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

DATA ACQUISITION AND PROCESSING REPORT

Type of Survey	**Hydrographic**
Project	**S-K977-KR-07-DEA**
Contract No	**DG133C-05CQ-1078**
Task Order No	**T0004**
Time Frame	**July 2007 - October 2007**

LOCALITY

State	**Louisiana**
General Locality	**Gulf of Mexico**

2007

CHIEF OF PARTY

Jonathan L. Dasler, David Evans and Associates, Inc.

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NOAA FORM 77-28
(11-72)

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

REGISTRY No
H11683
H11684

HYDROGRAPHIC TITLE SHEET

INSTRUCTIONS – The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

FIELD No
David Evans and Associates, Inc.

State Louisiana

General Locality Gulf of Mexico

Sub-Locality Bastian Bay to West Bay

Scale 1:10,000 **Date of Survey** July 2, 2007 to October 9, 2007

Instructions dated April 16, 2007 **Project No.** S-K977-KR-07-DEA

Vessel R/V Taku, R/V Chinook

Chief of party Jonathan L. Dasler, PE (OR) , PLS (OR,CA)

Surveyed by Jonathan Dasler, Jason Creech, Shyla Allen, Michael Hill

Soundings by echo sounder, hand lead, pole RESON 8101, Odom MkIII and CV-100, EdgeTech 4200-FS and 4200-HFL

Graphic record scaled by N/A

Graphic record checked by N/A **Automated Plot** N/A

Verification by

Soundings in Meters at MLLW

REMARKS: **All times are UTC.**

The purpose of this contract is to detect and map marine debris for the Gulf of Mexico Marine Debris Project and to provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area.

SUBCONSULTANTS: **ZEPHYR MARINE, P.O. Box 1575, Petersberg, AK 99833**

EMC Inc., 209 Main Street, Greenwood, MS 38930

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Acronyms and Abbreviations

AML	Applied Microsystems, Ltd.
BAG	Bathymetric Attributed Grid
BIN	HYPACK Digital Echogram File
CO-OPS	Center for Operational Oceanographic Products and Services
CUBE	Combined Uncertainty and Bathymetry Estimator
DEA	David Evans and Associates, Inc.
DXF	Drawing Exchange Format
DGPS	Differential Global Positioning System
FEMA	Federal Emergency Management Agency
GOMMDP	Gulf of Mexico Marine Debris Project
GPS	Global Positioning System
HDCS	Hydrographic Data Cleaning System
HIPS	Hydrographic Information Processing System
HSX	HYPACK Hysweep File
HVF	HIPS Vessel File
IMU	Inertial Motion Unit
MDB	Microsoft Access Database File
MLLW	Mean Lower Low Water
NATSUR	Nature of Surface
NATQUA	Nature of Surface Qualifying Terms
NMEA	National Marine Electronics Association
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
POS/MV	Position and Orientation System for Marine Vessels
PPS	Pulse per Second
RAW	HYPACK File
R/V	Research Vessel
RPM	Revolutions per Minute
RTK	Real-Time Kinematic
SBDARE	Seabed Area
SSS	Side Scan Sonar
SV	Sound Velocity
SVP	Sound Velocity Profile
TIF	Tagged Image Format
TPU	Total Propagated Uncertainty
UTC	Universal Time Coordinated
XTF	Extended Triton format file extension

S-K977-KR-07-DEA
Data Acquisition and Processing Report
Gulf of Mexico, Louisiana
July 2, 2007 – October 9, 2007
R/V Taku and *R/V Chinook*
David Evans and Associates, Inc.
Lead Hydrographers: Jonathan L. Dasler, Jason C. Creech

INTRODUCTION

This report applies to surveys H11683 and H11684, located in the Mississippi Delta, Louisiana. These surveys are part of the Gulf of Mexico Marine Debris Project (GOMMDP). The contract surveys were performed under S-K977-KR-07-DEA as specified in the *Statement of Work* dated April 16, 2007. In general, survey methods meet or exceed requirements as defined in the National Ocean Service (NOS*) Hydrographic Surveys Specifications and Deliverables (June 2006)*. Coverage requirements of 200% side scan sonar with concurrent single beam sonar and investigation of significant contacts with a multibeam echosounder were met.

A. EQUIPMENT

For this project David Evans and Associates, Inc. (DEA) implemented state-of-the-art data acquisition systems aboard the Research Vessel (*R/V*) *Taku* and *R/V Chinook*, in accordance with National Oceanic and Atmospheric Association (NOAA) standards and modern remote sensing techniques. Data processing took place in the field at a shore side processing station as well as at DEA's corporate headquarters in Portland, Oregon. Instrumentation used to conduct the survey and redundant systems to provide confidence checks, consisted of the equipment listed in Tables 1 and 2.

Table 1. R/V Taku Hardware

Instrument	Manufacturer	Model	S/N	Function
Side scan				
	Edgetech	**4200**		300/600 kHz Digital side scan sonar imagery with towfish heading and depth sensors.
Deck Unit		701-DL	35323	
		4200 HFL	33914	
Towfish		4200 HFL	33915	
Single beam				
Deck Unit	**Odom**	**Echotrac MKIII**	21149	200 kHz Single beam sonar with 9° beam angle.
Transducer		SMBB200-9		
Deck Unit	**Odom**	**CV100**	26020	
Transducer		SMBB200-9		
Multibeam				
	RESON	**8101**		240 kHz Shallow Water Multibeam sonar with 101 1.5° beams. Firmware 8101-2.09-E34D
Deck Unit	SeaBat 8101	Seabat 8101	16125	
Transducer		8101 ER	3899067	
Attitude and Position				
	Applanix	**POS MV 320 v4**		Integrated Differential Global Positioning System (DGPS) and inertial reference system for position, heading, heave, roll and pitch data
Deck Unit		PCS-29	2048	
IMU		LN200	361	
Port Antenna		Compact Zephyr	12572971	
Starboard Antenna		Compact Zephyr	12579381	
	Trimble	**ProBeacon**		Obtain differential corrections United States Coast Guard differential beacons.
Receiver		25785-00	220014495	
Antenna		24960-00	220014366	
	Trimble	**DSM132**		Secondary positioning system for Quality Assurance/Quality Control (QA/QC)
Receiver		33302-33	0 0224093932	
Antenna		33580-00	0220361419	
Sound Velocity				
	AML	**SV Plus V2**		Primary sound velocity profiler.
Sensor		SV Plus V2	3591	
Bottom Samples				
	Wildco	Standard Ponar Grab Sampler		

Table 2. R/V Chinook

Instrument	Manufacturer	Model	S/N	Function
Side scan				
	Edgetech	**4200**		100/400 and 300/600 kHz Digital side scan sonar imagery with towfish heading and depth sensors.
Deck Unit		701-DL	35324	
Towfish		4200 HFL 4200 FS 4200 FS	35493 32060 33773	
Single beam				
	Odom	**CV-100**		200 kHz Single beam sonar with 9° beam angle.
Deck Unit			26003	
Transducer		SMBB200-9	Unknown	
Position				
	Trimble	**SPS750 MAX**		Modular GPS Receiver
Receiver		58904-66	4706J04156	
Antenna		55550-00	30403372	
	Trimble	**DSM132**		Secondary positioning system for Quality Assurance/Quality Control (QA/QC)
Receiver		33302-33	224092892	
Antenna		33580-00	220398290	
	CSI Wireless	**MBX-3S**		Obtain differential corrections United States Coast Guard differential beacons.
Receiver		801-3012-000 (MBX-3S)	0716-1600-0009	
Antenna		801-3003-06A (MGL-3)	0716-3582-0008	
Attitude				
	Trimble	**SPS550H**		Add-on Modular GPS Receiver. When combined with SPS750 precise heading from dual Global Positioning System (GPS) antennas can be output.
Receiver		58801-00	4716K50001	
Antenna		39105-00	60154234	
	TSS	**DMS05**	2220	Provides real-time heave, roll, and pitch.
Sound Velocity				
	AML	**SV Plus V2**		Primary sound velocity profiler.
Sensor		SV Plus V2	3592	

A1. Survey Vessels

A1.a *R/V Taku* and *R/V Chinook*

The research vessels *R/V Taku* (Figure 1) and *R/V Chinook* (Figure 2) are owned and operated by Zephyr Marine were the primary survey vessels for this project. Both boats are 28-foot trailerable aluminum catamaran with a 10.5-foot beam and a draft of 2.0 feet. The vessels are equipped with twin 225 HP outboard motors, a 12-foot pilot house, a hull-mounted single beam transducer, stern mount A-frame, a side scan sonar bow mount for shallow water operations and data acquisition stations. No unusual sensor setup configurations were required for this survey.

Figure 1. *R/V Taku*

Figure 2. *R/V Chinook*

A2. Side Scan Sonar Systems

Daily checks were performed to ensure the side scan sonar was working correctly. Each day prior to deployment, a rub test was performed to ensure that both the port and starboard transducers were functioning and wired correctly. Confidence checks to confirm adequate target resolution at the outer limits of the selected range were conducted on a daily basis during acquisition and noted in the acquisition logs. Confidence checks were performed more frequently in deteriorating conditions to confirm detection of features at the outer range limits.

A2.a *R/V Taku*

Side scan sonar imagery was acquired with an EdgeTech 4200-HFL (same as FSL) dual frequency (300/600 kHz) digital side scan sonar (Figure 3) running in high definition mode at the 600 kHz high frequency setting. The sonar was operated at 50-meter range scale on 80 meter *main scheme* lines for each 100% coverage. Imagery was logged on DEA's Triton Isis system in extended Triton format (XTF) (16 bit, 1024 pixels/channel) along with ancillary data including: towfish heading, pitch, roll and depth, ship position and computed towfish position from layback calculations. Side scan data was acquired with the towfish deployed from the bow or stern. Fixed layback distance to the bow or stern tow point was manually entered in the Isis software.

Figure 3. Edgetech 4200-FSL Side Scan Sonar

A2.b *R/V Chinook*

Side scan sonar imagery was acquired with an EdgeTech 4200-FS dual frequency (100/400 kHz) and a 4200-HFL (300/600 kHz) digital side scan sonar (Figure 4) running in high definition mode at the 400 or 600 kHz (depending on the sonar used) high frequency setting. The sonar was operated at 50-meter range scale on 80 meter *main scheme* lines for each 100% coverage. Imagery was logged on DEA's Triton Isis system in XTF (16 bit, 1024 pixels/channel) along with ancillary data including: towfish heading, pitch, roll and depth, ship position and computed towfish position from layback calculations. Side scan data was acquired with the towfish deployed from the bow or stern. Fixed layback distance to the bow point was manually entered in the Isis software. Stern tow was layback was computed from a digital cable counter and pressure depth from the towfish.

Figure 4. Edgetech 4200-FS Side Scan Sonar

A3. Single Beam Systems

Draft checks were observed twice daily (beginning and end of day) to monitor vessel loading and fuel consumption. Weekly leadline checks were performed to ensure that the sonars were functioning properly and static draft was accurately documented. The leadline was constructed by attaching a mushroom anchor to a metric reel fiberglass tape enabling depths to be read to 5 mm.

Both survey platforms were outfit with Odom single beam echosounders that were operated concurrently with side scan sonar during survey operations. All single beam data were logged in HYPACK (RAW) and HYPACK Digital Echogram (BIN) file formats.

A3.a *R/V Taku*

An Odom Echotrac MKIII with a 9° transducer and 200 kHz operating frequency was deployed on the *R/V Taku* from July 5, 2007 to August 26, 2007. From August 26 to the end of the project an ODOM CV100 was used. The transducer remained the same and was hull mounted amidships on the starboard pontoon.

A3.b *R/V Chinook*

An Odom CV100 with a 9° transducer and 200 kHz operating frequency was deployed on the *R/V Chinook*. The transducer was hull-mounted amidships on the starboard sponson.

A4. Multibeam System

Weekly leadline checks were performed when utilizing the multibeam to ensure that the sonar was functioning properly and static draft was accurately documented. The leadline was constructed by attaching a mushroom anchor to a metric reel fiberglass tape enabling depths to be read to 5 mm.

A4.a *R/V Taku*

A Reson 8101 multibeam sonar was installed on the *R/V Taku* and used during item investigations of side scan sonar contacts. The multibeam echosounder was pole-mounted, which facilitated easy removal from the water when not in use to prevent damage to the sonar. The multibeam data were logged in XTF format on the Triton Isis acquisition system. The Reson 8101 series operates at 240 kHz producing a 150° swath of 101 uniform beams with a beam width of 1.5° x 1.5°.

A4.b *R/V Chinook*

No multibeam data were acquired from R/V Chinook.

A5. Position, Heading and Motion Reference System

A5.a *R/V Taku*

A position and orientation system for marine vessels (POS/MV), Applanix POS/MV 320 v4 integrated Differential Global Positioning System (DGPS) and inertial reference system was used to measure attitude, heading and position for the survey. The system was comprised of an inertial motion unit (IMU), dual GPS antennas, and a data processor. A Trimble ProBeacon receiver, acquiring corrections from the U.S. Coast Guard beacon located at English Turn, Louisiana (broadcast site ID 814 at 293 kHz) provided differential corrections for both the primary and secondary positioning systems. Position, heading, and motion data were output to Isis acquisition system using the real-time ethernet option at 25 Hz. Motion and position data were output to the HYPACK backup acquisition system over a serial connection with motion data output at 38,400 baud and 25 Hz; and position and heading at 9,600 baud and 1 Hz.

The POS/MV provided time synchronization of sonar instruments and logging computers using a combination of outputs from the POS/MV v4. The Reson processor and HYPACK logging computer were provided both a pulse per second (PPS) and a National Marine Electronics Association (NMEA) global positioning timing message (ZDA) to achieve synchronization with the POS/MV. The EdgeTech 4200 side scan sonar deck unit was provided a NMEA ZDA message for time synchronization. The Isis logging computer synchronized its time using the proprietary Trimble Universal Time Coordinated (UTC) message provided by the POS/MV. All messages contain time strings and cause the clocks of the computers and sonars to synchronize to the time contained within the message. Time offsets between instruments and computers, relative to times contained in POS/MV network packets, are typically sub-millisecond.

A Trimble DSM132 was installed as a redundant, secondary positioning system. However, the POS/MV navigation time was not synched correctly from the start of the project to DN255 requiring navigation from the Trimble DSM132 to be used for positioning during this time frame. The problem was corrected on DN256 and the POS/MV was used as primary navigation to the end of the project.

A Trimble ProBeacon receiver provided U.S. Coast Guard beacon corrected differential GPS positions using English Turn, Louisiana (broadcast site ID 814 at 293 kHz).

A weekly comparison between positions from the POS/MV and the DSM132 was observed and documented while the vessel was stationary in port and provided evidence of the incorrect set-up. Logged position data was imported into Excel and a difference computed.

A5.b *R/V Chinook*

Three instruments were used to provide geographic positioning and motion compensation for *R/V Chinook*. A Trimble SPS750 provided position data. The SPS750 was combined with a Trimble SPS550 to provide heading data for the GPS baseline. Finally, a TSS DMS05 HPR (heave, pitch and roll) provided motion compensation.

A Trimble DSM132 was installed as a redundant, secondary positioning system.

A CSI MBX-3S provided U.S. Coast Guard beacon corrected differential GPS positions using English Turn, Louisiana (broadcast site ID 814 at 293 kHz).

On DN207 and DN213 thru DN216, the navigation from SPS750 was not written to the RAW file and the secondary navigation from the DSM132 was used for position correction.

The DMS05 HPR data was output, for logging in HYPACK, at 25 Hz and 38,400 baud. The instrument was configured in "Fully Aided" mode to minimize heave-settling times. This was accomplished using position and speed inputs from the DGPS data stream and 5 Hz heading inputs from a KVH digital compass. Typical heave settling times were measured as less than 20 seconds in the "Fully Aided" mode. Turns between survey lines were programmed to provide sufficient "run-in" time to allow the heave to settle prior to start of data logging.

Time synchronization of all data was accomplished by using Isis to set the data-logging PC clock to UTC via the DGPS data stream. HYPACK was configured to use the data-logging PC clock for data time tags. Since both applications were running on the same PC, all data were time correlated and logged using UTC times.

A weekly comparison between positions from the SPS750 and the DSM132 was observed and documented while the vessel was stationary in port and provided evidence of the incorrect set-up. Logged position data was imported into Excel and a difference computed.

A6. Sound Velocity Measurement System

The sensors had been calibrated prior to the start and at the end of the survey. Factory calibration results are included in the Separates II of the Descriptive Reports for the survey. The two probes (one from each vessel) were lowered together and compared weekly to verify performance was within specifications.

A6.a *R/V Taku*

An Applied Microsystems, Ltd. (AML) SV Plus V2 sound velocity sensor was used to take multiple daily sound speed readings during single beam and multibeam operations.

A6.b *R/V Chinook*

An AML SV Plus V2 sound velocity sensor was used to take multiple daily sound speed readings during single beam and multibeam operations.

A7. Acquisition Systems

The software and version numbers used throughout the survey are listed in Table 3 below.

Table 3. Acquisition and Processing Software

SOFTWARE				
	Company	**Program Name**	**Version**	**Date**
Acquisition				
	Triton Imaging, Inc	Isis	7.1.428.53	07/01/2007
	HYPACK, Inc.	HYPACK /HYSWEEP	6.2.2.2	07/01/2007
	EdgeTech	Discover	5.30	07/01/2007
	Applanix	MV-POSView	3.4.0.0	07/01/2007
	Trimble	ProBeacon	1991 DOS	07/01/2007
	DEA	Digital LineLog	1.0.5	07/01/2007
Processing				
	Caris	HIPS	6.1/SP1/ HF 7	02/20/2008
	Caris	Notebook	3.0/HF 2	10/17/2007
	Caris	Bathy DataBASE	2.1/HF 2	10/18/2007
	Triton Imaging, Inc	Isis Sonar Office Suite	7.1.428.53	11/15/2006
	HYPACK, Inc.	HYPACK Lite	6.2.2.2	07/01/2007
	ESRI	ArcGIS	9.2/SP4	12/01/2007
	DEA	SVP Convert	0.0.8	11/15/2006
Other				
	Microsoft	Word	2003	
		Excel	2003	
		Access	2003	

A7.a *R/V Taku* and *R/V Chinook*

The acquisition stations installed and integrated on the *R/V Taku* and *R/V Chinook* by DEA consisted of a Triton Isis side scan and multibeam sonar data acquisition system and a HYPACK vessel navigation and single beam acquisition system (Table 3). During acquisition, data were logged locally on acquisition PCs and then transferred to the field processing office at the end of each survey day via external USB drives.

A8. Survey Methodology

A8.a Mobilization

Mobilization, sensor installation, and calibration occurred from July 2, 2007 through July 19, 2007 in Red Pass, Louisiana. Prior to mobilization in Louisiana surveys of *R/V Taku* and *R/V Chinook* were performed while the vessel was at the DEA's Portland office. A total station was used to survey the vessel's sensor mounting points and prominent structural features. Values from the survey were used to calculate sensor offsets and accuracies used in the Hydrographic Information Processing System Vessel File (HVF). In the survey location the vessel underwent system calibration tests and draft measurements were made under both static and dynamic (settlement and squat) conditions in the survey.

A8.b Survey Coverage

The Mississippi Delta (S-K977-KR-07-DEA) area was surveyed with line orientations appropriate for each of the survey boundaries. The side scan sonars were operated at 50-meter range scale with a survey line spacing of 80 meters to attain each 100% side scan coverage and allow for a 10-meter offline tolerance. Single beam echosounder data was acquired concurrently with side scan sonar operations. Shallow water multibeam coverage was acquired with the *R/V Taku* over 50 of the most significant contacts per survey sheet in order to develop least depths for the features.

For the vast majority of the survey *R/V Taku* acquired even, 100% lines while *R/V Chinook* acquired odd, 200% lines. This methodology ensured rapid feature confirmation and development.

A8.c Side Scan Sonar Operations

The primary purpose of this survey was to detect and map marine debris for the GOMMDP. Side scan and single beam data were acquired concurrently from both the *R/V Taku* and the *R/V Chinook*. Preplanned HYPACK line files were created for each survey sheet at 80-meter spacing for each 100% coverage.

The vessels were staffed with a vessel operator and a hydrographer. The lead hydrographer rotated between the two vessels to oversee acquisition, and quality assurance. The hydrographer’s tasks included: analyzing the digital sonogram, maintaining a digital acquisition log which was used to track contacts, daily confidence checks, and other survey activities. All acquisition occurred during daylight hours with the vessel leaving port in the morning and returning in the evening.

Side scan imagery was collected using the sonar’s high frequency (400 or 600 kHz) setting in the high definition mode at a range of 50 meters for all main scheme data acquisition. In accordance with the NOS *Hydrographic Surveys Specifications and Deliverables* (*June 2006*), vessel speed was monitored to ensure 3 pings per meter to ensure detection of a 1 meter x 1 meter x 1 meter object on the seafloor. The survey vessel maintained a speed under 8 knots throughout the side scan survey, which allowed for a minimum of 3.6 pings per meter.

In addition, the operator monitored coverage displays and towfish height, attempting to maintain within 8% to 20 % of the range when not limited to the extremely shallow waters within the survey area. When weather or sea conditions degraded side scan sonar imagery, operations were suspended.

Data was transferred to DEA’s Portland office and side scan sonar mosaics were created to illustrate completeness of coverage and any detected data holidays were filled by running additional survey lines. Least depths on the 50 most significant contacts were acquired with shallow water multibeam. A discussion of new items can be found in the Descriptive Report for each survey.

A8.d Single Beam Sonar Operations

Single beam sonar operations occurred concurrently with side scan sonar acquisition. The sonar operator monitored the single beam echosounder digital echogram, which was displayed and logged on the Hypack acquisition computer. A traditional paper trace was not recorded during this survey as the full water column return was digitally recorded.

A8.e Multibeam Operations

Multibeam investigations occurred after 200% side scan coverage was achieved and a list of the 50 most significant contacts requiring investigations was compiled. The list of top 50 contacts was compiled after examining parameters such as contact height, level of significance, depth of the contact and navigational significance. Further discussion of contacts and multibeam development can be found in the Descriptive Report for each survey.

The multibeam sonar system was operated at a recorded ping rate of 18 Hz during all data acquisition. The multibeam sonar was able to detect shoals that measure two meters by two meters horizontally and one meter vertically in depths of 40 meters or less. Based on a sonar update rate of 18 Hz and an average vessel speed of seven knots, the bottom coverage averaged 5.0 beam footprints per meter. The multibeam sonar was operated at different range scales throughout the survey by adjusting the depth range to obtain the best coverage in varying depths of water. The depth of the investigations ranged from 9 feet to 59 feet (-2.7 m to 17.9 m). Table 4 lists the typical sonar settings for the multibeam investigations.

Table 4. Reson 8101 Sonar Settings

8101 Parameter	Value
Range:	Variable, depth dependent
Gain:	Variable, depth and bottom type dependent
Power:	Variable, depth and bottom type dependent
Spreading	28 dB
Absorption:	50 dB/km
Ping Rate	18 p/s
Pulse Width:	113 µs

A8.f Bottom Sampling

A total of 90 bottom sediment grab samples were obtained within the two surveys. The samples were collected across a 2,000-meter grid. Samples were obtained with a Ponar grab sampler, which collects a sample size up to 8.2 liters with a typical penetration depth of 3.5 inches. Position, depth, date, time, unique identifier, description and photograph were recorded for each sample. Each sample was described in accordance with IHO S-57 requirements for Seabed Area

(SBDARE) features with attribution of COLOUR, Nature of Surface Qualifying terms (NATQUA), and Nature of Surface (NATSUR).

A9. Quality Assurance

A field processing office was stationed in Empire, Louisiana, in order to facilitate rapid review of survey data and meet the weekly reporting requirements of the Gulf of Mexico Marine Debris Project (GOMMDP). The field office was outfitted with a high capacity server, multiple processing workstations with a full suite of hydrographic processing and GIS software including Triton Isis and DelphMap, Caris Hydrographic Information Processing System (HIPS), HYPACK, and ESRI Arcmap. The day following acquisition a DEA hydrographer lead a processing team to perform a second review of the side scan sonar imagery, logging additional contacts if any were detected. A completed list of both online and post-survey review contacts was then compiled. The re-evaluation of imagery for contacts by the data processor resulted in two reviews of the side scan imagery before the weekly contact list was uploaded to the GOMMDP SharePoint.

During item investigations the multibeam data were reviewed in the field processing office after acquisition in order to ensure optimal system performance and that a valid least depth was found for each item (Figure 5).

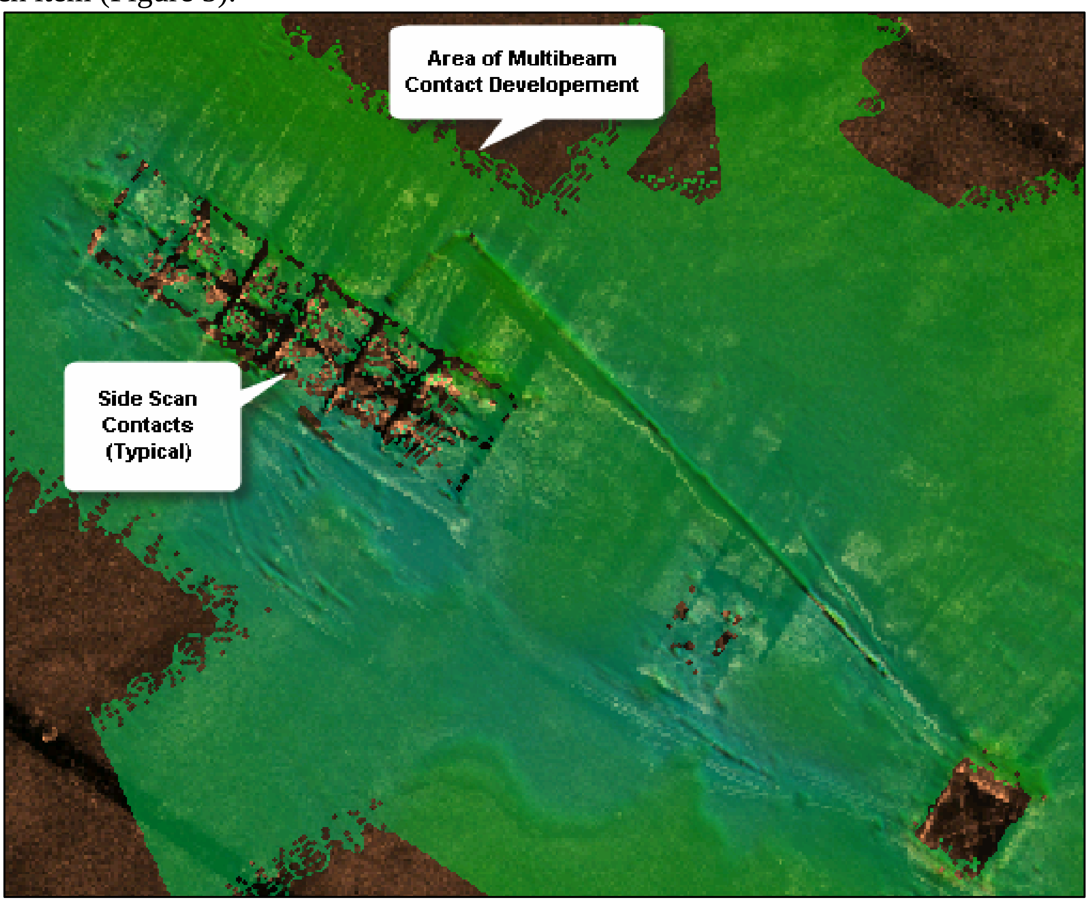

Figure 5. Graphic of side scan mosaic overlaid with contacts and multibeam swath coverage

B. QUALITY CONTROL

B1. Data Acquisition

B1.a Side Scan Sonar

Triton ISIS acquisition software was used to record side scan sonar data in XTF format. Adjustments to towfish height were made as necessary during data acquisition and logged in ISIS to ensure the best image quality. Layback values and changes were recorded in the daily acquisition log. Typical windows for monitoring raw sensor information included a waterfall display for the sonar imagery, graphs of vessel motions and a sonar signal voltage display. Data were displayed on a 30-inch LCD flat panel monitor mounted vertically at the acquisition station. The large format display allowed for increased time to analyze contacts prior to the display scrolling from view. Contacts were selected in real-time and during post-processing.

B1.b Single Beam *R/V Taku*

Odom MKIII or CV100 single beam echosounder data were acquired on the *R/V Taku* throughout side scan sonar operations. All single beam data were recorded in HYPACK in "RAW" format. A digital echogram and sonar signal voltage were displayed in HYPACK and recorded in the HYPACK BIN format. Due to a software design flaw in HYPACK's recording of the BIN file (file associated with the sonar echogram) the range of the sonar was not changed while online because the resultant change would not be recorded in the echogram. This did not adversely affect operations as the water depths across the survey area were fairly uniform and could be confined within a depth threshold. In addition, while ODOM outputs at 1600 samples over a given range and HYPACK survey logs data at full resolution; the data are down-sampled by about one-third of the resolution over a given range in HYPACK's single beam data processing software SB MAX. To capture the highest resolution echogram possible during survey acquisition the chart width was set to the minimum value of five meters.

A draft correction of 0.5 meters was entered into the ODOM MKIII echosounder and applied to the data during acquisition.

B1.c Single Beam *R/V Chinook*

ODOM CV-100 single beam echosounder data were acquired on *R/V Chinook* throughout side scan sonar operations. All single beam data were recorded in HYPACK in "RAW" format. A digital echogram and sonar signal voltage were displayed in HYPACK and recorded in the HYPACK BIN format. Due to a software design flaw in HYPACK's recording of the BIN file (file associated with the sonar echogram) the range of the sonar was not changed while online because the resultant change would not be recorded in the echogram. This did not adversely affect operations as the water depths across the survey area were fairly uniform and could be confined within a depth threshold. In addition, while ODOM outputs at 1,600 samples over a given range and HYPACK survey logs data at full resolution; the data are down-sampled by about one-third of the resolution over a given range in HYPACK's single beam data processing software SB MAX. To capture the highest resolution echogram possible during survey acquisition the chart width was set to the minimum value of five meters.

A draft correction of 0.5 meters was entered into the ODOM CV-100 echosounder and applied to the data during acquisition.

An incorrect Depth Index constant was applied during data acquisition on the *R/V Chinook*. This value accounts for the difference between the physical transducer face and the electronic phase center. A corrector value of 2.8 centimeters was applied during post-processing in CARIS as a "Z" value offset for the transducer in the HVF.

B1.d Multibeam

Multibeam echosounder data were only collected in order to develop side scan contacts deemed navigationally significant. Multibeam coverage was limited to the 50 most significant contacts per survey. During acquisition, data were monitored in real-time using the 2-D and 3-D data display windows in ISIS and the Reson SeaBat 8101. Typical windows for monitoring raw sensor information included a waterfall display for the sonar imagery, graphs of vessel motions, and a signal voltage display. Vessel navigation was monitored with HYPACK. Raw soundings, attitude, heading and position data were recorded in ISIS XTF format and also in HYPACK Hysweep file (HSX) format, as a supplementary backup. Adjustments to the sonar, including changes in range and gain were made, as necessary, during acquisition to ensure the best bathymetric data quality. Additionally, vessel speed was adjusted in accordance with the NOS *Hydrographic Surveys Specifications and Deliverables (June 2006)* to ensure the required along track coverage.

B2. Methodology Used to Maintain Data Integrity

The acquisition system and survey protocols were designed with some redundancy to demonstrate that the required accuracy was being achieved during the survey and provide a backup to primary systems. Data integrity was monitored throughout the survey through system comparisons. Two positioning systems were used to provide real-time monitoring of position data. Position confidence checks, leadline to single beam comparisons, and leadline to multibeam comparisons were conducted weekly to confirm required accuracy was being maintained. Weekly checks of the sound speed instrumentation were conducted by deploying both profilers in tandem. Sound speed profiles were computed for each sensor and compared to confirm instrumentation was functioning within survey tolerances.

Contacts were classified as significant if their height was greater than one meter in deeper areas, greater than 0.5 meters in shallow navigationally significant areas, or were observed to be baring features. When possible towfish altitude was maintained at 8% to 20% of the range, but in many cases this standard could not be met due to the extremely shallow waters within the survey area. To aid the hydrographer a table listing slant range and towfish altitude for one meter contacts at 50 meter range scale was posted at the acquisition station.

In order to manage the high volume of side scan sonar contacts DEA created a custom database that would meet the debris project's weekly reporting requirements as well as meet the contract tracking requirements of the NOS *Hydrographic Surveys Specifications and Deliverables (2006).* The database was maintained and stored in Microsoft Access using the Microsoft Access

Database File (MDB) format. Contacts were added into the database on a daily basis with the import of contacts occurring upon completion of the side scan review and contact identification. The use of the MDB format allowed direct geographic display of contacts and spatial queries within ESRI ArcGIS where contacts were correlated and compared to the chart and other survey data. The database had an export feature which created weekly reports in the Federal Emergency Management Agency (FEMA) format, which were uploaded to the GOMMDP SharePoint each Monday.

Flow diagrams of the single beam, shallow water multibeam, and side scan sonar data acquisition and processing pipelines are presented in Figures 6, 7 and 8 respectively. These diagrams graphically illustrate the data pipeline and processing workflow from acquisition to deliverable production.

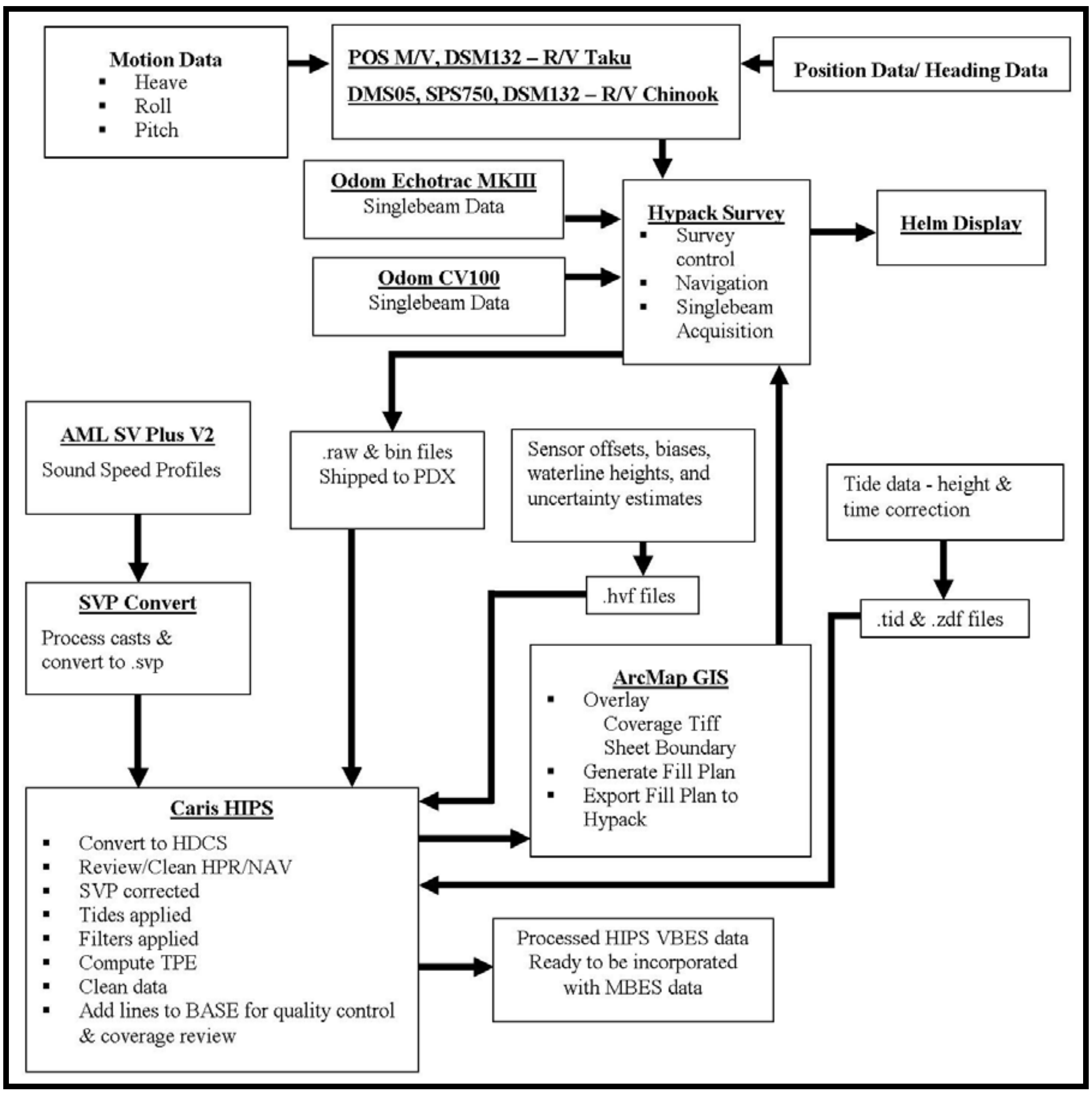

Figure 6. Flowchart of single beam data acquisition and processing pipeline

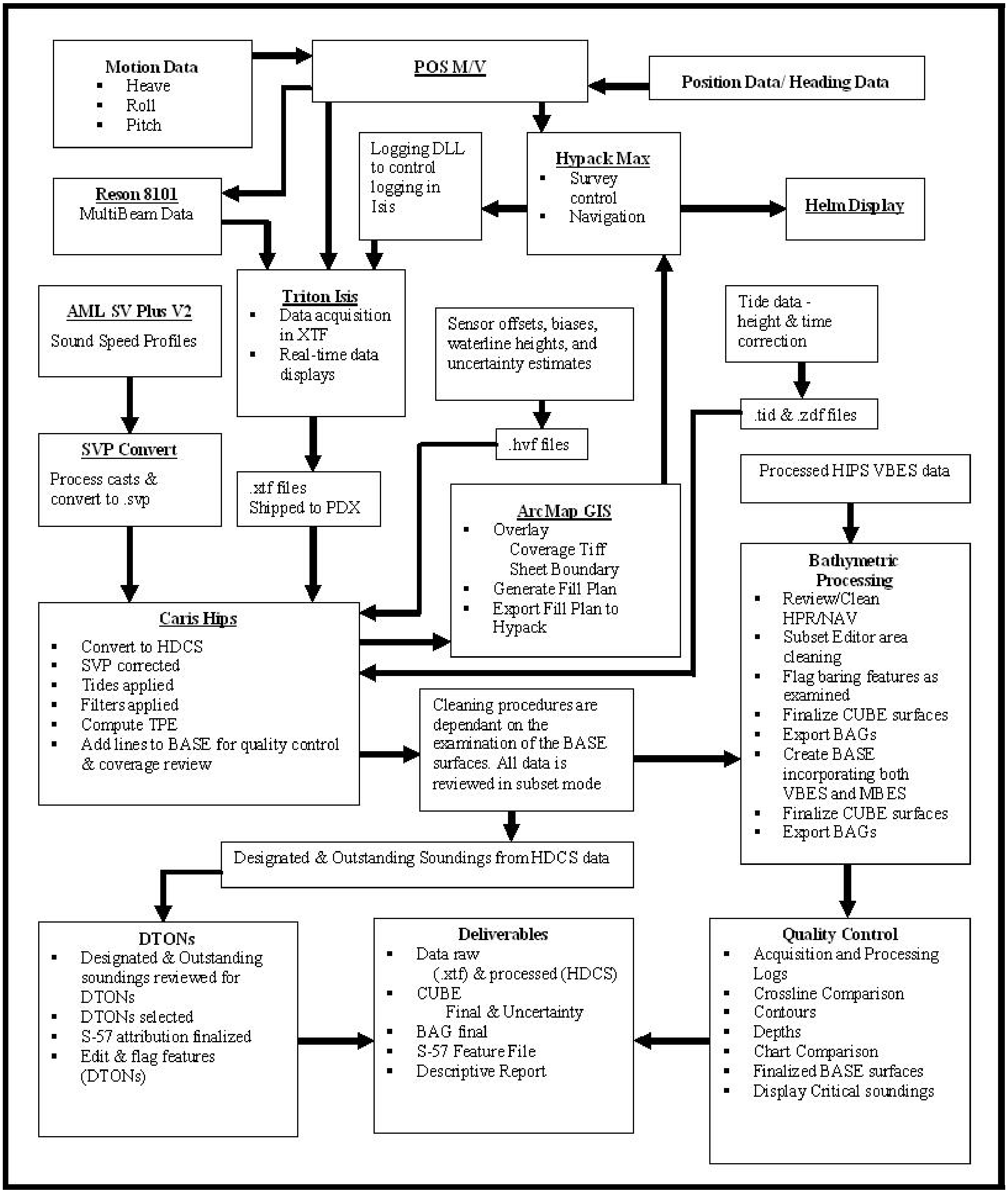

Figure 7. Flowchart of multibeam data acquisition and processing pipeline

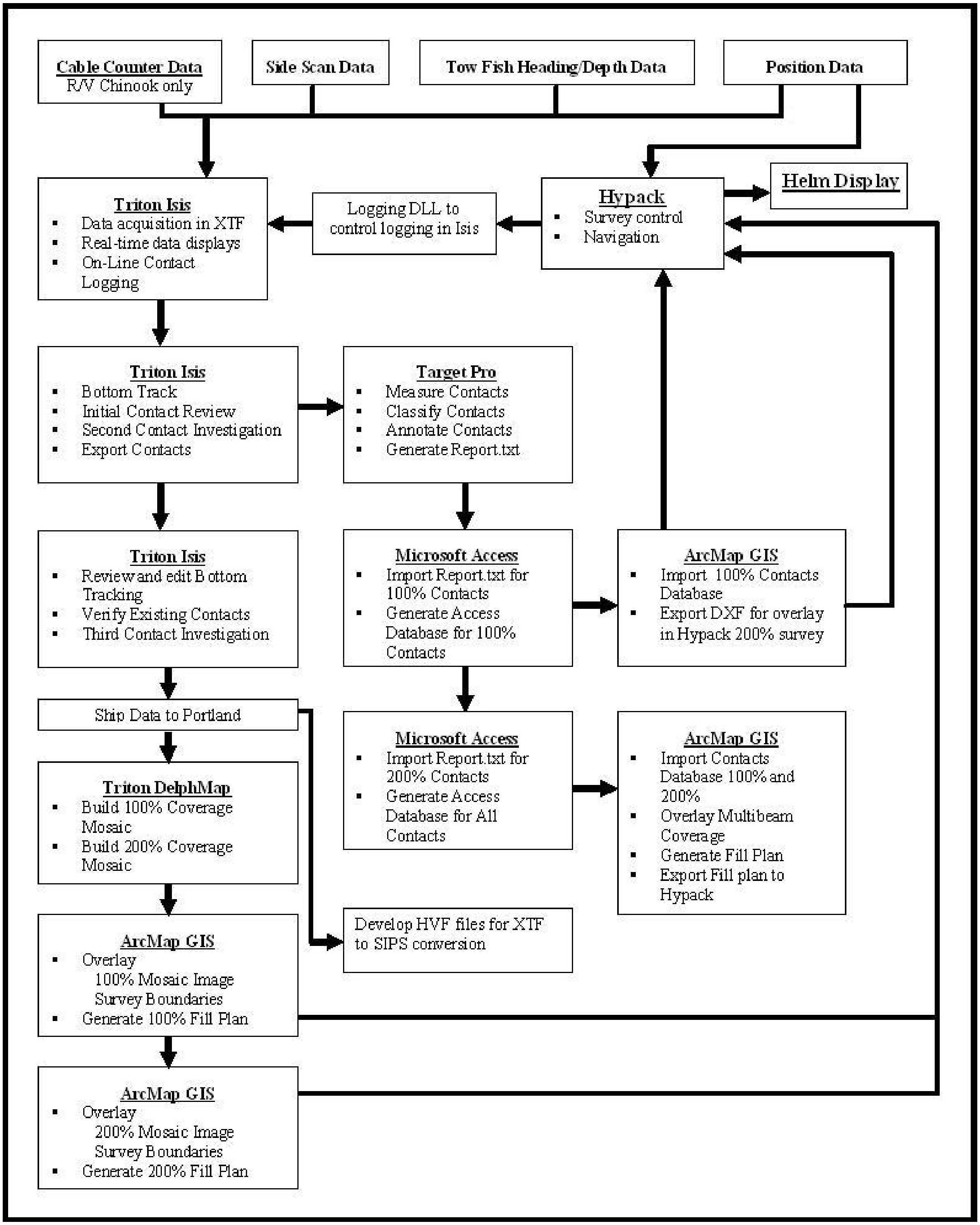

Figure 8. Flowchart of side scan sonar data acquisition and processing pipeline

At the end of each survey day that day's worth of data was copied from the boats to external hard-drives. The hard drives were removed from the boats and taken to the field processing office where the data was copied to the server and prepared for processing. Approximately every four days a high capacity hard drive containing raw and processed data was sent to DEA's Portland office. As a safeguard, DEA maintained at least three complete copies of the dataset during field operations.

B2.a HIPS Conversion

Multibeam data were converted from XTF format to CARIS Hydrographic Data Cleaning System (HDCS) format using HIPS conversion wizard (XTF converter 6.1.1.2) with the sensor navigation and ship gyro datagrams selected at conversion. No data were rejected based on quality flags during conversion. The CARIS output window was reviewed for failures during conversion.

All side scan sonar processing was performed using Triton Isis.

Single beam data were converted from RAW format to CARIS HDCS format using HIPS conversion wizard (XTF converter 6.1.0.1) with navigation from sensor 4. No data were rejected based on quality flags during conversion. The CARIS output window was reviewed for failures during conversion.

B2.b Vessel Files

Three HVF's were created for the systems used during the survey with two additional HVF's created for importing side scan data into Caris SIPS, as listed in Table 5. The vessel file contains all offsets and system biases for the survey vessels and its systems, as well as, error estimates for latency, sensor offset measurements, attitude and navigation measurements and draft measurements.

Table 5. HIPS Vessel Files

HIPS Vessel File	Survey Vessel	Echosounder Used
NOAA0009_MBES_Taku.hvf	*R/V Taku*	Reson 8101
NOAA0009_SSS_Chinook.hvf	*R/V Chinook*	Edgetech 4200FSL
NOAA0009_SSS_Taku.hvf	*R/V Taku*	Edgetech 4200FSL
NOAA0009_VBES_Chinook.hvf	*R/V Chinook*	ODOM CV-100
NOAA0009_VBES_Taku.hvf	*R/V Taku*	ODOM Echotrak MKIII

Sensor offset values were calculated from the vessel surveys.

Draft (water line) was measured twice daily, averaged and entered into the HVF as a correction for the applied water line value. Dynamic draft (settlement and squat) values were calculated through the use of Real-Time Kinematic (RTK) GPS observations.

Best estimates for total propagated uncertainty (TPU) values were entered into the vessel file based on current knowledge of the TPU Combined Uncertainty and Bathymetry Estimator (TPU/CUBE) processing model. Manufacturers' published values were entered into the sensor accuracy fields. Other values were either calculated or estimated. All other error estimates are read from the HVF and Device Model file. Table 6 represents HVF TPU values for each vessel.

Table 6. Hydrographic Vessel File TPU Values

Manufacture Accuracy Values for Total Propagation Error Computation
HIPS Vessel File (HVF)

All values given as 1 sigma

VESSEL		TAKU	Chinook
Motion Sensor		POS/MV	TSS DMS05
POSITION SYSTEM		POS/MV Model 320 V3	SPS750
Gyro/Heading			
	Gyro (deg)	0.02	0.2
Heave			
	Heave % Amp	5	5
	Heave (m)	0.05	0.05
Roll and Pitch			
	Roll (deg)	0.02	0.04
	Pitch (deg)	0.02	0.04
GPS Sensor			
	Pos. Navigation (m)	0.7	0.34
Latency			
	Timing Trans (s)	0.01	0.01
	Nav Timing (s)	0.01	0.01
	Gyro Timing (s)	0.01	0.01
	Heave Timing (s)	0.01	0.01
	Pitch Timing (s)	0.01	0.01
	Roll Timing (s)	0.01	0.01
Measurement			
	Offset X (m)	0.003	0.003
	Offset Y (m)	0.003	0.003
	Offset Z (m)	0.003	0.003
Speed			
	Vessel Speed (m/s)	0.03	0.36
Draft and Loading			
	Loading	0.03	0.033
	Draft (m)	0.05	0.016
	Delta Draft (m)	0.01	0.03

Physical Alignment Errors

All values given as 1 sigma

VESSEL		TAKU	Chinook
POSITION SYSTEM		POS/MV Model 320 V3	SPS750
Alignment			
	MRU align Stdev gyro	0	0
	MRU align roll/pitch	0	0

Manufacture Accuracy Values for Total Propagation Error Computation in CARIS HIPS
Survey Specific Parameters (These values from Specifications and Deliverables)

All values given as 1 sigma

Tide Value		
	Tide Value Measured	0.05
	Tided Value Zoning	0.1
Sound Speed Values		
	Sound Speed Measur	0.05
	Surface Sound Speed	0.05

B2.c Static Draft

The static draft marks were surveyed as part of the vessel's frame of reference on the starboard side of each vessel directly abeam of the single beam and multibeam transducers. Draft readings were observed twice per day and the average draft was used for the day. This resulted in an accurate draft applied during survey operations as most of the fuel burn was during transit to and from the survey area.

B2.d Sound Velocity

The individual sound velocity profiles were concatenated into CARIS SV format files, each representing one day of data collection. The individual day files were also concatenated into a single sheet CARIS SV format file. They were analyzed for errors or issues caused by sensor aeration then applied to the data sets. The sheet wide SV file was applied to the MB data using the "nearest in distance and time within 4 hours" option. The individual day SV files were applied to the SB data using the "nearest in distance" option.

B3. Preliminary Side Scan Processing

Side scan imagery was corrected for layback, slant range and speed as well as re-bottom tracked in ISIS. The data processor reviewed acquisition logs for contacts and performed a second review of side scan data. Using Triton Target Pro utility, the processor generated Isis targets for each contact. Contacts were designated as significant or insignificant based on shadow length. All contacts and processing comments were imported into the MDB, which was used to track and manage contacts for each survey. Any line that did not meet the quality criteria was rejected and re-acquired.

Once imported into the contact database least depths of the significant contacts were estimated using the tide corrected single beam depth collected at the time of contact acquisition and the contact height. Preliminary tides were used to reduce single beam depths and compute estimated clearance by subtracting contact height based on side scan image shadow analysis. The estimated clearance values were input into the "Estimated Clearance" field of the contact database and reported in the weekly GOMMDP submissions.

B4. Preliminary Bathymetric Processing

Single beam data were reviewed in CARIS and erroneous depths were rejected and sound velocity profiles and tides were applied.

Below is the list of correctors and filters applied to the bathymetric data in CARIS. Several of the steps are interim processes (such as the water levels) and were re-applied as needed. The TPU was re-computed for the multibeam data as needed to reflect changes in the correctors.

1. Apply zoned, water levels
2. Apply concatenated sound speed profiles for each day
    - "Nearest in distance or nearest in distance and time within 4 hours"
3. Merge vessel offsets

4. Compute TPU
   - Tide Value Measured 0.05
   - Tide Value Zoning 0.10
   - Sound Speed Measured 0.05
   - Surface Sound Speed 0.05
5. Filters applied based on the following criteria:
   - Reject soundings with poor quality flags (0 for Reson)
   - Reject TPE greater than the horizontal and vertical error limits specified in the NOS *Hydrographic Surveys Specifications and Deliverables (June 2006)*.
   - Reject based on depth threshold (if needed)
6. "Designate" critical soundings and mark baring features as "Examined"
7. Add data to field sheet
   - Two-meter "Uncertainty" weighted surface for single beam
   - 50-centimeter "CUBE" weighted surface for multibeam developments

Verified zoned tides were applied to the data prior to depth editing or surface creation. NOAA provided water level reducers and zoning for tide gauge Pilot Station East, LA (8760922). The final water level and zoning files are included with the HIPS deliverables on the "Processing" external data drive. Water levels were graphed in Excel or CARIS and reviewed for outliers or data gaps. Any observed problems with the tide file were reported to NOAA and resolved prior to final processing.

All bathymetric data were reviewed in HIPS subset mode. Subset tiles were used to track the progress of processing activities. In addition, data processors reviewed sounding data and CUBE surfaces for motion artifacts or systematic biases. All crosslines were manually reviewed to ensure high internal consistency between the datasets.

Side scan mosaics and contacts were displayed in the background in HIPS as a Drawing Exchange Format (DXF) file and reviewed for multibeam coverage. In addition, contact least depths were queried in subset editor and entered into the contact database with additional multibeam information such as ping, beam and time. Designated soundings were also created for each contact least depths. Contacts over the same feature were correlated in the database by entering contact identification numbers of matching contacts into the "Correlate" field of the database.

In areas of multibeam and single beam overlap, data were reviewed together in HIPS subset mode to ensure that data visually fit together and no systematic biases or artifacts were induced into the data.

B5. Final Side Scan Processing

Final review and editing of the side scan data were performed in DEA's Portland office using Triton Isis and Delphmap software. The data processor performed an additional review of all imagery for contacts (third review), created Tagged Image Format (TIF) images of all contacts and generated 100% and 200% side scan mosaics at 50-centimeter resolution. During mosaic creation in Delphmap, each 100% coverage was broken into several sections to facilitate reprocessing a mosaic if necessary without having to generate a new mosaic for the entire sheet. Each of the TIF images were merged using Lizardtech GeoExpress 6.1. A single TIF image per 100% coverage was created for submittal.

Side scan images were imported into ESRI ArcView and reviewed for data gaps and holidays and for problematic data that would warrant reprocessing the data or resurvey of an area. After review of the mosaics, side scan sonar fill plans were generated and sent to the survey vessel.

B6. Final Bathymetric Processing

Upon the completion of editing multibeam data in HIPS, a finalized CUBE grid of the item investigations was generated using the “greater of the two” option for the final uncertainty value. An uncertainty weighted grid was generated for the single beam data due to the sparse nature of single beam data. Depths and contours were generated from the surfaces and used for chart comparison purposes, but are not included with the deliverables. Bathymetric Attributed Grids (BAGs) for each CUBE surface were exported from HIPS for submittal.

Designated soundings and detached positions were used as a starting point for S-57 feature creation. Designated soundings that were determined to be obstructions or wrecks were imported into the S-57 feature files and attributed. In addition, S-57 objects were created for all uncharted baring features such as new oil production platforms. Many, if not all, items included in the S-57 feature file have already been submitted as Dangers to Navigtion (DtoNs).

The feature file also includes bottom samples (SBDARE) and required meta-objects (M_COVR and M_QUAL).

C. CORRECTIONS TO ECHO SOUNDINGS

C1. Static Draft

With the vessel out of the water, markings were surveyed and painted on the hulls of the *R/V Taku* and *R/V Chinook* providing a means to monitor vessel draft. At the start of the project the approximate draft of the single beam transducer was 0.50 meters. This value was entered into the single beam sonar and used throughout the survey enabling the output of a depth relative to the approximate vessel waterline, therefore enabling quick review of depths at time of acquisition. Static draft readings were recorded at the start and end of each survey day, while the ship was alongside the pier and where an accurate draft reading could be obtained. The vessel’s fuel and ballast levels were maintained to control the vessel draft and an average of the start and end of day draft values was calculated daily and entered into a draft tracking sheet. The average draft value best approximates the true draft value during acquisition, due to loading changes from fuel consumption during transit to and from the survey area at the start and end of each day. Ultimately the daily draft values were used to calculate the daily draft relative to the 0.50-meter value that was used during acquisition. These differences relative to the assumed 0.50-meter single beam draft were entered into the waterline field in the Caris HVF for that vessel.

C2. Dynamic Draft

C2.a *R/V Taku*

A settlement and squat test using real-time kinematic (RTK) GPS observations for the *R/V Taku* was performed on November 12, 2006 and November 13, 2006 (Day Numbers 316 and 317). Data from these measurements are displayed graphically in Figure 9.

The settlement and squat values were obtained by computing three-minute GPS height averages at different ship speeds, measured in knots and revolutions per minute (RPM) during transects. Each transect was run twice at each RPM interval with the second transect run at a heading, opposite of the first.

After running a series of 700 RPM transects, ship speeds at increments of 200 RPMs were observed from 1,000 RPM to 2,200 RPM with GPS height recorded at 1 Hz. With the vessel at rest, static RTK height observations were recorded between each RPM interval in order to have a baseline GPS height value not affected by tide changes during the test. Three-minute running averages of GPS height were calculated to remove any heave bias from the calculations. Each transect was run for approximately three minutes resulting in one average GPS height measurement per transect. Dynamic draft correctors were then calculated from the difference between the GPS height and an interpolated static GPS height (to account for changing tide) at the time of the average height value. The average speed for each RPM interval and the average dynamic draft corrector were entered into the HIPS vessel file. A slight decrease in squat was noticed at approximately 5.5 knots during both the full and half-tank tests. The cause of this change is not known. TPU values for dynamic draft were calculated by taking the average of the standard deviation for all dynamic draft calculations per transect.

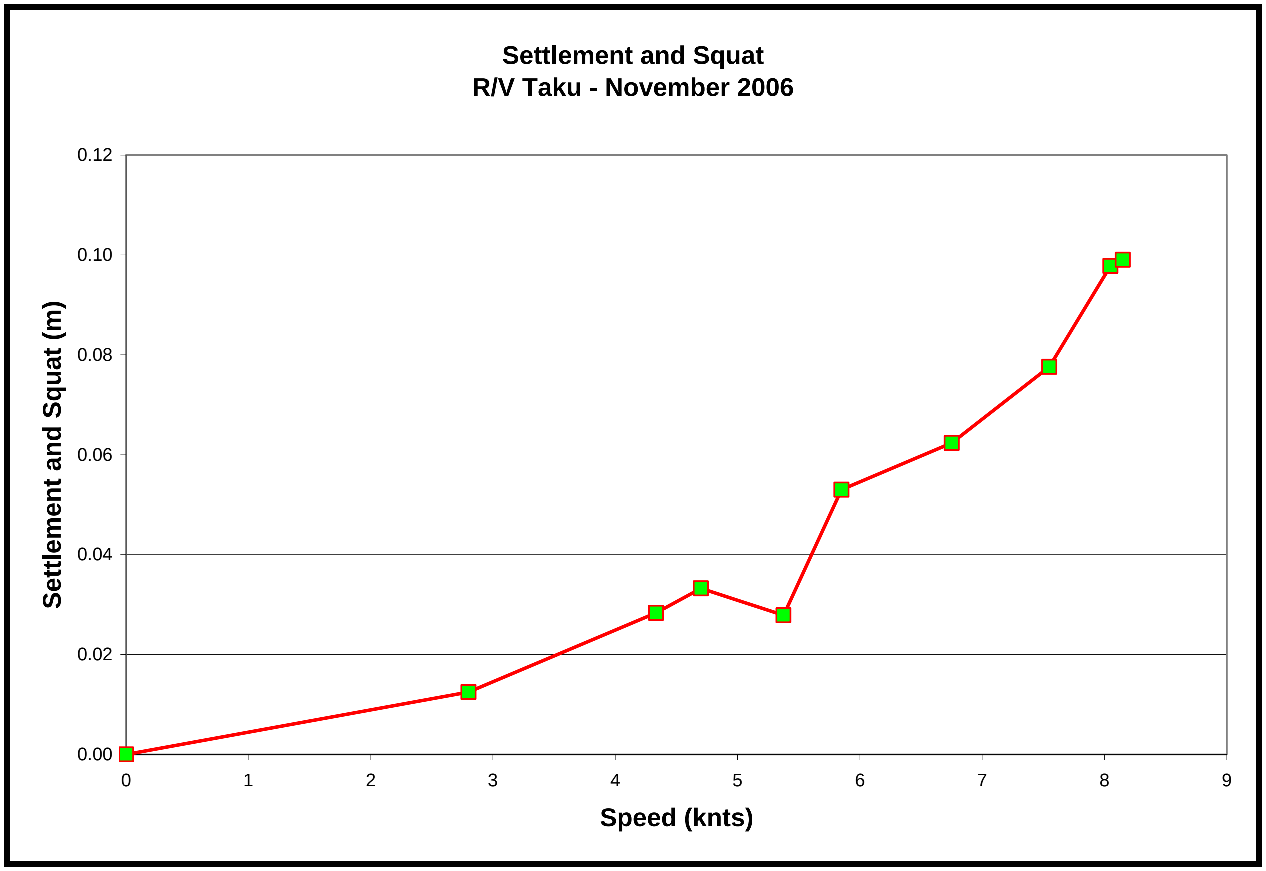

Figure 9. Settlement and squat of *R/V Taku*

C2.b *R/V Chinook*

A settlement and squat test using RTK GPS observations for the *R/V Chinook* was performed in the vicinity of the survey area on July 9, 2007 (Day Numbers 190). Data from these measurements are displayed graphically in Figure 10.

The settlement and squat values were obtained by computing three-minute GPS height averages at different ship speeds, measured in knots and RPM during transects. Each transect was run twice at each RPM interval with the second transect run at a heading, opposite of the first.

After running a series of 700 RPM transects, ship speeds at increments of 200 RPMs were observed from 1,000 RPM to 2,200 RPM with GPS height recorded at 1 Hz. With the vessel at rest, static RTK height observations were recorded between each RPM interval in order to have a baseline GPS height value not affected by tide changes during the test. Three-minute running averages of GPS height were calculated to remove any heave bias from the calculations. Each transect was run for approximately three minutes resulting in one average GPS height measurement per transect. Dynamic draft correctors were then calculated from the difference between the GPS height and an interpolated static GPS height (to account for changing tide) at the time of the average height value. The average speed for each RPM interval and the average dynamic draft corrector were entered into the HIPS vessel file.

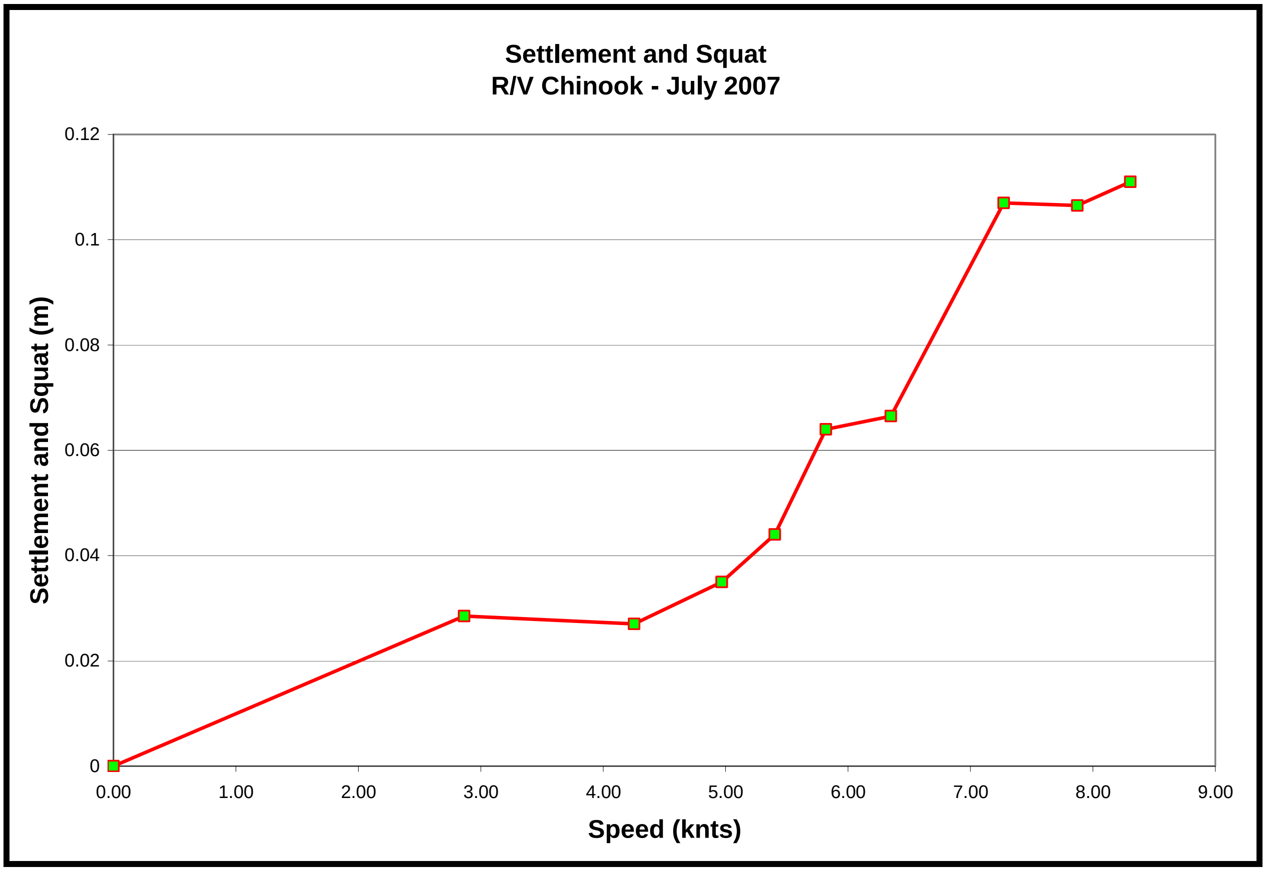

Figure 10. Settlement and squat of the *R/V Chinook*

C3. Leadline Comparisons and Bar Checks

Weekly leadline checks or bar checks were performed for each sonar if they were used to acquire data anytime within a particular week. Tabulated leadline comparisons may be found in the *Leadline Comparison* log included in Appendix V *Supplemental Survey Records and Correspondence* of the Descriptive Reports.

A leadline check was used to validate the single beam echosounders performance. While the vessels was alongside its berth in the marina, a leadline reading was taken and compared to the depth output by the echosounder after adjusting it for the draft offset. Leadline observations were recorded in a leadline comparison log. The average difference between the leadline and single beam measurements for the *R/V Taku* was 0.018 meters with a standard deviation of 0.021 meters. The average difference between the leadline and single beam measurements for the *R/V Chinook* was -0.021 meters with a standard deviation of 0.030 meters.

In addition, leadline checks were performed during multibeam investigations. An XTF file was logged as the leadline depth was read. The file was then loaded into HIPS and a depth was picked from the nadir beams. Leadline observations were recorded in the leadline comparison log. The average difference between leadline and multibeam was -0.020 meters.

C4. Heave, Roll and Pitch Corrections

An Applanix POS/MV 320 v4 integrated DGPS and inertial reference system was used for the motion sensor aboard the *R/V Taku*. The POS/MV 320 is a six-degree of freedom motion unit, with a stated accuracy of 0.05 meters or 5% for heave, 0.02 degrees for roll and pitch and heading. Real-time displays of the vessel motion accuracy were monitored throughout the survey with the POS/MV controller program.

A TSS DMS-05 was used for HPR motion sensing aboard the *R/V Chinook*. The DMS-05 has a stated accuracy of 0.05 meters or 5% for heave and 0.04 degrees for pitch and roll. Heading was obtained using the Trimble SPS750(Max)/SPS550H GPS receiver combination which has an accuracy of 0.05 degrees RMS. Real-time displays of the vessel motion were monitored throughout the survey in Triton ISIS and HYPACK.

If any of the vessel motion accuracy degraded to greater than 0.05 degrees, survey operations would be suspended until the inertial unit was able to regain the higher degree of accuracy.

Manufacturer reported accuracies as published on the Caris HIPS TPU website (http://www.caris.com/tpe/) were entered into the HIPS HVF and used for TPU computations. A schematic of the vessel and sensor set-up is shown in Figures 11 and 12.

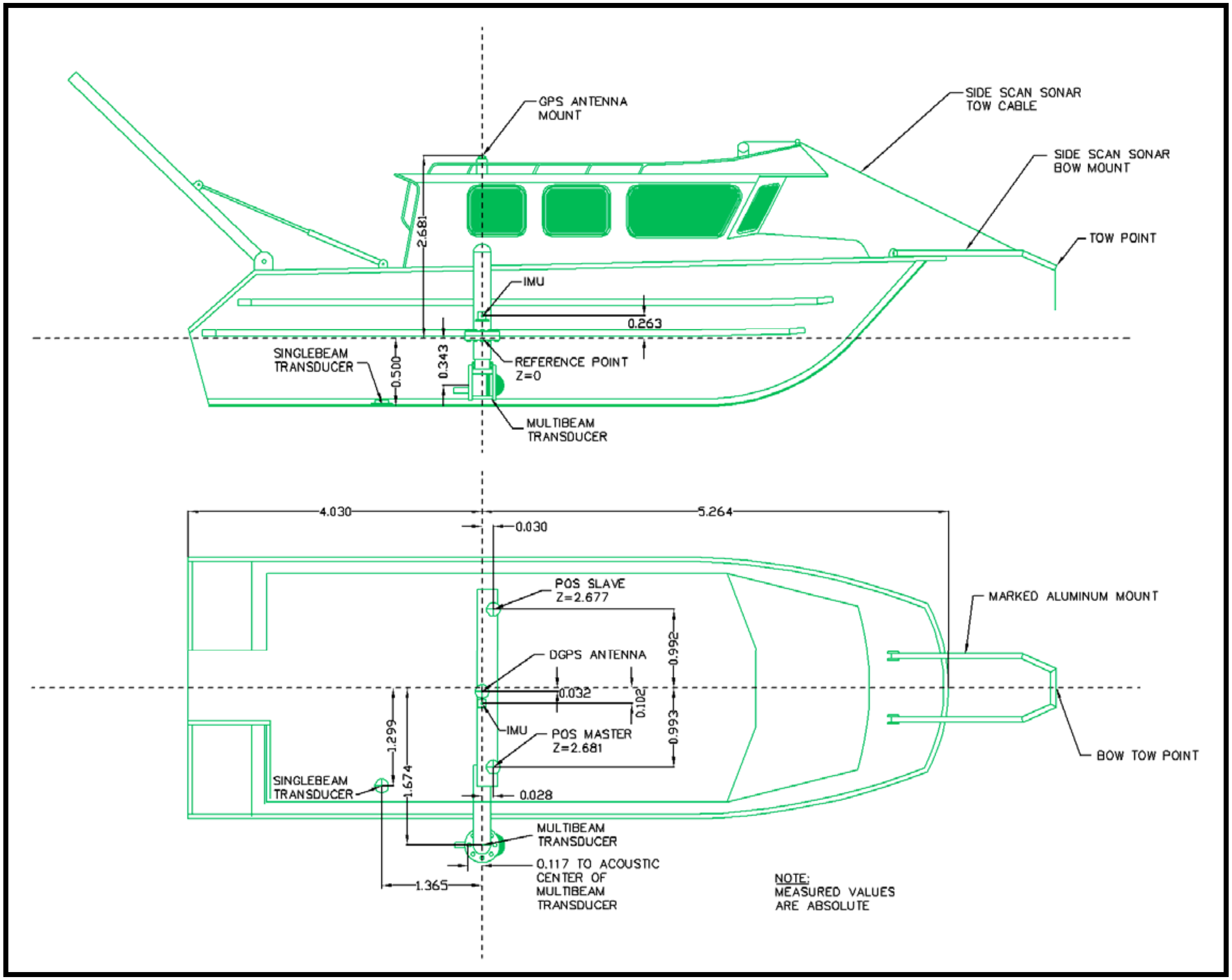

Figure 11. Schematic of *R/V Taku* and sensor setup

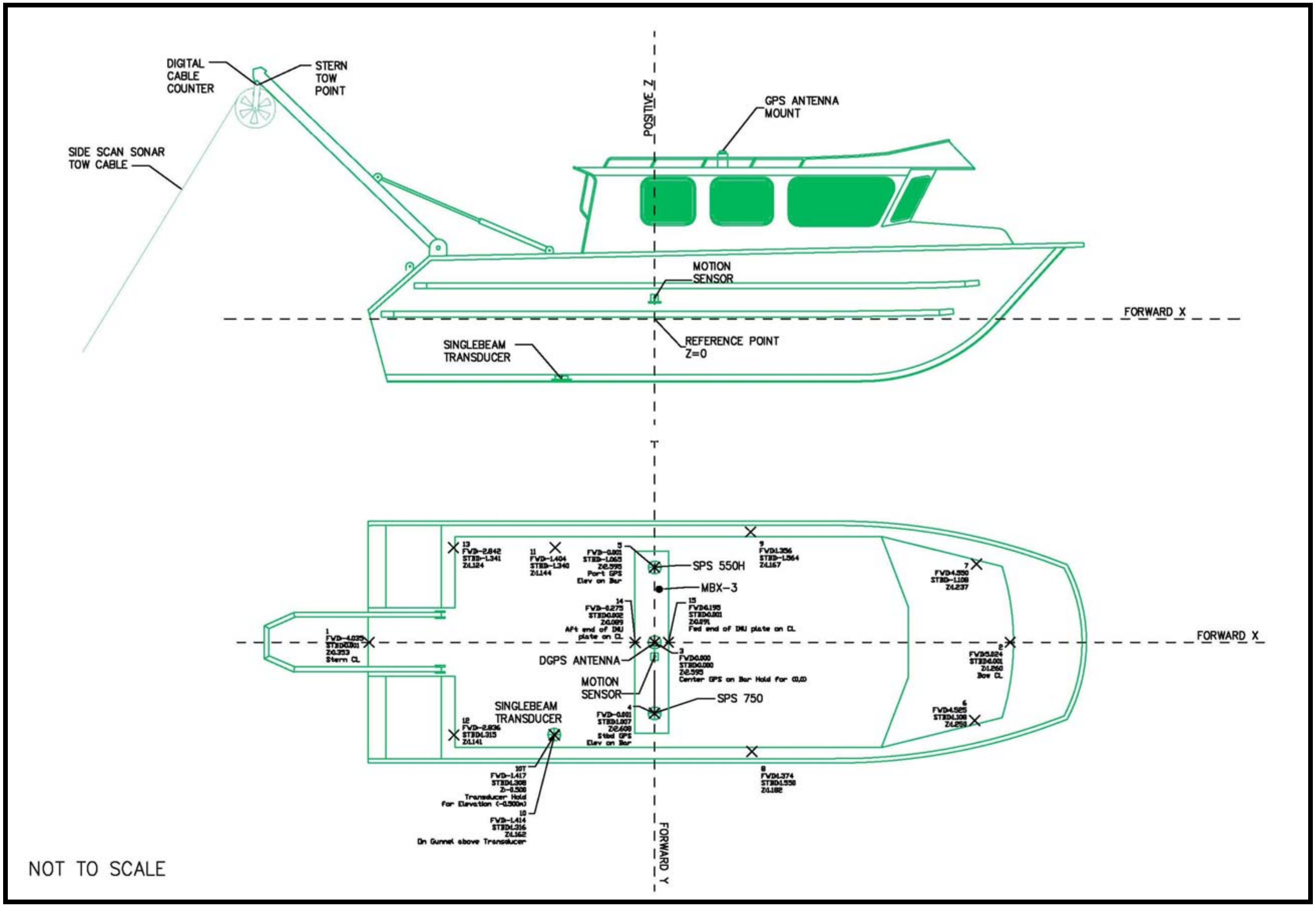

Figure 12. Schematic of the *R/V Chinook* and sensor setup

Installation bias was applied to all the data and stored in a Caris HIPS vessel file specific to bathymetry type. System offsets and biases for relative to single beam acquisition were stored in Caris vessel files NOAA0009_VBES_TAKU and NOAA0009_VBES_Chinook.Offsets and biases for the multibeam acquisition system, including the results obtained from the patch test at the start of the survey, were stored in the Caris "NOAA0009_MBES_Taku.hvf" vessel configuration file.

C5. Patch Tests

A patch test was conducted prior to performing multibeam item investigations to measure alignment offsets between the *R/V Taku's* IMU sensor and multibeam transducer, and to verify delay times applied to the time-tagged sensor data. The patch test consisted of a series of lines run in a specific pattern, which were then used in pairs to analyze roll, pitch and heading alignment bias angles, as well as, latency in the time-tagging of the sensor data. The patch test was conducted in Red Pass, Louisiana in accordance with *NOS Hydrographic Surveys Specifications and Deliverables (June 2006)* on Day Number 222.

A precise timing latency test was performed by running reciprocal lines 700 meters long over a flat bottom, in a water depth of approximately 20 meters. Sea conditions were slightly rough during the test in order to amplify the effects of latency and make the error conspicuous during data review. The lines were then opened in the HIPS calibration editor (after applying tide and Sound Velocity Profile (SVP) corrections) and a slice of along track data was evaluated in the outer swath of the line. Incremental changes to the roll time offset were made to evaluate the performance of the precise timing setup and to determine if a latency correction was needed. No latency was found in the system. These lines were also used to evaluate the roll bias.

Roll alignment was determined by evaluating a line acquired with heavy wake from a passing boat. The pitch test consisted of a set of reciprocal lines 750 meters in length over a mound in Red Pass. Yaw was determined by running parallel lines over the same area. Acquisition speeds varied based on the test and ranged from 1.5 knots to 7.0 knots.

Selected pairs of lines were then analyzed in the HIPS Calibration editor to measure the angular sensor bias values. Visual inspection of the data confirmed each adjustment. Two sets of lines were run and analyzed for each of the mounting biases. The second set was used to confirm the results of the data. Bias correction values are displayed in Table 7.

Table 7. Biases applied when using the POS/MV for pitch and roll.

Alignment	Bias
Roll	1.40°
Pitch	-0.60°
Yaw	-2.80°
Latency	0.00s

C6. Tide and Water Level Corrections

Verified zoned tides Pilot Station East, LA (8760922) were applied to all survey data. Water levels relative to the Mean Lower Low Water (MLLW) datum and UTC time system were downloaded from the Center for Operational Oceanographic Products and Services (CO-OPS) website. Tides zones were created by CO-OPS and evaluated by DEA to ensure that the time and range correctors agreed with the survey data.

Zoned water levels were applied to the bathymetric data in Caris HIPS. The HIPS tide file (8760922.tid) and zone definition file (K977KR2007CORP.zdf) are included on the data drive with the other Caris deliverables.

The Pilot Station East, LA (8760922) experienced no down time during periods of hydrographic survey.

C7. Sound Velocity Correction

Manual sound velocity casts were taken periodically throughout each survey day. A cast was typically taken onsite prior to starting acquisition and then approximately every two hours during the survey.

A sound velocity cast was taken by lowering the AML Smart sensor to the bottom while the vessel was holding station. A HYPACK target was taken to record the time and position of the cast which would later be entered into the HIPS sound velocity file. The sampling period was increased if large changes in sound speed were observed between casts. During concurrent single beam and side scan acquisition, casts were taken more frequently if refraction artifacts were visible in the side scan sonar record. During multibeam item investigations, casts were taken in the vicinity of each investigation. At least one deep cast (extending to 95% of depth) was taken per day.

After each cast the sound speed data was reviewed for outliers or anomalies such as a sharp thermocline or halocline which could impact data quality. In addition to these periodic comparisons, weekly check casts were taken to verify proper performance of the AML sensor. For this check both AML sensors were deployed simultaneously. Corrections for the speed of sound through the water column were computed for each sensor and imported into an Excel file where sound speed profiles were created and overlaid for comparison. Each sensor had been calibrated prior to the start and at the end of the survey. Factory calibration results are included in the Separates Section II *Sound Speed Data* of the Descriptive Reports for this project.

The sound speed correction was applied to each line using the nearest-in-distance option in the HIPS SVP correct routine. All casts were concatenated into a daily HIPS SVP file for each survey day. Time, position and sound speed for each profile were included in the HIPS file.

D. LETTER OF APPROVAL

LETTER OF APPROVAL

S-K977-KR-07-DEA
Data Acquisition and Processing Report

This report and the accompanying data are respectfully submitted.

Field operations contributing to the accomplishment of S-K977-KR-07-DEA were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and associated data have been closely reviewed and are considered complete and adequate as per the Statement of Work.

Digitally signed by Jon Dasler
DN: cn=Jon Dasler, email=jld@deainc.com, o=David Evans and Associates, Inc., c=US
Date: 2008.06.25 14:27:21 -07'00'

Jonathan L. Dasler, PE (OR), PLS (OR, CA)
Lead Hydrographer

Digitally signed by Jason Creech
DN: cn=Jason Creech, email=jasc@deainc.com, o=David Evans and Associates, Inc., c=US
Date: 2008.06.25 14:32:36 -07'00'

Jason Creech
Lead Hydrographer

David Evans and Associates, Inc.
October 2007