H10941

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey Hydrographic\ Side Scan Sonar\ Multibeam

Field No. Sheet U

Registry No. H10941

LOCALITY

State Texas

General Locality Gulf of Mexico

Locality 56 Miles South of Sabine Pass

1999-2000

CHIEF OF PARTY
Walter S. Simmons

NOAA FORM 77-28 (11-72)

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

HYDROGRAPHIC TITLE SHEET

REGISTRY NO. **H10941**

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. U

State TEXAS

General locality GULF OF MEXICO

Locality 56 MILES SOUTH OF SABINE PASS

Scale 1:20,000

Date of survey 23 Oct 1999 – 10 Nov 1999
30 Jan 2000, 07 Feb 2000 – 08 Feb 2000

Instructions dated 23 October 1997 as amended

Project No. OPR-K171-KR

Vessel R/V Neptune

Chief of party WALTER S. SIMMONS

Surveyed by W. Simmons, R. Nadeau, L. McAuliffe, J. Infantino, A. Quintal, R. DeKeyzer, D. Walker, J. Dietz

Soundings taken by **echo sounder**, hand lead, pole MULTIBEAM RESON SEABAT 8101

Graphic record scaled by survey personnel

Graphic record checked by survey personnel

Protracted by

Automated plot by HP1055CM (FIELD)

Verification by ATLANTIC HYDROGRAPHIC BRANCH PERSONNEL

Soundings in fathoms **feet**, meters at MLW, **MLLW**

REMARKS: Contract # 50-DGNC-8-90025/SAIC
Contractor Name: Science Applications International Corp.
221 Third Street; Newport, RI 02840
HAND WRITTEN NOTES IN DESCRIPTIVE REPORT WERE MADE DURING OFFICE PROCESSING

AWOIS ✓ & SURF ✓ by MBH 6/11/02

NOAA FORM 77-28 SUPERSEDES FORM C&GS-537

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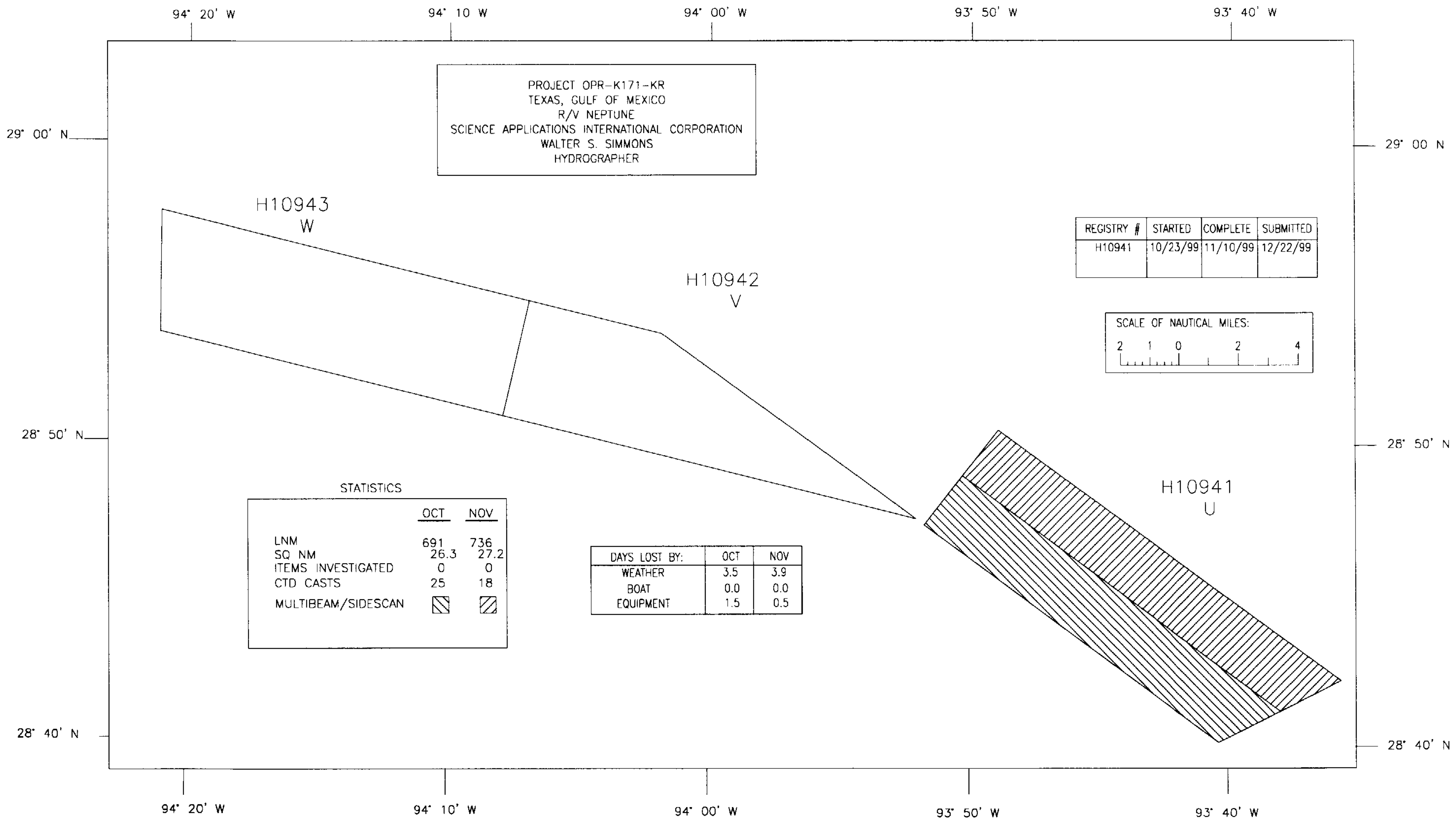
1. Survey Outlines
2. Field Survey Letters and Survey Registry Numbers
3. Work Accomplished by Month

PROGRESS SKETCH
H10941
MULTIBEAM SONAR – SIDESCAN SONAR

PROJECT OPR-K171-KR
TEXAS, GULF OF MEXICO
R/V NEPTUNE
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
WALTER S. SIMMONS
HYDROGRAPHER



REGISTRY #	STARTED	COMPLETE	SUBMITTED
H10941	10/23/99	11/10/99	12/22/99

STATISTICS

	OCT	NOV
LNM	691	736
SQ NM	26.3	27.2
ITEMS INVESTIGATED	0	0
CTD CASTS	25	18
MULTIBEAM/SIDESCAN	▧	▨

DAYS LOST BY:	OCT	NOV
WEATHER	3.5	3.9
BOAT	0.0	0.0
EQUIPMENT	1.5	0.5

Descriptive Report to Accompany
Hydrographic Survey H10941
Scale 1:20,000 Surveyed 1999, 2000
R/V NEPTUNE
Science Applications International Corporation (SAIC)
Walter S. Simmons, Hydrographer

A. PROJECT

Project Number: OPR-K171-KR

Dates of Instructions:	23 October 1997	**Original:** 50-DGNC-8-90025/SAIC
	5 January 1998	Modification #1:56-DGNC-8-24001/SAIC
	7 August 1998	Modification #2:56-DGNC-8-24002/SAIC
	9 November 1998	Modification #3:56-DGNC-9-24003/SAIC
	9 April 1999	Modification #4:56-DGNC-9-24004/SAIC
	12 July 1999	Modification #5:56-DGNC-9-24005/SAIC
	14 October 1999	Modification #6:56-DGNC-0-24006/SAIC
	04 January 2000	Modification #7:56-DGNC-0-24007/SAIC

Dates of Supplemental Instructions: 4 August 1998, 25 May 1999
Sheet Letter: U
Registry Number: H10941
Purpose: To provide NOAA with modern, accurate hydrographic survey data acquired using shallow water multibeam and side scan sonar technology with which to update the nautical charts of the assigned area.

B. AREA SURVEYED

Description: The area surveyed was primarily the Shipping Safety Fairway at the Approach to Galveston, Texas. The following coordinates bound the survey approximately:

28 47 19.84560N	093 51 45.08640W
28 50 30.50160N	093 48 55.01880W
28 42 14.34240N	093 35 44.68920W
28 40 10.56360N	093 40 24.15000W

Dates of multibeam acquisition (UTC)

10/23/99	JD 296
10/25/99 – 10/30/99	JD 298 – 303
11/04/99 – 11/09/99	JD 308 – 313
01/30/00	JD 030
02/07/00 –02/08/00	JD – 038 – 039

Dates of side-scan acquisition (UTC)

10/23/99	JD 296
10/25/99 – 10/30/99	JD 298 – 303
11/04/99 – 11/10/99	JD 308 – 314

C. SURVEY VESSEL

The R/V Neptune was the platform for multibeam sonar, side scan sonar, and sound velocity data collection. Two CONEX containers were welded in place on the aft deck of the R/V Neptune. One container was used for multibeam and side scan data collection, the other for data processing. The POS/MV IMU was mounted on the vessel centerline just forward and above the RESON 8101 transducer, below the main deck. The multibeam sounder transducer was mounted on the keel. The side scan sonar tow position was located at the "A" frame aft center. A double-armored co-ax conductor cable on a SeaMac winch was used for towing the side scan. Table C-1 is a list of vessel characteristics for the R/V Neptune.

Table C-1. Survey Vessel Characteristics

Vessel Name	LOA (Ft)	Beam (Ft)	Draft (Ft)	Gross Tonnage	Power (Hp)	Registration Number
R/V Neptune	106.9	26	8	90	1200	D595478

The R/V Neptune sensor configuration is depicted in Figure C-1 and the vessel offsets are shown in Table C-2. Figure C-2 shows the R/V Neptune's draft calculations. All measurements are in meters. The Reference Point for the entire multibeam system is located at the top centerline of the POS/MV IMU. The transducer depth was recorded as 3.42 meters below the boat's main deck. The distance below the boat deck to the water surface was measured and subtracted from the transducer hull depth to determine the draft of the electronic center of the transducer. Lead line comparisons to the corresponding beam confirmed the 3.42 meters as the correct transducer depth below deck. Measurements were made on each side of the vessel before departure from port and upon return to port in order to prorate the daily draft for fuel and water consumption.

Figure C-1. Configuration of R/V Neptune during Survey Operations, measurements in meters

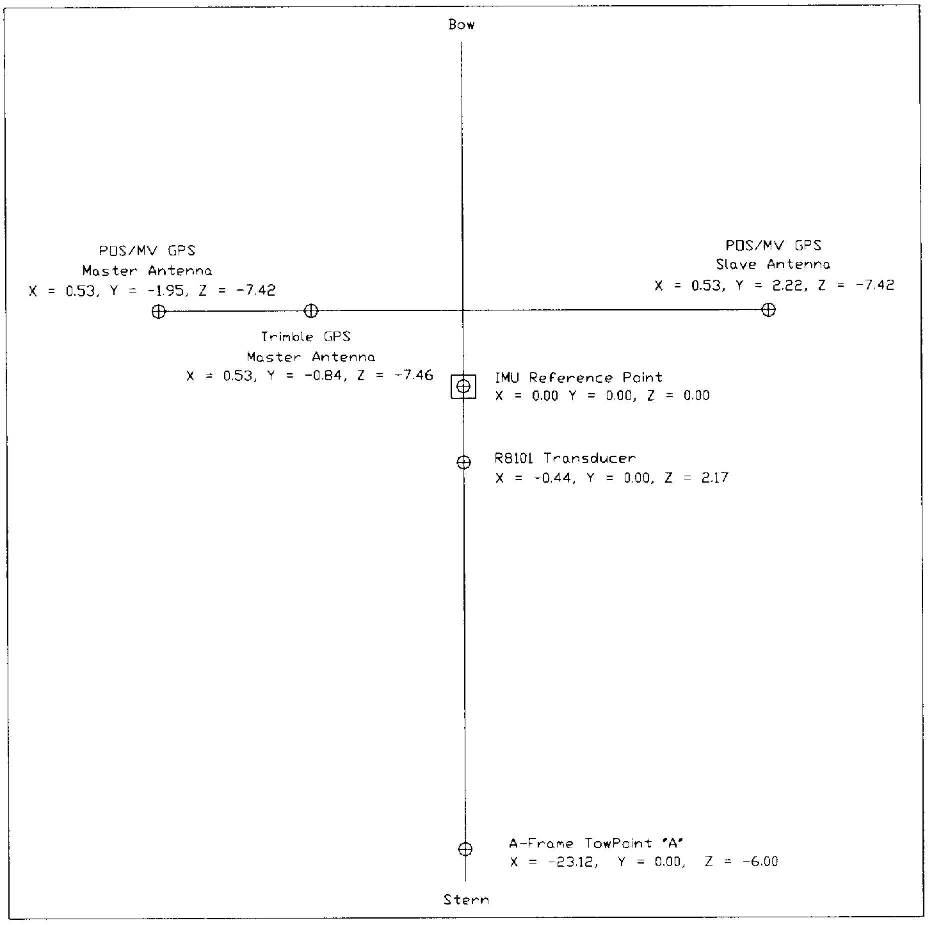
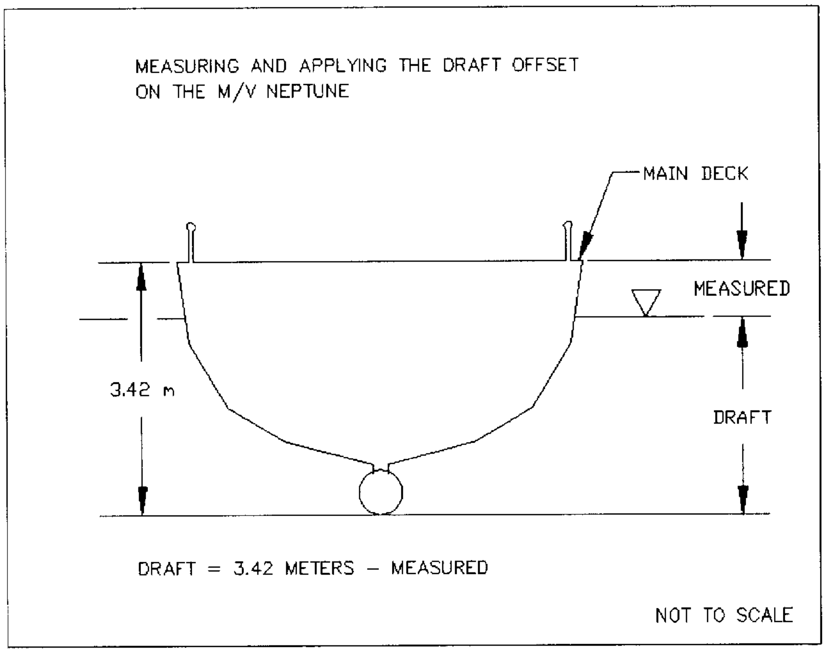


Table C-2. R/V Neptune Antenna and Transducer Locations Relative To the POS/MV IMU Vessel Reference Point, measurements in meters

Sensor	Offset in ISS2000		POS/MV IMU	
Multibeam Reson 8101 Transducer	X		X	-0.44
	Y		Y	0
	Z		Z	2.17
Trimble 7400 Antenna	X	0.53		
	Y	-0.84		
	Z	-7.46		
POS/MV GPS Master Antenna			X	0.53
			Y	-1.95
			Z	-7.42
Side Scan Tow Point "A" frame aft	X	-23.12		
	Y	0		
	Z	-6.00		

Figure C-2. R/V Neptune Draft Determination



The SAIC Integrated Survey System (**iss2000**) and the RESON 8101 multibeam system utilize different coordinate systems, and care must be taken when inputting correctors to the system. The **iss2000** considers "z" to be positive down, while both the RESON and POS/MV consider "z" positive up. Both the **iss2000** and POS/MV consider "x" positive forward, the RESON considers "x" as positive athwart ships to starboard. The SAIC **iss2000** considers "y" positive athwart ships to starboard, the POS/MV considers "y" positive athwart ships to port and the RESON considers "y" as positive forward.

D. AUTOMATED DATA ACQUISITION AND PROCESSING SEE ALSO THE EVALUATION REPORT

Data acquisition was carried out using the SAIC **iss2000** system. Survey planning, real-time navigation, and data logging were controlled by the **iss2000** on a HP UNIX machine, with navigation and data time tagging running on an WIN/NT machine. The **iss2000** also provided navigation data to the Klein 5500 sonar system for merging with the side scan sonar data.

Navigation was recorded from both the POS/MV system and the Trimble 7400. Data from the POS/MV was used as the primary navigation merged with both multibeam and side scan data. Positioning confidence checks were performed alongside survey control stations in port. Daily positioning confidence checks for the R/V Neptune were done by comparing data recorded from the POS/MV to data recorded from the Trimble DGPS.

The RESON 8101 range scale was set to 50 meters. The data acquisition rate for the R8101 was set at 8 pings per second. This means that the specified on average 3.2 pings per 3 meters could be obtained at up to 14.5 knots with the 8 pings per second data rate. At an average speed of 8.5 knots and 8 per pings second, the average along track coverage was 4.37 pings per 3 meters. In all instances, the specified average of 3.2 pings per 3 meters was met.

The side scan sonar equipment used throughout the H10941 survey was the Klein 5500 System. The Transceiver/Processor Unit (TPU) was networked to a personal computer that logged data to hard disk. On a watch-by-watch basis, these raw Klein formatted data were transferred to a side scan sonar-processing computer where they were archived to 4mm tape. Both channels were set at a range scale of 100-meters throughout the survey. Vessel speed averaged 8 to 9 knots and never exceeded 10 knots. This ensured three or more side scan sonar pings per meter along track.

Once collected and archived to tape, the side scan data were converted to eXtended Triton Format (XTF). A side scan processor then reviewed the side scan data using Triton ISIS software. The processor would note data gaps due to weather, system problems, the fish altitude out of range, data masking, or any other events that would cause the data to be rejected. With the assistance of the hydrographer, the processor would locate and verify contacts and create a contact list using ISIS. This contact list was later imported into the **iss2000** system for side scan contact to multibeam feature correlation.

Cleaning of the R8101 multibeam data began with an evaluation of the navigation track line. An automated filter was then applied for minimum and maximum depths of 4 and 30 or 35 meters, depending on the water depth. Interactive editing was then performed to remove noise, fish, etc. The editing process used the geoswath geo-referenced editor which allows for both plan and profile views with each beam in its true geographic position and depth. Tidal correctors were not applied in real-time. Observed tides were down loaded from the NOAA/CO-OPS web page. Preliminary and verified data from the Sabine Offshore Station (877-1081) were applied to the multibeam data using the zoning provided August 4, 1998. NOAA memorandum, "Final Water Level Data for Application to Hydrographic Survey OPR-K171-KR-1998", which is in Appendix F.* All H10941 multibeam data were reprocessed using verified tide data from the Sabine Pass Offshore (877-1081) station as downloaded from the NOAA/CO-OPS web page.

Depth data were then gridded to 1-meter cells for quality evaluation and for comparing to side scan sonar contacts. When anomalies were seen in the 1-meter grids, the edited multibeam files were re-examined and re-edited as needed. When all multibeam files were determined to be satisfactory, the data were binned to a 10-meter cell size, populating the bin with the shoalest sounding in the bin and maintaining its true position and depth with tracking to the gsf data file. APPROVED TIDES AND ZONES WERE APPLIED DURING FIELD PROCESSING.

Soundings were selected from the 10-meter binned layer using the **sel_sound** sounding selection software. This routine starts with the shoalest sounding in the survey, flags out soundings that would overlap it on the plot, proceeds to the shoalest remaining sounding and repeats the above process until all soundings in the 10-meter bin layer have been evaluated. The **set_sound** program was run to flag all selected soundings in the gsf multibeam file. The selected sounding file, the platform and navigation aids file, and the feature file were combined to produce the smooth sheet in **AutoCAD**.

Throughout this descriptive report wherever software is mentioned, it is inferred that the most current version of the software available was used. A complete list of all software versions and dates is provided in Appendix K.*

Processing of side scan sonar data is discussed in Section E.

The real time multibeam acquisition system used for the H10941 survey included:

One UNIX workstation – Used for system control, survey operations, real-time quality control.
One personal computer – Used for running POS/MV and Trimble software, for downloading and conversion of sound velocity data from CTD's.

* DATA FILED WITH ORIGINAL FIELD RECORDS.

One personal computer – Used for navigation and time syncing on the WIN/NT operating system.
A custom computer from RESON was used to operate the 8101 system.
A custom computer from RESON was used to operate the R6042 system.

Uninterrupted power supplies (UPS) protected the entire system.

Multibeam Data Processing

Multibeam data processing was performed in two stages. Initial data cleaning and validation was done shortly after the data were collected, usually by the same watchstander who had collected the data. To maintain a high degree of continuity between data collection and data processing it was convenient to split a watchstander's work into two phases, one to collect data and the next to process that same data.

On a watch by watch basis, tracklines were created, verified, and corrected to ensure data coverage and to also check for navigation errors. Next, outer beams of the multibeam data, exceeding the accuracy standards calculated by the Hydrographer, were flagged as invalid using the **iss2000** software. Multibeam data were manually edited and the preliminary multibeam coverage grid was then updated. Each watchstander would perform a backup of all data on the processing system at the end of each processing watch. After the watchstander had completed the initial data cleaning, a different watchstander, a data manager, or the hydrographer verified the data. Any questionable possible obstructions were noted and later evaluated by the hydrographer. A data manager on the survey vessel would later correct the data for draft and tides, make updated coverage grids, tracklines, sounding grids, selected sounding plots and preliminary data products. The data manager's duties also included routine system backups on all computers and quality control on all data.

In the processing lab in Newport, RI, further quality assurance reviews were done, and corrections were made to all data. Contact analysis was performed correlating side scan contacts with multibeam features. Multibeam coverage and sounding grids were updated following changes found during the contact analysis. The **iss2000** system used proprietary algorithms to create the grids and selected soundings. Final plots were produced exporting data to a dxf format using the **iss2000** software. These data were then imported into **AutoCAD** for final map production.

E. SIDE SCAN SONAR

The following side scan sonar equipment was used for the H10941 survey:

Klein 5500 Side scan Sonar System towfish
- Serial Number 250
- Vertical beam width 40°, 0° depression, 455kHz.
- K-Wing-II Depressor, serial number 435

Transceiver/Processing Unit (TPU), serial number 109
Display/Control/Data logging computer

1. Side Scan Sonar Data Acquisition Procedure

The watchstander would always have the assistance of the previous watchstander who was located close by processing data. This assistance was necessary for conducting CTD casts as well as towfish deployment and retrieval. A minimum of four people were used during towfish deployment and retrieval.

Side scan operations were conducted in water depths ranging from 62 to 103 feet. The side scan towfish altitude off the bottom was maintained between eight and twenty meters. The MacArtney Sheave was equipped with a cable counter with a read out in meters. The cable out data was broadcast from the cable counter to the **iss2000** system where layback and fish positions were calculated. The cable length was manually adjusted to maintain the proper fish altitude using a remote controller for the SeaMac winch. The watchstander appended to a side scan annotation file when changes were made to the cable out length. These annotation files were later merged with the XTF data using proprietary software.

Maintaining towfish height above the bottom was relatively easy using the remote controller for the winch. A proprietary software program, which graphically displays the towfish and water depths, aids in monitoring the towfish altitude.

The use of a hydrodynamic depressor allowed the amount of cable out to be kept less than the water depth. Thus permitting turns to be tighter and faster than surveys previously conducted without the use of a depressor. This also removed all concern about the towfish hitting the seafloor while conducting CTD casts. In addition, the depressor kept the towfish below the propwash even at higher survey speeds of 9 knots.

Survey line spacing was 80-meters. Survey lines were run at an azimuth of 126° and 306°. Navigation file names were manually changed after each survey line was completed. Because the high data rates of the Klein 5500 side scan, the Klein data logging software automatically changes the file name every ten minutes. The range scale was set to 100-meters.

Daily confidence checks were conducted using trawl marks, anchor scours, and any other geologic features (sand waves) that ran through both channels while on line.

2. Problems Encountered During Side Scan Sonar Survey Acquisition

The Klein 5500 locks on to the strongest signal. In water depths less than 60 feet, this often meant the water surface if Sargasso or wind waves were present. Weather also had a negative impact on the quality of the side scan data. When operating in 3 to 4 foot seas, it was frequently impossible to avoid surface wave noise and the subsequent large number of data gaps.

3. Side Scan Sonar Processing

After being archived to 4mm tape, digital side scan data from the Klein 5500 system were converted from the Klein proprietary format to eXtended Triton Format (XTF) using a SAIC proprietary program called xtf_io. These XTF files were copied to 4mm tape in tar format and are the deliverables to be used with CARIS SIPS. The XTF data also allowed data review and target analysis in Triton Isis.

A side scan processor looked at each record using Triton ISIS to review the data. A spreadsheet was used to log times where data gaps were caused by seaweed interference, biota in the water column, or other reasons. The time, survey line, corresponding multibeam file, start/end of line, side scan file name, watch id number, line azimuth, and data gaps information were all logged in the spreadsheet. This information was used to set the bad data off line so that they were ignored in processing and in coverage analysis.

On June 16, 1999 a slave IRIG-B card was installed in the TPU to provide accurate time stamping of the ping data in synchronization with the **iss2000** and UTC from the GPS signal. After the IRIG-B card was installed, numerous erroneous dates, times and positions were found in the raw Klein data. The duration of the problem was typically 2 to 3 seconds and could be as large as 6 seconds. The xtf_io program was customized to do an interpolation over these gaps to resolve the problem. As of the writing of this report, Klein Associates is still working on determining the cause of the problem.

Annotation files logged in real-time by the watchstanders were later corrected for errors and additional annotations were added. Additional annotations include contacts, confidence checks, and comments on the records. The corrected annotations were merged into the XTF data using the xtf_io program. Trackline data were extracted from the XTF files for each Julian day.

A time window file, which lists the times of all valid data, was created for each 100% of coverage in order to create both trackline and coverage plots in the **iss2000** system. By viewing the coverage plots in the **iss2000** survey-planning tool, a user can easily plan survey lines to fill in any data gaps. Once the sidescan coverage has been reviewed, a mosaic of the sidescan data is generated for additional verification of these data collected.

Side Scan Contact Analysis

ISIS and Contact Post Processing Software (Triton/Elics Inc.) were used to select and process contact information from the XTF sonar files. Contact information includes the following:

1. Year and Julian Day contact was acquired.
2. Time contact was acquired.
3. Contact position - Latitude and Longitude.
4. Contact identified.
5. Slant range to contact (Note: Negative number if contact was detected on port side).
6. Fish altitude when contact was acquired.
7. Shadow length of contact.
8. Contact height, based on length of shadow and geometric calculation using steps 5, 6, and 7.

Contact information was stored in .CON files that were converted into a .CTV file using a SAIC proprietary program called isis2ctv. During the conversion, a postscript image file was made of each contact. This .CTV file can be directly loaded into **iss2000** as a separate data layer. Once in the **iss2000** system, contacts were correlated by position and height with the one-meter grid of the multibeam data displayed with side scan contacts overlaid. Bathymetric features in the multibeam data were then compared with the side scan contact data.

F. SOUNDING EQUIPMENT

The following components were used for acquisition of multibeam sounding data using the RESON SeaBat 8101 multibeam system:

- Transducer, Serial Number 099707
- 8101 Processor, Serial Number 13819
- R6042 Controller and Processing Unit, Serial Number 590 P0 794-387

A lead line made of Kevlar line with an 8 pound mushroom anchor as a weight was used for checking the multibeam echo sounder. The line was marked in feet and was calibrated against a steel tape. Lead line comparisons are summarized in Appendix G*, Table App. G-1. Daily comparisons of R8101 nadir soundings to ODOM EchoTrak 200 kHz vertical echo sounder are also summarized in Appendix G*, Table App. G-2.

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G. CORRECTIONS TO SOUNDINGS

1. Speed of Sound

The following systems were used to determine sound velocity profiles for corrections to multibeam sonar soundings.

- "A" - Sea-Bird Electronics, Inc., Model 19 CTD, Serial Number 193607-0565, Calibration Date 14 September 1999.
- "B" - Sea-Bird Electronics, Inc., Model 19 CTD, Serial Number 2710, Calibration Date 14 September 1999.

The primary unit was SBE19 #0565. Daily confidence checks were obtained using simultaneous casts with the primary CTD and the secondary CTD. After downloading CTD casts, both were converted to the proper format and compared to each other and to the previously applied cast. All profiles were computed using **SBE Term19** and converted using the **SBE DatCnv** software. Computed profiles were copied to the **iss2000** for comparison on the screen. A selected profile was applied to the system, recorded, and sent to the RESON 6042, where a refraction lookup table was computed for application of speed of sound and ray tracing correctors to the multibeam sounding data. If sounding depths exceeded the cast depth, the RESON 6042 used the bottom of the table to extend correctors below the table.

Factors considered in determining how often a CTD cast was needed included: shape and proximity of the coastline, sources and proximity of freshwater, seasonal changes, wind, sea state, cloud cover, and changes from the previous profile. A cast was taken at least once during each 6-hour watch.

Quality control tools, including real-time displays and a multibeam swath editor, were used to monitor how the sound velocity was affecting the multibeam data. Severe effects due to improper sound velocity could easily be seen by viewing multibeam data in an along track direction.

A table including all CTD casts, dates of each cast, the location of the cast, and the maximum depth of each cast is located in Appendix J. * DATA FILED WITH ORIGINAL FIELD RECORDS

2. Instrument Corrections

No instrument corrections were necessary after the initial installation and calibration was complete.

3. Corrections Determined from Vertical Casts

Lead line comparisons to multibeam soundings were made at least every two weeks to verify the transducer draft and echo sounder instrument correctors. For each comparison, a CTD cast was taken and the sound velocity profile loaded into the **iss2000** and the RESON 6042. Twenty lead line readings, ten from the port side and ten from starboard were recorded along with the UTC time of observation while the **iss2000** recorded the multibeam readings. **Exammb** was used to determine the appropriate port and starboard beam depth readings for the time and position of each lead line reading.

The results of these readings were entered into a spreadsheet along with the draft readings and any settlement correctors that may have been entered into the **iss2000**. The spreadsheet applied a calibration corrector to the lead line readings and converted the readings from feet to meters. It also applied correctors for any settlement inadvertently left in the **iss2000** to the port and starboard multibeam readings.

Each corrected lead line cast depth was compared to the simultaneous multibeam. The ten comparisons were averaged and the standard deviations were computed. The lead line cumulative results are included in Appendix G. *

4. Static draft

Depth of the transducer below the deck was determined from measurements made while the boat was on the marine railway in 1998, and was verified by lead line comparisons. The static draft was observed by measuring from the main deck to the waterline before getting underway from Galveston and subtracting that measurement from the transducer distance below the deck. If the static draft value changed from the previously noted value, the new value was entered into the RESON system. The static draft was again determined upon return to port and the change in draft was prorated on a daily basis. The measured and prorated draft results are reported in Appendix G,* Table App. G-5.

5. Settlement and Squat

Measurements of settlement were conducted near 29° 11' 42"N 094° 28' 48"W on day 138, May 19, 1999, in fifteen meters of water. The following procedures were used to determine the settlement correctors:

- Selected an area of flat bottom at a depth similar to the survey area.
- Planned a survey line across the flat bottom.
    1. Considered the current and wind in planning the line.
    2. Used Sabine Offshore (877-1081) station for the water level during the test.
    3. Calibrated the echo sounder, and applied sound velocity profile for the test area. (Timing latency and pitch, roll and heading biases had been determined and applied.)
    4. Approached the line at a slow to moderate speed, brought the RPM's to zero and drifted down the line while recording soundings over the flat bottom.
    5. Ran the line at each of the predetermined RPM settings while recording soundings over the flat bottom.
    6. Applied water level correctors to the soundings.
    7. Subtracted the depth determined from each of the RPM passes from the depth determined on the drifting, zero RPM pass. These differences are the settlement and squat correctors to be applied when operating at the corresponding RPM.
    8. Constructed a lookup table of RPM and settlement and squat correctors in the configuration file so that the computer could interpolate a corrector based upon the RPM entered into the system

Geoswath was used to measure the depth for each pass. The results were compiled into a lookup table of vessel's engine RPM vs. settlement and squat. When on survey line, the engine's RPM was entered into the **iss2000** system by the real-time system operator. The computer applied settlement and squat correctors interpolated from the lookup table, and recorded them in the "Depth Corrector" field of the GSF data file for each ping. All results are reported in Appendix G,* Table App. G-6.

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6. Roll, Pitch and Heading Biases

The following sensor was used for acquisition of Heave, Roll, Pitch and Heading data:

- TSS POS/MV Inertial Navigation System, Serial Number 024

The accuracy of the sensor was five percent of one meter or five centimeters for heave ± 0.10° dynamic accuracy for roll and pitch, and ± 0.05° static accuracy for roll and pitch. The dynamic heading accuracy of the unit is better than 0.05°.

Heading, roll, and pitch biases were determined in a series of tests performed in the survey area prior to the start of the survey. Prior to conducting any of the tests, a CTD cast was taken to determine the sound velocity profile and entered into the RESON system. Initially, the roll, pitch, and heading bias were set to 0° in the RESON system.

The roll bias test was run first in an area with relatively flat bottom. The range scale of the RESON was set to 75-meters. One line was run in opposite directions at the same speed. The width of the swath was measured and entered in a spreadsheet along with paired port and starboard depth measurements. An equal number of pairs were measured from swaths in opposite directions. This was to eliminate any influence from true slope in the bottom. The spreadsheet computed the apparent roll bias from each pair, and the mean and standard deviation of all the computed biases. The spreadsheet allows for entry of the roll bias that was in the **iss2000** system during the test, and outputs the new bias to be entered in the **iss2000.** Roll bias results are shown in Appendix G*, Table App. G-4.

After the roll biases were calculated and applied to the data, a pitch bias test was conducted using the same lines and measuring the change in position of a small obstruction covered by the roll lines. During the test, ship speed was maintained at as constant a rate as possible. Pitch biases were computed by comparing runs in opposite directions. There was no discernable pitch bias as a result of these tests, and a bias of 0.0° was kept in the system for the survey. Pitch bias results are shown in Appendix G*, Table App. G-3.

Table App. G-6* contains the results of the Accuracy test conducted on JD 295
Roll, pitch, and heading biases applied in H10941 are shown in Table G-1.

Table G-1. Roll, Pitch, and Heading Bias for the R/V Neptune

Julian Days	296 - 039
Roll	0.13
Pitch	0.00
Heading	0.00

H. CONTROL STATIONS SEE ALSO THE EVALUATION REPORT

The horizontal datum used for the survey was the North American Datum (NAD) 1983.

Horizontal control stations CG-20 1974 and CG-21 1974 were used for independent checks of the positioning system on the survey vessel. Data for these stations were downloaded from the NOAA/NGS web page.

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I. HYDROGRAPHIC POSITION CONTROL

The following equipment was used for positioning on the R/V Neptune:

- TSS POS/MV, Serial Number 024
- Trimble 7400 GPS Receiver, Serial Number 3713A18839
- Trimble Probeacon Differential Beacon Receiver, Serial Number 0220159406
- 41R Differential Beacon Receiver, Serial Number 3508-102-18550

The primary hydrographic positioning equipment was the POS/MV, which used correctors from the USCG differential station at Galveston, TX. The **iss2000** monitored HDOP, number of satellites, elevation of satellites, and age of correctors to ensure the resulting hydrographic positioning errors did not exceed ten meters at the 95% confidence level.

When in port, the R/V Neptune tied up to Pier 15 where measurements were made to calculate the offset between the hydrographic navigation position and horizontal control stations CG-20, 1974, or CG-21, 1974. While measurements were being made, navigation data were being logged. Comparison of the navigation center position computed from the control station and the average position based on navigation resulted in confidence checks that were well within specifications, with no more than 3 meters inverse distance from the check position. Daily position confidence checks were established using a Trimble DGPS with correctors from the U.S. Coast Guard station at Port Aransas, TX. A real-time monitor raised an alarm when the two DGPS positions differed by more than 10 meters horizontally. Positioning confidence checks were well within the allowable inverse distance of less than 15 meters.

All antenna, transducer, towpoint, and towfish offsets were measured relative to the POS/MV's IMU. Two separate teams of two people measured and calculated all offsets using a measuring tape. The final offsets from both teams were compared and were found to agree.

The **iss2000** software calculates the towfish position using an automatic cable out value and the towpoint configuration or offsets previously measured.

J. SHORELINE

Not applicable.

K. CROSSLINES

There were 76 linear nautical miles of crosslines surveyed and 1263 linear nautical miles of mainscheme lines surveyed resulting in 6.0 percent coverage by crosslines.

Comparisons of all crossing data show that more than 91 percent of comparisons are within 20 centimeters and 99.53 percent of comparisons are within 30 centimeters. All comparisons were within 50 centimeters.

Table K-1. Junction Analysis Main Scheme vs. Cross Lines

Depth Difference Range			All Difference		Positive Difference		Negative Difference		Zero Difference
From		To	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulativ e Percent	Count
00.0cm	->	10.0cm	4,193,706	61.52	1,870,720	53.88	2,087,021	67.14	235,965
10.0cm	->	20.0cm	2,042,549	91.49	1,193,507	88.26	849,042	94.45	
20.0cm	->	30.0cm	548,225	99.53	379,875	99.20	168,350	99.86	
30.0cm	->	40.0cm	31,309	99.99	27,068	99.98	4,241	100	
40.0cm	->	50.0cm	829	100	811	100	18	100	
50.0cm	->	60.0cm	0	100	0	100	0	100	
60.0cm	->	70.0cm	0	100	0	100	0	100	
70.0cm	->	80.0cm	0	100	0	100	0	100	
sub-totals ->			6,816,618		3,471,981		3,108,672		235,965
			100.00%		50.93%		45.60%		3.46%
H10941 Cross Line Sounding Minus Main Scheme Sounding.									

L. JUNCTIONS SEE ALSO THE EVALUATION REPORT

This survey junctions with H10874 on the north. See Table L-1 for the listing of the Junction Analysis, H10941, Sheet U to H10874, Sheet T. Of the 412,568 comparisons, 91.86% were within 30 centimeters, and more than 99.98% were within 50 centimeters. No differences exceeded 60 centimeters.

Table L-1. Junction Analysis H10941, Sheet U vs. H10874, Sheet T

Depth Difference Range			All Difference		Positive Difference		Negative Difference		Zero Difference
From		To	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count
00.0cm	->	10.0cm	172,117	41.72	43,251	74.69	120,587	34.81	8,279
10.0cm	->	20.0cm	123,743	71.71	12,057	95.52	111,686	67.06	
20.0cm	->	30.0cm	83,115	91.86	2,529	99.88	80,586	90.32	
30.0cm	->	40.0cm	28,344	98.73	67	100	28,277	98.48	
40.0cm	->	50.0cm	5,176	99.98	0	100	5176	99.98	
50.0cm	->	60.0cm	73	100	0	100	73	100	
60.0cm	->	70.0cm	0	100	0	100	0	100	
sub-totals ->			412,568		57,904		346,385		8,279
			100.00%		14.04%		83.96%		2.00%
H10941 Sounding Minus H10874 Sounding Junction Analysis									

M. COMPARISON WITH PRIOR SURVEYS SEE ALSO THE EVALUATION REPORT

Comparison with prior surveys was not required under this contract. See Section N for comparison to the nautical chart.

N. COMPARISON WITH THE CHART SEE ALSO THE EVALUATION REPORT

H10941 was compared to Chart 11330, 12th edition, 08 August 1998, at a scale 1:250,000.

Soundings on this survey are within one foot of the charted soundings. However, there are only four charted soundings within the area of this survey, and they do not truly reflect the shape of the bottom. Recommend a more closely spaced charting of additional soundings to more fairly represent the bottom. CONCUR

Charted pipeline within this survey is a buried pipeline whose trace is visible in the data. This pipe is not useful as an aid to navigation. No new pipelines were detected.

Comparisons with charted soundings are illustrated in figures N-1 through N-4. Selected soundings from this survey are shown as overlays on the chart. In Figure N-4 the detected buried pipeline is shown as an overlay over the charted pipeline.

Figure N-1 Charted 78 Feet in Surveyed 79 Feet.

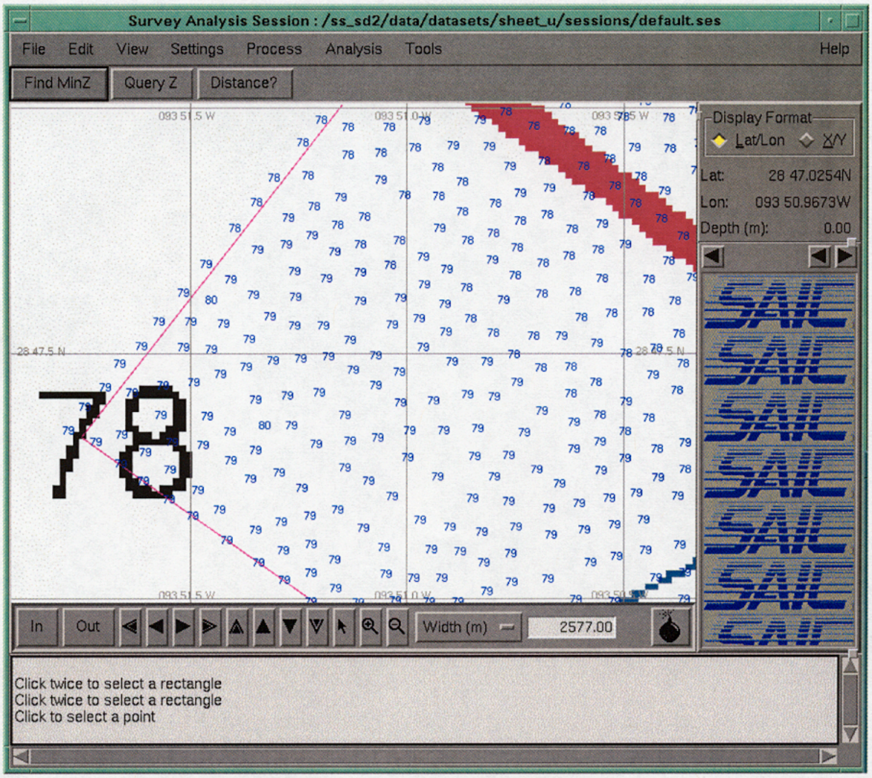


Figure N-2. Charted 76 Feet in Surveyed 75 to 76 Feet.

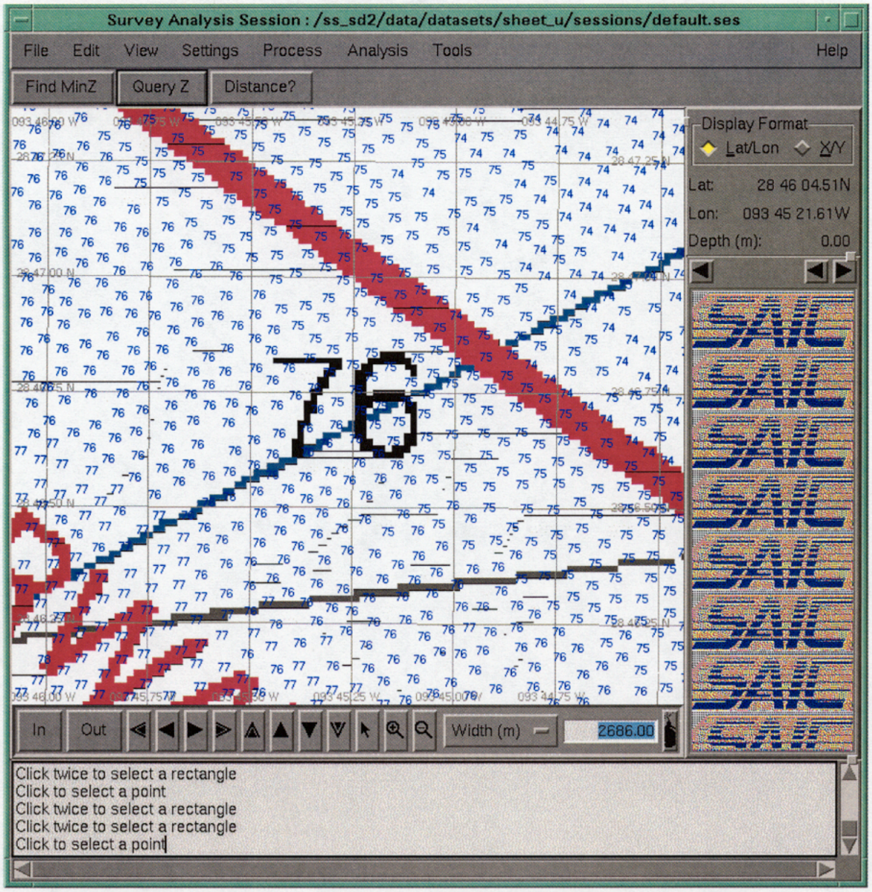


Figure N-3. Charted 82 Feet in Surveyed 82 Feet.

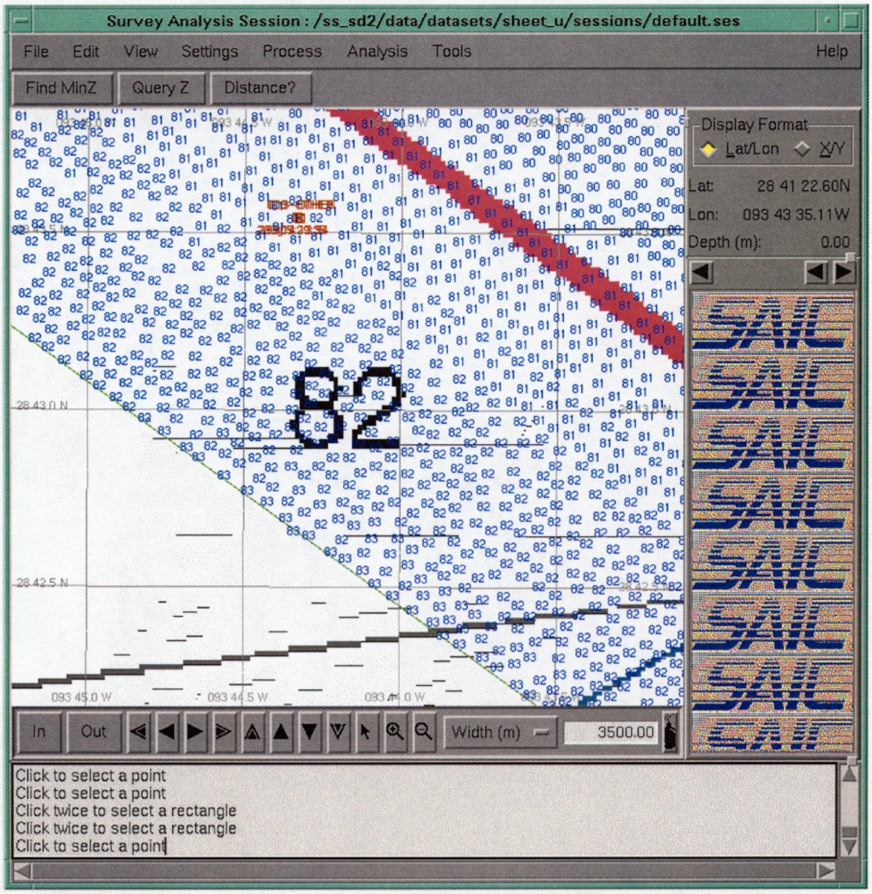


Figure N-4. Charted 85 Feet in Surveyed 84 to 86 Feet.

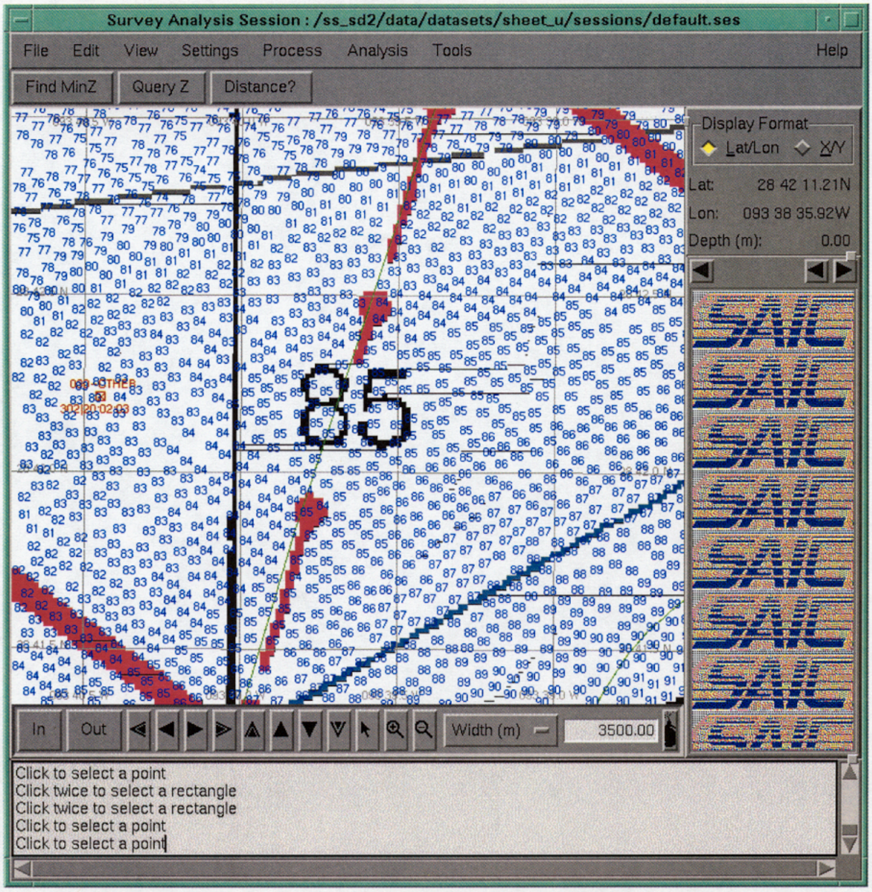


Figure N-5 illustrates the area of the charted dangerous obstruction PA. No significant obstructions were found in the 200 percent side scan or the multibeam coverage. Recommend removal of the charted dangerous obstruction PA. Recommend no further investigation. CONCUR – DELETE OBSTN PA

Figure N-5. Charted Obstruction PA With 1500-Meter Radius Shown.

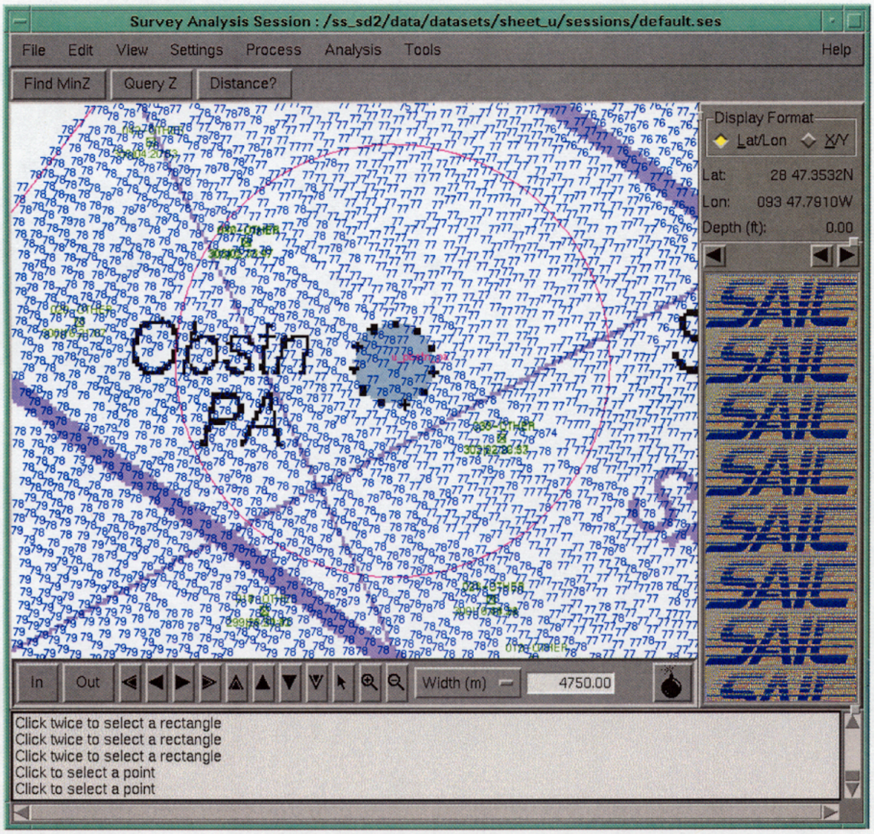


Figure N-6 illustrates the area of the charted dangerous wreck PA. No significant features were found within the survey. Recommend additional side scan 200 percent coverage to prove or disprove the charted wreck. CONCUR
RETAIN AS CHARTED

Figure N-6. Charted Wreck PA With 1500-Meter Radius Circle Shown.

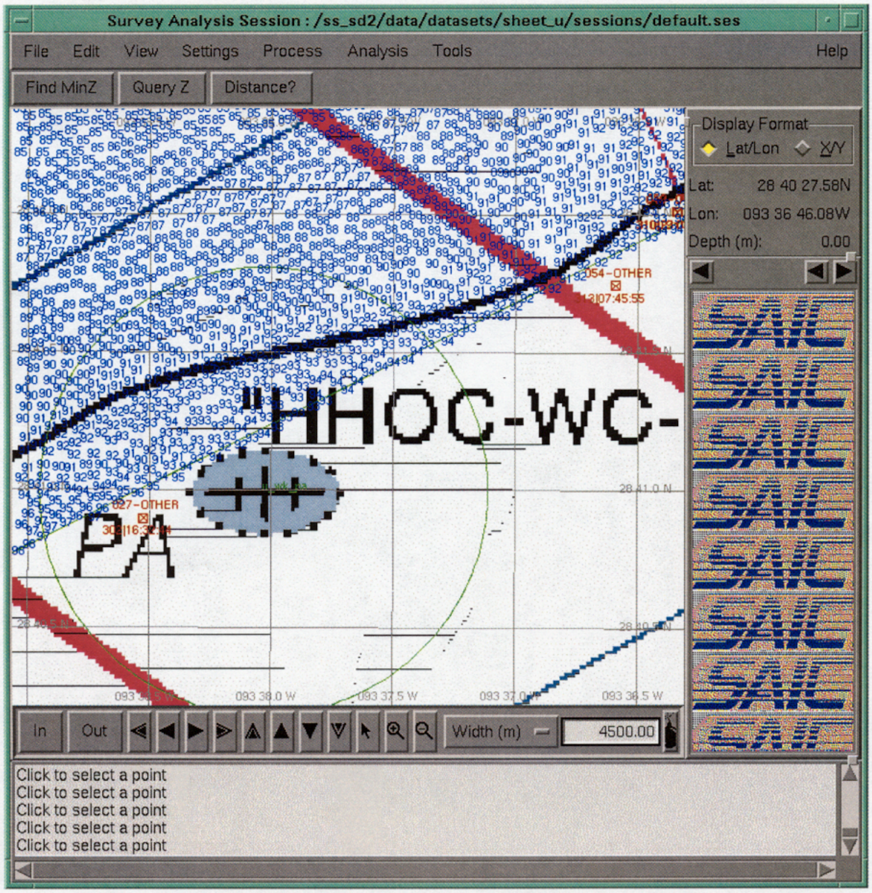


Figure N-7 illustrates the shallowest area, 61-feet, on the north side of the survey. Charted 59 feet is in an area of sand waves with least depths of 61, 62, and 63 feet from this survey. A second sand wave field with least depths of 62 and 63 feet is just south of the charted 59. Recommend deleting the charted 59 feet, and charting least depths from this survey.* There is evidence of several nearly parallel sand wave fields oriented east to west. This area was investigated as follows: *CONCUR

Additional Multibeam Coverage: Additional multibeam shall be acquired within this region, filling in the original multibeam and completing the remainder of the region to ensure 100% multibeam coverage.

28.752856N, 93.690445W
28.764548N, 93.709717W
28.782507N, 93.690252W
28.769798N, 93.670208W
28.752856N, 93.690445W

Figure N-7. Sand Waves on North Side of Survey, Least Depth 61 Feet.

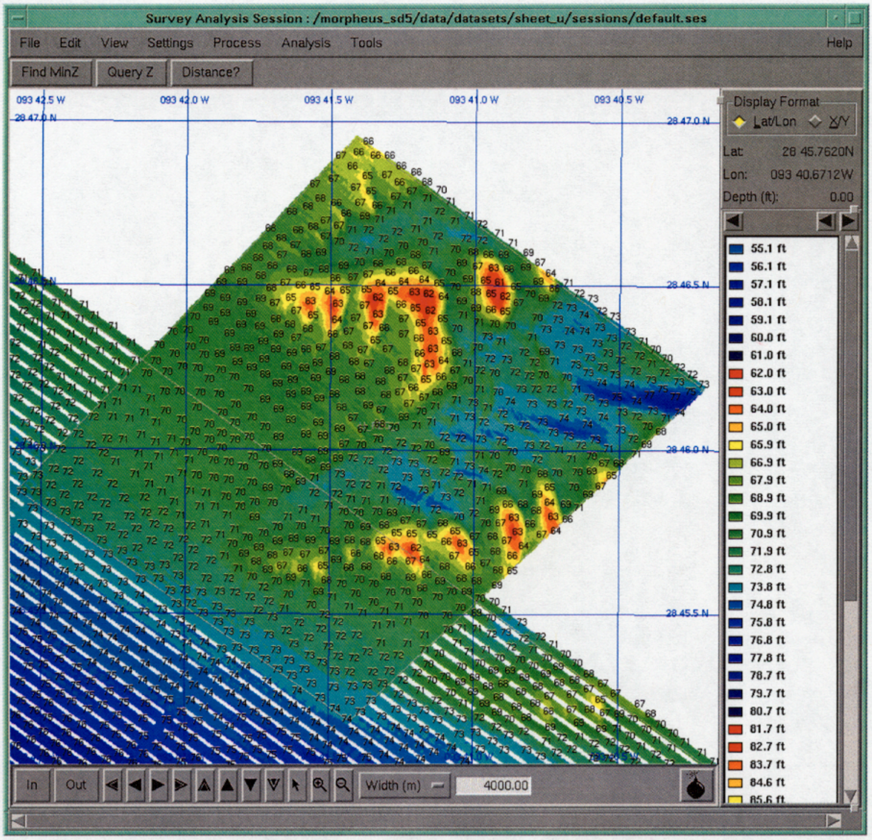
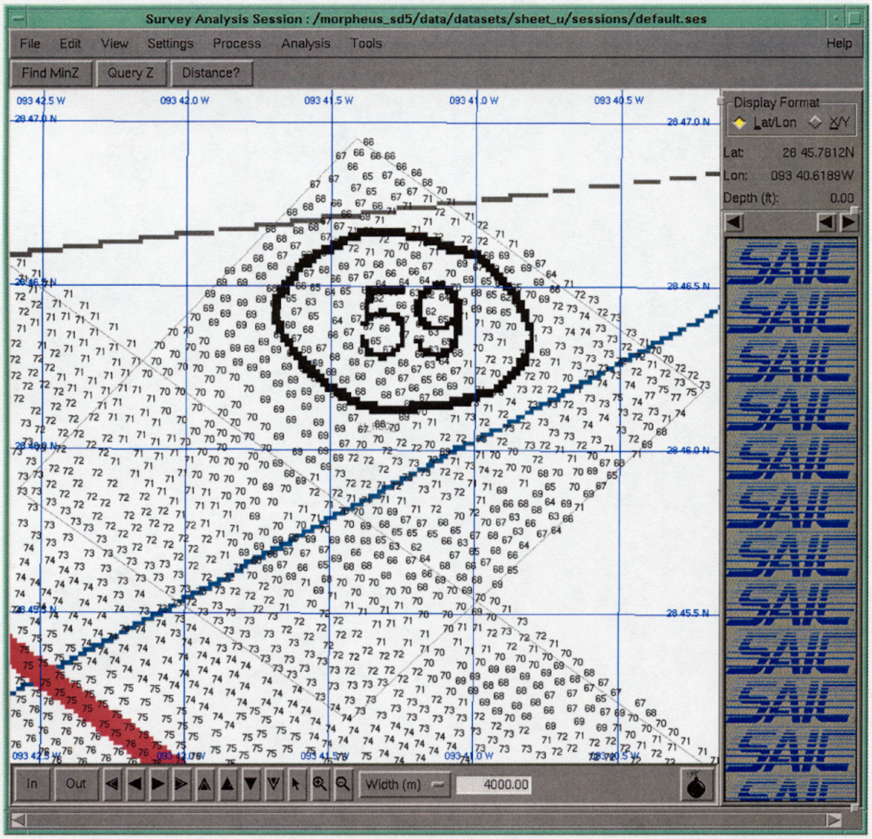


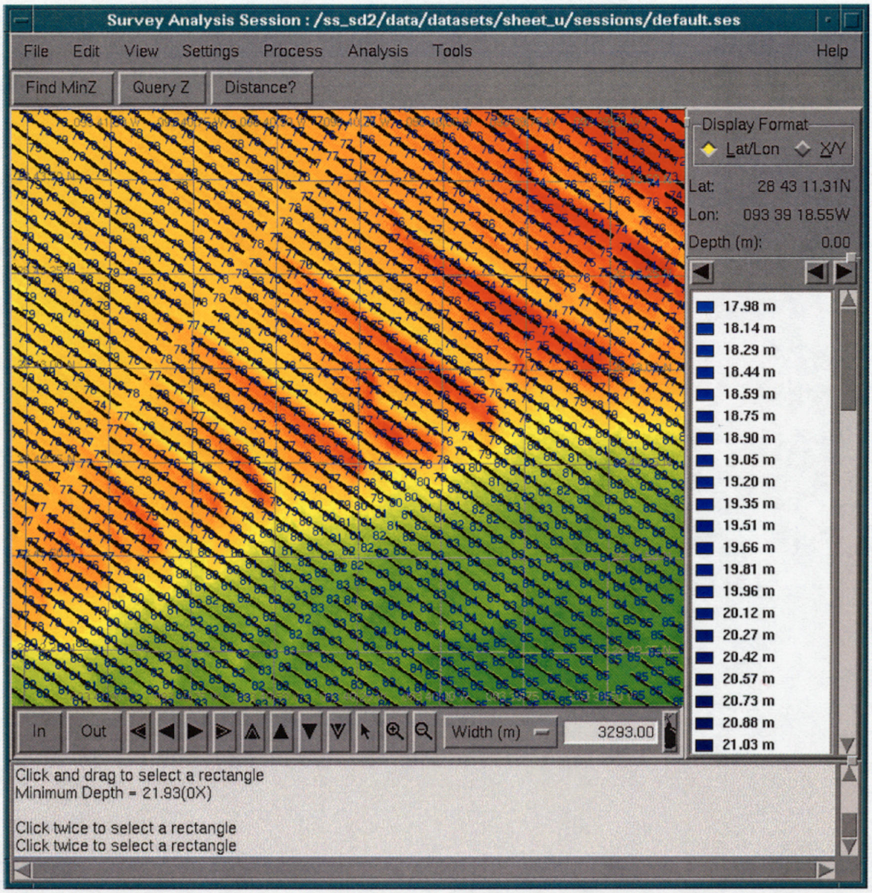
Figure N8. Charted 59 Feet in Surveyed 61 Feet.



A small obstruction, Feature # 3 was found at 28° 45' 50.17"N 093° 43' 52.45"W. Although only one foot above the surrounding bottom, it is clearly a feature. CONCUR - DO NOT CHART AS OBSTN

Figure N-8 illustrates a portion of the sand wave area near the center of the survey. This area is easily identified in the multibeam coverage plot. The waves appear in the selected soundings.

Figure N-9. Sand Wave Area Near Center of Survey.



A Danger to Navigation Report was submitted November 04, 1999, reporting a mooring buoy in the center of the shipping safety fairway. This buoy remained in position at 28 46 16.6N 093 46 02.4W through the end of the survey, apparently held in place by its trailing mooring cable. This buoy is depicted on the smooth sheet. Danger to Navigation Report is included in Appendix A.

Two individual items were investigated as follows:

Item 1:

I-1 was identified as Feature #1 by SAIC, and recommended for an additional investigation. I-1 is the correlation of side scan contacts #39 and #41 (heights 3.5m, 2.5m). This contact was located at the outer edge of the multibeam swath (beam 86). I-1 is located at 28° 42' 53.3" N, 093° 41' 02.6" W. NOAA has determined that this contact justifies additional work by SAIC. Additional investigation shall be conducted using shallow water multibeam, specifically two orthogonal lines crossing the contact near nadir.

Method of investigation: Orthogonal multibeam lines with the feature near nadir.

Results of investigation: Feature #1 is an apparent manmade obstruction just north of a sand wave field near the center of the survey shown in Figure N-~~8~~9. This obstruction is between the charted depths of 82 feet to the west, 85 feet to the southeast, and 59 feet to the north. Recommend this obstruction be charted, and charted soundings be replaced with a more closely spaced selection of soundings from this survey. CONCUR - REVISE OBSTN PA 68 TO OBSTN 68

Least depth:	68 feet
Latitude:	28 42 53.38 N
Longitude:	093 41 02.59 W
File:	hbmba00030.d30
Time:	15:19:34

Item 2:

I-2 was identified as Feature #2 by SAIC, and recommended for an additional investigation. I-2 is the correlation of side scan contacts #32 and #35 (heights 0.43m, 0.41m). This contact was detected on the outer portion of the multibeam swath, with a height of 1.3 m (beam 85). I-2 is located at 28° 46' 28.1" N, 093° 46' 53.9" W. NOAA has determined that this contact justifies additional work by SAIC. Additional investigation shall be conducted using shallow water multibeam, specifically two orthogonal lines crossing the contact near nadir.

Method of investigation: Orthogonal multibeam lines with the feature near nadir.

Results of investigation:

Three lines run with multibeam proved that no significant feature existed at this position. The multibeam files run in this area were hbmba00030.d28, hbmba00030.d29, and hbmba00038.d17. Feature #2 was removed from the smooth sheet, and from the Features List. CONCUR

O. ADEQUACY OF SURVEY

Not used by Contractor.

P. AIDS TO NAVIGATION

Charted pipeline within this survey is a buried pipeline whose trace is visible in the data. This pipe is not useful as an aid to navigation. No new pipelines were detected. There are no aids to navigation in this survey. Mooring buoy reported as a danger to navigation is shown on the smooth sheet because it remained in position at completion of the survey.

Q. STATISTICS

Survey statistics are as follows:

1427 nm	Linear nautical miles of sounding lines (multibeam and side scan)
53.5 nm^2	Square nautical miles of multibeam and side scan
43	Number of sound velocity casts
3	Number of items investigated

R. MISCELLANEOUS SEE ALSO THE EVALUATION REPORT

Figure R-1 shows the distribution by beam number of the 21,531 soundings selected for the smooth sheet. Figure R-1 shows the percentage distribution by beam number. The majority of soundings appear to be in the area where the bottom detection algorithm changes from phase to amplitude. All of the soundings selected meet the position and depth accuracy specifications (position error not to exceed 10 meters at 95% confidence, depth error not to exceed 0.3 meter at 90% confidence).

Figure R-1. Histogram of Selected Soundings by Beam Number

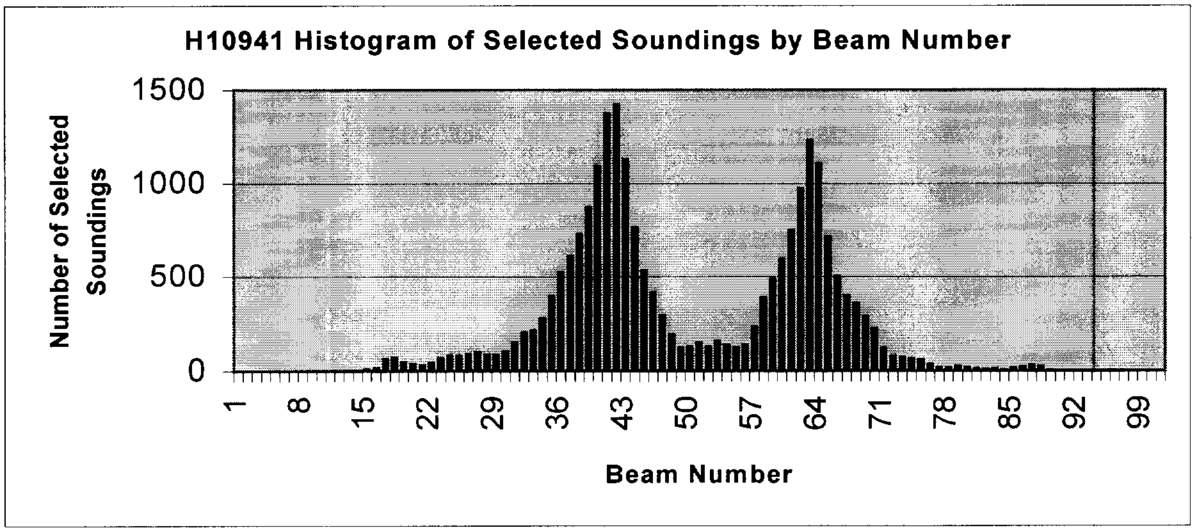
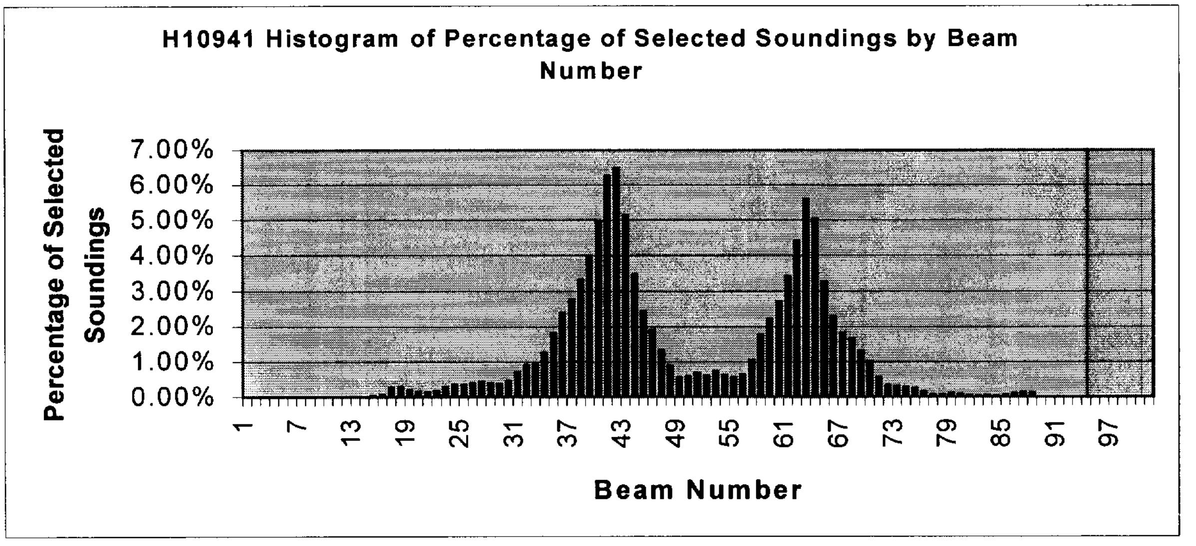


Figure R-2. Histogram of Percentage of Selected Soundings by Beam Number



S. RECOMMENDATIONS

Recommend the entire common area of charts 11330, 11300, and 11340 be reconstructed with data from this survey, and that soundings be more closely spaced in order to more truly depict the bottom. CONCUR

See Section N for additional recommendations.

T. REFERRAL TO REPORTS

None.

APPENDIX A: DANGER TO NAVIGATION REPORT

SEE ALSO SECTION N. IN THE EVALUATION REPORT

From: Walter Simmons <wsimmons@mtg.saic.com>
To: Dave Neander <dave.neander@noaa.gov>
Cc: Rod Evans <revans@mtg.saic.com>; Andrew L. Beaver <Andrew.L.Beaver@noaa.gov>
Subject: Danger to Navigation
Date: Thursday, November 04, 1999 8:51 AM

At 28 degrees 46.26 minutes north, 093 degrees 46.03 minutes west a cylindrical mooring buoy approximately 5 feet diameter and 10 feet long, bit on top with line attached. appears to be dragging line or its anchor cable underwater. Slow drift. In the center of the shipping safety fairway.

Walter S. Simmons
Science Applications International Corporation
Hydrographic Field Party in the R/V NEPTUNE
offshore 713-646-9221, inshore 409-770-4362
Newport RI office 401-847-4210

April 3, 2000

LETTER OF APPROVAL

REGISTRY NUMBER H10941

This report and the accompanying smooth sheet are respectfully submitted.

Field operations contributing to the accomplishment of survey H10941 were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and smooth sheet have been closely reviewed and are considered complete and adequate as per the Statement of Work.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Walter S. Simmons
Hydrographer
April 3, 2000

NOAA FORM 61-29
(12-71)

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

LETTER TRANSMITTING DATA

REFERENCE NO.
N/CS33-17-02

DATA AS LISTED BELOW WERE FORWARDED TO YOU BY (Check)

- [ ] ORDINARY MAIL
- [ ] AIR MAIL
- [ ] REGISTERED MAIL
- [X] EXPRESS
- [ ] GBL (Give number)__________

DATE FORWARDED 05/31/2002

NUMBER OF PACKAGES 1

TO:

CHIEF, DATA CONTROL GROUP, N/CS3x1
NOAA / NATIONAL OCEAN SERVICE
STATION 6815, SSMC3
1315 EAST-WEST HIGHWAY
SILVER SPRING, MARYLAND 20910-3282

NOTE: A separate transmittal letter is to be used for each type of data, as tidal data, seismology, geomagnetism, etc. State the number of packages and include an executed copy of the transmittal letter in each package. In addition the original and one copy of the letter should be sent under separate cover. The copy will be returned as a receipt. This form should not be used for correspondence or transmitting accounting documents.

H10941

Texas, Gulf of Mexico, 56 Miles South of Sabine Pass

ONE TUBE CONTAINING THE FOLLOWING:

1 (AHB) SMOOTH SHEET FOR SURVEY H10941
1 (CONTRACTOR) SMOOTH SHEET FOR H10941
1 RECORD OF APPLICATION TO CHART FORM (NOAA FORM #75-96)
1 H-DRAWING ON MYLAR FOR NOS CHART 11330
1 (CONTRACTOR) VERTICAL MAPPER PLOT OF H10941
1 DESCRIPTIVE REPORT FOR H10941

FROM: (Signature) Richard Bluvoin

Return receipted copy to:

NOAA \ NATIONAL OCEAN SERVICE
ATLANTIC HYDROGRAPHIC BRANCH N/CS33
439 WEST YORK STREET
NORFOLK, VA. 23510-1114

RECEIVED THE ABOVE
(Name, Division, Date)

ATLANTIC HYDROGRAPHIC BRANCH
EVALUATION REPORT FOR H10941 (1999)

This Evaluation Report has been written to supplement and/or clarify the original Descriptive Report. Sections in this report refer to the corresponding sections of the Descriptive Report.

D. AUTOMATED DATA ACQUISITION AND PROCESSING

The following software was used to process data at the Atlantic Hydrographic Branch:

MicroStation J, version 7.1
I/RAS B, version 5.01
NADCON, version 2.10
MapInfo, version 6.5
CARIS HIPS/SIPS

The smooth sheet was plotted using a Hewlett Packard DesignJet 2500CP plotter.

H. CONTROL STATIONS

Horizontal control used for this survey during data acquisition is based upon the North American Datum of 1983 (NAD 83). Office processing of this survey is based on these values. The smooth sheet has been annotated with ticks showing the computed mean shift between the NAD 83 and the North American Datum of 1927 (NAD 27).

To place this survey on the NAD 27, move the projection lines 0.905 seconds (27.861 meters or 13.93 mm at the scale of the survey) north in latitude, and 0.583 seconds (15.818 meters or 7.91 mm at the scale of the survey) west in longitude.

L. JUNCTIONS

H10874 (1999-2000) to the northwest

A standard junction could not be effected between the present survey and H10874 (1999-2000). The smooth sheet is annotated with the "ADJOINS H10874 (1999-2000)". Any adjustments to the depth curves in the junctional areas will have to be made on the chart during compilation.

There are no junctional surveys to the northeast, southeast or southwest. Present survey depths are in harmony with the charted hydrography to the northeast, southeast and southwest.

M. COMPARISON WITH PRIOR SURVEYS

A comparison with prior surveys was not done during office processing in accordance with section 4. of the memorandum titled "Changes to Hydrographic Survey Processing", dated May 24, 1995.

N. COMPARISON WITH CHART 11330 (13^{th} Edition, Apr 21/01)

The charted hydrography originates with the prior surveys and requires no further consideration. The hydrographer makes adequate chart comparisons in section N. of the Descriptive Report. Attention is directed to the following:

A mooring buoy reported as a danger to navigation in the vicinity of Latitude 28°46'16.60"N, Longitude 93°46'02.40"W was reported as adrift in the shipping channel. It is recommended that the mooring buoy not be charted unless other information indicates otherwise.

Except as noted above, the present survey is adequate to supersede the charted hydrography within the common area.

ADEQUACY OF SURVEY

This is an adequate hydrographic/multibeam survey. No additional field work is recommended.

R. MISCELLANEOUS

Chart compilation was done by Atlantic Hydrographic Branch personnel, in Norfolk, Virginia. Compilation data will be forwarded to Marine Chart Division, Silver Spring, Maryland. The following NOS Chart was used for compilation of the present survey:

11330 (13^{th} Edition, Apr 21/01)

H10941

Robert Snow

Robert Snow
Cartographic Technician
Verification of Field Data
Evaluation and Analysis

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE, Office of Coast Survey
Atlantic Hydrographic Branch
439 W. York Street
Norfolk, VA 23510-1114

April 20, 2000

Commander (oan)
Eighth Coast Guard District
Hale Boggs Federal Building
501 Magazine Street
New Orleans LA 70130-3396

Dear Sir,

During office processing of hydrographic survey operations, 56 NM south of Sabine Pass, Texas (Project OPR-K171-KR, 1999 Registry H10941) by Science Applications International Corporation (SAIC), two items have been identified as hazards to navigation. I recommend these items be included in the next Local Notice to Mariners. The items were located using Differential GPS and are based on NAD83 datum. The soundings have been reduced to Mean Lower Low Water (MLLW). All depth data is preliminary pending final office verification.

Objects Addressed:

Feature	Latitude	Longitude
68-ft Obstn	28°42'53.38"N	93°41'02.59"W
mooring buoy	28°46'16.60"N	93°46'02.40"W

Affected Nautical Charts:

Chart	Edition No.	Date
11330	12TH	Aug 08/98

Questions concerning this report should be directed to the Atlantic Hydrographic Branch, by calling (757) 441-6746.

Sincerely,

for Andrew L. Beaver, LCDR, NOAA
Chief, Atlantic Hydrographic Branch

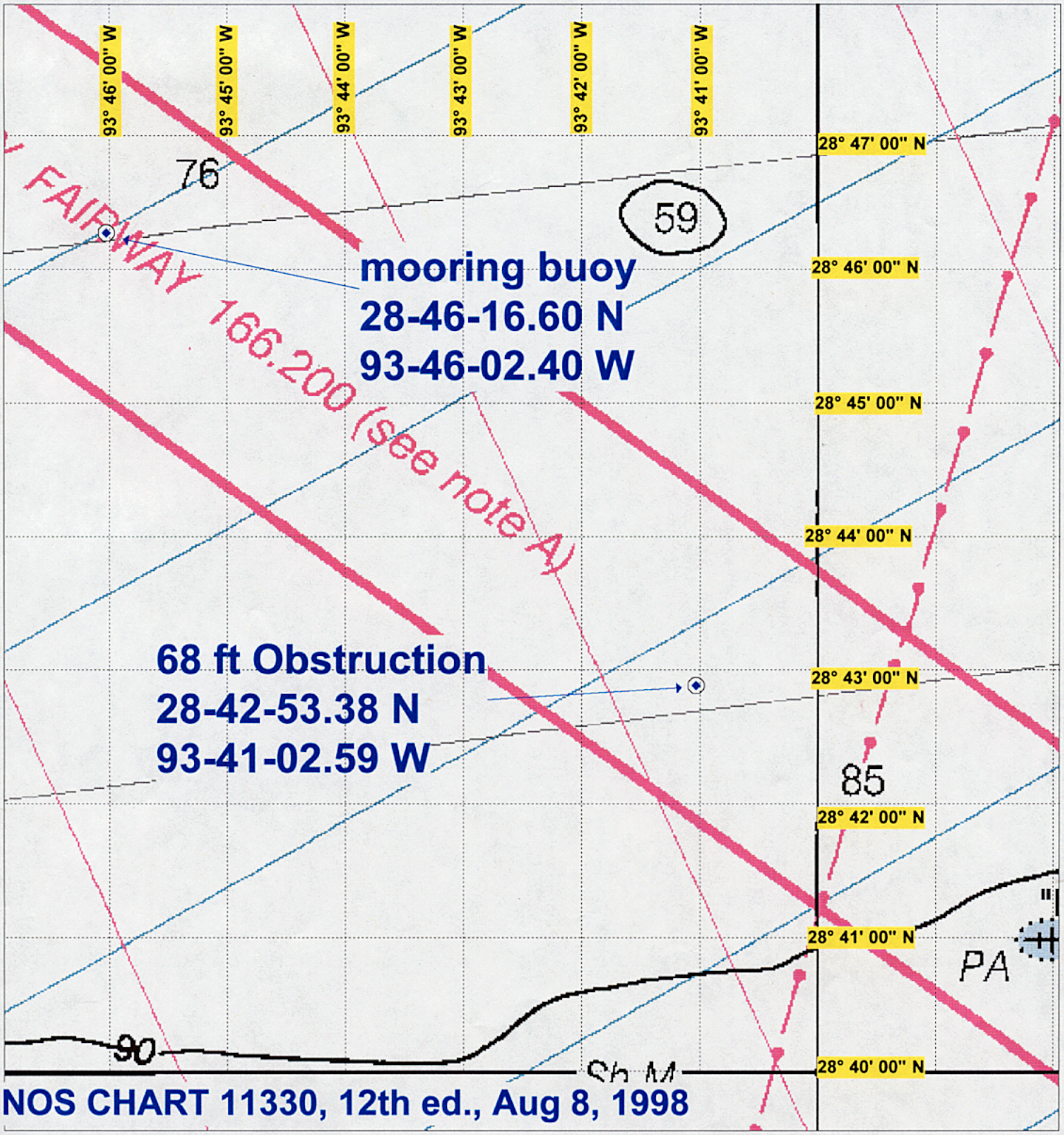
Attachment

cc: NIMA-NIS
N/CS26
N/CS31

DANGER TO NAVIGATION

NOS SURVEY: H10941 **NOAA Contractor: SAIC**

All depths were obtained using a multibeam echosounder and are referenced to MLLW using NOS verified tides. All positions were obtained using DGPS and are referenced to NAD83.



NOS CHART 11330, 12th ed., Aug 8, 1998

PRELIMINARY INFORMATION ...SUBJECT TO OFFICE REVIEW ... NOT FOR USE IN NAVIGATION

APPROVAL SHEET
H10941

Initial Approvals:

The completed survey has been inspected with regard to survey coverage, delineation of depth curves, development of critical depths, cartographic symbolization, and verification or disproval of charted data. The digital data have been completed and all revisions and additions made to the smooth sheet during survey processing have been entered in the digital data for this survey. The survey records and digital data comply with NOS requirements except where noted in the Evaluation Report.

_____________ Date: 25 April 2002
Robert G. Roberson
Cartographer
Atlantic Hydrographic Branch

I have reviewed the smooth sheet, accompanying data, and reports. This survey and accompanying digital data meet or exceed NOS requirements and standards for products in support of nautical charting except where noted in the Evaluation Report.

_____________ Date: 4/25/2002
Emily B. Christman
Commander, NOAA
Chief, Atlantic Hydrographic Branch

****

Final Approval:

Approved: _____________ Date: July 12, 2002
Samuel P. DeBow
Captain, NOAA
Chief, Hydrographic Surveys Division

NOAA FORM 75-96
(10-83)

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

MARINE CHART BRANCH

RECORD OF APPLICATION TO CHARTS

FILE WITH DESCRIPTIVE REPORT OF SURVEY NO. H10941

INSTRUCTIONS

A basic hydrographic or topographic survey supersedes all information of like nature on the uncorrected chart.

1. Letter all information.
2. In "Remarks" column cross out words that do not apply.
3. Give reasons for deviations, if any, from recommendations made under "Comparison with Charts" in the Review.

CHART	DATE	CARTOGRAPHER	REMARKS
11330	05/06/02	Richard Blum	Full ~~Part Before~~ After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
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