Data Acquisition & Processing Report

Type of Survey……..**Hydrographic**

Project No……**S-G902-NRT2-16; H12748**

Time Frame…….**April 2016- June2017**

Locality

State……**Georgia**

General Locality……**St. Andrews Sound**

Sublocality……**Cumberland River**

2017

Chief of Party

James Kirkpatrick

Acting Team Lead, NRT2

Library & Archives

Date…….

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Navigation Response Team 2
Chief of Party: James L. Kirkpatrick IV
Year: 2016
Version: 1
Publish Date: 2017-08-22

A Equipment

A.1 Survey Vessels

A.1.1 S-1210

Name	S-1210
Hull Number	SAMA#0847E797
Description	NOAA launch 1210, a 30-foot SeaArk with an 8.5-foot beam and draft of 0.5 meters, was used to collect all survey data. Launch 1210 is equipped with a J-arm to deploy the side scan sonar. An electric winch controls the tow-fish height during side scan acquisition. The operator maintains the proper depth for the best coverage at the sonar scale. There were no unusual vessel configurations or problems encountered with the vessel. Launch 1210 is equipped with an Edgetech 4125 Side Scan Sonar system. Launch 1210 is equipped with a 3PS Inc SD-41 counter that measures the side scan towfish tow cable by counting revolutions of the towing block on the J-Arm. The length of cable deployed is computed automatically and output to Edgetech D2. Launch 1210 is equipped with a POS MV Applanix system for heave, pitch and roll corrections, as well as vessel position and speed. Launch 1210 is equipped with a Reson T20-P MBES system, on a USM pole mount , located on the starboard quarter. Hypack 2015 is used for survey navigation, Detached Positioning (DP), and MBES data logging bathymetry. Discover 2 is used for on line acquisition of side scan sonar.
Utilization	Hydrographic Surveys and Emergency Response work

Dimensions	*LOA*	9.144 meters
	Beam	2.59 meters
	Max Draft	0.5 meters
Most Recent Full Static Survey	*Date*	2016-01-05
	Performed By	NGS Field Operations Branch
	Discussion	See Report included in additional discussion below.
Most Recent Partial Static Survey	Partial static survey was not performed.	
Most Recent Full Offset Verification	*Date*	2016-01-05
	Method Used	NGS Total Station
	Discussion	See Report included in additional discussion below.
Most Recent Partial Offset Verification	Partial offset verification was not performed.	
Most Recent Static Draft Determination	*Date*	2016-01-28
	Method Used	Draft marks on hull.
	Discussion	Mean working load draft remains consistent.
Most Recent Dynamic Draft Determination	*Date*	2016-03-23
	Method Used	Ellipsoidally referenced method
	Discussion	Post-Processed Kinematic GPS method as outlined in FPM.

Figure 1: S-1210 on trailer

Additional Discussion

Offset Survey Report

DESCRIPTION	X (METERS)	Y (METERS)	Z (METERS)
MULTIBEAM MOUNT STARBOARD	0.953	1.639	0.458
MULTIBEAM MOUNT PORT	0.958	1.412	0.455
MULTIBEAM MOUNT AFT	0.702	1.520	0.459
MULTIBEAM MOUNT CENTER	0.956	1.526	0.458
STARBOARD AFT BENCHMARK	-1.040	1.091	-1.068
PORT AFT BENCHMARK	-1.038	-1.080	-1.073
STARBOARD POS ANTENNA	3.327	0.775	-2.707
PORT POS ANTENNA	3.306	-0.760	-2.696
REFERENCE POINT	**0.000**	**0.000**	**0.000**
IMU	0.113	0.001	-0.136
SIDE SCAN SONAR TOW POINT	-0.930	1.964	-2.601
BOW BENCHMARK	6.616	0.000	-1.381
SINGLE BEAM TRANSDUCER	2.294	-0.179	0.156

Figure 2: NGS Offset Survey Report

A.2 Echo Sounding Equipment

A.2.1 Side Scan Sonars

A.2.1.1 EdgeTech 4125

Manufacturer	EdgeTech
Model	4125
Description	The 4125 utilizes EdgeTech's Full Spectrum® CHIRP technology which provides higher resolution imagery. Operated at 400 and 900 kHz to collect imagery and detect obstructions on the sea floor.

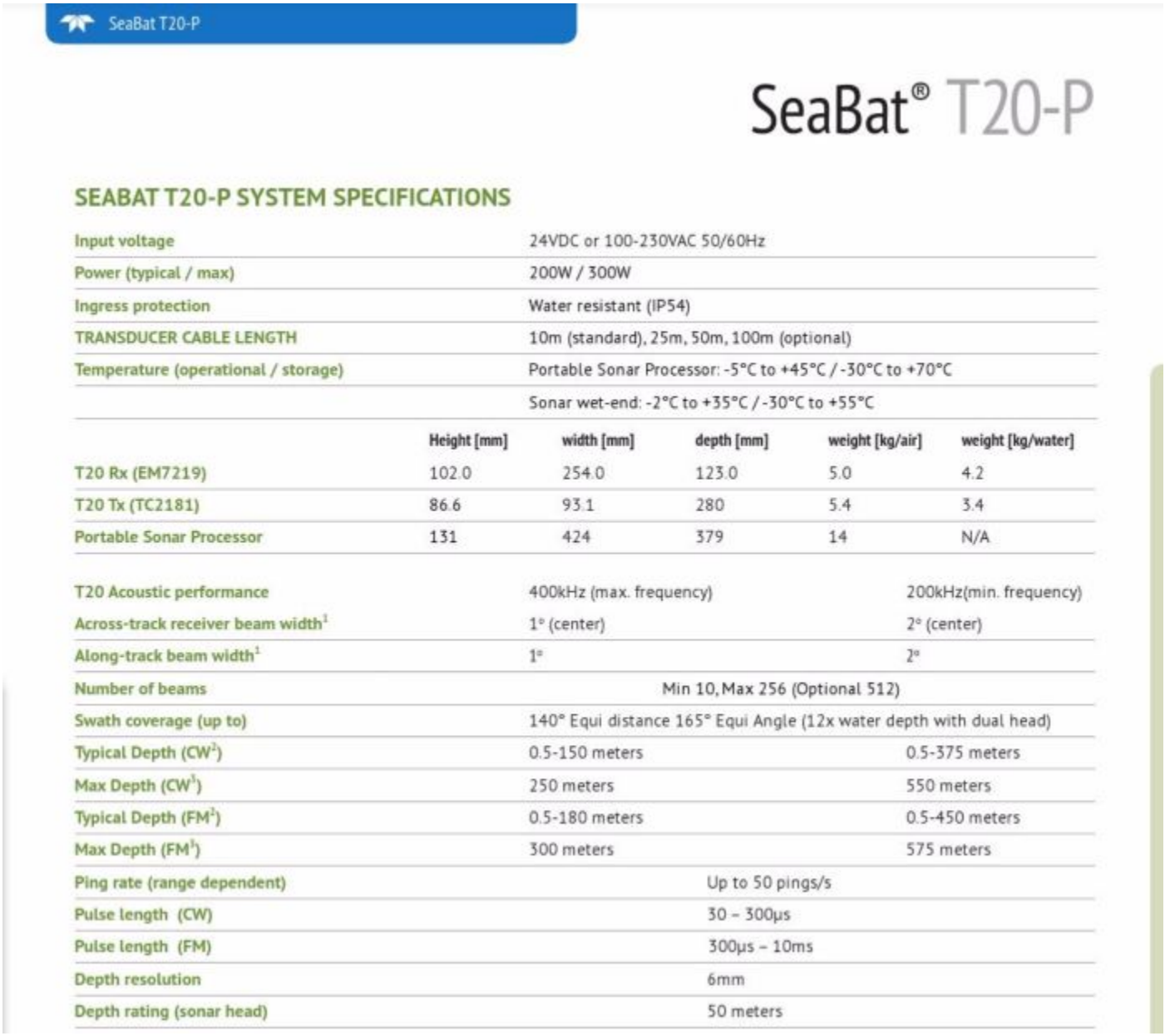
Serial Numbers	*Vessel Installed On*	S-1210		
	TPU s/n	sn: 40256		
	Towfish s/n	sn:40425		
Specifications	*Frequency*	400 kilohertz		900 kilohertz
	Along Track Resolution	*Resolution*	7.9 centimeters	*Resolution* 4.7 centimeters
		Min Range	20 meters	*Min Range* 20 meters
		Max Range	150 meters	*Max Range* 120 meters
	Across Track Resolution	2.3 centimeters		1.5 centimeters
	Max Range Scale	150 meters		120 meters
Manufacturer Calibrations	Manufacturer calibration was not performed.			

A.2.2 Multibeam Echosounders

A.2.2.1 Reson SeaBat T20-P

Manufacturer	Reson	
Model	SeaBat T20-P	
Description	See attached specifications sheet for more details.	
Serial Numbers	*Vessel Installed On*	S-1210
	Processor s/n	84143413019
	Transceiver s/n	NA
	Transducer s/n	2413031
	Receiver s/n	2313068
	Projector 1 s/n	2413031
	Projector 2 s/n	NA

Specifications	*Frequency*	330 kilohertz	
	Beamwidth	*Along Track*	1.0 degrees
		Across Track	0.5 degrees
	Max Ping Rate	60 hertz	
	Beam Spacing	*Beam Spacing Mode*	Equiangular
		Number of Beams	512
	Max Swath Width	160 degrees	
	Depth Resolution	1.25 centimeters	
	Depth Rating	*Manufacturer Specified*	100 meters
		Ship Usage	50 meters
Manufacturer Calibrations	*Vessel Installed On*	S-1210	
	Calibration Date	2014-11-03	
System Accuracy Tests	*Vessel Installed On*	S-1210	
	Methods	Conducted patch test over flat bottom, steep slope and an active buoy block approx. 1m cubed.	
	Results	Excellent. Pitch=0° // Roll=0.70° // Yaw=0°	
Snippets	Sonar has snippets logging capability.		



SeaBat T20-P

SeaBat® T20-P

SEABAT T20-P SYSTEM SPECIFICATIONS

Input voltage	24VDC or 100-230VAC 50/60Hz				
Power (typical / max)	200W / 300W				
Ingress protection	Water resistant (IP54)				
TRANSDUCER CABLE LENGTH	10m (standard), 25m, 50m, 100m (optional)				
Temperature (operational / storage)	Portable Sonar Processor: -5°C to +45°C / -30°C to +70°C				
	Sonar wet-end: -2°C to +35°C / -30°C to +55°C				
	Height [mm]	width [mm]	depth [mm]	weight [kg/air]	weight [kg/water]
T20 Rx (EM7219)	102.0	254.0	123.0	5.0	4.2
T20 Tx (TC2181)	86.6	93.1	280	5.4	3.4
Portable Sonar Processor	131	424	379	14	N/A

T20 Acoustic performance	400kHz (max. frequency)	200kHz(min. frequency)
Across-track receiver beam width[1]	1° (center)	2° (center)
Along-track beam width[1]	1°	2°
Number of beams	Min 10, Max 256 (Optional 512)	
Swath coverage (up to)	140° Equi distance 165° Equi Angle (12x water depth with dual head)	
Typical Depth (CW[2])	0.5-150 meters	0.5-375 meters
Max Depth (CW[1])	250 meters	550 meters
Typical Depth (FM[2])	0.5-180 meters	0.5-450 meters
Max Depth (FM[1])	300 meters	575 meters
Ping rate (range dependent)	Up to 50 pings/s	
Pulse length (CW)	30 – 300µs	
Pulse length (FM)	300µs – 10ms	
Depth resolution	6mm	
Depth rating (sonar head)	50 meters	

Figure 3: Reson SeaBat T20P Specifications sheet.

A.2.3 Single Beam Echosounders

A.2.3.1 Odom CV-2

Manufacturer	Odom
Model	CV-2

Description	Dual Frequency Sounder. Operating only at 200 kHz. Hull mounted.		
Serial Numbers	*Vessel*	S1210	
	Processor s/n	23031	
	Transducer s/n	1751935	
Specifications	*Frequency*	200 kilohertz	
	Beamwidth	*Along Track*	9 degrees
		Across Track	9 degrees
	Max Ping Rate	20 hertz	
	Depth Resolution	0.01 meters	
	Depth Rating	*Manufacturer Specified*	200 meters
		Ship Usage	60 meters
Manufacturer Calibrations	Manufacturer calibration was not performed.		
System Accuracy Tests	*Vessel Installed On*	S1210	
	Methods	Lead Line comparison, Hypack Latency	
	Results	Pass;-0.30 seconds added to Hypack Survey offset settings	

A.2.4 Phase Measuring Bathymetric Sonars

No phase measuring bathymetric sonars were utilized for data acquisition.

A.2.5 Other Echosounders

No additional echosounders were utilized for data acquisition.

A.3 Manual Sounding Equipment

A.3.1 Diver Depth Gauges

No diver depth gauges were utilized for data acquisition.

A.3.2 Lead Lines

Manufacturer	NOAA NRT-2
Model	Custom
Description	Standard 13m with mushroom anchor. Only used during HSSR verifications.
Serial Numbers	S-1210
Calibrations	*Serial Number*: S-1210 *Date*: 2014-03-05 *Procedures*: Checked tick marks with steel tape
Accuracy Checks	No accuracy checks were performed.
Correctors	Correctors were not determined.
Non-Standard Procedures	Non-standard procedures were not utilized.

A.3.3 Sounding Poles

No sounding poles were utilized for data acquisition.

A.3.4 Other Manual Sounding Equipment

No additional manual sounding equipment was utilized for data acquisition.

A.4 Positioning and Attitude Equipment

A.4.1 Applanix POS/MV

Manufacturer	Applanix
Model	MV-320 v5
Description	POS MV blends GNSS data with angular rate and acceleration data from an IMU and heading from GNSS Azimuth Measurement System (GAMS) to produce a robust and accurate full six degrees of freedom Position and Orientation solution.

PCS

Manufacturer	Applanix
Model	POS MV V-5
Description	model 320
Firmware Version	V5
Software Version	7.60
Serial Numbers	*Vessel Installed On*: S-1210 *PCS s/n*: 5805

IMU

Manufacturer	Applanix
Model	IMU 7
Description	A self-contained system that measures linear and angular motion usually with a triad of gyroscopes and triad of accelerometers. Outputs the integrating quantities of angular velocity and acceleration in the sensor/ body frame.
Serial Numbers	*Vessel Installed On*: S-1210 *IMU s/n*: 2422_424340
Certification	*IMU s/n*: 2422_424340 *Certification Date*: 2013-06-26

Antennas

Manufacturer	Trimble
Model	Zephyr 2
Description	GNSS Capability

Vessel Installed On	*Antenna s/n*	*Port or Starboard*	*Primary or Secondary*
S-1210	1441132512	Port	Secondary

Manufacturer	Trimble
Model	GA 530
Description	GNSS Capability

Vessel Installed On	*Antenna s/n*	*Port or Starboard*	*Primary or Secondary*
S-1210	14597	Starboard	Secondary

GAMS Calibration	*Vessel*	S-1210
	Calibration Date	2016-02-17
Configuration Reports	*Vessel*	S-1210
	Report Date	2014-01-22

A.4.2 DGPS

Description	Trimble SPS 361, used to provide RTCM correctors from USCG Beacon Stations.	
Antennas	*Manufacturer*	Trimble
	Model	SPS MSK
	Description	Beacon receiver DGPS combo
	Serial Numbers	*Vessel Installed On*: S-1210
		Antenna s/n: 14757
Receivers	*Manufacturer*	Trimble
	Model	SPS-361
	Description	Provides DGPS correctors.
	Firmware Version	N/A
	Serial Numbers	*Vessel Installed On*: S-1210
		Antenna s/n: 5330K63697

A.4.3 Trimble Backpacks

Trimble backpack equipment was not utilized for data acquisition.

A.4.4 Laser Rangefinders

No laser rangefinders were utilized for data acquisition.

A.4.5 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 SonTek Castaway

Manufacturer	SonTek
Model	Castaway
Description	Measures conductivity and temperature of seawater versus pressure in depths up to 100 meters. GPS enabled for positioning, data is uploaded via bluetooth to an onboard laptop. Primary sound speed measurement device.
Serial Numbers	*Vessel Installed On*: S1210 *CTD s/n*: CC1433010
Calibrations	*CTD s/n*: CC1433010 *Date*: 2016-02-11 *Procedures*: Manufacturer

A.5.1.2 Sound Speed Profilers

A.5.1.2.1 Odom Hydrographic DigiBar-Pro

Manufacturer	Odom Hydrographic
Model	DigiBar-Pro
Description	Direct reading sound speed probe used to validate measurements taken by the Castaway at least once per week.

Serial Numbers	*Vessel Installed On*: S-1210 *Sound Speed Profiler s/n*: 98295
Calibrations	*Sound Speed Profiler s/n*: 98295-010412 *Date*: 2016-03-03 *Procedures*: Shipped to MFN for annual service and calibration

A.5.2 Surface Sound Speed

A.5.2.1 AML Micro-X

Manufacturer	AML
Model	Micro-X
Description	Used in real time for Reson T20P beam steering based on surface sound speed.
Serial Numbers	*Vessel Installed On*: S-1210 *Sound Speed Sensor s/n*: 203523
Calibrations	*Sound Speed Sensor s/n*: 203523 *Date*: 2016-01-29 *Procedures*: manufacturer

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.7.1 Computer Hardware

Manufacturer	Dell
Model	Precision T3500
Description	Survey Data Processing PC
Serial Numbers	*Computer s/n* / *Operating System* / *Use* CD0001281213 / WIN 7 64bit / Processing

Manufacturer	3PS Inc
Model	SD-41 cable counter
Description	SSS Tow cable payout counter system, feeds directly into PC port.
Serial Numbers	*Computer s/n* / *Operating System* / *Use* JF1J2H1 (ESC42268426309) / NA / Acquisition

Manufacturer	Dell
Model	Precision T3500
Description	Survey Data Processing PC
Serial Numbers	*Computer s/n* / *Operating System* / *Use* CD0001670307 / Win 7 / Processing

Manufacturer	Dell
Model	Precision T5500
Description	Acquisition
Serial Numbers	*Computer s/n* / *Operating System* / *Use* CD0004098575 / Win 7 / Acquisition

Manufacturer	Dell
Model	Latitude E6530
Description	Acquisition and processing laptop
Serial Numbers	*Computer s/n* / *Operating System* / *Use* CD0004100973 / Win 7 / Acquisition and Processing

A.7.2 Computer Software

Manufacturer	CARIS
Software Name	Base Editor
Version	4
Service Pack	1
Hotfix	11
Installation Date	2016-02-15
Use	Processing
Description	Data processing software which opens gridded data, S-57 shoreline files, raster and ENC charts. It is mainly used for shoreline feature processing.

Manufacturer	CARIS
Software Name	HIPS & SIPS
Version	9
Service Pack	1
Hotfix	5
Installation Date	2016-02-15
Use	Processing
Description	Bathymetric and seafloor imagery processing software which allows conversion of raw hydrographic data and application of correctors such as SVP, heave, tides, merge and TPU, gridding and editing/cleaning of noise.

Manufacturer	NOAA
Software Name	Pydro
Version	16
Service Pack	9
Hotfix	r6903
Installation Date	2016-02-15
Use	Processing
Description	NOAA proprietary GIS system with many extra functions.

Manufacturer	Coastal Oceanographic
Software Name	Hypack
Version	2015

Service Pack	N/A
Hotfix	N/A
Installation Date	2016-02-15
Use	Acquisition
Description	Used for survey acquisition and planning.

Manufacturer	Odom Hydrographic
Software Name	Digibar Pro
Version	3.0
Service Pack	0
Hotfix	3
Installation Date	2011-01-01
Use	Processing
Description	Used to process Digibar sound velocity data from the probe.

Manufacturer	Trimble
Software Name	MV POSVIEW
Version	7.6
Service Pack	N/A
Hotfix	N/A
Installation Date	2014-01-21
Use	Acquisition
Description	Control software for the POSMV system.

Manufacturer	Odom Hydrographic
Software Name	e-Chart
Version	1.4
Service Pack	N/A
Hotfix	N/A
Installation Date	2011-01-01
Use	Acquisition
Description	Control software for single beam echo sounder.

A.8 Bottom Sampling Equipment

A.8.1 Bottom Samplers

A.8.1.1 Custom Clam Shell

Manufacturer	Custom
Model	Clam Shell
Description	4" penetration grab sampler designed to collect unconsolidated bottom material.

Figure 4: Bottom Sampler

B Quality Control

B.1 Data Acquisition

B.1.1 Bathymetry

B.1.1.1 Multibeam Echosounder

As per manufacturer and NOAA protocols within the FPM and Specs and Deliverables.
At present this system is being used primarily for development of contacts and areas of specific interest.
Instrument approved by HSTB in October 2016 for charting applications.

B.1.1.2 Single Beam Echosounder

As per manufacturer and NOAA protocols within the FPM and HSSD.

B.1.1.3 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar bathymetry was not acquired.

B.1.2 Imagery

B.1.2.1 Side Scan Sonar

As per manufacturer and NOAA protocols within the FPM and Specs and Deliverables.
Primary instrument being used is the Edgetech4125. Operated normally on the 50-100m range scale and processing 900kHz data. 400kHz data is logged it is only processed and used where warranted by better quality data than the HF.

B.1.2.2 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar imagery was not acquired.

B.1.3 Sound Speed

B.1.3.1 Sound Speed Profiles

As per manufacturer and NOAA protocols within the FPM and Specs and Deliverables.

Normal operation for VBES work are 1 cast acquired during each survey day, with a dual cast taken once per week for quality control method of "Compare 2 cast".

When MBES work is being conducted an opening day cast is taken, then a cast is taken each hour during operations, unless a more frequent interval is needed due to changing conditions, locations, or deviation of surface speed by more than 2m/s is noted.

B.1.3.2 Surface Sound Speed

As per manufacturer and NOAA protocols within the FPM and Specs and Deliverables. Surface sound speed is applied in real time to the MBES system to provide refraction corrections and beam steering.

B.1.4 Horizontal and Vertical Control

B.1.4.1 Horizontal Control

Horizontal control data were not acquired.

B.1.4.2 Vertical Control

Vertical control data were not acquired.

B.1.5 Feature Verification

As per manufacture and NOAA protocols.

Normal verification of existing features are performed by Hypack Detached Positions.

B.1.6 Bottom Sampling

Bottom sample density is determined by the PI.

B.1.7 Backscatter

Backscatter data is logged as .7k files when collecting MBES and included in raw project data for branch processing.

B.1.8 Other

No additional data were acquired.

B.2 Data Processing

B.2.1 Bathymetry

B.2.1.1 Multibeam Echosounder

As per manufacture , and NOAA protocols within the FPM and Specs and Deliverables. The processing work flow example, is listed on the attached Processing Work Sheet used by NRT2. True Heave data is applied during the SVP application process. When reviewing MBES data in 3-D editor a SSS.000 file is loaded as a background, created as a .000 export from Pydro of the SSS imagery contacts to help better ascertain the true contact position.

The raw .hsx data is converted and navigation and attitude data are examined in their respective editors. All correctors are applied (True Heave, Tides, Sound Velocity, Merged, then TPU). A base surface is created and tiles are created for validating the reviewed areas. Data is reviewed and edited within Subset editor, in both 2D and 3D views to remove flyers in the data sets not attributed to hard SSS contacts. At this point the "Find Designated Sounding" function is used over the contacts to flag the least depth obtained. Survey Bases are updated throughout the survey. Finalized Base Surfaces are created prior to submittal.

Figure 5: NA

B.2.1.2 Single Beam Echosounder

NOAA protocols, Field Procedures, and Specs and Deliverables were used as guidelines. The processing work flow example, is listed on the attached Processing Work Sheet used by NRT2.

Survey data for single beam is transferred to a removable hard drive on the launch and entered into the post processing system in the Office trailer. Vertical Beam sonar data is converted from Hypack format to CARIS format using the CARIS “Hypack” data converter. After conversion the data is opened in CARIS Attitude Editor, Navigation Editor, and Single Beam Editor. Vessel navigation data is manually checked for

errors which are rejected with break interpolation. Attitude data are checked for errors or gaps. Sounding data are checked for irregular pings.

Survey personnel scan raw VBES soundings in CARIS Single Beam Editor. Any sounding questions are then compared directly to the sounders graphic record file (.bin) for edits required to validate or correct the values in question. Once VBES soundings are scanned the raw data is corrected by applying sound velocity, tides, and true heave then TPE values are applied and merged. The tide data is applied either by Pydro via TCARI, or Caris by a ZDF file.

B.2.1.3 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar bathymetry was not processed.

B.2.1.4 Specific Data Processing Methods

B.2.1.4.1 Methods Used to Maintain Data Integrity

Consistent processing steps and review of all data continually through the survey. At the end of the Survey a final detailed review is conducted of all data for errors.

B.2.1.4.2 Methods Used to Generate Bathymetric Grids

VBES data only required one 4m CUBE surface, uncertainty selected. A Finalized surface is generated to reflect critical soundings.

MBES data is processed as per NOAA 2013 FPM & HSSD's using CUBEParams_NOAA. A 0.5m base is generated and submitted with the survey.

B.2.1.4.3 Methods Used to Derive Final Depths

Methods Used	Surface Computation Algorithms
Description	No filtering was used during survey work processing for VBES or MBES. Records were compared to the BIN files for direct visual comparison to digital data and edits were made to correct any errors noted such as minor bottom loss or blowouts caused by biological, tidal, or man-made noise.

B.2.2 Imagery

B.2.2.1 Side Scan Sonar

All side scan sonar imagery is converted from JSF formats to CARIS format using CARIS JSF converters. After conversion the data is opened in CARIS Navigation Editor, Attitude Editor, and Side Scan Editor. Survey personnel then check vessel attitude, cable out, gyro, and sonar height. Due to the higher rate of current data logging of position 25-50Hz some minor noise is present in the speed data, these are left unedited due to their insignificance. Data showing speed jumps may be rejected with interpolation. Survey personnel then confirm the validity of the vessel navigation, cable out, and towfish depth values. Towfish nav is not recomputed in Caris since layback is automatically burned into the .jsf file. Side scan sonar data is examined in CARIS Side Scan Editor. Survey personnel correct errors in bottom tracking, slant range correct is done automatically in Caris. Data is examined for significant contacts. Mosaics are then generated to show coverage at 30cm resolution. A 1m mosaic is created for submission.

B.2.2.2 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar imagery was not processed.

B.2.2.3 Specific Data Processing Methods

B.2.2.3.1 Methods Used to Maintain Data Integrity

Direct comparison between the 100% and 200% coverage, as well as MBES & VBES data.

B.2.2.3.2 Methods Used to Achieve Object Detection and Accuracy Requirements

NOAA protocols, Field Procedures, and Specs and Deliverables were used as guidelines.

B.2.2.3.3 Methods Used to Verify Swath Coverage

Mosaics are generated and overlaid on red chart background to check for any gaps. Typical line layout allows for 15-20m overlap

B.2.2.3.4 Criteria Used for Contact Selection

Hydrographer judgment and NOAA protocols, Field Procedures, and Specs and Deliverables were used as guidelines.

B.2.2.3.5 Compression Methods Used for Reviewing Imagery

No compression methods were used for reviewing imagery.

B.2.3 Sound Speed

B.2.3.1 Sound Speed Profiles

Sound Velocity profiles are acquired using two SVP profilers. Data quality assurance tests were performed by the “Compare two Profiles” method of two casts acquired at the same time with two different instruments.

Cast data is processed via Velocipy and the cast data is extended using "most probable slope" method. The cast to be used for the survey data is then exported to a Caris SVP file, concatenated and applied within Caris process " Apply SVP Cast".

B.2.3.1.1 Specific Data Processing Methods

B.2.3.1.1.1 Caris SVP File Concatenation Methods

By Survey Number. Each Survey has one SVP file named as the master file such as " H12345.SVP" which would contain all SVP cast for that survey.

B.2.3.2 Surface Sound Speed

Surface sound speed data were not processed.

B.2.4 Horizontal and Vertical Control

B.2.4.1 Horizontal Control

Horizontal control data were not processed.

B.2.4.2 Vertical Control

Vertical control data were not processed.

B.2.5 Feature Verification

NOAA protocols, Field Procedures, and Specs and Deliverables were used as guidelines.

Features assigned in the AFF are loaded into Hypack and processed in BDB.

B.2.6 Backscatter

Backscatter data were not processed.

B.2.7 Other

No additional data were processed.

B.3 Quality Management

NOAA protocols, Field Procedures, and Specs and Deliverables were used as guidelines. All data is reviewed by the Team Lead during and at the end of the survey for errors and completeness.

B.4 Uncertainty and Error Management

NOAA protocols, Field Procedures, and Specs and Deliverables were used as guidelines.

B.4.1 Total Propagated Uncertainty (TPU)

B.4.1.1 TPU Calculation Methods

Caris applied

B.4.1.2 Source of TPU Values

vessel config file entries (data obtained from NOAA and Manufacturers sources).

B.4.1.3 TPU Values

Vessel	NRT2_1210_SB		
Echosounder	Odom Hydrographic CV-2 200 kilohertz		
TPU Standard Deviation Values	*Motion*	*Gyro*	0.025 degrees
		Heave	5.000 % Amplitude 0.050 meters
		Pitch	0.020 degrees
		Roll	0.020 degrees
	Navigation Position	1.000 meters	

	Timing	*Transducer*	0.000 seconds
		Navigation	0.010 seconds
		Gyro	0.010 seconds
		Heave	0.005 seconds
		Pitch	0.005 seconds
		Roll	0.005 seconds
	Offsets	*x*	0.01 meters
		y	0.01 meters
		z	0.01 meters
	MRU Alignment	*Gyro*	0.200 degrees
		Pitch	0.050 degrees
		Roll	0.050 degrees
	Vessel	*Speed*	0.030 meters/second
		Loading	0.010 meters
		Draft	0.010 meters
		Delta Draft	0.010 meters
Vessel	NRT2_1210_Reson_T20P_MB		
Echosounder	Reson T20-P 330 kilohertz		
TPU Standard Deviation Values	*Motion*	*Gyro*	0.025 degrees
		Heave	5.000 % Amplitude 0.050 meters
		Pitch	0.020 degrees
		Roll	0.020 degrees
	Navigation Position	0.5000 meters	
	Timing	*Transducer*	0.005 seconds
		Navigation	0.005 seconds
		Gyro	0.005 seconds
		Heave	0.005 seconds
		Pitch	0.005 seconds
		Roll	0.005 seconds
	Offsets	*x*	0.01 meters
		y	0.01 meters
		z	0.01 meters

	MRU Alignment	*Gyro*	0.200 degrees
		Pitch	0.050 degrees
		Roll	0.050 degrees
	Vessel	*Speed*	0.030 meters/second
		Loading	0.010 meters
		Draft	0.010 meters
		Delta Draft	0.010 meters

B.4.2 Deviations

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

Additional Discussion

All Tpu values for the "NRT2_1210_DP" vessel file are the same as the "SB" vessel file.

C Corrections To Echo Soundings

C.1 Vessel Offsets and Layback

C.1.1 Vessel Offsets

C.1.1.1 Description of Correctors

All Offsets are applied by the vessel config file values during processing.

C.1.1.2 Methods and Procedures

Caris process functions apply all correctors and offsets. Vessel offsets were surveyed by NGS with a TOPCON total station on January 5th, 2016. Measurements compared fairly well to historical values performed by the team with traditional methods. The coordinate system used by NGS has the X and Y planes reversed from the coordinate system used by Caris which is why the X and Y values are reversed in this DAPR.

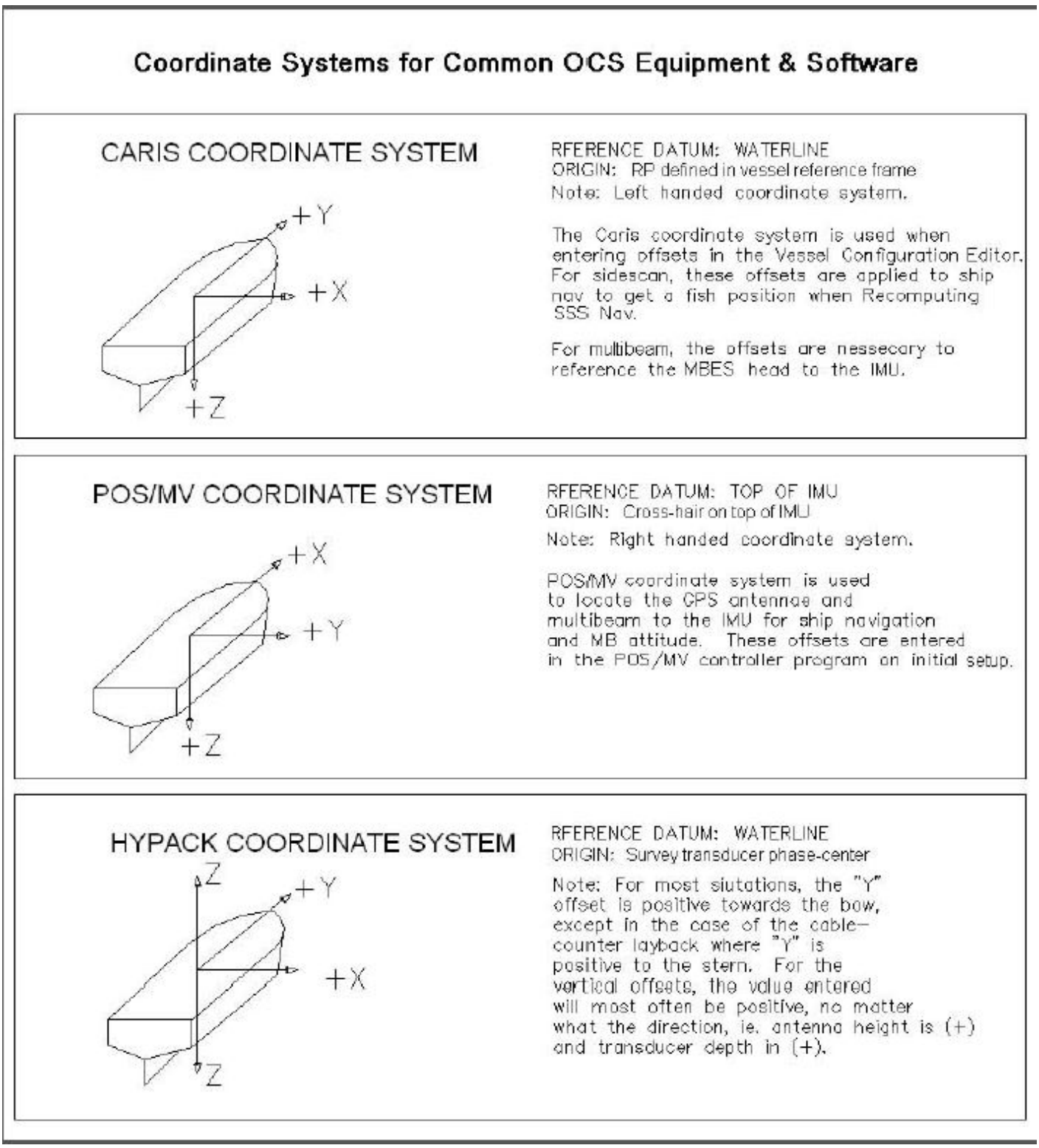


Figure 6: Equipment Coordinate System Comparison

C.1.1.3 Vessel Offset Correctors

Vessel	NRT2_1210_SB
Echosounder	Odom Hydrographic CV-2 200 kilohertz
Date	2016-01-19
Offsets	*MRU to Transducer*: *x* -0.178 meters; *y* 2.181 meters; *z* 0.292 meters; *x2* N/A; *y2* N/A; *z2* N/A *Nav to Transducer*: *x* -0.179 meters; *y* 2.294 meters; *z* 0.156 meters; *x2* N/A; *y2* N/A; *z2* N/A *Transducer Roll*: *Roll* 0.000 degrees; *Roll2* N/A
Vessel	NRT2_1210_Reson_T20P_MB
Echosounder	Reson T20P 330 kilohertz
Date	2016-01-19
Offsets	*MRU to Transducer*: *x* 1.527 meters; *y* 0.843 meters; *z* 0.716 meters; *x2* N/A; *y2* N/A; *z2* N/A *Nav to Transducer*: *x* 1.526 meters; *y* 0.956 meters; *z* 0.578 meters; *x2* N/A; *y2* N/A; *z2* N/A *Transducer Roll*: *Roll* 0.70 degrees; *Roll2* N/A

C.1.2 Layback

Layback correctors were not applied.

Additional Discussion

A 12 cm correction is added in the positive Z (down) offset to account for the difference in the NGS measurement to the center of the multibeam mount and the actual phase center of the unit.

C.2 Static and Dynamic Draft

C.2.1 Static Draft

C.2.1.1 Description of Correctors

Normal working load static draft value is entered into the vessel config file. The value is 26 cm above RP.

C.2.1.2 Methods and Procedures

Applied during standard application of the vessel config file to survey data. Static draft was measured under normal load with approximately 3/4 fuel capacity. A mark on the hull was scratched at the water line (26 cm above the reference point), using steel tape and levels and checked periodically to validate consistency.

C.2.2 Dynamic Draft

C.2.2.1 Description of Correctors

Post Processed in POSPAC using the ERDDM procedure in the 2014 FPM Section 1.4.2.1.2.1.

C.2.2.2 Methods and Procedures

Applied during standard application of the vessel config file to survey data. Third (3rd) order polynomial was used.

C.2.2.3 Dynamic Draft Correctors

Vessel	NRT2_1210_SB
Date	2014-01-15

Dynamic Draft Table	*Speed*	*Draft*
	0	0
	0.5	0.060
	1	0.060
	1.5	0.030
	2.0	-0.020
	2.5	-0.060
	3.0	-0.080
	3.5	-0.060

C.3 System Alignment

C.3.1 Description of Correctors

Hypack latency Test was conducted for the VBES.

C.3.2 Methods and Procedures

Derived value was entered into the Hypack Survey .ini file for direct application, as there is no corrector entry in Caris for this value. No change from previous year.

C.3.3 System Alignment Correctors

Vessel	NRT2_1210_Reson_T20P_MB.hvf	
Echosounder	Reson T20-P 330 kilohertz	
Date	2016-02-17	
Patch Test Values	*Navigation Time Correction*	0 seconds
	Pitch	0 degrees
	Roll	0.70 degrees
	Yaw	0 degrees
	Pitch Time Correction	0 seconds
	Roll Time Correction	0 seconds
	Yaw Time Correction	0 seconds
	Heave Time Correction	0 seconds

C.4 Positioning and Attitude

C.4.1 Description of Correctors

Pos Pac data and true heave logged. When available POSPac MMS was used to create SBET which was then applied during Caris Auxilary Data function.

C.4.2 Methods and Procedures

Applied to post processed sounding data , by Caris process " Apply True Heave" function, during Apply SVP process.

C.5 Tides and Water Levels

C.5.1 Description of Correctors

TCARI and or ZDF zoning were used for all surveys, provided by COOP.

C.5.2 Methods and Procedures

Verified Tide at MLLW were applied to all sounding data by either Pydro or Caris.

C.6 Sound Speed

C.6.1 Sound Speed Profiles

C.6.1.1 Description of Correctors

All SVP cast were taken with a YSI Castaway. Comparisons made against Odom digibar weekly. These instruments are calibrated annually.

C.6.1.2 Methods and Procedures

Cast data is processed through Velocipy. The cast data is then exported to a single Survey SVP cast (Concatenated) and is applied by closest in time. Sound speed TPU was applied according to the 2013 FPM and HSSD. 4 m\s was used because of the frequency of casts.

C.6.2 Surface Sound Speed

C.6.2.1 Description of Correctors

An AML Hydrographic Micro-X sound speed probe is attached to the outside of the Reson T20-P MBES head.

C.6.2.2 Methods and Procedures

0.5 m\s was used for surface sound speed TPU due to the manufacturer's recommendation.

D. Approval

As Chief of Party, I have ensured that standard field surveying and processing procedures were used during this project in accordance with the Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables Manual, as updated for 2016.

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

Approved and Forwarded: KIRKPATRICK.JAMES.LEROY.IV.1400487398

Digitally signed by KIRKPATRICK.JAMES.LEROY.IV.1400487398
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=KIRKPATRICK.JAMES.LEROY.IV.1400487398
Date: 2017.08.22 13:32:04 -04'00'

James Kirkpatrick

Acting Team Lead NRT2