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

# DATA ACQUISITION AND PROCESSING REPORT

*Type of Survey:* __Navigable Area __

*Time Frame:* __2006 Field Season__

**2006**

**CHIEF OF PARTY**

**LCDR Lawrence T. Krepp, NOAA**

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**October 26th, 2006**

**DATE:**________________________________________________

# NOAA SHIP RUDE

## 2006 DATA ACQUISITION AND PROCESSING REPORT

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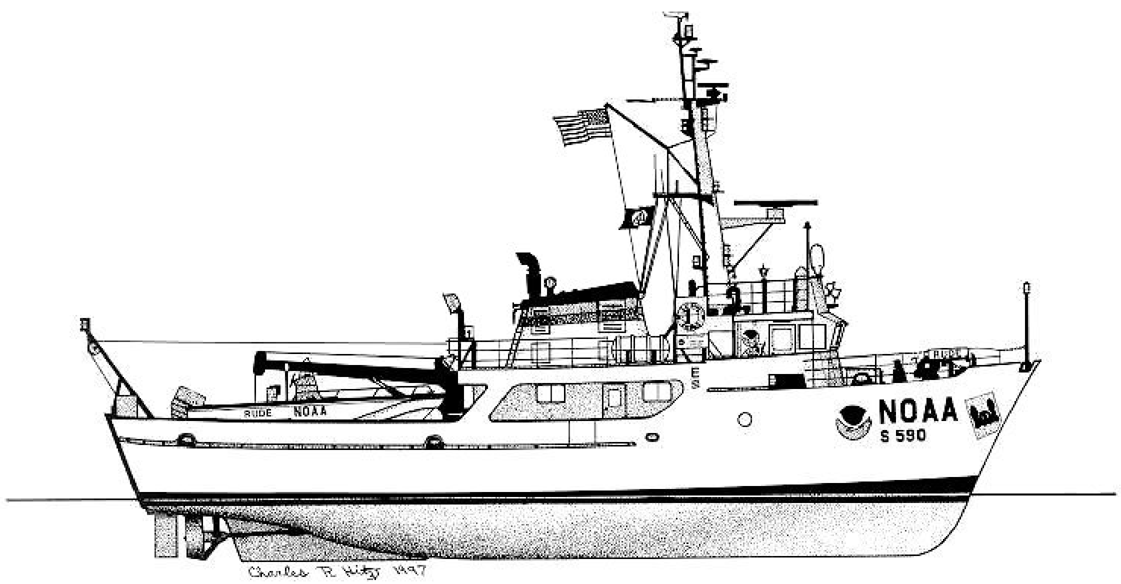
### OPR-H320-RU-06: APPROACHES TO PORT CANAVERAL, FL
### OPR-E350-RU-06: SOUTHERN CHESAPEAKE BAY, VA



# A. EQUIPMENT

## A.1 Platforms

All data are acquired from NOAA Ship RUDE (S590, EDP #9040) and NOAA Survey Launch 1017. RUDE is a Class V Hydrographic Survey Ship, 90 feet in length overall, with a 22-foot beam and 7-foot draft. RUDE acquires multibeam echosounder data, vertical beam echosounder data, side scan sonar data, and bottom samples. NOAA Survey Launch 1017 is a 29 ft Jensen launch acquires vertical beam echosounder data and side scan sonar data.

Refer to Appendix III for more detailed vessel descriptions and equipment positioning diagrams.

## A.2 Sounding Instruments

### A.2.1 Vertical Beam Echo Sounder

RUDE is equipped with an Odom Echotrac DF3200 MKII Dual Frequency Vertical-Beam Echosounder (VBES). The Odom Echotrac DF3200 MKII is a dual frequency digital recording echosounder system with an analog paper recorder. The transducer of this system is thru-hull mounted to the vessel approximately 0.3m to port of the keel. The high frequency transducer operates at 200 kHz with a circular beam footprint of 7.5° at the -6 dB point. The low frequency transducer operates at 24 kHz with a rectangular beam of 27° (fore-aft) by 47° (athwartships) at the -6 dB point. The ping rate for both high and low frequency transducers is 5 Hz. Soundings in meters are acquired on both frequencies, with the high frequency usually selected for sounding data.

Survey Launch 1017 is equipped with an Innerspace single frequency VBES with analog paper recorder configured for 125 kHz operation. The transducer is rigidly affixed to the hull. The nominal ping rate for the transducer is 5 Hz. Actual ping rates are dependent on the depth of water. Analog paper VBES data are acquired and scanned along with the digital VBES data.

On the RUDE and 1017, VBES data is logged by *Hypack* software package (see section A.5 below), but paper records are acquired and retained for comparison with digitized depths during processing whenever the VBES is the primary sounding instrument.

The VBES data are acquired in conjunction with side scan sonar or multibeam echo sounder acquisition. Side Scan Sonar line spacing is dictated by the acquisition requirements of the survey and the range scale used for a survey. Multibeam sonar system is used for shoal developments and item investigations with typical line spacing of 10 meters.

### A.2.2 Multibeam Echosounder

The RESON SeaBat 8125 multibeam echosounder is a single-frequency, digital-recording multibeam echosounder (MBES) with an operating frequency of 455 kHz. The RESON 8125 transducer consists of a flat transmitter array and solid cylindrical receiver array. The transducer unit is affixed to a swing-arm pole assembly, which is locked into vertical position for survey operations. Due to excessive pole vibration at high speeds, the maximum survey speed during MBES operation is 8 knots.

The RESON 8125 forms 240 beams each of which has a 0.5° across-track beam footprint for a maximum total swath width of 120°. Each beam has an along-track resolution of 1°. The ping rate is nominally 20-40 Hz, but may vary according to user specification. According to manufacturer specification, the RESON 8125 sonar is capable of bottom detection in depths from 3-120m.

The RESON 8125 performs active beam steering to correct for sound velocity at the transducer head using an ODOM Hydrographic Systems Digibar Pro sea surface sound velocity sensor. This sensor will be discussed in more detail in the Sound Velocity Equipment section (A.4).

While the primary use of the RESON 8125 is acquiring survey soundings, acoustic backscatter data from this sonar is recorded and archived. This data is recorded in RESON “snippet” format, where the acoustic backscatter strength for each ping/beam is measured over time (on the order of hundreds of microseconds). Backscatter snippet data is not used to generate hydrographic products; it is usually archived or used to generate end-user scientific products.

MBES data are monitored in real-time during data acquisition with TRITON ISIS software and RESON on-screen display. The RESON 8125 MBES system incorporates real time sound speed measurements from a sea surface sound velocimeter (refer to section A.4) for use in computing initial beam forming and beam steering. Sonar range scale, transmitter power, receiver gain, and pulse width are monitored and adjusted by the sonar operator to optimize echosounder operation.

### A.2.3 Side Scan Sonar

RUDE is equipped with a Klein 5500 High Speed High Resolution Side Scan Sonar (HSHRSSS) system. This system is comprised of a KLEIN 5250 towfish, a T5100 network card, and Transceiver Processing Unit (TPU). The KLEIN 5250 towfish emits a single pulse with a central frequency of 455 kHz. The towfish is deployed using a deck-mounted winch spooled with armored coaxial cable. A slipring assembly traverses the length of the cable, connecting the 5250 towfish to the TPU. Cable out is monitored remotely at the acquisition station via an MD Totco Cable counter that measures the side scan towfish tow cable by counting revolutions of the towing block. The length of cable deployed is computed automatically and output to Hypack.

The minimum depth for RUDE side scan sonar surveying operations is 8 meters due to wake turbulence. The maximum towing speed is 10kt and typical towing speeds vary from 6 to 10 knots.

Survey Launch 1017 is equipped with a KLEIN 3200 dual-frequency side-scan sonar system. The KLEIN 3000 towfish transmits at 100 kHz or 500 kHz, according to user specification. The towfish is connected to the TPU with a coaxial cable and slip ring assembly similar to the KLEIN 5250 towfish described above. The KLEIN 3000 towfish is deployed manually. Cable out on Launch 1017 is manually entered by survey personnel and read from calibrated taped markings on the SSS cable. Side scan sonar operations aboard Survey Launch 1017 are limited to a minimum depth of 4 meters due to wake turbulence. Sonar data from 1017 is recorded digitally from the TPU using the KLEIN SonarPro software and logged in Sonar Data Format (.sdf) file format (see section A.5).

Side scan sonar lines are planned to run parallel to bottom contours, spaced in accordance with the Side Scan Sonar Manual. Lines are planned with at least 15m of overlap with adjacent swaths on either side. Range scales are determined primarily by water depth.

Vessel speed is adjusted to ensure that an object one meter in characteristic size would be detected and clearly imaged across the sonar swath. Confidence checks are performed and noted frequently to ensure this standard of resolution is met.

### A.2.4 Lead Line

A lead line test on NOAA Ship Rude was conducted in March 2006 to confirm the calibration of RUDE's VBES and SWMB. This test showed that under the prevailing conditions at that time and location, RUDE's sonar systems exceeded the International Hydrographic Organization "Special Order" specification for vertical soundings. See the attached Lead line report in Appendix IV.

### A.2.5 Diver Least Depth Gauge

Dive investigations are primarily for contact/AWOIS verification and/or least depth confirmation of selected contacts. Diver Least-Depth Gauges (DLDG) are used by divers during item investigations to acquire least depths over selected contacts. The DLDG measures pressure, and together with a CTD cast, is processed using HSTP Velociwin software to compute a fully-corrected depth. These depths are compared to SWMB least depths processed in HSTP Pydro.

## A.3 Positioning and Attitude Instruments

### A.3.1 RUDE

#### A.3.1.1 POS/MV 320

RUDE's primary positioning and attitude sensor is a POS/MV Model 320 Ver. 4. This system combines data from an inertial attitude sensor and carrier-phase GPS receivers to compute position, heading, heave, pitch, and roll to the accuracy required for shallow water multibeam sonar surveys. The three major components of the POS/MV are: an Inertial Measurement Unit (IMU) mounted close to the ship's center of motion; two GPS antennas on the ship's mast mounted perpendicular to the line of the ship; and a POS Computer System (PCS) processing unit on the bridge.

Differential GPS corrector input from an external source is required. These correctors are brought in with GPS data from the Trimble GPS system. A GPS receiver is directly connected to the POS/MV processor computer. RUDE's position and heading is calculated by measuring the phase difference of the GPS signals arriving at the two antennas and computing the vector between them. The resulting GPS position is corrected for the lever arm from the antennas to the center of motion. The GPS heading data and linear and angular acceleration values from the IMU are processed through a Kalman filter.

Precise timing is employed on both the POS and ISIS, and is thus being recorded in the .xtf data. In the Ethernet logging control of the POS control window, Group 102, Sensor 1 Data message, is enabled to allow this synchronized time stamping to occur. More information is discussed in Section A.5.1.2 ISIS of this document, as well as in Appendix III.

Heave is computed by double integration of acceleration in the vertical axis as measured by the IMU. Since this measurement is subject to long term drift, the data is high pass filtered with a rolloff frequency and damping coefficient selected to stabilize the measurement while preserving the phase and amplitude of the ship's vertical position in sea states anticipated in RUDE's area of operations.

All vessel attitude and position data are corrected to the position of the IMU. The final position, heave, and attitude data are outputted to the Hypack and Isis data acquisition systems via RS-232 serial and Ethernet connections. This correction data is stored within the Hypack and Isis output data files. The POS/MV system is configured for 20 Hz output of the "TSS" Heave / Roll / Pitch message and 5 Hz output of the NMEA-0183 GGA and HDT messages. Refer to Appendix III for further discussion of POS/MV settings.

### A.3.1.2 Trimble DSM-212L

RUDE's auxiliary positioning system is a Trimble DSM-212L DGPS receiver. The DSM-212L is an integrated unit combining a 12 channel L1 C/A code receiver with a 2 channel Differential Beacon receiver. This unit is used primarily to receive USCG Differential Beacon messages, which are passed with GPS data to the POS/MV auxiliary input. Although the DSM-212L has the ability to automatically select stations based on signal strength or geographic proximity, the receiver is manually tuned to avoid unexpected and undocumented changes in the differential beacon in use.

Position, time, and velocity data from the Trimble is available in a 1 Hz NMEA message as an auxiliary input to the POS/MV. The DSM-212L is configured using the "TSIP Talker" software to suspend output in the event NOS Hydrographic Position Control specifications are not met.

### A.3.2 LAUNCH 1017

### Trimble DSM-212L

1017's primary positioning system is a Trimble DSM-212L DGPS receiver. The DSM-212L is an integrated unit combining a 12 channel L1 C/A code receiver with a 2 channel Differential Beacon receiver. This unit is used to receive USCG Differential Beacon messages, which are passed with GPS data to the POS/MV auxiliary input. Although the DSM-212L has the ability to automatically select stations based on signal strength or geographic proximity, the receiver is manually tuned to avoid unexpected and undocumented changes in the differential beacon in use.

## A.4 Ancillary Instruments

### A.4.1 Water Column Sound Speed

Water column sound speed profiles are calculated from electric conductivity, water temperature, and water pressure as measured by two Sea-Bird SBE 19 conductivity, temperature, and depth (CTD) profilers. The SBE-19 is a self-contained battery-powered unit with a serial interface for configuration and data download. The SBE 19 is equipped with a 300 psi pressure gauge to provide high resolution data in the relatively shallow water typical of RUDE's areas of operations. Sound speed profiles in CARIS .SVP format are computed using the HSTP *Velocwin* software described in section A.5.

Sea surface sound speed is continuously monitored during multibeam acquisition with an Odom Hydrographic Digibar Pro sound velocimeter. The Digibar Pro is a real-time time-of-flight sea surface sound velocimeter. The manufacturer specified sound velocity accuracy is 0.3 $ms^{-1}$. Sea surface temperature and sound speed are output to the RESON 8125 system at 10 Hz. It is mounted just above the multibeam transducer head. During MBES data acquisition, a new CTD cast is taken if the surface sound speed is observed to have changed more than +/-5 m/s from its value at the last CTD cast.

Comparisons between the two CTDs and the Digibar Pro are conducted on a regular basis to ensure data quality.

#### A.4.2 Bottom Sampler

Where required by project instructions, RUDE personnel acquire sediment samples from the sea floor in the survey area. The primary tool for this operation is a “clamshell” style gravity-closed sediment sampler, which penetrates approximately 0.05m into the bottom; sample volume is 2309 cm3 maximum. Bottom samples are evaluated for sediment type, color, texture, and particle size.

### A.5 Data Acquisition and Processing Software

#### A.5.1 Acquisition

#### A.5.1.1 HYPACK

*Coastal Oceanographics Hypack Max* is a multi-function marine survey software package. *Hypack Max* is used for vessel navigation during sidescan and multibeam acquisition, and acquisition of vertical-beam echosounder data. Survey lines, vessel position with respect to lines, and various navigation parameters are displayed on a screen both at the acquisition station and on a repeater screen for the helmsman (RUDE) or coxswain (1017). During side scan sonar operations, *Hypack* collects cable out data and computes towfish position, which, along with raw water depth from the VBES, is also passed to *ISIS/SonarPro*.

#### A.5.1.2 ISIS

Triton Imaging *Isis* is an acquisition software package providing imagery displays, area coverage displays, and real-time ping strength displays. *Isis* is used for both acquisition of side-scan sonar imagery and MBES bathymetry on RUDE. Data is logged in .XTF (eXtended Triton Format) file format.

*Isis* aboard RUDE is equipped with Precise Timing, a multibeam sonar data acquisition configuration which is intended to improve the timing of sonar, attitude, and positiong data. A time stamp is applied at the point of acquisition and retained through the .XTF data. This time stamp is honored by *CARIS HIPS* during post-processing. A detailed description of Precise Timing, its effect on survey data, and calibration of a Precise Timing-equipped multibeam echosounder system can be found in the document “Upgrading NOAA Multibeam Acquisition Systems to Precise Timing,” dated 10 May 2004, by LT Ben Evans.

#### A.5.1.3 SonarPro

*Klein SonarPro* is used to acquire side scan sonar data on Survey Launch 1017.

Survey acquisition computers running *Hypack*, *Isis* and *SonarPro* are automatically synchronized to UTC time from the NMEA-0183 GPS messages. The time update occurs during the start and stop logging messages on the Hypack computer and during the start-logging message on the *Isis* computer onboard RUDE and *SonarPro* computer onboard 1017.

### A.5.2 Bathymetric Data Processing

#### A.5.2.1 CARIS HIPS and SIPS

*CARIS HIPS* and *SIPS* software is used to process all bathymetry and imagery data.

**A.5.2.1 *CARIS HIPS*** (Hydrographic Information Processing System) is used for all processing of multibeam and vertical beam echosounder bathymetry data, including tide, sound velocity, and vessel offset correction and data cleaning. CARIS *HIPS* 6.0 uses statistical modeling to create uncertainty-weighted grid surfaces (BASE surfaces) to assist the hydrographer in data cleaning and hydrographic product generation.

**A.5.2.1.2 *CARIS SIPS*** (Side-scan Information Processing System) version 5.4 is used for all processing of side-scan sonar imagery data, including cable layback correction, slant range correction, contact selection, and mosaic generation. Side scan sonar lines processed in *SIPS* 6.0 has been observed to be unstable and crash more frequently than lines processed in *SIPS* 5.4.

#### A.5.2.2 Pydro

HSTP *Pydro* is a proprietary program for the classification of side-scan sonar and multibeam bathymetry contacts, report generation, chart comparison, and S-57 attribution.

#### A.5.2.3 Velociwin

HSTP *Velociwin* is a proprietary program for the processing of sound velocity casts. This program uses Sea-Bird Electronics *SeaSoft* software to convert hexadecimal SeaCat data into ASCII conductivity-temperature-depth data, and then converts the ASCII data into a depth-binned sound velocity file. These sound velocity files are applied to the data in CARIS *HIPS*.

#### A.5.2.4 MapInfo Professional

*MapInfo* Professional is the Geographic Information System (GIS) software package used aboard RUDE. *MapInfo* is used for final data analysis and creating end-user plots.

Refer to the 2006 RUDE HSRR for a list of data acquisition and processing hardware serial numbers and software versions.

# B. QUALITY CONTROL

## B.1 Bathymetry Data

### B.1.1 Vertical beam Echosounder Data

When VBES soundings are the primary source of bathymetry, survey lines are converted from *Hypack* format to *CARIS* HDCS format using the *CARIS* Conversion Wizard (See Conversion Parameters Appendix II).

After conversion, the data is opened in *CARIS* Navigation Editor, Attitude Editor, and Single Beam Editor. Vessel navigation data is manually checked for speed jumps greater than 2 knots, which are rejected with interpolation. Attitude data (if present) are checked for errors or gaps. Following examination, water level correction, draft correction, and sound velocity correction are performed. The raw multibeam data is then merged with the vessel attitude and navigation data.

Survey personnel scan merged VBES soundings in CARIS Single Beam Editor. The digital data is compared with analog paper records to ensure no valid depths are missed by the bottom detection algorithm or irregular pings are accepted. Low frequency soundings found to be shoaler than the corresponding high frequency depths can be manually “selected”. Depth filters are applied as needed to reject both shoal and deep fliers. A crossline-to-mainscheme comparison is performed to ensure accuracy of the sounding data. Following crossline comparison, the VBES data are used to generate a shoal-biased binned depth grid using a resolution of 25 meters or coarser. This depth grid is used for quality control, assessment of data coverage and general bathymetric evaluation.

When VBES soundings are not the primary source of bathymetry, VBES survey lines are archived in raw *Hypack* format. These data should not be used for the creation of any data product.

### B.1.2 Multibeam Echosounder Data

Multibeam sonar data is converted from ISIS XTF format to *CARIS* HDCS format using the *CARIS* Conversion Wizard (See Conversion Parameters Appendix II). After conversion, multibeam lines are examined in *CARIS* Navigation Editor and Attitude Editor for errors. Obvious blunders in the navigation or vessel attitude data (“fliers”) are rejected by the hydrographer. Following examination, water level correction, draft correction, and sound velocity correction are performed. The raw multibeam data is then merged with the vessel attitude and navigation data. This processed data is analyzed by the hydrographer and used to generate hydrographic data products. Refer to the 2005 Field Procedures Manual for a detailed description of hydrographic data products, including but not limited to BASE Surfaces, designated soundings, and CUBE surfaces, described in this section of this report.

When multibeam echosounder soundings are used for developments only and are not the primary source of bathymetry, the processed MBES lines are examined in *CARIS* Swath Editor and *CARIS* Subset Editor. Obvious blunders and fliers are rejected. Designated soundings are selected by the hydrographer for insertion to *Pydro*. These survey lines are added to a high-resolution, small-area BASE Surface to be submitted in addition to the shoal-biased binned VBES dataset.

When multibeam echosounder soundings are the primary source of bathymetry, Total Propagated Error (TPE) is computed for each data point prior to further processing. After computation of TPE, MBES lines are used to create a collection of BASE surfaces at resolutions appropriate to the depth of the survey. Under typical conditions, this resolution will be between 2 and 5 meters. At the discretion of the hydrographer, individual BASE Surfaces may or may not include child layers generated by the CUBE algorithm. Targeted data cleaning with filters, Swath Editor, and Subset Editor is performed using the Depth, Standard Deviation, Shoal, and CUBE child layers. Systematic biases in the surface are identified and alleviated if possible. Designated soundings are chosen to highlight significant features and to modify the surface model such that the best possible representation of the seafloor is achieved.

Each BASE Surface is then finalized and designated soundings are applied. The finalized BASE Surfaces are then combined to form a single-resolution BASE Surface over the entire survey area.

### B.2 Side Scan Sonar Imagery

All side scan sonar imagery is converted from XTF/SDF formats to *CARIS* format using *CARIS* converters (See conversion parameters Appendix II).

After conversion, the data are opened in *CARIS* Navigation Editor, Attitude Editor, and Side Scan Editor. Survey personnel check vessel attitude (if present), cable out, Gyro, and sonar height. Vessel navigation data is manually checked for speed jumps greater than 2 kts. Data showing these speed jumps are rejected with interpolation.

After confirming the validity of the vessel navigation, cable out, and towfish depth values, survey personnel then use the “recompute towfish navigation” function to calculate towfish position. The *CARIS* towfish positioning is based on a smoothed course made good value from the towing vessel.

Side scan sonar data is scanned in *CARIS* Side Scan Editor. Survey personnel correct errors in bottom tracking, slant range correct the imagery at default resolution (0.1m), and scan the data for significant contacts. Contacts deemed “significant” include, but are not limited to, contacts with a shadow indicating a contact height of 1 m or greater in water depths of 20m or less or contact heights 10% of the water depth in water deeper than 20m. Other contacts considered significant by RUDE personnel include smaller contacts in particularly shoal areas or channels, cables and pipelines, large sand wave ridges, and contacts of possible historical significance.

Point feature contacts are picked using *CARIS* “single point contacts.” Larger contacts and line features are picked using *CARIS* “multipoint contacts.” All contacts are descriptively labeled and feature codes selected if conclusive identification is possible. TIF format images of all contacts are saved. After the initial SSS imagery scan, a check scan of all data is conducted.

Survey personnel assess SSS coverage by using *CARIS* to mosaic side scan data. These mosaics are drawn at 1 - 5m resolution, using the “autoseam” option.

### B.3 Data Analysis

*HSTP Pydro* software package is the primary tool for sounding and feature integration and assessment. Side scan contacts and detached positions are inserted into the *Pydro* Preliminary Smooth Sheet (PSS). VBES bathymetry is inserted into *Pydro* in line-by-line format at a 15m by 15m bin, with default sounding excessing at 15m at 1:1000 scale. MBES bathymetry is imported into *Pydro* as either as shoal-biased binned lines or as a combined finalized BASE surface.

*Pydro* provides five flags for categorizing features: “Significant”, “Chart”, “Report”, “Investigate”, and “DTON”. In addition, Pydro provides “Primary” and “Secondary” flags for grouping correlated features.

After insertion, SSS features are first categorized by significance. Contacts that meet the standard of significance described in section B.2. are marked as such; those contacts which are deemed insignificant are marked “Resolved” and not investigated further. Also, multiple contacts representing the same physical feature are grouped. The contact that the hydrographer believes best represents the feature (typically, the most clear SSS image) is selected as the “Primary” contact, while the rest are flagged as “Secondary.”

Significant contacts are then reassessed to determine if additional investigation (typically MBES development) is required. Using the “bathymetry grid” feature of *Pydro,* the hydrographer checks the bathymetry coverage of the contact in question. If additional bathymetry is required, the “investigate” flag is checked. This can then be queried in *MapInfo* to select only those contacts requiring development for line planning.

After contacts are sufficiently investigated, they are further assessed to determine whether they require charting. Features that the hydrographer believes should be added or retained on the chart are marked as such. Features that will be reported in the survey Descriptive Report are flagged “Report.” Features that pose a special threat to vessel traffic have their shoal soundings marked as “DTONS,” and a Danger to Navigation Report is generated. Refer to the 2005 Field Procedures Manual for a detailed description of each *Pydro* classification and the criteria used to meet that classification.

Contacts and bathymetry analyzed in *Pydro* may be imported into *MapInfo* for plotting and further contact development planning. Contact and sounding plots are printed at survey scale for final survey assessment.

## C. CORRECTIONS TO ECHO SOUNDINGS

It is OCS and RUDE policy that all data be acquired and logged in raw format without application of any corrections for vessel offsets, sensor alignment, sound speed profile, or tides. These factors are logged separately or contained in the *CARIS* "Vessel Configuration File" (VCF), and applied in post-acquisition data processing.

### C.1 Vessel Offsets and Static Draft

A table of vessel offsets and static draft measurements for both RUDE and Survey Launch 1017 is contained in Appendix III.

Static transducer offsets are applied to all bathymetry data during the *CARIS* "SVP Correct" operation. Horizontal offsets are applied during *CARIS* Merge.

### C.2 Dynamic Draft

Settlement and squat tables for RUDE and Survey Launch 1017 are contained in Appendix III.

Dynamic Draft corrections are applied to all bathymetry data in the *CARIS* SVP Correct operation.

### C.3 Attitude and Heave

Heave, pitch, and roll corrections are applied to MBES and VBES bathymetry data in the *CARIS* SVP Correct operation. Yaw corrections are applied during *CARIS* Merge.

### C.4 Sound Speed Correction

RUDE carries two Seabird SBE-19 Conductivity, Temperature, and Depth profilers. These instruments are returned to the manufacturer yearly for calibration. Records of the latest calibrations are included in Appendix IV. During MBES data acquisition, CTD casts are conducted when starting work in an area and every 4 hours thereafter, or when the surface sound speed is observed to have drifted outside accepted limits as discussed below. For VBES data, casts are conducted at least once a week or when survey personnel suspect a significant change in the properties of the water column.

RUDE personnel conduct CTD data quality assessments prior to a new sheet survey project by comparing CTD readings at the surface with Digibar Pro or with a simultaneous cast from the second CTD.  This information is processed using HSTP *Velociwin* “comparison cast” feature.

As described in Section A.4, A.5, and B.1, raw conductivity, temperature and depth data are processed to produce sound speed files in *CARIS* format.  These profiles are applied in *CARIS* “SVP Correct”.

## C.5 Water Levels

Soundings are corrected to Mean Lower Low Water using first Preliminary Unverified tides.  Verified tides are applied where available and according to the procedure described in Section B.1.  All raw tide data is corrected according to the zoning provided with the relevant project instructions prior to application to bathymetry data.

During bathymetric data collection, subordinate gauges included in the project instructions are monitored via the CO-OPS web site, “Tidebot” email, and the CORMS Morning Report.  When water level measurement problems are suspected, RUDE personnel bring them to the attention of CO-OPS staff before continuing bathymetric data acquisition.

Water level corrections are applied during *CARIS* Merge.

## D. APPROVAL SHEET

### LETTER OF APPROVAL

Data acquisition and processing is conducted under my direct supervision with frequent personal checks of progress and adequacy. All equipment is continuously monitored for proper operation during data acquisition and all supplemental and supporting records are reviewed in their entirety.

This Data Acquisition and Processing Report is adequate to accompany Descriptive Reports for surveys including data collected during NOAA Ship RUDE's 2006 Field Season.

Respectfully Submitted:

__________________________________
Shawn Maddock
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Approved:

__________________________________
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