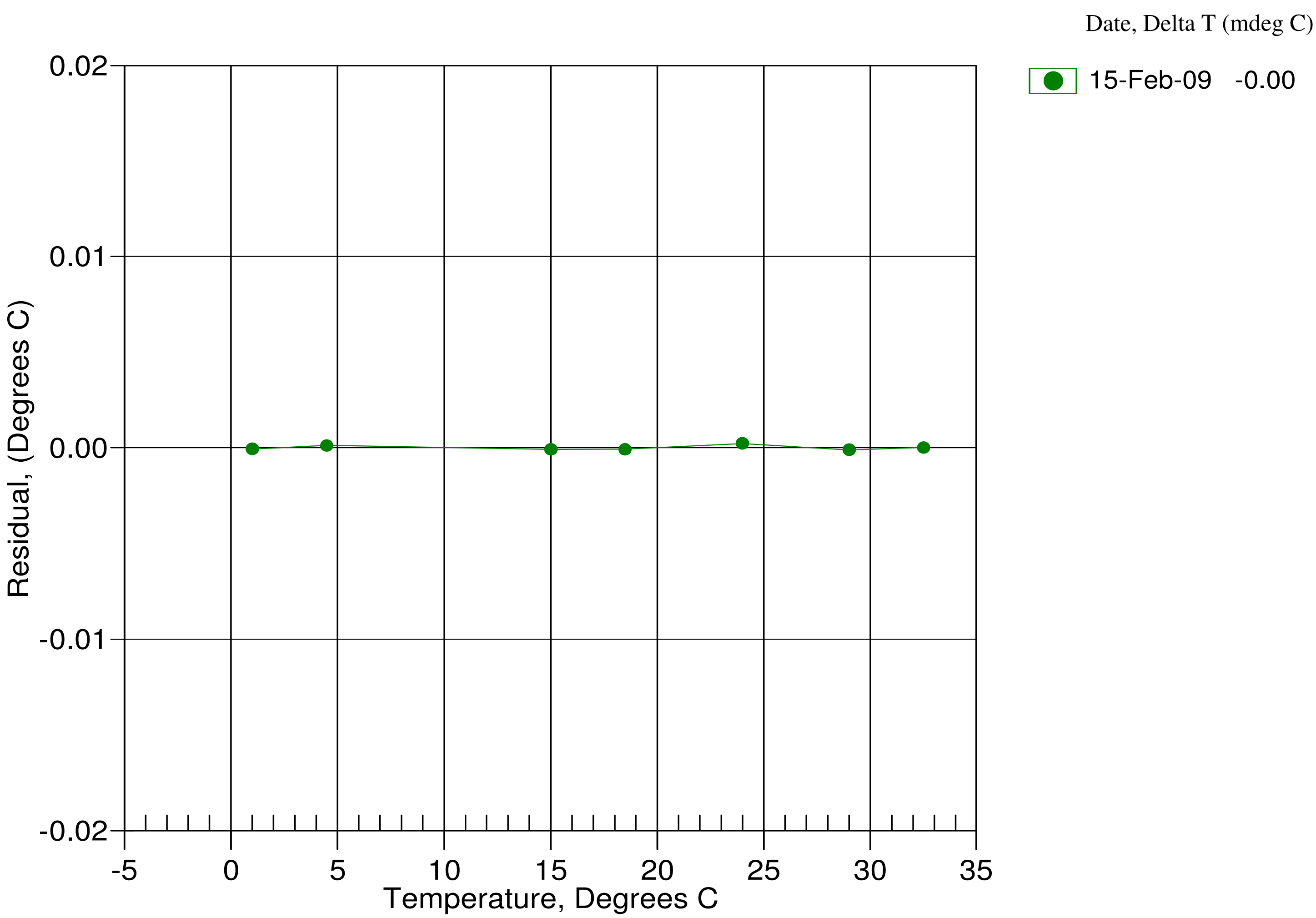
ITS-90 COEFFICIENTS

a0 = 1.268100e-005
a1 = 2.854515e-004
a2 = -3.347123e-006
a3 = 1.747491e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	638612.3	0.9999	-0.0001
4.5000	544690.8	4.5001	0.0001
15.0000	344730.4	14.9999	-0.0001
18.4999	297839.2	18.4998	-0.0001
23.9998	238125.7	24.0000	0.0002
29.0001	195496.2	29.0000	-0.0001
32.5000	170855.0	32.5000	0.0000

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

Residual = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 0277
CALIBRATION DATE: 15-Feb-09

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -9.768655e-001
h = 1.532775e-001
i = -2.703518e-004
j = 4.580328e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 4.2855e-007

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	2527.73	0.00000	0.00000
1.0000	34.8168	2.97600	5081.46	2.97601	0.00000
4.5000	34.7972	3.28310	5274.50	3.28310	0.00000
15.0000	34.7546	4.26484	5848.23	4.26483	-0.00001
18.4999	34.7451	4.60993	6036.68	4.60992	-0.00001
23.9998	34.7341	5.16773	6329.15	5.16776	0.00003
29.0001	34.7263	5.68925	6590.49	5.68924	-0.00001
32.5000	34.7200	6.06109	6770.48	6.06109	-0.00000

f = INST FREQ * sqrt(1.0 + WBOTC * t) / 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