H10983C

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey Hydrographic / Multibeam

Field No. Sheet C

Registry No. H10983C

LOCALITY

State Massachusetts

General Locality Salem Harbor

Locality Salem Channel

2000

CHIEF OF PARTY
Walter S. Simmons

LIBRARY & ARCHIVES

DATE September 27, 2002

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NO. H10983a, H10983b, H10983c
	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. A, B, C

State MASSACHUSETTS

General locality ~~ATLANTIC OCEAN, SALEM SOUND~~, SALEM HARBOR

Locality ~~Middle Ground to Bakers Island, Whaleback Shoal to Coney Island,~~ Salem Channel

Scale ~~(a) 1:10,000 (b) 1:5,000~~ (c)1:5,000 Date of survey 18 May – 27 June 2000

Instructions Dated 01 November 1999 as amended Project No. OPR-A338-KR

Vessel R/V OceanExplorer US905425

Chief of Party WALTER S. SIMMONS

Surveyed by Walter Simmons, George Ghiorse, Rick Nadeau, Dave Walker, Paul Donaldson, Steven Lemke

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 HEWLETT PACKARD DESIGNJET 2500 CP Automated plot by ~~HP1055CM~~

Verification by ATLANTIC HYDROGRAPHIC BRANCH PERSONNEL

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

REMARKS: Contract # 50-DGNC-0-90015
Contractor Name: Science Applications International Corp.
221 Third Street; Newport, RI 02840
NOTES IN DESCRIPTIVE REPORT WERE MADE DURING OFFICE PROCESSING

AWOIS ✓ & SURF ✓ by MBH on 8/6/02

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

☆ U.S. GOVERNMENT PRINTING OFFICE: 1976—665-661/1222 REGION NO. 6

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The Progress Sketch on the following page indicates:

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

PROGRESS SKETCH

PROJECT OPR-A338-KR

H10983

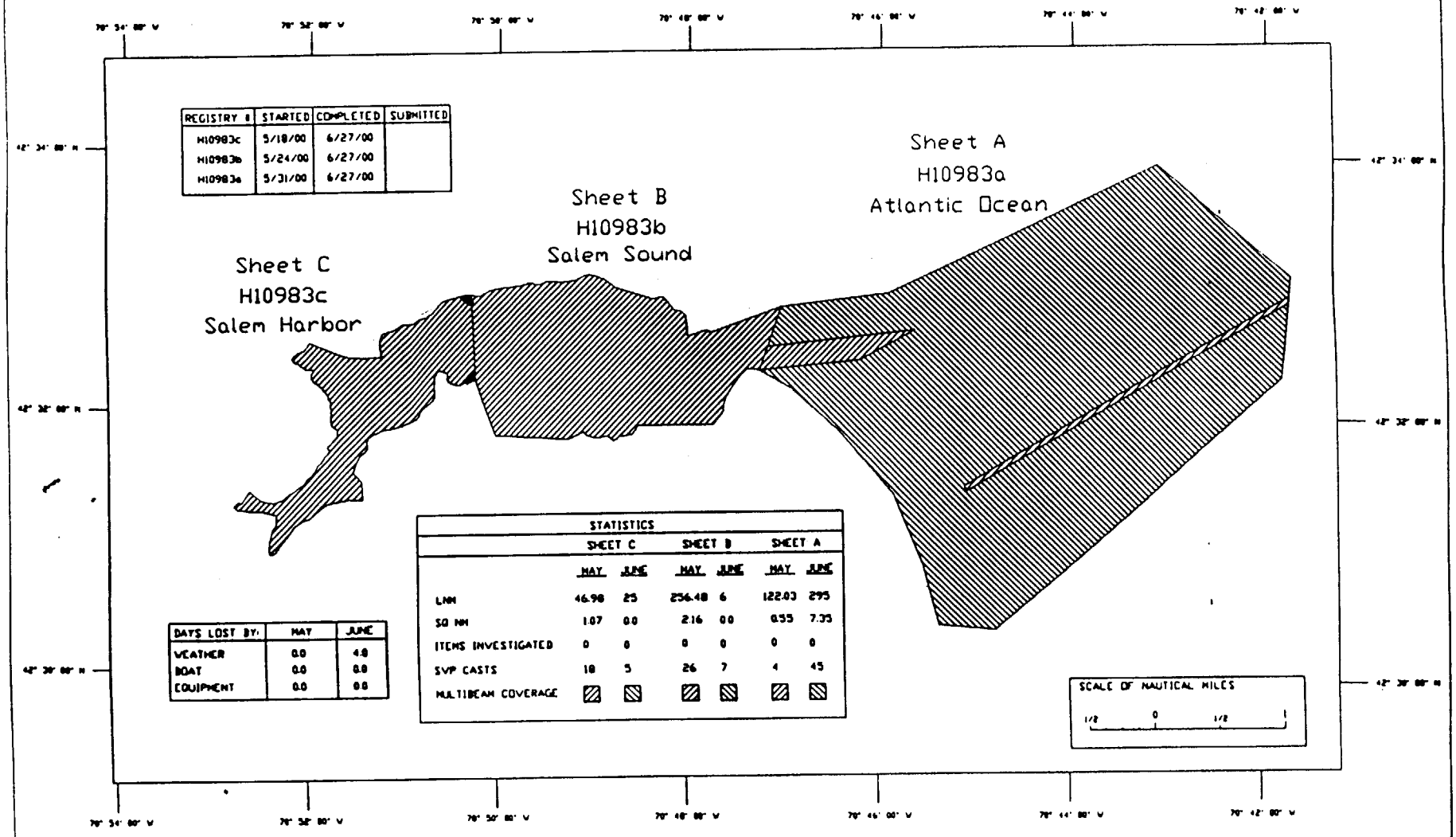
MULTIBEAM SONAR

R/V OCEAN EXPLORER

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

WALTER S. SIMMONS

HYDROGRAPHER



REGISTRY #	STARTED	COMPLETED	SUBMITTED
H10983c	5/18/00	6/27/00	
H10983b	5/24/00	6/27/00	
H10983a	5/31/00	6/27/00	

DAYS LOST BY:	MAY	JUNE
WEATHER	0.0	4.0
BOAT	0.0	0.0
EQUIPMENT	0.0	0.0

STATISTICS

	SHEET C		SHEET B		SHEET A	
	MAY	JUNE	MAY	JUNE	MAY	JUNE
LNM	46.98	25	256.48	6	122.03	295
SQ NM	1.07	0.0	2.16	0.0	0.55	7.35
ITEMS INVESTIGATED	0	0	0	0	0	0
SVP CASTS	18	5	26	7	4	45
MULTIBEAM COVERAGE						

SCALE OF NAUTICAL MILES

1/2 0 1/2 1

Science Applications International Corporation (SAIC) warrants only that the survey data acquired by SAIC and delivered to NOAA under Contract 50-DGNC-0-90015 reflects the state of the sea floor in existence on the day and at the time the survey was conducted.

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* NOT APPLICABLE
** DATA FILED WITH ORIGINAL FIELD RECORDS

Descriptive Report to Accompany
Hydrographic Survey H10983~~a~~, ~~b~~, c
Scale ~~"a" 1:10,000, "b" 1:5,000,~~ "c" 1:5000 Surveyed 2000
R/V OceanExplorer
Science Applications International Corporation (SAIC)
Walter S. Simmons, Hydrographer

A. PROJECT

Project Number: OPR-A338-KR
Dates of Instructions: 1 November 1999
1 May 2000
16 May 2000

Original: 50-DGNC-0-90015
Task Order #1: 56-DGNC-0-33001
Task Order #2: 56-DGNC-0-33002

Dates of Supplemental Instructions: none
Sheet Letters: ~~A, B,~~ C
Registry Number: ~~H10983a, H10983b~~, H10983c
Purpose: To provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area.

B. AREA SURVEYED

Description:

The area surveyed extended from Salem Harbor eastward through Salem Sound into the Atlantic Ocean along Salem Channel. Included were mooring areas at Salem and Beverly, most of Salem Sound, and the Atlantic Ocean eastward to Middle Ground and southward to Newcomb Ledge.

Dates of multibeam data acquisition (UTC):

Sheet C, H10983c	
5/18/2000 – 5/22/2000	139 – 143
6/2/2000	154
6/7/2000	159
6/15/2000	167
6/27/2000	179

~~Sheet B, H10983b~~	
5/24/2000 – 5/30/2000	145 – 151
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~~Sheet B, H10983b (cont.)~~	
6/15/2000	167
6/27/2000	179

~~Sheet A, H10983a~~	
5/31/2000	152
6/2/2000	154
6/5/2000	157
6/7/2000 – 6/10/2000	159 – 162
6/13/2000 – 6/14/2000	165 – 166
6/27/2000	179

C. SURVEY VESSEL

The R/V OceanExplorer was the platform for multibeam sonar and sound velocity data collection. The main cabin of the vessel was used as the data collection center. All data were shipped to the Data Processing Center in the Newport office for post-processing. The POS/MV IMU was mounted on the vessel centerline just forward and above the RESON 8101 transducer, below the

~~*~~ NA

main deck. The multibeam sounder transducer was mounted on the keel. Multibeam data were collected by the 8101. Table C-1 is a list of vessel characteristics for the R/V OceanExplorer.

Table C-1. Survey Vessel Characteristics

Vessel Name	LOA (Ft)	Beam (Ft)	Draft (Ft)	Gross Tonnage	Power (Hp)	Registration Number
R/V OceanExplorer	61'	16'4"	3'3"	56	1100	US905425

The R/V OceanExplorer sensor configuration is depicted in Figure C-1 and the vessel offsets are shown in Table C-2. For these surveys, the R8101 transducer was installed on the hull mount. Figure C-2 shows the draft calculations for the R/V OceanExplorer. 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 3.07 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. 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 OceanExplorer during Survey Operations, measurements in meters

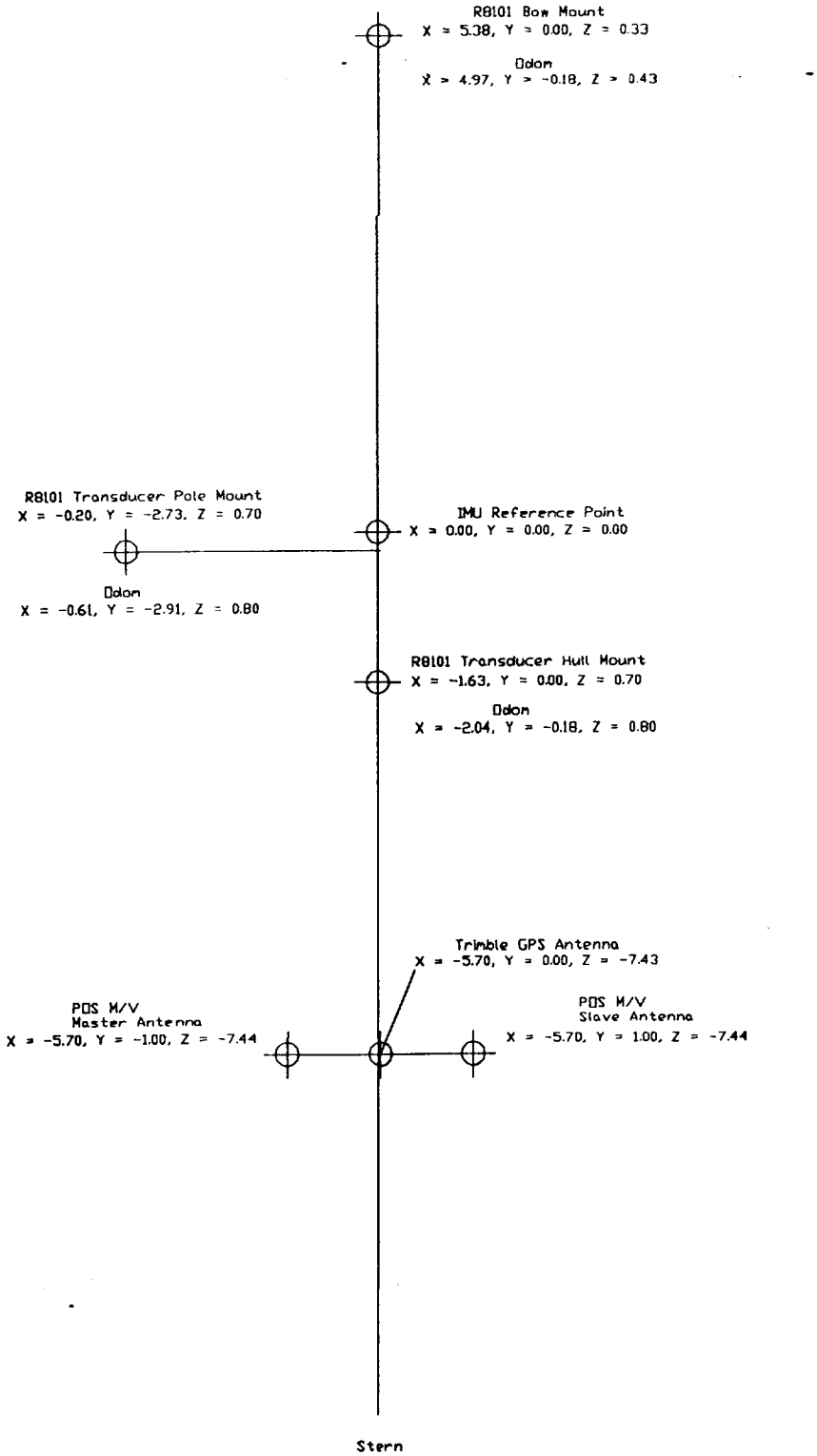
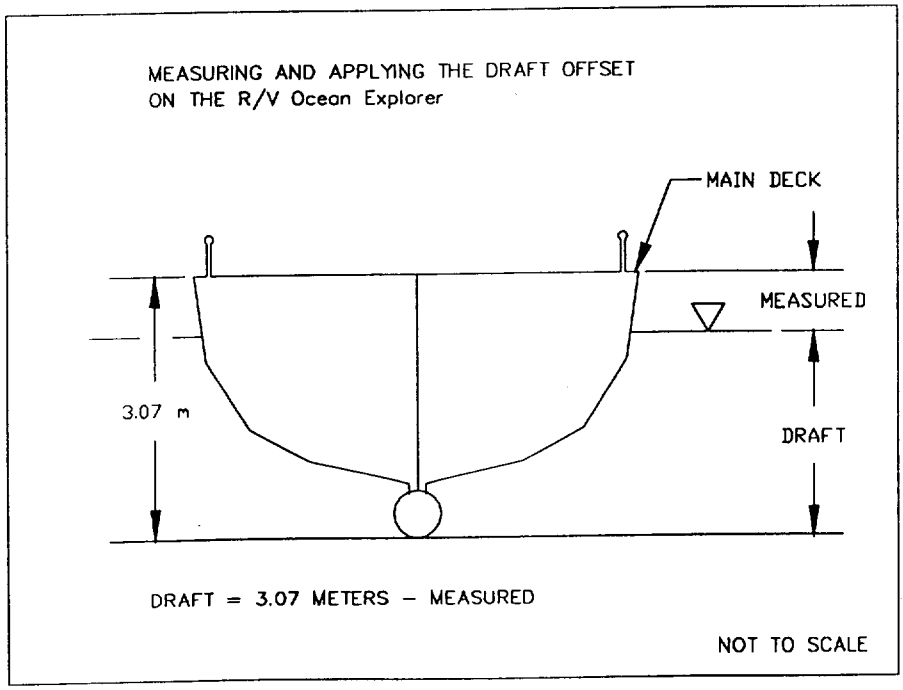


Table C-2. R/V OceanExplorer Antenna and Transducer Locations Relative to the POS/MV IMU Vessel Reference Point, measurements in meters

Sensor	Offset in ISS2000		POS/MV IMU	
Multibeam Reson 8101 Transducer Hull Mount			X	-1.63
			Y	0.00
			Z	0.70
ODOM Singlebeam Transducer	X	-2.04		
	Y	-.018		
	Z	0.80		
Trimble 7400 Antenna	X	-5.70		
	Y	0.00		
	Z	-7.43		
POS/MV GPS Master Antenna			X	-5.70
			Y	-1.00
			Z	-7.44

Figure C-2. R/V OceanExplorer 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. Real-time navigation, data time tagging and data logging were controlled by the **iss2000** on a Windows NT 4.0. Survey Planning and data processing were done on UNIX machines.

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 multibeam data. Positioning confidence checks were performed alongside survey control stations in port during Sea Acceptance Tests. Daily positioning confidence checks for the R/V OceanExplorer were done by comparing data recorded from the POS/MV to data recorded from the Trimble DGPS.

The RESON 8101 range scale was changed as necessitated by water depth between 5 and 150 meters. The data acquisition rate for the R8101 was set at 12 pings per second maximum rate with exception of Julian Day 179 when it was set to 15 pings per second. At an average speed of 7 knots and 12 per pings second, the average alongtrack coverage was 3.3 pings per meter in water depths to 25 meters, 2.6 pings per meter in water depths 25 meters to 40 meters, and 2.1 pings per meter in depths greater than 40 meters. In all cases, ensonification was adequate for detection of 2 meter by 2-meter objects.

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 1 and 150 meters. Interactive editing was 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. Predicted tidal correctors were applied in real-time. Observed tides were down loaded from the NOAA/CO-OPS web page. Preliminary and verified data from Boston, MA (844-3970) were applied to the multibeam data using the zoning provided November 1, 1999. APPROVED TIDES AND ZONING WERE APPLIED DURING FIELD PROCESSING

Depth data were then binned to 1-meter cells for Sheets B and C and 2-meter cells for Sheet A. The resulting grids were used for coverage and quality evaluation. When anomalies were seen in the 1 and 2 meter bins, 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 5-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 multibeam data file.

Soundings were selected from the 5-meter binned layer using the **sel_sound** sounding selection program. 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 5-meter bin layer have been evaluated. The **set_sound** program was run to flag all selected soundings in the gsf multibeam data. The selected sounding file, the navigation aids file, and the feature file were combined to produce the smooth sheet in **AutoCAD** and **MicroStation**.

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 I.* DATA FILED WITH ORIGINAL FIELD RECORDS

Multibeam Data Processing

The real time multibeam acquisition system used for the H10983 survey included:

- One Windows NT workstation – Used for system control, survey operations, real-time quality control, POS M/V and Trimble software.
- One personal computer – Used for downloading and conversion of sound velocity data from CTDs and for navigation logs.
- 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.
- One personal computer – Used for maintaining daily real-time system logs.

Initial navigation quality control was done on the vessel shortly after the data was collected. Tracklines were created, verified, and corrected to ensure data coverage and to check for navigation errors. Where time allowed, multibeam data were edited onboard the vessel using the **geoswath** editor. At the end of each day, both the raw and processed data were backed up onto 4mm tape and shipped to the data processing lab in Newport, RI.

In the processing lab in Newport, RI, manual editing was completed and reviewed by a data manager or Hydrographer. Any questionable possible obstructions were noted and later evaluated by the Hydrographer. A data manager would then correct the data for draft and tides, update the coverage plots, tracklines, sounding bins, 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.

Feature analysis was performed correlating multibeam features from different swaths. Multibeam coverage and sounding plots were updated following changes found during the feature analysis. The **iss2000** system used proprietary algorithms to create the binned depths and selected soundings. Final plots were produced exporting data to a dxf format using the **iss2000** software. These data were then imported into **AutoCAD** and **MicroStation** for final map production.

E. SIDESCAN SONAR

Not used by contractor.

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

Weekly comparisons of R8101 nadir soundings to ODOM EchoTrak 200 kHz vertical echo sounder are summarized in Appendix E. DATA FILED WITH ORIGINAL FIELD RECORDS

G. CORRECTIONS TO SOUNDINGS

1. Tides and water levels

Preliminary and verified tide data were downloaded from the NOAA CO-OPS web page based on the Boston, MA (844-3970) station. Tide corrector files for each tide zone were created from actual tide data using the **iss2000 tid2hmps** routine. These corrector files were then applied to the multibeam data using the **appcors** program within the **iss2000 Survey Analysis** software. After verified tides were applied to all multibeam data, grids were created at 1 meter cell size for survey sheets B and C, and 2 meter cell size for sheet A. These grids were then analyzed using color change intervals of 0.1, 0.2, 0.5, and 1 meter. This analysis showed shifts due to tide correction errors, unusual currents, storm surges, etc. There were no significant shifts due to tides.

2. Speed of Sound

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

Brooke Ocean Technology Ltd., Moving Vessel Profiler-30, Serial Number 4404
Calibration Dates: 1 May 2000

Brooke Ocean Technology Ltd., Moving Vessel Profiler-30, Serial Number 4523
Calibration Dates: 11 April 2000

Weekly confidence checks were obtained using consecutive casts with the primary SVP sensor and a secondary SVP. After downloading the SVP casts, both were compared to each other and to the previously applied cast. 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 refraction 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 sound velocity of the cast to extend the profile to the maximum depth.

Factors considered in determining how often a SVP 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. Casts were taken at approximately two-hour intervals.

Quality control tools, including real-time displays of color-coded coverage 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 SVP casts, dates of each cast, the location of the cast, and the maximum depth of each cast is located in Table App. H-1, Appendix H. DATA FILED WITH ORIGINAL FIELD RECORDS

2. Instrument Corrections

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

3. Static draft

Depth of the transducer below the deck was determined from measurements made while the boat was hauled in May 2000. The static draft was observed daily by measuring from the main deck to the waterline before getting underway 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 **iss2000** 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 Table App. E-1, Appendix E. DATA FILES WITH ORIGINAL FIELD RECORDS

4. Settlement and Squat

Measurements of settlement were conducted near 41 31 56N 071 19 30W on day 134, May 13, 2000, in 18 meters of water off the end of the Coddington Cove breakwater, Narragansett Bay, RI. The following procedures were used to determine the settlement correctors:

Measurement by Surveyor's Level and Rod, the preferred method when the attitude sensor (IMU) and the transducer are not co-located.

1. Used a surveyor's level and a level rod with target, or a stadia board to measure the elevation of a spot above the attitude sensor (IMU) on the survey boat as the boat was operated at different shaft RPMs.
2. Selected a location to set up a surveyor's level ("level") overlooking adequate water for the survey vessel to run a survey line at various speeds, including full speed. Established communication between "level" and the boat.
3. Selected the "static" point for initial measurements, which was the point at which the vessel was to hold station.
4. Planned the "settlement and squat" survey line through "static". The vessel ran this line at various shaft RPM settings to make settlement and squat measurements. The line ran more nearly toward the "level" than across in front of it. This made it more likely that the observer was able to focus on and read, or direct the reading, of the level rod on the boat. For this reason, a breakwater end was chosen.
5. Marked a spot on the vessel above the attitude sensor (IMU) so that the level rod was always held at the same point on the boat.
6. Stopped the vessel at "static" with the starboard side toward "level".
   A. Held the rod on mark with face toward "level".
   B. Adjusted the rod target according to signals from "level".
   C. On signal from "level", recorded time and rod reading from target.
   D. Repeated the reading at least three times.
   E. The NOAA water level gauge at Newport was used to record water levels.
7. On a signal from the surveyor at "level", made way on "settlement and squat" survey lines at predetermined shaft RPM.
   A. On survey track, held rod on mark with face toward "level".
   B. Adjusted rod target according to signals from "level".
   C. On signal from "level", recorded time and rod reading from target. Readings were taken as nearly as possible at "static" to reduce errors from level instrument adjustment and earth curvature.
   D. Repeated the reading at least three times.
   E. The NOAA water level gauge at Newport was used to record water levels.
8. Increased speed to the predetermined shaft RPM settings up to and including full speed, and reran "settlement and squat" tests as described in Step 7.

9. Computed the **settlement and squat** correctors:
   A. Computed the water level correctors from the time of the "static" reading to the time of each of the shaft RPM observations. (Water level during shaft RPM pass minus water level "static").
   B. Applied the water level corrector to each of the shaft RPM rod observations.
   C. Subtracted the corrected rod reading at each shaft RPM from the rod reading at "static". These differences are the settlement and squat correctors to be applied when operating at the corresponding shaft RPM.
   D. Constructed a lookup table of shaft **RPM** and **settlement and squat correctors** so that the computer may interpolate a corrector based upon the shaft RPM entered into the system during the survey.
   E. Entered these values in the **iss2000 .cfg** file.

All results are reported in Table App. E-4, Appendix E. DATA FILED WITH ORIGINAL FIELD RECORDS

5. 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 314

The POS/MV was used for heave, roll, pitch, and heading. 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 Narragansett Bay during the Sea Acceptance Test. Prior to conducting any of the tests, an SVP was calculated from the MVP-30 and entered into the RESON system. Initially, the roll, pitch, and heading biases were set to 0° in the RESON system.

For this project SAIC has used a combination of the **geoswath** editor and a spreadsheet to compute the roll bias between the POS/MV IMU and the transducer. This technique was developed and used on the Gulf of Mexico project for roll bias determination over flat bottom. Because the bottom is seldom truly flat, the test is accomplished by running the same line in opposite directions over a smooth bottom. An area is selected for the measurements, and an equal number of port and starboard depth pairs is measured from each direction. The apparent port to starboard slope of the bottom is computed for each pair of measurements. Averaging the equal number of slopes from each direction removes the bottom slope and leaves the roll bias. If a roll bias was in the system at the time of the test, it is added algebraically to the apparent slope to compute the values to be averaged.

On Julian day 132, three separate determinations of roll bias were made and then averaged for a bias value of 0.18. On Julian day 134, a test of roll bias was made with a 0.00 roll bias in the system. The result of this test was a roll bias of 0.09. Because we mistakenly thought we had a bias of 0.18 in the system at the time of this test, we added the 0.09, and started the Salem MA surveys with a roll bias of 0.27 in the system. Upon discovery of the mistake, we changed the real time system to a roll bias of 0.18, and we corrected all previously collected Salem data to a roll bias of 0.18. Examination of the data shows this to be the correct value.

Roll bias results are shown in

Table App. E-2 in Appendix E. DATA FILED WITH ORIGINAL FIELD RECORDS

After the roll bias was calculated and entered into the RESON system, timing latency test and then pitch bias tests were conducted. Timing latency testing was conducted by running the same line in the same direction, at slow speeds then at fast speed, over distinct rocks on the bottom. The **geoswath** editor was used to measure the positions of the rocks from data taken at the two speeds. Differences in positions of the rocks were less than one meter and were both positive and negative in sign as well as across track. This indicated no timing latency, only the scatter associated with DGPS positioning.

Pitch bias testing was conducted by running the same line as for timing latency, but in the opposite direction at the same speed. Positioning of the rocks was similar to the timing results, indicating no pitch bias. Since there was no discernable timing latency or pitch bias as a result of these tests, a bias of 0.0° was kept in the system for the survey.

Following the roll and pitch bias tests, a heading bias test was conducted by running parallel lines in opposing directions so that the outer beams of adjacent swaths ensonified the same rocks used for timing and pitch. Positioning of the rocks was similar to the results of the timing and pitch tests, indicating no heading bias. Therefore, a heading bias of 0.0° was kept in the system for this survey.

Table App. E-5 contains the results of the Accuracy test conducted on JD 134. Roll, pitch, and heading biases applied in H10983 are shown in Table G-1.

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

Julian Days	139-179
Roll	0.18
Pitch	0.00
Heading	0.00

H. HYDROGRAPHIC POSITION CONTROL

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

- TSS POS/MV, Serial Number 314
- Trimble 7400 GPS Receiver, Serial Number 3713A18839
- Trimble Probeacon Differential Beacon Receiver, Serial Number 0220159406
- Leica MX41R 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 Portsmouth Harbor, NH. The **iss2000** monitored HDOP, number of satellites, elevation of satellites, and age of correctors to ensure the resulting hydrographic positioning errors did not exceed five meters at the 95% confidence level.

Daily position confidence checks were established using a Trimble DGPS with correctors from the U.S. Coast Guard station at Chatham, MA. 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 5 meters.

The USCG Portsmouth Harbor, NH DGPS station was used as the primary positioning corrector source. The USCG Chatham, MA DGPS station was used for daily positioning confidence checks. The secondary DGPS receiver, Leica MX41R, automatically locks onto the strongest DGPS signal; therefore, if the USCG Portsmouth Harbor, NH DGPS station was off the air for upgrades, then the station used by the secondary DGPS could be set as primary. When the USCG Portsmouth Harbor, NH DGPS station came back online, primary navigation switched back to it.

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.

I. SHORELINE

Not applicable, shoreline verification was not required. However, a section of shoreline is shown at the power plant in Salem, MA. The charted dolphins are connected by a deck, and are essentially a pier. The shoreline shown was drawn from the position of the pilings in the multibeam data.

J. CROSSLINES

The following are statistics of crossline and main scheme lineal nautical miles surveys:

Sheet	Main Scheme lines (Nautical miles)	Crosslines (Nautical miles)	% covered by crosslines
H10983a	278	36	13
H10983b	206	20	10
H10983c	213	13	6

Comparisons of all crossing data in H10983c show that 95.9 % of comparisons are within 30 centimeters and 98.6 % of comparisons are within 40 centimeters. The 1.40 % of comparisons larger than 40 centimeters are accounted for by the normal small DGPS position scatter in areas of steep slope, rocks and obstructions. Table J-1 shows the comparisons using all crossings in H10983c.

Table J-1. Junction Analysis All Main Scheme vs. Cross Lines, H10983c

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	53574	58.24	29503	48.98	17715	69.74	6356
10.0cm	->	20.0cm	24391	84.75	18895	80.34	5496	91.38	
20.0cm	->	30.0cm	10325	95.97	8671	94.74	1654	97.89	
30.0cm	->	40.0cm	2449	98.63	2052	98.14	397	99.46	
40.0cm	->	50.0cm	813	99.52	713	99.33	100	99.85	
50.0cm	->	60.0cm	196	99.73	178	99.62	18	99.92	
60.0cm	->	70.0cm	99	99.84	90	99.77	9	99.96	
70.0cm	->	80.0cm	56	99.9	51	99.86	5	99.98	
80.0cm	->	90.0cm	25	99.93	22	99.89	3	99.99	
90.0cm	->	100.0cm	24	99.95	24	99.93	0	99.99	
100.0cm	->	110.0cm	43	100	40	100	3	100	
sub-totals ->			91995	100.00%	60239	65.48%	25400	27.61%	6356
									6.91%
H10983c Cross Line Sounding Minus Main Scheme Sounding, approximately 1000 crossings.									

Comparisons at 160 crossings in nine different areas of H10983c comprise approximately 16% of the crossings in the survey, and are listed in the separates to this report. These comparisons were made over relatively flat bottom, and reflect main scheme soundings taken on several different days. These comparisons show 97.7% are within 30 centimeters and 99.4% are within 40 centimeters.

Comparisons of all crossing data in H10983b show that more than 96 % of comparisons are within 30 centimeters and 98.3 % of comparisons are within 40 centimeters. The 1.70 % of comparisons larger than 0.4-meters are accounted for by the normal small DGPS position scatter in areas of steep slope, rocks and obstructions. Table J-2 shows the comparisons using all crossings in H10983b. N/A

Comparisons at 234 crossings in eleven different areas of H10983b comprise approximately 10% of the crossings in the survey, and are listed in the separates to this report. These comparisons were made over relatively flat bottom, and reflect main scheme soundings taken on several different days. These comparisons show 99.5% within 30 centimeters and 99.9% within 40 centimeters. N/A

Table J-2. Junction Analysis All Main Scheme vs. Cross Lines, H10983b N/A

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	122714	63.56	56424	53.06	58027	73.95	8263
10.0cm	->	20.0cm	46988	87.89	31482	82.67	15506	93.71	
20.0cm	->	30.0cm	16261	96.32	12324	94.25	3937	98.72	
30.0cm	->	40.0cm	3833	98.30	3280	97.34	553	99.43	
40.0cm	->	50.0cm	1680	99.17	1488	98.74	192	99.67	
50.0cm	->	60.0cm	546	99.46	445	99.16	101	99.8	
60.0cm	->	70.0cm	375	99.65	312	99.45	63	99.88	
70.0cm	->	80.0cm	243	99.78	202	99.64	41	99.94	
80.0cm	->	90.0cm	131	99.84	116	99.75	15	99.95	
90.0cm	->	100.0cm	103	99.9	93	99.84	10	99.97	
100.0cm	->	110.0cm	200	100	174	100	26	100	
sub-totals ->			193074	100.00%	106340	55.08%	78471	40.64%	8263
									4.28%
H10983b Cross Line Sounding Minus Main Scheme Sounding, approximately 2000 crossings.									

Comparisons of all crossing data in H10983a show that more than 91 % of comparisons are within 30 centimeters and 96.3 % of comparisons are within 40 centimeters. The comparisons larger than 0.4-meter are accounted for by the normal small DGPS position scatter in areas of steep slope, rocks and obstructions. Table J-3 shows the comparisons using all crossings in H10983a. N/A

Comparisons at 147 crossings in eight different areas of H10983a comprise approximately 10% of the crossings in the survey, and are listed in the separates to this report. These comparisons were made over relatively flat bottom, and reflect main scheme soundings taken on several different days. These comparisons show 94.6% within 30 centimeters and 98.9% within 40 centimeters. N/A

Table J-3. Junction Analysis All Main Scheme vs. Cross Lines, H10983a N/A

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	349961	44.76	185908	34.91	141979	62.47	22074
10.0cm	->	20.0cm	231261	74.34	173373	67.47	57888	87.94	
20.0cm	->	30.0cm	130875	91.08	110157	88.16	20718	97.06	
30.0cm	->	40.0cm	41292	96.36	37609	95.22	3683	98.68	
40.0cm	->	50.0cm	15220	98.31	14027	97.86	1193	99.2	
50.0cm	->	60.0cm	4437	98.87	3828	98.57	609	99.47	
60.0cm	->	70.0cm	2693	99.22	2336	99.01	357	99.63	
70.0cm	->	80.0cm	1795	99.45	1515	99.3	280	99.75	
80.0cm	->	90.0cm	984	99.57	833	99.45	151	99.82	
90.0cm	->	100.0cm	816	99.68	716	99.59	100	99.86	
100.0cm	->	110.0cm	2510	100	2190	100	320	100	
sub-totals ->			781844	100.00%	532492	68.11%	227278	29.07%	22074
									2.82%
H10983a Cross Line Sounding Minus Main Scheme Sounding, approximately 1100 crossings.									

K. JUNCTIONS SEE ALSO THE EVALUATION REPORT

N/A

The H10983c survey junctions with H10983b, ~~and H10983b then junctions with H10983a~~. See Table K-1 for the listing of the Junction Analysis, H10983c, Sheet C to H10983b, Sheet B, and ~~Table K-2 for the listing of the Junction Analysis, H10983b, Sheet B to H10983a, Sheet A~~. N/A

Comparison between H10983c and H10983b shows 95.5% were within 50 centimeters. Differences exceeding 60 centimeters are attributed to position differences in steeply sloping and rocky bottom. In the flat channel bottom, comparisons show 87.0% were within 30 centimeters and 99.2% were within 40 centimeters.

Table K-1. Junction Analysis H10983c, Sheet C vs. H10983b, Sheet B

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	1539	16.34	1150	13.17	309	50.91	80
10.0cm	->	20.0cm	1956	37.11	1751	33.23	205	84.68	
20.0cm	->	30.0cm	3236	71.48	3147	69.28	89	99.34	
30.0cm	->	40.0cm	1701	89.54	1700	88.75	1	99.51	
40.0cm	->	50.0cm	570	95.59	567	95.25	3	100	
50.0cm	->	60.0cm	254	98.29	254	98.16	0	100	
60.0cm	->	70.0cm	158	99.97	158	99.97	0	100	
70.0cm	->	80.0cm	1	99.98	1	99.98	0	100	
80.0cm	->	90.0cm	1	99.99	1	99.99	0	100	
90.0cm	->	100.0cm	0	99.99	0	99.99	0	100	
100.0cm	->	110.0cm	1	100	1	100	0	100	
sub-totals ->			9417	100.00	8730	92.70	607	6.45	80
									0.85
H10983b Sounding Minus H10983c Sounding Junction Analysis, all comparisons									

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	542	24.98	412	20.28	91	91.92	39
10.0cm	->	20.0cm	466	46.45	463	43.06	3	94.95	
20.0cm	->	30.0cm	881	87.05	879	86.32	2	96.97	
30.0cm	->	40.0cm	265	99.26	265	99.36	0	96.97	
40.0cm	->	50.0cm	16	100	13	100	3	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	
80.0cm	->	90.0cm	0	100	0	100	0	100	
90.0cm	->	100.0cm	0	100	0	100	0	100	
100.0cm	->	110.0cm	0	100	0	100	0	100	
sub-totals ->			2170	100.00	2032	93.64	99	4.56	39
									1.80
H10983b Sounding Minus H10983c Sounding Junction Analysis, flat channel bottom									

Comparison between H10983b and H10983a shows 95.9% within 50 centimeters. This includes rocky and steeply sloping portions of the common area. Comparisons in the flat bottom of the channel show 98.2% within 20 centimeters, 99.8% within 30 centimeters and 100% of 2637 comparisons within 50 cm. N/A

N/A

Table K-2. Junction Analysis H10983b, Sheet B vs. H10983a, Sheet A

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	2927	38.37	1508	66.81	1233	23.78	186
10.0cm	->	20.0cm	1176	53.79	455	86.97	721	37.69	
20.0cm	->	30.0cm	1503	73.49	158	93.97	1345	63.63	
30.0cm	->	40.0cm	1254	89.93	79	97.47	1175	86.29	
40.0cm	->	50.0cm	455	95.9	29	98.76	426	94.5	
50.0cm	->	60.0cm	159	97.98	11	99.25	148	97.36	
60.0cm	->	70.0cm	77	98.99	5	99.47	72	98.75	
70.0cm	->	80.0cm	38	99.49	3	99.6	35	99.42	
80.0cm	->	90.0cm	17	99.71	5	99.82	12	99.65	
90.0cm	->	100.0cm	9	99.83	1	99.87	8	99.81	
100.0cm	->	110.0cm	13	100	3	100	10	100	
sub-totals ->			7628	100.00	2257	29.59	5185	67.97	186
									2.44
H10983a Sounding Minus H10983b Sounding Junction Analysis, entire bottom									

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	2087	79.14	1233	81.39	710	72.6	144
10.0cm	->	20.0cm	504	98.26	275	99.54	229	96.01	
20.0cm	->	30.0cm	42	99.85	6	99.93	36	99.69	
30.0cm	->	40.0cm	2	99.92	1	100	1	99.8	
40.0cm	->	50.0cm	2	100	0	100	2	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	
80.0cm	->	90.0cm	0	100	0	100	0	100	
90.0cm	->	100.0cm	0	100	0	100	0	100	
100.0cm	->	110.0cm	0	100	0	100	0	100	
sub-totals ->			2637	100.00	1515	57.45	978	37.09	144
									5.46
H10983a Sounding Minus H10983b Sounding Junction Analysis, flat bottom only									

L. 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.

M. ITEM INVESTIGATION REPORTS

AWOIS No. 10466
Massachusetts, Salem Channel
Reported position: 42 32 15.34 N, 070 51 10.17 W
Datum: NAD83
Reported Depth: Hung at 30 feet, cleared at 27 feet (MLW)
Type of feature: unknown, probably metal

AWOIS No. 10466 originated from Project CS-265, C&GS WAINWRIGHT & HILGARD surveyed in 1954. An unexpected hang with effective depth of 30 feet, cleared by an effective depth of 27 feet (MLW). Rust on the ground wire and fittings indicated the hang was on something metal.

Survey requirements: 100% multibeam coverage of a 300 meter search radius.

Investigation was 100% multibeam coverage, with additional lines run over the reported position.

Results: A small feature, covered 30 feet at MLLW, was found at 42 32 15.54N 070 51 08.17W (NAD83), 44 meters east of the reported position. This is in an area of 31-foot depth. The search radius extends into depths of 19 feet to the north, 28 feet to the west, and 27 feet to the south. However, no other features were noted within the radius.

Recommendation: Delete the charted obstruction cleared to 27 feet at 42 32 15N 070 51 10W. Chart the 30 feet sounding at 42 32 15.5N 070 51 08.2W. concur Delete (27) Obstn

AWOIS No. 8005 N/A
Massachusetts Salem Sound, Salem Channel
Reported Position: 42 32 31.85 N, 070 48 19.52 W
Datum: NAD83

AWOIS 8005 originated with a chart letter 1467/72 report. The Vessel OVERSEAS VIVIAN touched bottom on September 20, 1972, drawing 36.6 feet, on Hospital Range. NOAA Ship FERREL investigated on September 25, 1972. Divers located a rock in Salem Channel in approximately reported position. Top of rock " cut level " with paint streaks on top. About two feet across the top. Approximate position 42 32 32.5N 070 48 25.0W. Least depth of 32.7 feet. NM44/72 rock reported northeastward covered 33 feet at MLLW in 42 32 32N 070 48 26W. FE256WD/81-OPR-A652-RU/HE-81, Item # 1 located in 42 32 31.5N 070 48 21.36W, rock outcrop, least depth of 34 feet.

Survey requirements: 100% multibeam coverage of a 250 meter search radius.

Investigation was by 100% multibeam coverage.

Results: The search radius encompasses the entire outcrop of which this rock is a part. Least depth on the outcrop is 18 feet MLLW in 42 32 24.7N 070 48 20.9W. However, this is not the rock in question.

The charted position is in 40 to 45 feet MLLW, and is east of the rock outcrop. The FERREL position is in 44 feet MLLW, and is west of the outcrop. The RU/HE-81 position is in 42 feet MLLW, in a saddle of the rock outcrop. N/A

The rocks designated in this survey are features #2, 34.8 feet MLLW; #3, 36.8 feet MLLW; #4, 35.1 feet MLLW; #5, 35.6 feet MLLW; and #6, 35.3 feet MLLW. See Section N for a tabulation of features. See Separates notebook for an image of this area. N/A

Recommendation: Delete the charted 34 rock at 42 32 32N 070 48 20W. Chart rocks selected from features #2 through #6 (Table N-1). N/A

N. COMPARISON WITH THE CHART SEE ALSO THE EVALUATION REPORT

H10983 was compared to Chart 13275, 27th edition, 24 July 1999 at scale 1:25,000, Chart 13276, 21st edition, 20 September 1997 at scale 1:10,000, Chart 13274 SC, 23rd edition, 18 December 1999 at scale 1:40,000, Chart 13279, 29th edition, 10 January 1998 at scale 1:40,000, and Chart 13267 29th edition, 28 February 1998 at scale 1:80,000. Recommend reconstruction of the common areas of all listed charts using data from these surveys.

Comparison of H10983c to Chart 13276

The charted 24 feet at 42 32 30N 070 50 20W is 27 feet on this survey. The surrounding shoal has shifted in position. Least depth is now 26 feet near the west end of the shoal. Concur

Haste Shoal, charted at 42 32 25N 070 50 44W, continues to have a least depth of 17 feet, but the extent of the shoal is larger than indicated by the chart. Concur SEE ALSO THE EVALUATION REPORT N.I.

The charted 18 feet at 42 32 51N 070 50 22W was found to have least depth of 15 feet slightly northeast of the previous position. Concur

The charted 18 foot curve across the north of this survey is in good agreement H10983c. Soundings in Beverly Channel are in general agreement for depths less than 27 feet, but this survey is shoaler by up to 4 feet for deeper depth. Concur

The shoal with charted 13 and 17 feet at 42 32 15N 070 51 50W was found to encompass a larger area with least depth of 12 feet. The adjacent shoal to the east with charted 18 feet has a least depth of 14 feet. The 18 foot curve encloses both these shoals. Concur

This survey shows 17 feet in charted 20 to 23 feet at 42 32 10N 070 51 47W. Concur

This survey shows 16 feet at:
42 32 16N 070 51 54W in charted 21 feet,
42 32 12N 070 51 49W in charted 22 feet and
42 32 12N 070 51 48W in charted 18 feet. Concur

This survey shows least depth of 17 feet on charted 15 foot shoal at 42 32 01N 070 51 37W. Concur

The two charted shoals near 42 32 04N 070 50 53W with charted depths of 16 and 17 feet have depths of 14 and 15 feet. The 18 foot curve encloses both these shoals as one. Concur

The charted shoal with charted 14 and 17 feet at 42 31 55N 070 51 39W is larger than charted and has least depth of 12 feet. Concur

The charted 18 foot shoal at 42 31 28N 070 51 28W has least depth of 14 feet. The charted 18 foot curve across the north side of South Channel encompasses this shoal, which extends further southwest than charted. CONCUR

South Channel is generally 1 to 3 feet shoaler than charted. CONCUR The mooring area at the south end of the survey is generally 1 to 3 feet shoaler than charted. CONCUR The Salem Harbor basin is generally one foot shoaler than charted. The mid-width of the Salem channel project is 30 to 35 feet. SEE ALSO THE EVALUATION REPORT

CONCUR

Comparison of H10983b to chart 13276 and chart 13275 N/A

Charted 21 feet in 42 32 49N 070 50 10W is found as 26 feet in this survey. Surrounding charted soundings agree with this survey. There are numerous objects, apparently rocks, on the bottom in this area.

The charted 24 foot curve around 42 32 16N 070 50 09W should enclose a larger area as shown in this survey. The charted 30 foot curve around this area is close to this survey's 30 foot curve. Depths deeper than 30 feet are in general agreement.

Charted 20 feet in 42 31 56N 070 49 59W is in 22 feet from this survey. Other charted soundings in the area are in agreement.

Soundings in Salem Channel and Marblehead Channel generally agree within one foot, except for features and dangers reported.

On Misery Shoal, 42 32 51N 070 48 42W, survey soundings are 1 to 3 feet shoaler than charted. At Misery rock, 42 32 53N 070 48 27W, charted soundings are within one foot of survey soundings. On Misery ledge, 42 32 41N 070 48 40W charted soundings agree with this survey. At John Ledge, 42 32 42N 070 48 50W, charted soundings are within one foot of survey soundings.

On Bowditch Ledge, 42 32 25N 070 48 41W, the red and white square day beacon is atop a round stone cairn. Soundings were not obtained to the base of the cairn. However, charted 3 feet is in surveyed 12 feet, and the charted 6 feet is in surveyed 9 to 12 feet. This survey shows a least depth of 5 feet to the Northwest. Other soundings within the 30 foot curve are within one foot of the charted depths.

The charted 19 feet, 42 32 25N 070 48 21W, is the surveyed 18 feet mentioned under AWOIS No. 8005 in Section M.

Soundings on Rising States Ledge, 42 32 08N 070 48 09W, are one to five feet shoaler than charted depths. Least depth is three feet.

At Hardy Rocks, 42 32 09N 070 48 00W, the square red and white day beacon is on a single pipe structure. Soundings and depth curves are in general agreement. There are rocks awash and bare at MLLW.

Soundings on House Ledge, 42 32 22N 070 48 12W, are in general agreement with the chart.

Charted 20 feet, 42 32 42N 070 48 15W, is in surveyed 27 feet.

Comparison of H10983a to chart 13275 N/A

On Newcomb Ledge, the charted least depth at 42 30 43N 070 45 18W is 18 feet. This survey found the least depth at 20 feet. The charted 23 feet on the east of Newcomb Ledge at 42 30 38N 070 44 58W was found to be 25 feet. Other soundings in the area agree fairly well with the charts.

In the rocky area of H10983a, soundings from this survey range from agreement with the chart to differences of several feet. This is probably because of differences in positioning accuracy, and in the partial coverage obtained in prior surveys.

The charted 16 feet, 42 31 44N 070 45 45W, is in 76 feet on this survey. The charted 17 feet, 42 31 41N 070 45 49W is found as 16 feet on top of a large rock outcrop. There is a smaller rock outcrop with least depth of 30 feet between the above charted 16 feet and 17 feet.

The rock outcrop, 42 32 52N 070 45 54W, is in general agreement with the chart with least depth 17 feet. The charted 23 feet, 42 32 56N 070 46 04W, is found as least depth 19 feet on a rock outcrop.

Charted 27 feet, 42 32 48N 070 46 50W, is found as depths of 28 and 30 feet on a rock outcop that extends southwest through a surveyed 38 feet.

Comparison of H10983a to chart 13279 N/A

Survey soundings are in general agreement with the chart.

Comparison of H10983a to chart 13267 N/A

In areas not previously discussed, survey soundings are in general agreement with the chart.

Features

In H10983c, there is one charted pipeline area. Within that area, there is one pipeline trench visible in the data between 42 32 3.93N 70 51 47.17W and 42 32 2.33N 70 50 48.30W. Additionally, there is a pipeline trench visible in the data from 42 31 21.41N 70 52 15.31W to 42 31 7.32N 70 52 8.57W. ~~In H10983b, there is a pipe covered by riprap from 42 32 15.37N 70 50 7.49W to 42 32 9.24N 70 50 11.45W. This is reported to be a disused sewer outfall~~. None of these apparent pipelines are useful as an aid to navigation.

Table N-1 lists eight new features discovered in H10983b. SAIC recommends that these features be charted as determined in this survey. N/A

Table N-1. New Features Discovered in H10983b

Feature Number	Latitude	Longitude	Depth (feet)	Category	Multibeam File Name	Ping	Beam	Depth (meters)
1	42 32 34.13N	70 48 07.07W	33.30	ROCK	mba00149.d14	2503	27	10.14
2	42 32 33.14N	70 48 22.65W	34.84	ROCK	mba00179.d11	11471	44	10.62
3	42 32 33.49N	70 48 20.55W	36.81	ROCK	mba00179.d11	8549	54	11.22
4	42 32 29.33N	70 48 17.19W	35.07	ROCK	mba00149.d14	6846	78	10.71
5	42 32 29.77N	70 48 18.34W	35.56	ROCK	mba00145.d09	15009	18	10.84
6	42 32 29.84N	70 48 19.58W	35.33	ROCK	mba00147.d16	9288	78	10.77
7	42 32 24.25N	70 49 02.20W	31.33	OBSTR	mba00179.d13	2200	40	9.55
8	42 32 14.05N	70 49 37.46W	32.61	WRECK	mba00179.d12	22538	44	9.94

N/A

In H10983a, there is a charted cable area. During the survey, a U.S. Coast Guard vessel was observed removing a cable.

There were 10 items submitted to NOAA determined to be Dangers to Navigation on H10983b and 10 items submitted on H10983c. Of the 10 items submitted on H10983b, 6 are listed in Table 1 and features 5 and 6 are discussed in section M, AWOIS #8005. Feature number 1 was previously submitted to NOAA as a 34 ft obstruction based on predicted tides. All of the items reported as Danger to Navigation had at least two different lines of bathymetry run and in some cases as many as 6 passes.

There were four Danger to Navigation items submitted to NOAA for consideration that have not previously been discussed: An 18 foot sounding was found at 42 32 10.50N, 70 50 13.53W, outside the charted 24ft curve. A 27 foot sounding was found at 42 32 13.30N, 70 50 05.01W, outside the charted 30ft curve. A 3 foot sounding was found at 42 32 11.40N, 70 48 06.00W, near Hardy Rocks near a charted 13ft. A 25 foot sounding was found at 42 32 26.03N, 70 50 00.38W, near a charted 31ft.

N/A

* Of the 10 items submitted to NOAA on H10983c, two were submitted to the USCG as Dangers to Navigation, a 13 ft sounding at 42 31 08.39N 70 52 07.99W, outside the 18 ft curve and a 16 ft sounding at 42 32 11.86N 70 51 45.75W, near a charted 22 ft. An additional 8 obstructions were submitted to NOAA for consideration: a 15 foot sounding in position 42 31 03.05N 070 52 20.82W, near a charted 20 ft. A 17 foot sounding in position 42 32 14.55N 070 51 47.46W, near a charted 18 ft. A 23 foot sounding in position 42 32 10.18N 070 51 24.97W, near a charted 29 ft. A 14 foot sounding in position 42 31 54.85N 070 51 37.34W, near a charted 17 ft. A 20 foot sounding in position 42 31 50.79N 070 51 33.42W, near a charted 22 ft. A 14 foot sounding in position 42 32 04.12N 070 50 52.17W, near a charted 17 ft. A 17 foot sounding in position 42 31 27.47N 070 51 27.74W, near a charted 18 ft. A 16 foot sounding in position 42 32 12.21N 070 51 45.75W, near a charted 22 ft.

O. ADEQUACY OF SURVEY

SEE ALSO THE EVALUATION REPORT

Not used by Contractor.

* THESE ITEMS WERE DETERMINED NOT TO BE DANGERS TO NAVIGATION DURING OFFICE PROCESSING.

P. AIDS TO NAVIGATION *SEE ALSO THE EVALUATION REPORT*

See Section N for discussion of charted pipelines. U.S. Coast Guard buoys were found on station as listed in Table P-1. These buoys adequately serve their purpose.

Table P-1. U.S. Coast Guard Buoys

Latitude	Longitude	Buoy Descriptor
		H10983c
42 32 30.30N	070 51 59.90W	R N "4"
42 31 24.51N	070 52 00.79W	R "22" Q R
42 32 22.44N	070 51 31.26W	R N "2"
42 32 19.82N	070 51 45.16W	G C "3"
42 32 28.44N	070 52 02.40W	G C "5"
42 32 35.02N	070 50 21.34W	G "13" Fl G 4s
42 32 28.67N	070 50 43.93W	G "15" Q G
42 32 14.08N	070 51 08.16W	R "16" Fl R 4s
42 31 56.27N	070 51 21.20W	G "17" Fl G 2.5s
42 31 58.50N	070 51 26.03W	R N "18"
42 31 41.40N	070 51 43.20W	R N "20"
42 31 34.09N	070 51 44.28W	G "21" Fl G 4s
42 31 18.00N	070 52 21.50W	R N "24"
42 31 15.06N	070 52 30.72W	G C "25"
		H10983b
42 31 56.28N	070 48 00.84W	R N "4"
42 32 09.72N	070 50 00.82W	G C "7"
42 32 24.00N	070 47 18.18W	G "9" Q G Bell
42 32 34.68N	070 48 01.86W	R "10" Fl R 2.5s
42 32 32.88N	070 48 33.42W	G "11" Fl G 4s
42 32 36.90N	070 48 52.86W	R "12" Fl R 4s
42 32 43.62N	070 50 11.85W	R N "14"
42 32 01.17N	070 47 42.44W	G C "3"
42 32 21.42N	070 47 45.36W	GR C "SE"
		H10983a
42 31 08.82N	070 45 04.48W	G C "3"
42 31 45.90N	070 45 43.10W	G C "5"
42 32 05.70N	070 46 28.90W	G C "7"
42 32 49.87N	070 45 54.14W	R N "6"

N/A

N/A

Four U.S. Coast Guard fixed aids were found on station as listed in Table P-2. These aids adequately serve their purpose. Both structures on H10983c, wooden pile dolphins, were positioned from the outer portion of the multibeam swath data. Position was taken as the centroid of the piling structure. The Hardy Rocks beacon, a single pipe structure, was positioned by hydrographer's estimate of distance abeam from two survey lines at near right angles to each other. The two computed positions were 3 meters apart. The average of these two positions is reported, and is about 20 meters south of the charted RW "HR" (7) PA. This new position is believed to be accurate within 5 meters. Position of the rock cairn at Bowditch Ledge was determined by intersection from the four survey lines surrounding the beacon. Recommend charting these four structures as found in this survey.

Table P-2. U.S. Coast Guard Fixed Aids

Latitude	Longitude	Fixed Aid Descriptor
		H10983c
42 30 54.43N	070 52 28.32W	Triangular Beacon, R "2"
42 31 13.28N	070 52 22.18W	Light, Q G 20ft 4M "23" (SALEM LIGHT)
		H10983b N/A
42 32 25.00N	070 48 41.30W	Rock Cairn, Square Beacon, RW Bn
42 32 09.42N	070 47 59.91W	Square Beacon, RW "HR" (7)

Q. STATISTICS

Survey statistics are as follows:

752 nm — Linear nautical miles of sounding lines (multibeam)
11.13 nm^2 — Square nautical miles of multibeam

H10983a

417.03	Linear nautical miles of sounding lines (multibeam)	N/A
7.9	Square nautical miles of multibeam	
11	Days of data acquisition	
0	Number of detached positions	
0	Number of bottom samples	
49	Number of sound velocity casts	
0	Number of tide stations installed	

H10983b

262.48	Linear nautical miles of sounding lines (multibeam)	N/A
2.16	Square nautical miles of multibeam	
11	Days of data acquisition	
0	Number of detached positions	
0	Number of bottom samples	
33	Number of sound velocity casts	
0	Number of tide stations installed	

H10983c

71.98	Linear nautical miles of sounding lines (multibeam)
1.07	Square nautical miles of multibeam
9	Days of data acquisition
0	Number of detached positions
0	Number of bottom samples
23	Number of sound velocity casts
0	Number of tide stations installed

R. MISCELLANEOUS

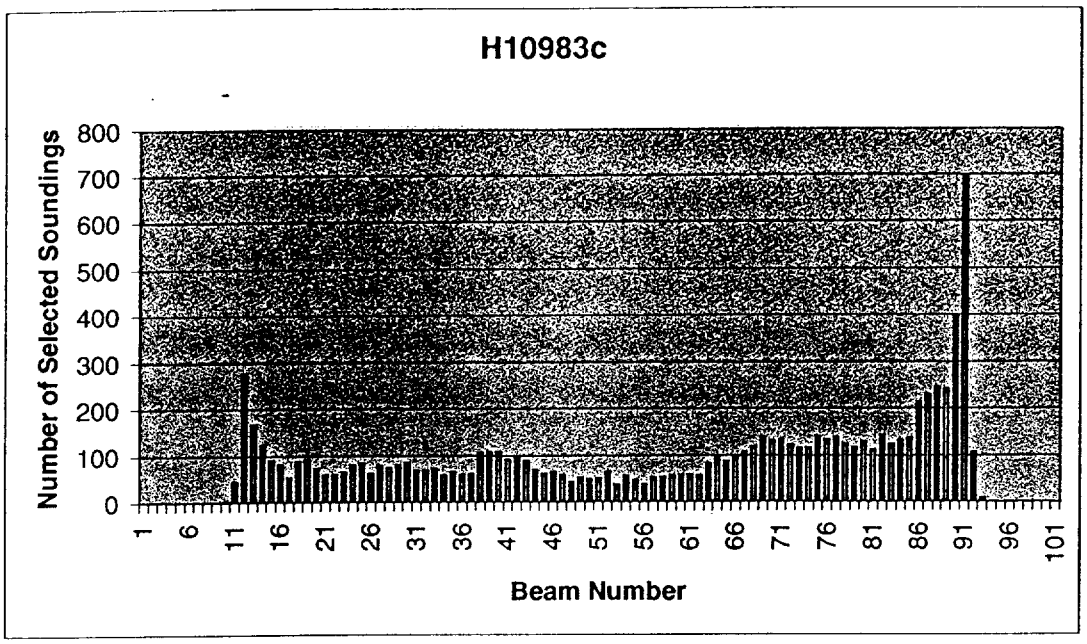


Figure R-1. Histogram of Selected Soundings by Beam Number – H10983c

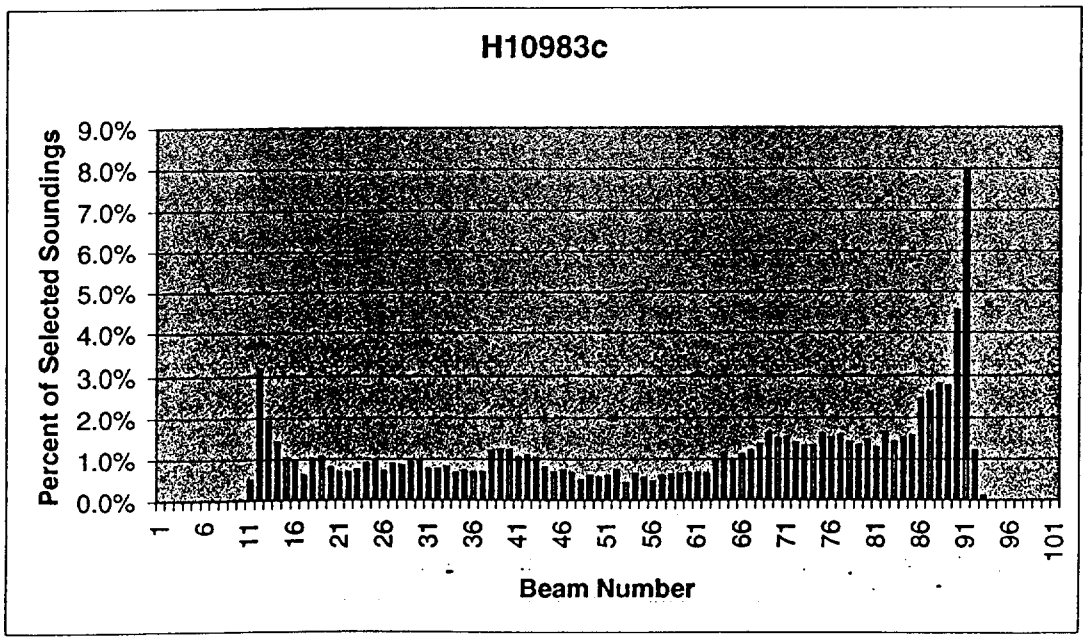
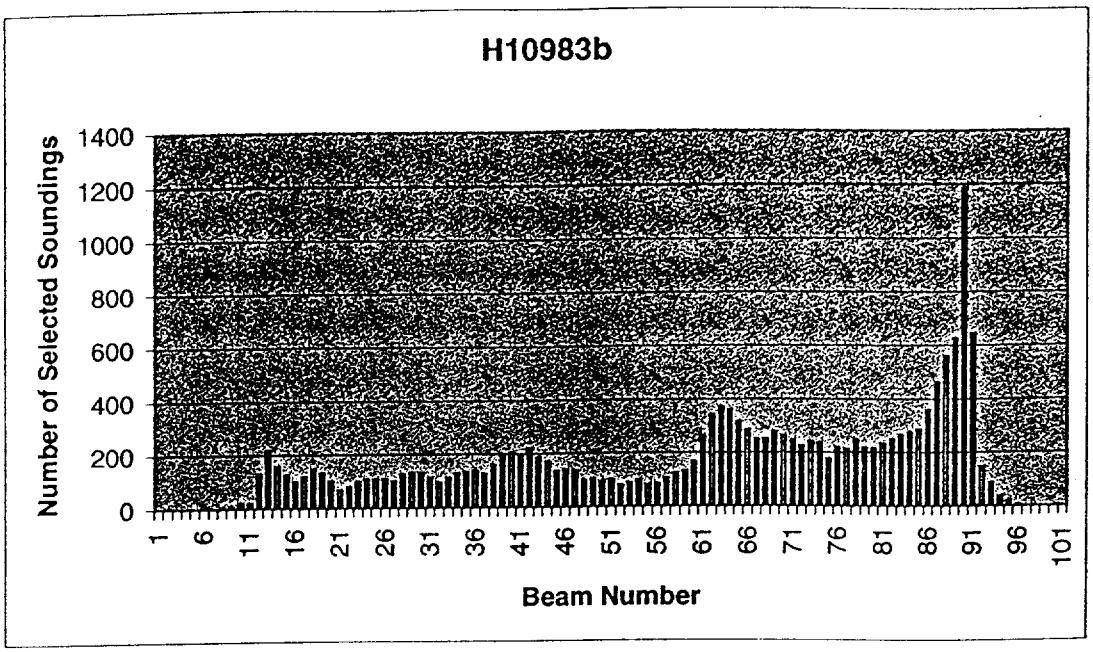
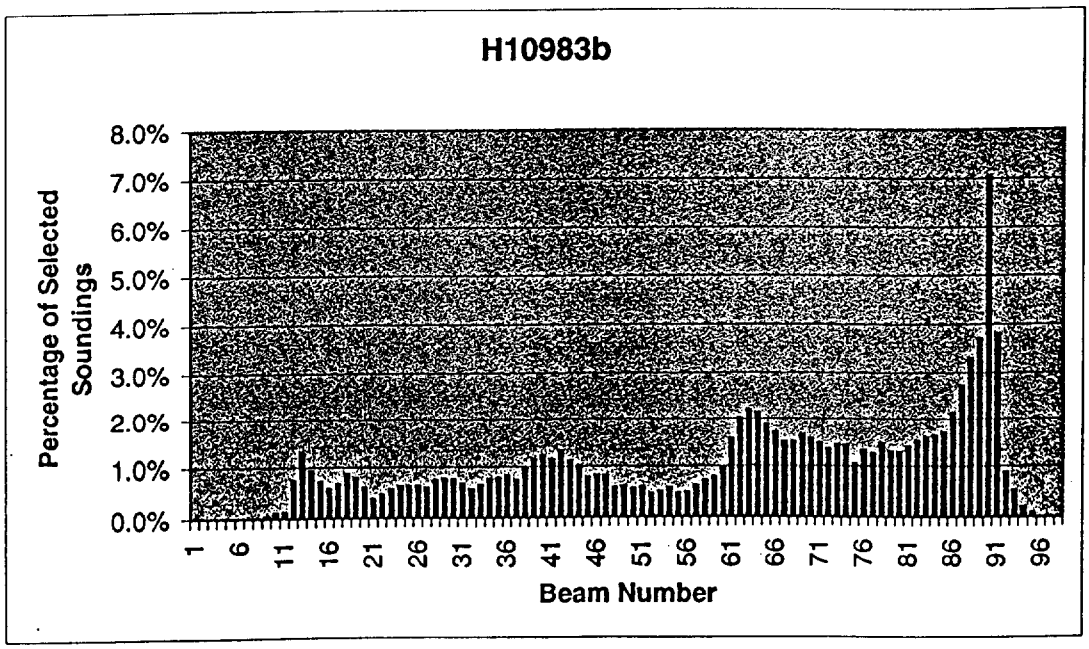


Figure R-2. Histogram of Percentage of Selected Soundings by Beam Number - H10983c



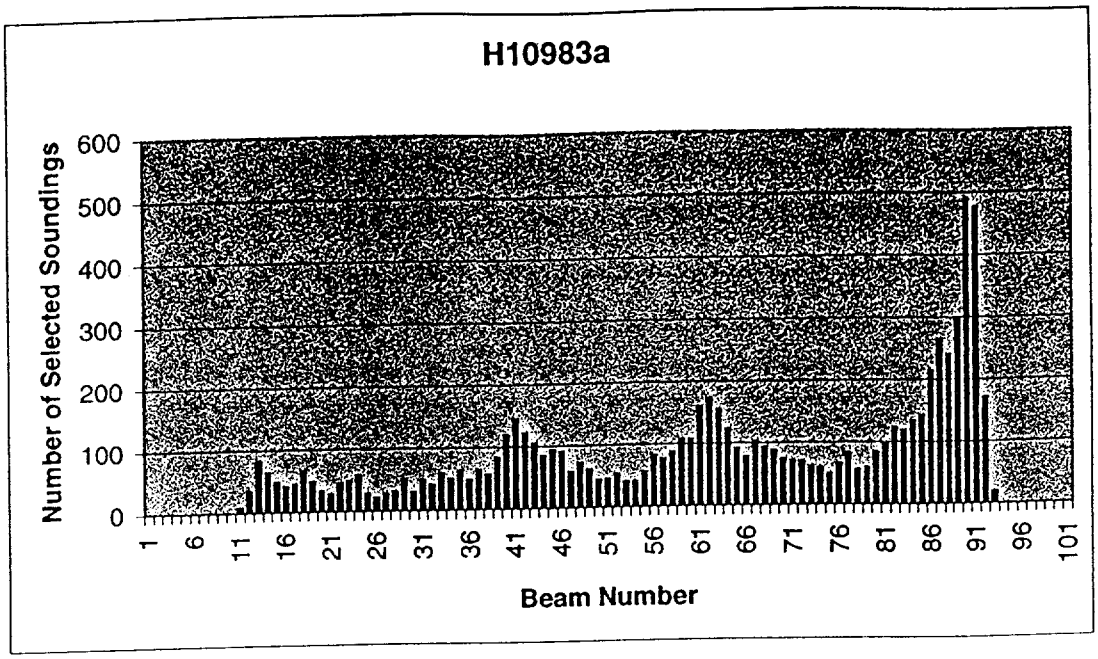
N/A

Figure R-3. Histogram of Selected Soundings by Beam Number – H10983b



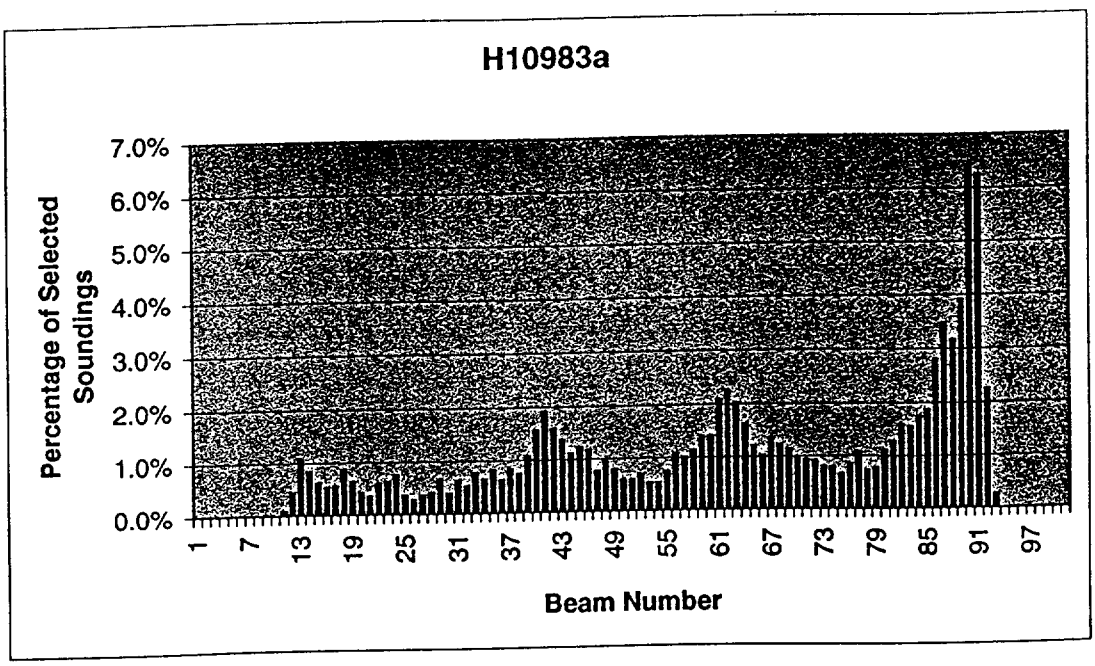
N/A

Figure R-4. Histogram of Percentage of Selected Soundings by Beam Number – H10983b



N/A

Figure R-5. Histogram of Selected Soundings by Beam Number – H10983a



N/A

Figure R-6. Histogram of Percentage of Selected Soundings by Beam Number – H10983a

S. RECOMMENDATIONS

Recommend the entire common area of charts 13275, 13274 SC, 13279, 13267, and 13276 be reconstructed with data from this survey. There are no recommendations for further investigation. See Sections M and N for specific recommendations. CONCUR

T. REFERRAL TO REPORTS SEE ALSO THE EVALUATION REPORT

None.

Danger to Navigation Report

June 23, 2000

Hydrographic Survey Registry Number: **H10983c**

State: MA

Locality: Salem Sound

Sub-Locality: Salem Channel

Project: OPR-A338-KR-00

The following objects were discovered during hydrographic survey post-processing operations:

1) **Sounding:** 15 feet in position 42 32 51.12N 070 50 21.32W, near charted 18 feet. Sounding reduced to Mean Lower Low Water using verified tide correctors.

2) **Sounding:** 13 feet in position 42 31 08.39N 070 52 07.99W, outside of the 18 foot curve. Sounding reduced to Mean Lower Low Water using verified tide correctors.

Affected Charts: 13275, 13276, 13274_SC

These ITEMS WERE DETERMINED NOT TO BE DANGERS TO NAVIGATION DURING OFFICE PROCESSING.

Danger to Navigation Report

July 02, 2000

Hydrographic Survey Registry Number: **H10983c**

State: MA

Locality: Salem Sound

Sub-Locality: Salem Channel

Project: OPR-A338-KR-00

* The following objects were discovered during hydrographic survey post-processing operations:

1) **Obstruction:** 15 feet in position 42 31 03.05N 070 52 20.82W, near charted 20 feet. Sounding reduced to Mean Lower Low Water using verified tide correctors.
2) **Obstruction:** 13 feet in position 42 32 14.55N 070 51 47.46W, near charted 18 feet. Sounding reduced to Mean Lower Low Water using verified tide correctors.
3) **Obstruction:** 23 feet in position 42 32 10.18N 070 51 24.97W, near charted 29 feet. Sounding reduced to Mean Lower Low Water using verified tide correctors.
4) **Obstruction:** 14 feet in position 42 31 54.85N 070 51 37.34W, near charted 17 feet. Sounding reduced to Mean Lower Low Water using verified tide correctors.
5) **Sounding:** 20 feet in position 42 31 50.79N 070 51 33.42W, near charted 22 feet, on the northern boundary of Salem Channel. Sounding reduced to Mean Lower Low Water using verified tide correctors.
6) **Obstruction:** 14 feet in position 42 32 04.12N 070 50 52.17W, near charted 17 feet. Sounding reduced to Mean Lower Low Water using verified tide correctors.
7) **Obstruction:** 14 feet in position 42 31 27.47N 070 51 27.74W, near charted 18 feet. Sounding reduced to Mean Lower Low Water using verified tide correctors.
8) **Obstruction:** 16 feet in position 42 32 12.21N 070 51 45.75W, near charted 22 feet. Sounding reduced to Mean Lower Low Water using verified tide correctors.

Affected Charts: 13275, 13276, 13274_SC

* THESE ITEMS WERE DETERMINED NOT TO BE DANGERS TO NAVIGATION DURING OFFICE PROCESSING.

Danger to Navigation Report

July 02, 2000

Hydrographic Survey Registry Number: **H10983c**

State: MA

Locality: Salem Sound

Sub-Locality: Salem Channel

Project: OPR-A338-KR-00

Recommend the following changes made to the 18ft and 24ft curves from findings during hydrographic survey post-processing operations. Sounding reduced to Mean Lower Low Water using verified tide correctors.

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

July 31, 2000

Commander (oan)
First Coast Guard District
408 Atlantic Avenue
Boston, MA 02110-3350

Dear Sir,

During hydrographic survey operations in Salem Sound, Massachusetts, in the vicinities of Salem Harbor and Beverly Harbor (Project OPR-A338-KR-00, Registry H10983, sheet 'C') by Science Applications International Corporation (SAIC), two items have been identified as hazards to navigation. I recommend the 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) using predicted tide correctors. All depth data is preliminary pending final office verification.

Sounding	Latitude	Longitude
13-ft	42°31'08.39"N	70°52'07.99"W
16-ft	42°32'11.86"N	70°51'45.75"W

Affected Nautical Charts:

Chart	Edition No.	Date
13275	27th	Jul 24/99
13276	21st	Sep 20/97

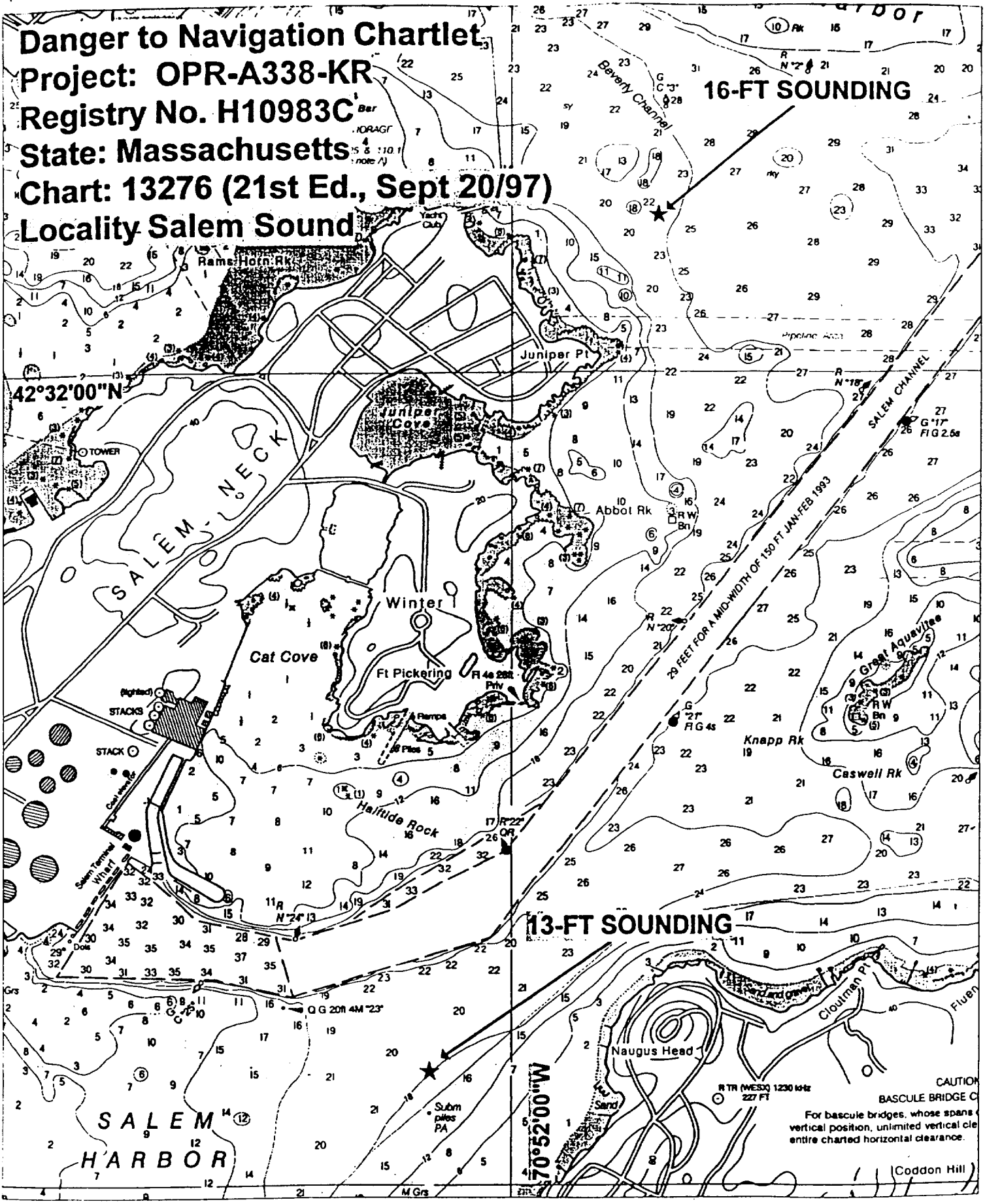
Questions concerning this report should be directed to the Atlantic Hydrographic Branch by calling (757) 441-6746.

Sincerely,

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

Attachment

cc: NIMA-NIS
N/CS26
N/CS31



Preliminary information...not for use in navigation
subject to further office review

August 18, 2000

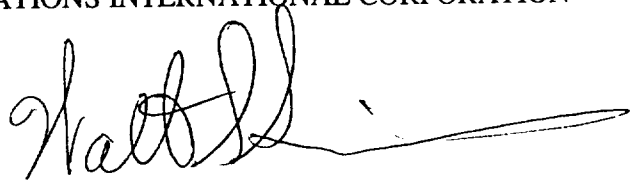
LETTER OF APPROVAL

REGISTRY NUMBER H10983 (SHEETS a, b, c)

This report and the accompanying smooth sheets are respectfully submitted.

Field operations contributing to the accomplishment of survey H10983 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
August 18, 2000

NOAA FORM 61-29
(12-71)

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

LETTER TRANSMITTING DATA

REFERENCE NO.
N/CS 33-22 -02

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

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

DATE FORWARDED 07/26/2002

NUMBER OF PACKAGES 1

TO:

NOAA / National Ocean Service
Chief, Data Control Group, N/CS 3x1
SSMC3, Station 6815
1315 East-West Hwy.
Silver Spring, MD 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.

H10983c

Massachusetts
Salem Harbor

1 Descriptive Report / Evaluation Report

1 Mylar final AHB Smooth Sheet
1 Mylar H-Drawing for NOS chart 13276

ATTN: George Myers 301-713-2709

FROM: (Signature)

Return receipted copy to:

Maxine Fetterly
Atlantic Hydrographic Branch
439 W. York St.
Norfolk, VA 23510

RECEIVED THE ABOVE
(Name, Division, Date)

NOAA FORM 61-29 SUPERCEDES FORM C AND GS 413 WHICH MAY BE USED.

• U.S. GOVERNMENT PRINTING OFFICE: 1988 - 554-006-61309

ATLANTIC HYDROGRAPHIC BRANCH
EVALUATION REPORT FOR H10983C (2000)

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:

NADCON, version 2.10
MicroStation J, version 7.1
I/RAS B, version 5.01
CARIS HIPS/SIPS, version 5.1a

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

H. HYDROGRAPHIC POSITION CONTROL

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 0.344 seconds (10.613 meters or 2.12 mm at the scale of the survey) north in latitude, and 1.827 seconds (41.695 meters or 8.34 mm at the scale of the survey) east in longitude.

K. JUNCTIONS

H10983B (2000) to the east

A standard junction was effected between the present survey and H10983B (2000).

There are no junctional surveys to the north, south, or west. Present survey depths are in harmony with the charted hydrography to the north, south, and west.

L. 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 13276 (21st Edition, Sept 20/97) 13275 (27th Edition, July 24/99)

Hydrography

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

1. The charted geographic name, Haste Shoal in the vicinity of Latitude 42°32'26"N, Longitude 70°50'44"W, is incorrectly spelled on chart 13275, 27th Edition, 24 July 1999.

2. A row of three (3) charted dolphins, in the vicinity of Latitude 42°31'17.37"N, Longitude 70°52'44.25"W, extending to shore, originate with an unknown source. These features were not addressed by the hydrographer. It is recommended that the dolphins be retained as charted.

Controlling Depths

Conflicts exist with the charted controlling depth in the southern section of the Salem Channel and turning basins. The present survey shows depths ranging from 25 to 28 feet with a controlling depth of 29 feet. The following depths were submitted as a Danger to Navigation during office processing, a copy of the report is appended to this report.

Depth ft/(m)	Latitude (N)	Longitude (W)
25/7[6]	42°31'20.35"	70°52'11.45"
28/8[5]	42°31'19.49"	70°52'09.02"
28/8[5]	42°31'20.70"	70°52'07.39"

It is recommended that the charted channel notation *29 FT for a mid-width of 150 FT JAN-FEB 1993* be revised to *28 FT for a mid-width of 150 FT MAY-JUNE 2000*.

The present survey is adequate to supersede the charted hydrography within the common area.

DANGERS TO NAVIGATION

Ten potential dangers to navigation items were submitted to AHB for consideration during field operations. Only two of the ten items were chosen for submission. The final Danger to Navigation report was sent to the Commander (oan), First Coast Guard District, Boston, Massachusetts for inclusion in the Local Notice to Mariners, and is appended to the Descriptive Report. During office processing it was determined that the above items were not dangers to navigation.

A Danger to Navigation report was submitted to the Marine Charting Division, N/CS3x1, Silver Spring, Maryland during office processing. A copy of the report is appended to the Evaluation Report.

O. ADEQUACY OF SURVEY

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

P. AIDS TO NAVIGATION

The hydrographer located fourteen (14) floating aids and two (2) fixed aids to navigation. These aids appear adequate to serve their intended purpose. Attention is directed to the following:

It was noted that the position listed in the U.S. Coast Guard Light List for Salem Light 23 (#10100), differs from the charted position. It is recommended that the First Coast Guard District, Boston, MA, be consulted and the Light List updated with the actual charted position for the aid.

MISCELLANEOUS

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

13276 (21st Edition, Sept 20/97)

REPORT OF DANGERS TO NAVIGATION

Hydrographic Survey Registry Number: H10983c

Survey Title:	State:	Massachusetts
	Locality:	Salem Harbor
	Sub-Locality:	Salem Channel

Project Number: OPR-A338-KR-00

Field Unit: Science Applications International Corporation

Survey Dates: 18 May - 27 June, 2000

Soundings are reduced to Mean Lower Low Water (MLLW) using Verified Tides.
The horizontal datum is North American Datum 1983 (NAD83).

Charts affected:
13276 21st Edition, 20 September 1997
13275 27th Edition, 24 July 1999
13274 23rd Edition, 12 May 2001
13279 29th Edition, 10 January 1998

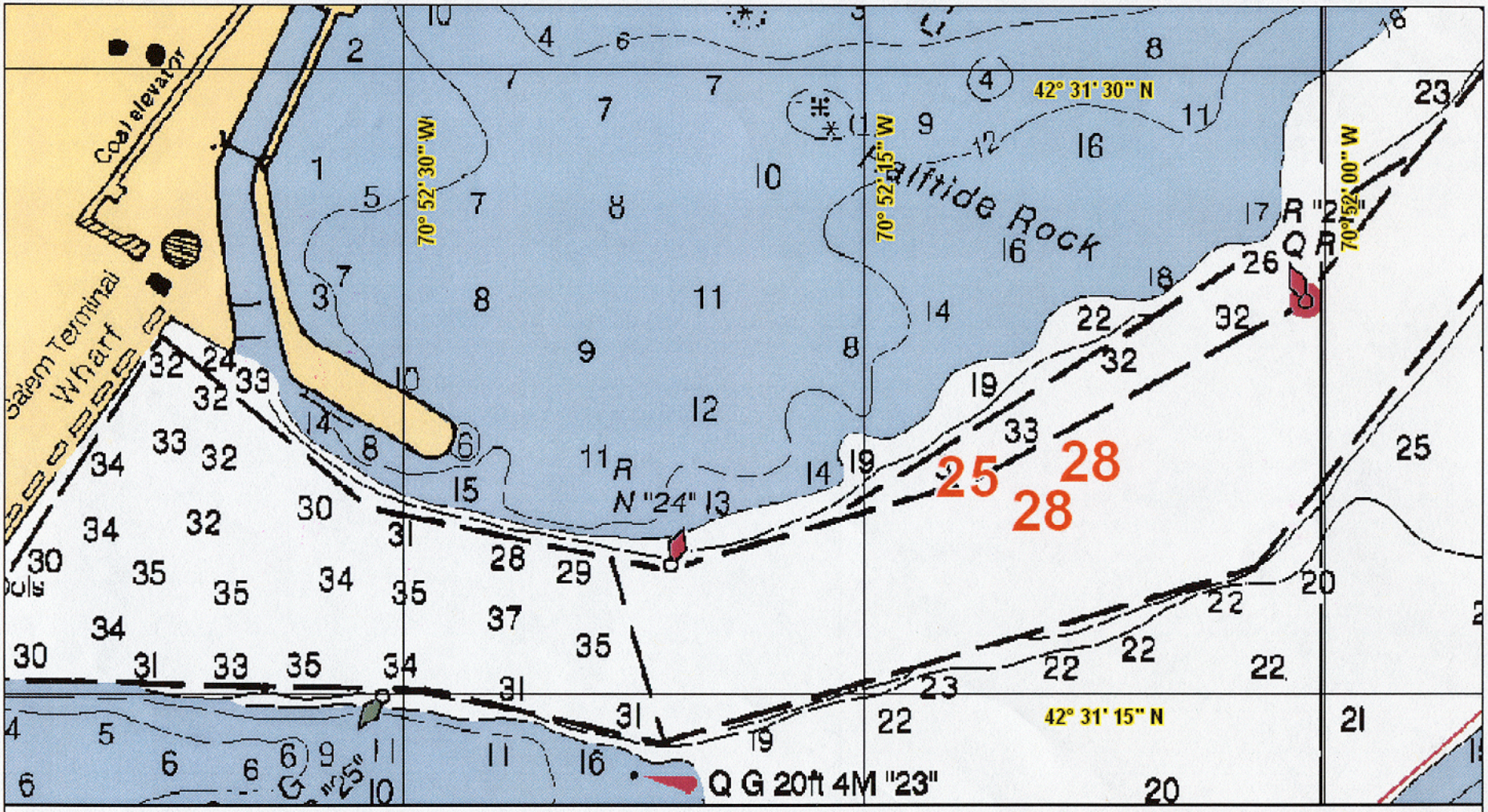
DANGERS TO NAVIGATION

During office processing, three soundings were determined to be dangers to navigation in the Salem Harbor Channel:

25 foot	Latitude 42° 31' 20.35"N	Longitude 70° 52' 11.45"W
28 foot	Latitude 42° 31' 19.49"N	Longitude 70° 52' 09.02"W
28 foot	Latitude 42° 31' 20.70"N	Longitude 70° 52' 07.39"W

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

Atlantic Hydrographic Branch June 10, 2002



Chartlet 1 of 1 *Chart No. 13276 21st Edition, 20 September 1997*

This chartlet has not been corrected through Notice to Mariners dated June 10, 2002.
NOT FOR NAVIGATION.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

Project: *OPR-A338-KR-00*
Survey: *H10983c*
State: *Massachusetts*
Locality: *Salem Harbor*
Sub-locality: *Salem Channel*
Survey Scale: *1:5,000*

Sounding Units: *Feet*
Sounding Datum: *MLLW*
Horizontal Datum: *NAD 83*
Projection: *UTM 19*
Central Meridian: *069° 00 00*
Scale Factor: *0.9996*

SAIC
R/V Ocean Explorer
Walt Simmons
Hydrographer in Charge
May 18 to
June 27, 2000

Robert Snow

Robert Snow
Cartographic Technician
Verification of Field Data
Evaluation and Analysis

APPROVAL SHEET
H10983C

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 disapproval 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: 6/26/02

Maxine Fetterly
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: 7/10/02

Emily B. Christman
Commander, NOAA
Chief, Atlantic Hydrographic Branch

****

Final Approval:

Approved: Samuel P. DeBow, Jr. Date: September 27, 2002

Samuel P. DeBow, Jr.
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. H10983c

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
13276		[illegible signature]	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
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
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			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.

SUPERSEDES C&GS FORM 8352 WHICH MAY BE USED.