

**W00045**

NOAA FORM 76-35A

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

**DESCRIPTIVE REPORT**

*Type of Survey:* **Navigable Area**

*Registry Number:* **W00045**

**LOCALITY**

*State:* Massachusetts

*General Locality:* Massachusetts Bay

*Sub-locality:* 7 NM East of Eastern Point

**2003**

CHIEF OF PARTY  
**Donald W. Haines, LCDR, NOAA**

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DATE

NOAA FORM 77-28 U.S. DEPARTMENT OF COMMERCE  
(11-72) NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REGISTRY NUMBER:

**HYDROGRAPHIC TITLE SHEET**

**W00045**

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

State: **Massachusetts**  
General Locality: **Massachusetts Bay**  
Sub-Locality: **7 NM East of Eastern Point**  
Scale: **1:20,000** Date of Survey: **04/24/1995 to 12/01/1995**  
**08/24/2003 to 09/17/2003**  
Instructions Dated: **07/17/03** Project Number: **OPR-A397-TJ-03**  
Vessel: **NOAA Ship THOMAS JEFFERSON, S-222**  
Chief of Party: **LCDR Donald W. Haines, NOAA**  
Surveyed by: **THOMAS JEFFERSON Personnel**  
Soundings by: **KongsbergSimrad EM1002 multibeam echosounder**  
Graphic record scaled by: **N/A**  
Graphic record checked by: **N/A**  
Protracted by: **N/A** Automated Plot: **N/A**  
Verification by: **Atlantic Hydrographic Branch Personnel**  
Soundings in: **Meters at MLLW**

Remarks: ***Bold, Italic, Red notes in Descriptive Report were made during office processing. Charted depths in feet at MLLW.***

- 1) All Times are UTC.***
- 2) This is a Navigable Area Hydrographic Survey.***
- 3) Projection is UTM Zone 19.***

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# **DESCRIPTIVE REPORT**

to accompany  
HYDROGRAPHIC SURVEY W00045

Scale of Survey: 1:20,000

Year of Survey: 2003

NOAA Ship THOMAS JEFFERSON  
LCDR Donald W. Haines, Commanding

## **A. AREA SURVEYED**

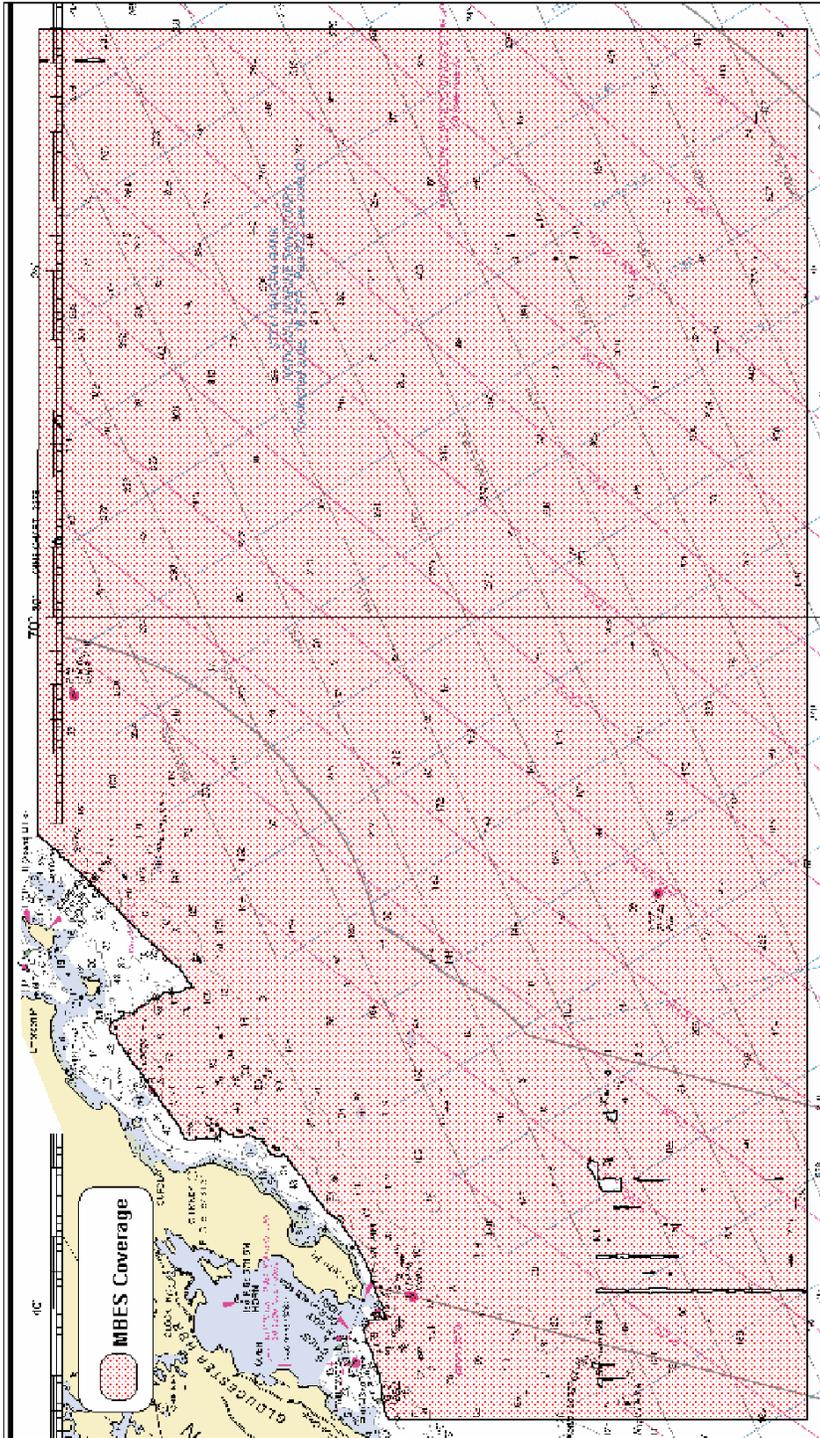
This hydrographic survey was conducted in accordance with Hydrographic Survey Letter Instructions\* for project OPR-A397-TJ03, Massachusetts Bay, Massachusetts. The original instructions\* are dated July 17, 2003.

*\*Data filed with original field records.*

This Descriptive Report pertains to sheet "O" of project OPR-A397-TJ-03. The assigned registry number for this sheet is W00045, as prescribed in the Letter Instructions\*.

This project is being conducted to provide contemporary hydrography with full bottom multibeam coverage in the approaches to Boston Harbor. This project responds to requests from the Massachusetts Port Authority (MASSPORT), Boston Pilots, the First U.S. Coast Guard District, Massachusetts Coastal Zone Management (Boston, MA), and the U.S. Geological Survey (Woods Hole, MA).

This project will also contribute valuable bathymetric data to the Stellwagen Bank Marine Sanctuary program in conjunction with the U.S. Geological Survey (USGS), Woods Hole Oceanographic Institution (WHOI), and the Canadian Hydrographic Service (CHS). Multibeam tracklines will be run in order to validate Outside Source Data (OSD) from the USGS and the University of New Hampshire (UNH). For complete survey limits, see the chartlet on the following page.



**This chartlet has been corrected through  
Notice to Mariners dated August 28, 2004  
NOT FOR NAVIGATION.**

**Chartlet 1 of 1** Chart 13267, 31st Edition, October, 2003, Scale 1:80000, Massachusetts Bay

NOM, SHIP THOMAS, JEFFERSON  
LCDR Donald W. Haines  
Commanding  
August 25 to  
September 17, 2003

Sounding Units: Meters  
Sounding Datum: MLLW  
Horizontal Datum: NAD 83  
Projection: UTM 19  
Central Meridian: 069° 00' 00"  
Scale Factor: 0.9996

Project: OPR-4397-7J-03  
Survey: W000045  
State: Massachusetts  
Locality: Approaches to Boston  
Sub-locality: 7 MW East of Eastern Point  
Survey Scale: 1:20,000

NATIONAL OCEANIC AND  
ATMOSPHERIC ADMINISTRATION  
NATIONAL OCEAN SERVICE



## **B. DATA ACQUISITION AND PROCESSING** *See Also Evaluation Report.*

### **EQUIPMENT**

This survey took advantage of a vast data set acquired by U.S. Geological Survey (USGS). The USGS and their partnership with the Canadian Hydrographic Survey, acquired multibeam bathymetric data over a time span of ten years. The data for this sheet were acquired from April 1, 1995 to April 21, 1995. Data were delivered to NOAA in UNB swathed format. The data were assembled and converted to Caris HIPS format at University of New Hampshire's Joint Hydrographic Center as part of the preparation for the project. This Outside Source Data (OSD) was integrated into our quality control pipeline (see Quality Control section). The majority of this OSD was located in waters greater than 20 meters and not located in high priority navigation areas as depicted in the national survey plan.

Data were also acquired by NOAA Ship THOMAS JEFFERSON on August 24, 2003 through September 17, 2003 to help verify the OSD. NOAA Ship THOMAS JEFFERSON acquired multibeam echosounder (MBES) data using a Simrad 1002 multibeam system. All positioning and attitude were determined with a TSS POS/MV 320 (version 3) GPS-aided inertial navigation system. Sound velocity casts were conducted with a Sea Bird 19 profiler.

Due to a roll calibration error affecting outer beams at more than 50° off nadir, all data acquired by NOAA Ship THOMAS JEFFERSON were filtered to 45° from nadir on each side. Refer to this projects associated DAPR\* for detailed discussion of equipment and vessel configuration information, MBES system calibrations, data acquisition, and data processing.

*\*Data filed with original field records.*

### **QUALITY CONTROL**

#### **Multibeam Quality Control**

Main scheme MBES data is defined to be the Outside Source Data (OSD). There were no known faults with the MBES system which affected data integrity. *Concur.*

All outside source data were analyzed using Caris HIPS and SIPS 5.4, taking advantage of the new statistical analysis and error tracking capabilities. The data were used in the creation of HIPS BASE (Bathymetry Associated with Statistical Error) surfaces and analyzed using the standard deviation, density, and uncertainty layers. No systematic problems with the OSD were found. *Concur.*

The OSD were acquired prior to the formation of NOAA standards for MBES coverage. As such, the data do not generally meet the sounding density and coverage requirements. The

data are, however, sufficient to supersede the prior VBES surveys. ***Concur with clarification. See also Appendix V and Evaluation Report.***

### **Crosslines**

On DN 236 and 237, data from four MBES crosslines were acquired by NOAA Ship THOMAS JEFFERSON. Mainscheme and crossline data were analyzed in a HIPS BASE surface (see project DAPR\*). Based on ten randomly chosen sample points per crossline, the crosslines averaged 0.6 meters deeper than the mainscheme data. Several potential causes of this discrepancy were tested (See USGS Stellwagen Bank Data Memorandum in Appendix V). There was no single cause that could adequately explain the difference, but it is likely due to a combination of draft measurement errors on both CREED and THOMAS JEFFERSON, and tidal epoch change. The OSD shows excellent agreement with charted soundings and is valid for superseding the chart in those places where there is disagreement. ***Concur. See Also Evaluation Report.***

### **Junctions**

Hydrographic survey W00042, Sheet L, adjoins the southern edge of W00045. Survey W00044, Sheet N, adjoins the western edge of W00045. Survey W00047, Sheet Q, adjoins the northern edge of W00045. Survey W00046, Sheet P adjoins the eastern edge of W00045. All four surveys are part of project OPR-A397-TJ-03, and are validations of the same outside source data. As such, the data used for the survey overlaps were identical. Additionally, Survey H11277 lies within the sheet limits of W00045. Surveys H11277 and W00045 agree well, with the higher density, higher resolution data of H11277 being generally shoaler, as expected. ***Concur. See Also Evaluation Report.***

### **CORRECTIONS TO ECHO SOUNDING**

All methods or instruments used were as described in the project DAPR\*. A table detailing all sound velocity casts is located in Separate III\*. ***Concur.***

***\*Data filed with original field records.***

## C. VERTICAL AND HORIZONTAL CONTROL

### VERTICAL CONTROL

The tidal datum for this project is Mean Lower Low Water (MLLW). The operating tide stations at Boston, MA (844-3970) and Portland, ME (841-8150) served as control for datum determination. Tertiary gauges at Boston Light (844-4162) and Fort Point, NH (842-3898) provided ancillary tide data. *Concur.*

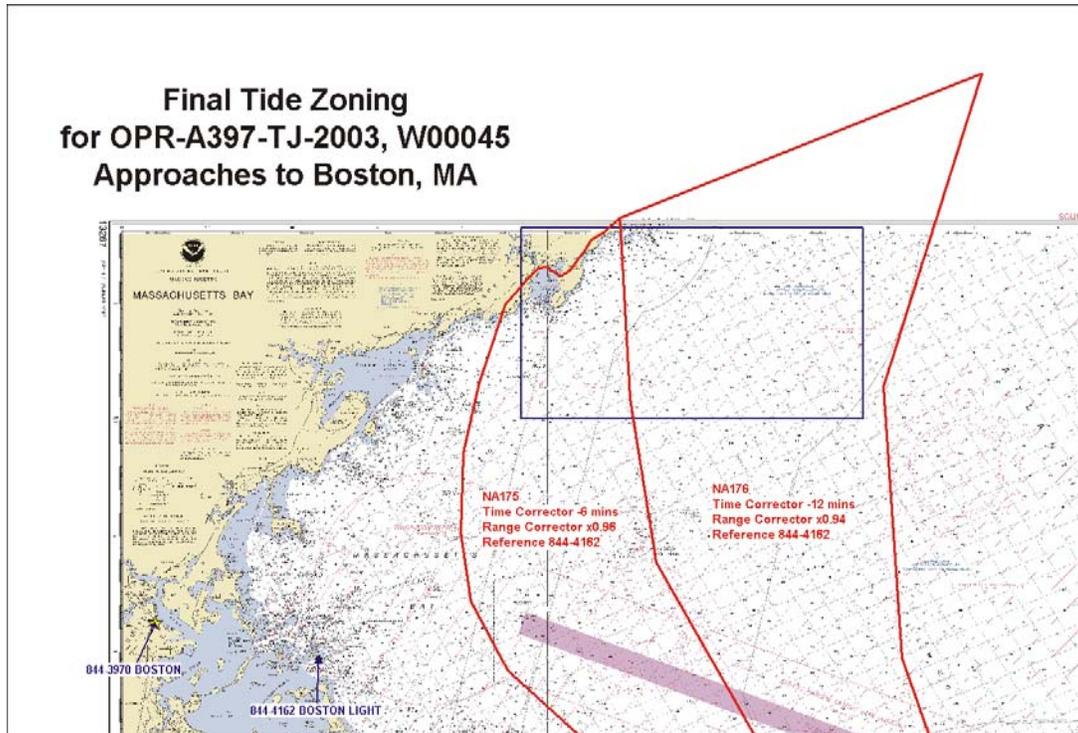
Tidal zoning for this survey is consistent with the Letter Instructions\*. The zones used for this survey are as follows:

ZONE NAME	CORRECTOR (min)	RATIO	REFERENCE
NA175	-6	x0.96	844-4162
NA176	-12	x0.94	844-4162

A Request for Approved Tides letter was sent to N/OPS1 on October 15, 2003 (Appendix IV). Verified tides from the N/OPS1 CO-OPS website were applied to THOMAS JEFFERSON data on February 20, 2004. Verified tides were applied to Creed data on September 10, 2003.

Preliminary zoning and verified water levels downloaded from the CO-OPS web site were used for the OSD data within the limits of this sheet. There were no differences in the preliminary and final zoning for this survey sheet. The controlling station at Boston Light (844-3970) was used for vertical water levels. *Concur.*

*\* Data filed with original field records.*



### **HORIZONTAL CONTROL** *See also Evaluation Report.*

The horizontal datum used for this survey is the North American Datum of 1983 (NAD 83), projected using UTM zone 19.

Sounding positional control was determined using the Global Positioning System (GPS) corrected by U.S. Coast Guard differential GPS (DGPS) beacon stations. The primary and only DGPS beacon used for this survey was Portsmouth, New Hampshire (Beacon #771). No horizontal control stations were established for this survey.

Horizontal dilution of precision (HDOP) was monitored during data acquisition. That value did not exceed 2.50, and the survey was conducted during times of adequate satellite coverage.

## **D. RESULTS AND RECOMMENDATIONS** *See also Evaluation Report.*

### **CHART COMPARISON**

There are eleven charts affected by this survey:

**13279**, 31<sup>st</sup> edition, August, 2004, scale 1:20000  
**13274**, 25<sup>th</sup> edition, September, 2003, scale 1:40000  
**13267**, 31<sup>st</sup> edition, October, 2003, scale 1:80000  
**13278**, 25<sup>th</sup> edition, September, 2000, scale 1:80000  
**13260**, 39<sup>th</sup> edition, June, 2003, scale 1:378838  
**13200**, 33<sup>rd</sup> edition, January 19, 2002, scale 1:400000  
**13009**, 30<sup>th</sup> edition, August 1, 2002, scale 1:500000  
**13006**, 31<sup>st</sup> edition, June, 2003, scale 1:675000  
**5161**, 13<sup>th</sup> edition, October, 2003, scale 1:1058400  
**13003**, 47<sup>th</sup> edition, June, 2003, scale 1:1200000

### **General Agreement with Charted soundings**

The sounding data acquired during this survey agree well with the charted depths. The charted depths are from partial bottom NOS surveys conducted before 1970. The MBES data acquired for this survey are adequate to supercede the charted depths. *Concur. See also Evaluation Report.*

### **AWOIS Items and Significant Contacts**

There are ten assigned AWOIS items within the survey limits, three of which are discussed in the Descriptive Report for H11277, Gloucester Harbor. The remaining eight are information only and are discussed in the Item Investigation Reports in Appendix I. *Concur.*

### **Dangers to Navigation**

There were no Dangers to Navigation (Dton) reported by the Hydrographer for this project. *Concur.*

### **Charted Features**

There are five Charted Features discussed in the Item Investigation Reports in Appendix I. *Concur. See also Evaluation Report, Chart Comparison, Additional Results, Charted AWOIS Item*

### **Uncharted Features**

There were no Uncharted Features found within the survey limits.

## **Charting Recommendations**

Select survey soundings and redraw contour lines to represent the OSD soundings acquired except where noted elsewhere in this Descriptive Report. *Concur.*

## **BASE SURFACE PRODUCTS**

The data for survey W00045 are submitted as two finalized BASE surfaces. One surface's threshold covers the depth range from 0 to 35 meters, the second covers the range from 30 to 200 meters. *Concur.*

## **ADDITIONAL RESULTS**

### **Aids to Navigation and Other Detached Positions**

No Aids to Navigation were positioned during this survey. The Hydrographer recommends that all Aids to Navigation within the survey limits remain as charted. *Concur.*

### **Bridges and Overhead Cables**

There are no bridges or overhead cables within the survey limits. *Concur.*

### **Ferry Routes**

Boston ferry routes exist within sheet W00045. The hydrographer recommends that Atlantic Hydrographic Branch or Marine Charting Division work with the Northeast Navigation Manager to ensure that they are properly charted. *Concur.*

### **Submarine Cables and Pipelines**

There are no charted submarine cables or pipelines within the survey limits, nor were any found during the survey. *Concur.*

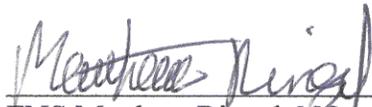
**E. APPROVAL SHEET****OPR-A397-TJ  
Massachusetts  
Approaches to Boston Harbor****7 NM East of Eastern Point  
Survey Registry No. W00045**

Field operations for this basic hydrographic survey were conducted under my daily supervision with frequent checks of progress and adequacy. All field sheets, this Descriptive Report, and all accompanying records and data are approved.

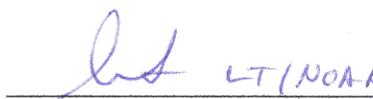
I have ensured that standard field surveying and processing procedures were adhered to during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables, as updated for March, 2003. This survey was conducted as outlined in the Data Acquisition and Processing Report (August - November, 2003) submitted March 30, 2004, as well as the DAPR Change No. 1 submitted April 11, 2004. Refer to the Horizontal and Vertical Control Report (20 January, 2004) submitted March 4, 2004 for further information not included with this Descriptive Report.

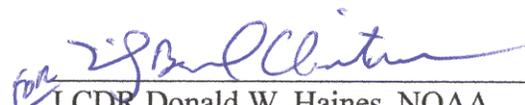
This survey is adequate to supersede all prior surveys in common areas, and for application to the relevant NOS nautical charts.

Respectfully Submitted:

  
\_\_\_\_\_  
ENS Matthew Ringel, NOAA  
Junior Officer

Approved and Forwarded:

  
\_\_\_\_\_  
LT Shepard Smith, NOAA  
Field Operations Officer

  
\_\_\_\_\_  
LCDR Donald W. Haines, NOAA  
Commanding Officer

## **APPENDIX I**

### **ITEM INVESTIGATIONS AND CHARTED FEATURES**

**Registry Number:** W00045  
**State:** Massachusetts  
**Locality:** Approaches to Boston  
**Sub-locality:** 7 NM East of Eastern Point  
**Project Number:** OPR-A397-TJ-03  
**Survey Date:** 11/29/2004

### Charts Affected

Number	Version	Date	Scale
13279	31st Ed.	08/01/2004	1:20000
13274	25th Ed.	09/01/2003	1:40000
13267	31st Ed.	10/01/2003	1:80000
13278	25th Ed.	12/09/2000	1:80000
13260	39th Ed.	06/01/2003	1:378838
13200	33rd Ed.	01/19/2002	1:400000
13009	30th Ed.	08/01/2002	1:500000
13006	31st Ed.	06/01/2003	1:675000
5161	13th Ed.	10/01/2003	1:1058400
13003	47th Ed.	06/01/2003	1:1200000

### Features

No.	Name	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	Charted PA wreck	GP	[None]	042° 31' 02.071" N	70° 26' 05.107" W	---
1.2	Charted PA wreck	GP	[None]	042° 30' 37.539" N	70° 22' 47.376" W	---
2.1	RESTLESS	AWOIS	[no data]	[no data]	[no data]	---
2.2	GLOUCESTER QUEEN	AWOIS	[no data]	[no data]	[no data]	---
2.3	UNKNOWN	AWOIS	[no data]	[no data]	[no data]	---

## 1.1) Charted PA wreck

### Survey Summary

**Survey Position:** 042° 31' 02.071" N, 70° 26' 05.107" W  
**Least Depth:** [None]  
**Timestamp:** 2004-334.17:58:49 (11/29/2004)  
**GP Dataset:** ChartGPs - Digitized  
**GP No.:** 3  
**Charts Affected:** 13267\_1, 13260\_1, 13200\_1, 13009\_1, 13006\_1, 5161\_1, 13003\_1

#### Remarks:

Feature is the charted PA wreck. This wreck is not in the AWOIS database. This wreck was not found. Detection with the EM 1000 used for this survey would have been unlikely.

### Feature Correlation

Address	Feature	Range	Azimuth	Status
ChartGPs - Digitized	3	0.00	000.0	Primary
stellwagen/creed/1996_109/stell_109_0600	2142/8	24.23	013.8	Secondary (grouped)

### Hydrographer Recommendations

Retain as charted.

### S-57 Data

[None]

### Office Notes

Concur.

## 1.2) Charted PA wreck

### Survey Summary

**Survey Position:** 042° 30' 37.539" N, 70° 22' 47.376" W  
**Least Depth:** [None]  
**Timestamp:** 2004-334.18:05:46 (11/29/2004)  
**GP Dataset:** ChartGPs - Digitized  
**GP No.:** 4  
**Charts Affected:** 13267\_1, 13260\_1, 13200\_1, 13009\_1, 13006\_1, 5161\_1, 13003\_1

#### Remarks:

Feature is the charted wreck. This wreck is not in the AWOIS database. This wreck was not found. Detection with the EM 1000 used for this survey would have been unlikely.

### Feature Correlation

Address	Feature	Range	Azimuth	Status
ChartGPs - Digitized	4	0.00	000.0	Primary
stellwagen/creed/1995_115/stell_115_0386	1695/10	9.97	348.4	Secondary (grouped)

### Hydrographer Recommendations

Retain as charted.

### S-57 Data

[None]

### Office Notes

Concur.

## 2.1) AWOIS #2133 - RESTLESS

### No Primary Survey Feature for this AWOIS Item

**Search Position:** 042° 30' 00.350" N, 70° 24' 58.130" W  
**Historical Depth:** [None]  
**Search Radius:** 0  
**Search Technique:** [unknown]  
**Technique Notes:** [unknown]

**History Notes:**

[unknown]

### Survey Summary

**Charts Affected:** 13267\_1, 13260\_1, 13200\_1, 13009\_1, 13006\_1, 5161\_1, 13003\_1

**Remarks:**

Feature is the charted wreck corresponding to AWOIS 2133. This wreck was not found. Detection with the EM 1000 used for this survey would have been unlikely.

### Feature Correlation

Address	Feature	Range	Azimuth	Status
A397_03_TJ	AWOIS # 2133	0.00	000.0	Primary
stellwagen/creed/1995_115/stell_115_0395	992/27	2.65	130.0	Secondary (grouped)

### Hydrographer Recommendations

Retain as charted.

### S-57 Data

[None]

### Office Notes

Concur.

## 2.2) AWOIS #7572 - GLOUCESTER QUEEN

### No Primary Survey Feature for this AWOIS Item

**Search Position:** 042° 34' 48.340" N, 70° 37' 10.150" W  
**Historical Depth:** [None]  
**Search Radius:** 0  
**Search Technique:** [unknown]  
**Technique Notes:** [unknown]

**History Notes:**

[unknown]

### Survey Summary

**Charts Affected:** 13279\_1, 13274\_5, 13267\_1, 13278\_1, 13260\_1, 13200\_1, 13009\_1, 13006\_1, 13003\_1

**Remarks:**

Feature is the charted PA wreck corresponding to AWOIS 7572. This wreck was not found. Detection with the EM 1000 used for the OSD would have been unlikely.

### Feature Correlation

Address	Feature	Range	Azimuth	Status
A397_03_TJ	AWOIS # 7572	0.00	000.0	Primary
stellwagen/creed/1996_093/stell_093_0041	1263/26	5.68	118.4	Secondary

### Hydrographer Recommendations

Retain as charted.

### S-57 Data

[None]

### Office Notes

Concur.

## 2.3) AWOIS #7573 - UNKNOWN

### No Primary Survey Feature for this AWOIS Item

**Search Position:** 042° 37' 00.340" N, 70° 33' 34.140" W  
**Historical Depth:** [None]  
**Search Radius:** 0  
**Search Technique:** [unknown]  
**Technique Notes:** [unknown]

**History Notes:**

[unknown]

### Survey Summary

**Charts Affected:** 13279\_1, 13274\_5, 13267\_1, 13278\_1, 13260\_1, 13200\_1, 13009\_1, 13006\_1, 13003\_1

**Remarks:**

Feature is the charted PA wreck corresponding to AWOIS 7573. No evidence of this wreck was found in the EM 1000 OSD. NOAA Ship THOMAS JEFFERSON did not do any further investigation on this wreck. The OSD is not of sufficient density or resolution to disprove this wreck.

### Feature Correlation

Address	Feature	Range	Azimuth	Status
A397_03_TJ	AWOIS # 7573	0.00	000.0	Primary
stellwagen/creed/1996_113/stell_113_0701	538/17	4.93	191.1	Secondary

### Hydrographer Recommendations

Retain as charted.

### S-57 Data

[None]

### Office Notes

Concur.

**APPENDIX V****SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCES**

The hydrographer reviewed the Coast Pilot report for the survey limits. There was no new additional information to be added to the Coast Pilot. *Concur.*



**UNITED STATES DEPARTMENT OF COMMERCE**

National Oceanic and Atmospheric Administration  
NOAA Marine and Aviation Operations  
NOAA Ship Thomas Jefferson S-222  
439 W. York Street  
Norfolk, VA 23510-1114

October 5, 2004

MEMORANDUM FOR: LCDR Tod Schattgen, NOAA  
Chief, Atlantic Hydrographic Branch

THROUGH: CDR Emily B. Christman, NOAA  
Commanding Officer, NOAA Ship THOMAS JEFFERSON

FROM: LT Shepard M. Smith, NOAA   
Executive Officer, NOAA Ship THOMAS JEFFERSON

SUBJECT: USGS Stellwagen Bank Data

This memorandum serves to document the background, approach, and processing steps employed to incorporate the USGS Stellwagen Bank and Massachusetts Bay multibeam data into the NOAA charting system.

**Background**

During the planning of OPR A397, I became aware that the survey areas assigned to WHITING, then LITTLEHALES, then THOMAS JEFFERSON overlapped significantly with the multibeam data acquired by USGS during the mid 1990s. This project was funded by USGS, with technical assistance from the Ocean Mapping Group at the University of New Brunswick and surveyed using the Canadian Hydrographic Service vessel *Frederick Creed*. It was also a cooperative project with NOAA, and several NOAA Corps hydrographers sailed aboard for portions of the project.

The data was collected under the guidance of some of the worldwide experts in multibeam surveying at the time. While it was NOAA's intention at the time to chart this data, we did not have the capability to process this large a dataset, and the data that NOAA did get languished in a collection of shoeboxes in Silver Spring.

In March 2003, after discussing the possibility with LT Jon Swallow at HSD operations, I contacted USGS in Woods Hole through Dr. Larry Mayer to inquire about the status of the data. I told them that we would be surveying the area on the NOAA Ship THOMAS JEFFERSON, and that we wanted to reduce duplication of effort. Dr. Bill Danforth replied enthusiastically that they would make the data available to us in whatever form we needed.

In addition, UNH's Center for Coastal and Ocean Mapping (CCOM) had contracted with SAIC to conduct a multibeam survey of Jeffrey's Ledge, an area just to the north of the



USGS Stellwagen Bank data set. During a break in their hydrographic survey work for NOAA, the SAIC team went up to Jeffreys Ledge and conducted the survey in the winter of 2002-2003. The data was sent to UNH in lightly edited form and turned over to graduate student Mashkoor Malik to work on. The CCOM leadership team offered the data to NOAA for charting. Because of the plans to incorporate the USGS data into NOAA's pipeline aboard the THOMAS JEFFERSON, I offered to add this SAIC data to the USGS data and work with it all together.

I then contacted HSD operations again to plan our approach to the project.

## **The Approach**

This was an unusual opportunity to incorporate a large amount of Outside Source Data into the charting process. The most unusual aspect was that we had a ship available to junction and check the data. We came up with the following premises:

- 1) We would convert the data to a form where it could be manipulated as if it were our own data. This necessitated a new convertor to get the data into Caris HIPS format.
- 2) The tides applied to the data were inconsistent. We would plan to reapply all tides using historic NOAA station data and modern zoning.
- 3) We would use a Navigation Surface approach to process the data for charting. We would estimate the sensor errors for the Creed data and compute TPE as appropriate.
- 4) The data was edited to some extent by the Creed in the one case and CCOM in the other. We would further clean data only as necessary to produce a clean Navigation Surface.
- 5) The grids provided by the USGS were at a coarse resolution of 10m. For parts of the survey area, this is insufficient to capture all the seafloor detail in the data.
- 6) Various techniques were used by the CHS and USGS hydrographers to correct for sound velocity. The Simrad 1000 multibeam sonar system was corrected for sound velocity at the head and in the water column in real time. In order to compensate for head velocity errors and the difference between the last cast and the water column at their location, the hydrographers made extensive use of head velocity offsets and the interactive refraction editor. We would not second-guess the hydrographer's judgement on this, but merely reapply the values as they intended.
- 7) In general, we would compare *their results* to *our results*. We would not compare their *processes* to our *processes*. Because of the difference in the purpose of the survey and the changes in technology, it would not be useful to spend a lot of time worrying about processing techniques.
- 8) We would run crosslines with the TJ or her launches to check the accuracy of the data. We could also fill holidays or develop shoals at our discretion.
- 9) The TJ data would be combined with the OSD data to create a single survey with a "W" designation. TJ would write DRs and submit the surveys to AHB in a form

similar to that used for our own surveys. This should ease its inclusion in our workflow.

This approach was discussed with LT Jon Swallow Mike Riddle and Steve Verry, HSD Operations, and CDR Emily B. Christman at AHB, and is consistent with the project instructions issued for the project.

### **Preliminary Processing**

Because I would be going out to the THOMAS JEFFERSON as Operations Officer and would oversee the project, I volunteered to be the focal point for data conversion and preliminary troubleshooting.

The data from USGS had all arrived by May 2003, and I was able to restore it all from CDs. The Swathed files were converted using a Swathed→Caris HIPS convertor written by Caris for this purpose. The first draft of the convertor assumed that the data had been fully merged with all refraction editing applied. This was not the case and a second version of the convertor was written which converted Swathed's three-parameter refraction editor files and converted them to a new HIPS format. In addition, the merge function in HIPS was modified to be able to perform a head velocity change in addition to changes at depth, to be consistent with the Swathed technology. After those changes, the data looked pretty good.

I contacted Cary Wong through HSD Operations and explained the project. Cary was able to find tide files going back to 1994. However, the files for 1994 were archived on a type of media that is no longer readable, so that year is only hourly data, which was interpolated by HIPS.

### **The Survey**

THOMAS JEFFERSON arrived on scene in Massachusetts Bay in August 2003. In making up the cross line files for the survey, we estimated the total level of effort we wanted to spend on the project, then determined the number of crosslines that would be possible to run in that time frame. It came out to about three lines per sheet, run lengthwise east-west. In addition, in some areas, we ran some holiday lines and a few item investigations. On sheets D and F, we junctioned NOAA launch and ship data with the USGS data to form a complete survey.

### **Comparison of Data**

In general, we found that the USGS data was consistently shoaler than the TJ ship multibeam data by 0.5m to 0.8m. In order to try to determine which was right, we tested several hypotheses.

- 1) Tidal Epoch-the tidal epoch changed in April 2003. The change is in the "right" direction to explain the difference, but the maximum magnitude in the survey area is 0.05m, not enough to explain the difference on its own.

- 2) Changing seafloor-The difference is too consistent
- 3) USGS use of the refraction editor-This could explain some differences in the outer beams, but the difference is consistent across the swath.
- 4) TJ draft error-We sought to test this hypothesis by doublechecking our draft and by conducting a leadline check. We conducted numerous tests and checked as many static measurements as possible. In addition, we installed a tube in the sonar void to be able to measure the waterline-reference mark directly. We were able to correct the difference by about 15 cm after adjusting our draft based on the new measurements. However, even after all the checking, we were unable to make the leadline test close with the Simrad processed soundings. The difference was about 0.4m, and the leadline measurements would be in general agreement with the USGS data.
- 5) The launches data was also compared to the USGS data and the TJ ship data. In general, the launch data was also shoaler than the ship data by 0.2-0.3m, placing it between the ship data and the USGS data.
- 6) Creed draft/loading error-*Creed* is a SWATH vessel with active stabilization and controllable draft to optimize seakeeping abilities. It is possible that the draft was poorly measured or controlled. If it were poorly controlled, however, we would expect that there would be considerable inconsistency within the USGS data set. A draft measurement error would be consistent with a constant offset.

## Conclusions

- 1) We were not able to find a single cause for the difference between the USGS data and TJ data, but believe it to be a combination of TJ draft measurement, Creed draft measurement, and tidal epoch change.
- 2) The data collected for these surveys by USGS and TJ were collected under circumstances other than an NOS-specified hydrographic survey for charting, and need to be treated differently than other surveys.
  - a. The current version of NOS Specifications and Deliverables is inapplicable to these surveys.
  - b. The results of the surveys should be examined, with far less emphasis on the processes employed during acquisition and processing.
  - c. These surveys were not intended to find and characterize small features such as rocks, wrecks, and obstructions. In the few cases where these features were in fact visible in the data, they will be noted in the DR. In other cases, the items should remain as charted.
  - d. Most of the survey area was in deep water (>30m) and there was continuous coverage in these areas. In shoaler areas, the line spacing was frequently too wide to achieve continuous coverage. As a result, there are a few shoals on some sheets that TJ has recommended be retained as charted because the least depth was not determined by these surveys. It was beyond the scope of this project to investigate every shoal and fill every holiday.

- 3) This procedure of running a few crosslines over OSD data was very successful and has resulted in a set of surveys that NOAA can stand behind for charting purposes. However, I do not think it should generally be necessary for ship's personnel take the lead on the project. I recommend that future similar efforts should be encouraged, with shoreside processing personnel taking the lead on the project from start to finish. This includes:
- a. Discussing the form of data transfer from the supplying organization to NOAA in manner conducive to continued cooperation and collaboration.
  - b. Ensuring that the data is rigorously converted to our processing software (HIPS), paying special attention to the application of ancillary data such as tides, sound velocity, and draft. Conversion should also be made in such a way as to preserve any edits that the original hydrographers made to the data.
  - c. Well before any planned field work, the data should be analyzed for holidays, searched for rocks, wrecks, obstructions and compared to the chart. With this information, the hydrographers can develop a survey plan that optimizes the use of the ship.
  - d. Survey work should include regularly spaced crosslines sufficient to check most of the OSD survey lines. It should include holiday lines and item investigation lines as necessary to minimize unresolved items and unaddressed charted features.
  - e. Preliminary processing can occur on the ship, but a shoreside team should write up the DR and do the final analysis and processing.

**Subject:** [Fwd: status of stellwagen data]

**Date:** Mon, 10 Apr 2006 15:17:54 -0400

**From:** Shepard Smith <Shep.Smith@noaa.gov>

**To:** Daniel Wright <Daniel.Wright@noaa.gov>

----- Original Message -----

**Subject:** status of stellwagen data

**Date:** Wed, 10 Sep 2003 17:41:25 GMT

**From:** Kim Sampadian <[kim.sampadian.atsea@noaa.gov](mailto:kim.sampadian.atsea@noaa.gov)>

**To:** [shep.smith@noaa.gov](mailto:shep.smith@noaa.gov)

**CC:** [matthew.ringel@noaa.gov](mailto:matthew.ringel@noaa.gov), [peter.lewit@noaa.gov](mailto:peter.lewit@noaa.gov)

Status of applying zoned verified tides to the Stellwagen Data as of 9/10/03

Contents of Tide file (8443970.tid)-

1994 verified tide is hourly with coverage from 10/01/1994 to 2/31/1994; Dates of acquisition are 11/11/1994 to 12/04/1994

1995 verified tide is hourly with coverage from 3/01/1995 to 5/31/1995; Dates of acquisition are 3/29/1995 to 4/26/1995

1996 verified tide is six-minute with coverage from 3/01/1996 to 5/31/1996 and 11/01/1996 to 12/31/1996; Dates of acquisition are 4/2/1996 to 4/26/1996 and 12/4/1996 to 12/13/1996

1997 verified tide is six-minute with coverage from 11/01/1997 to 12/31/1997; Dates of acquisition are 11/20/1997 to 12/01/1997

1998 verified tide is six-minute with coverage from 01/01/1998 to 01/31/1998 (not needed for the data but left them in anyway) and hourly from 11/10/1998 to 11/30/1998; Dates of acquisition are 11/22/1998 to 11/23/1998

All data has preliminary zoned verified tides applied off the primary Boston gauge(H:\tide\2003\Boston\844-3970\AppBostonCORP.zdf) with the exception of the following lines that only have the verified tide applied directly(H:\tide\2003\Boston\844-3970\8443970.tid-- 7 out of 1748 lines isn't bad):

1996\_116  
stell\_116\_0732 (cross zones from NA156 to NA176 and back to NA156)

1996\_342  
stell\_342\_0892 (cross zones from NA169 to NA156 and back to NA169)

1996\_344  
stell\_344\_0919 (cross zones from NA156 to NA176 and back to NA156)

stell\_344\_0943 (cross zones from NA169 to NA156 and back to NA169)  
stell\_344\_0950 " "  
stell\_344\_0962 " "

1996\_345  
stell\_345\_1034 (cross zones from NA156 to NA176 back to NA156 and then back to NA176)

These lines crash Caris when trying to apply zoned tides but work fine when applying the tide file directly. I verified that there isn't any gaps or overlaps in these zones and tried rejecting the parts of the

lines that cross between zones (reaccepted the data once I tested this theory). I also tried deleting the ProcessedDepths.lsf file for a couple of the lines and then trying to reapply and still no luck. Hopefully the Caris Hotfix will take care of these remaining lines. I've created a session "stellwagen\_tide.hsf" for these lines.



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL OCEAN SERVICE  
Silver Spring, Maryland 20910

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE: January 7, 2004

HYDROGRAPHIC BRANCH: Atlantic  
HYDROGRAPHIC PROJECT: OPR-A397-TJ-2003  
HYDROGRAPHIC SHEET: W00045

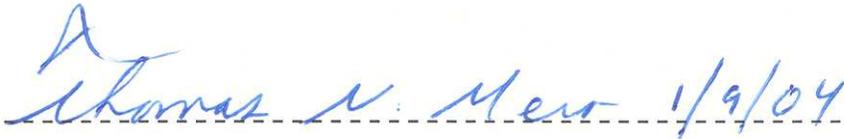
LOCALITY: Approaches to Boston, MA  
TIME PERIOD: August 24 - September 17, 2003

TIDE STATION USED: 844-4162 Boston Light, MA  
Lat. 42° 19.7'N Lon. 70° 53.5'W  
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters  
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.858 meters

REMARKS: RECOMMENDED ZONING  
Use zone(s) identified as: NA175, NA176

Refer to attachments for zoning information.

Note 1: Provided time series data are tabulated in metric units (meters), relative to MLLW and on Greenwich Mean Time on the new 1983-2001 National Tidal Datum Epoch (NTDE).

  
CHIEF, REQUIREMENTS AND DEVELOPMENT DIVISION



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**ATLANTIC HYDROGRAPHIC BRANCH  
EVALUATION REPORT FOR W00045 (1995,2003)**

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.

**B. DATA ACQUISITION AND PROCESSING**

**B.1 EQUIPMENT**

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

MapInfo, version 8.5, Release Build 32  
PYDRO, version 6.4.9-HF4  
CARIS HIPS/SIPS version 6.1  
CARIS BASE Editor 2.1  
CARIS HOM ENC Version 3.3 SP3  
DKART INSPECTOR, version 5.1

**B.2 PROCESSING**

**H-CELL**

H-cell layers in CARIS HOM are organized as follows:

Layer 100 Soundings at 1:20,000  
Layer 200 Skin of the Earth(SOTE)  
Layer 300 Wrecks & sea bed areas  
Layer 500 Line & meta data

Office processing entailed the use of CARIS HIPS to generate the Finalized Combined Uncertainty Bathymetry Error (CUBE) surface W00045\_AHB\_5m\_Deep\_Final.hns. This surface was computed at 5 meter resolution using the "Density & Local" disambiguation parameter and the "Deep" advanced configuration. The finalized surface was computed using the greater of standard deviation or uncertainty with designated soundings applied. No depth threshold was applied, as 5 meters gave the highest resolution surface with fewest gaps for the survey area. The CUBE surface is the bathymetric and feature presentation source for soundings incorporated within the submitted Electronic Navigational Chart Base Cell file.

Final CUBE surfaces were used as the source data for the

nautical chart update products. During office processing, it was determined to exclude the Thomas Jefferson crossline data due to an undetermined inconsistency between the two data sources. Creed data was selected as the source for CUBE surfaces and nautical chart products.

CARIS Bathy DataBase processing included the generation of Product Surface W00045\_AHB\_5M\_13279\_PS.hob at 5m resolution and extraction of a sounding data set at 1:10,000. A second file, W00045\_AHB\_10M\_13267\_PS.hob was generated at 10m resolution and a sounding set extracted at 1:20,000 scale, files W00044\_AHB\_SNDG\_13279.hob and W00044\_AHB\_SNDG\_13267.hob respectively. For the Survey scale H-Cell, the two non overlapping sounding sets were combined in HOM at 1:20,000 from which W00045\_SS.000 was generated. For the chart scale H-Cell, the sounding sets were decimated in separate HOM files, then combined in BASE Editor at 1:20,000, and imported into HOM from which W00045\_CU.000 was generated. These steps were taken to accommodate a MCD request for two different sounding densities within the H-Cell. The depth area was generated from a 10 meter resolution product surface at the intervals 0.229 and 183.109 meters.

Chart scale soundings were extracted from the 1:20,000 survey scale sounding set with the HOM sounding suppression utility, using the table method with one set of variables, (0,1000,60) which best represents the sounding density shown on chart 13267. In a separate file, chart scale soundings were extracted from a 1:10,000 survey scale sounding set using the HOM sounding suppression utility, following the table method with two sets of variables, (0,39,15 and 40,1000,25) which best represents the sounding density shown on chart 13279.

The soundings listed below were selected from ENC US4MA04M and Raster Chart 13279 in areas with incomplete coverage.

From Chart 13279			From ENC US4MA04M.000		
Depth ft	Lat	Lon	Depth ft	Lat	Lon
22	42-37-46.481N	70-34-34.299W	46	42-36-09.4070	37-06.060W
28	42-37-39.756N	70-34-44.529W	44	42-36-49.4070	35-24.940W
25	42-37-34.553N	70-34-53.682W	65	42-36-35.7070	34-53.072W
35	42-37-24.657N	70-35-51.167W	23	42-37-46.2070	34-25.860W

Soundings were selected during HOM processing with the CARIS GIS Environmental Variable set to a metric scale (-1,-1,t) in

order to accommodate millimeter precision of the sounding value (CARIS default rounding regime with truncation) during H-Cell processing and export of Base Cell file. This environmental variable was reset to NOAA standard values (0,0,N) when converting the metric exchange file to chart depth units after the Base Cell File export.

H-Cell W00045\_01.des was created in HOM to produce the Base Cell final product W00045\_CU.000 at 1:80,000 scale as per Chart 13267. H-Cell W00045\_02.des was created in HOM to produce the Base Cell final product W00045\_SS.000 at 1:20,000 survey Scale.

### **BASE CELL TESTING**

The base cell file W00045\_CU.000 was examined using dKart Inspector. Warnings received were all inconsequential. The DSPM.HUNI and DSPM.DUNI were reported to have illegal values, but these errors were expected as originating during ENC conversion to NOAA chart values, so they also can be ignored. All other errors refer to ENC features being retained where QUASOU and TECSOU are attributed as unknown.

### **CROSS LINES**

Office processing determined the field unit acquired more than the required 5% (approximately 7.3%) of cross line data for quality assurances and system assessment as specified in the *NOS Hydrographic Surveys Specifications and Deliverables (NOS HHSSD)*, 2003 Edition. Although not authorized for use in NOAA surveys, the CARIS Refraction editor was applied to the USGS data set, however the cross lines acquired by Thomas Jefferson validate the data. The cross line analyses conducted at AHB were consistent with the field analysis. W00045 has been deemed as acceptable for charting purposes.

The vertical depth variance at crossline junctions were on the average 0.6m. This discrepancy falls between the IHO Order 1 depth accuracy vertical error budget which ranges between 0.50m to 4.21m for the survey's depth range. This method does not technically meet the conventional standards set forth in the *NOS HHSSD*. However, Hydrographic Surveys Technical Directive 2004-03, dated 01/08/05, has given approval that NOAA field units may vary from the established procedures and documentation with respect to CARIS HIPS BASE Surface processing methods.

**JUNCTIONS**

Hydrographic survey W00044, Sheet N, adjoins the south western edge of W00045 and overlaps the sheet area. The overlapping H-Cell area from W00044 was excluded from H-cell W00045. Likewise, hydrographic survey H11227, Sheet X, adjoins the north western edge of W00045 and overlaps the sheet area. The overlapping H-Cell area from H11277 was excluded from H-cell W00045.

**C. HORIZONTAL CONTROL**

Office ENC processing of this survey required translating the datum to meet S-57 ENC requirements. During CARIS HOM processing the horizontal geodetic datum was translated to Latitude and Longitude (LLDG) World Geodetic System-84 (WGS-84). The S-57 ENC format serves as the exchange file submitted to Marine Chart Division.

D.1 CHART COMPARISON      13279 (32<sup>nd</sup> Edition, February, 2007)  
Corrected through NM Feb 24/07  
Corrected through LNM Feb 20/07  
13267 (34<sup>th</sup> Edition, May, 2007)  
Corrected through NM May 26/07  
Corrected through LNM May 15/07

ENC Comparison                      US4MA04M (Edition 4 2007-08-29)

The charted hydrography originates with prior surveys and requires no further consideration. The hydrographer makes adequate chart comparisons in the Descriptive Report. The MBES data acquired for this survey are adequate to supersede the charted hydrography.

## ADDITIONAL RESULTS

### General Agreement with Charted soundings

The charted depths are from partial bottom NOS surveys before 1970. The MBES data acquired for this survey are adequate to supercede the charted soundings.

### Charted Bottom Characteristics

The field unit did not acquire bottom samples during survey operations. It is therefore recommended to retain the present charted bottom characteristics.

### 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.

### ADEQUACY OF SURVEY

The OSD were acquired prior to the formulation of NOAA standards for MBES coverage. As such, the data do not generally meet the sounding density and coverage requirements. The data are, however, sufficient to supercede the charted hydrography where survey depths are shoaler than charted depths. Full seafloor coverage was not achieved and uncharted features hazardous to surface navigation are not expected but may exist.

### MISCELLANEOUS

ENC products were created by Atlantic Hydrographic Branch personnel, Norfolk, Virginia, using CARIS HOM v3.3. ENC products and electronic data will be forwarded to Marine Chart Division, Silver Spring, Maryland.

For charted features the field unit used positions sourced from the raster chart. These positions appear in the item investigation forms and vary slightly from the positions of corresponding features in the H-Cell. The positions of the charted features in the H-Cell are from the last version of the ENC at the time of processing.

A handwritten signature in blue ink, appearing to read "Daniel B. Wright", written over a horizontal line.

Daniel B. Wright  
Physical Scientist  
Verification of Field Data  
Evaluation and Analysis

**APPROVAL SHEET**  
**W00045**

The completed surveys have been inspected with regard to survey coverage, delineation of depth curves, development of critical depths, cartographic symbolization, and verification or disproval of charted data. All revisions and additions made to the H-Cell files during survey processing have been entered in the digital data for these surveys. The survey records and digital data comply with NOS requirements except where noted in the Evaluation Report.

\_\_\_\_\_ Date: \_\_\_\_\_  
Daniel Wright  
Physical Scientist,  
Atlantic Hydrographic Branch

All final products have undergone a comprehensive review as per the Atlantic Hydrographic Branch Processing Manual and are verified to be accurate and complete except where noted in the Evaluation Report.



\_\_\_\_\_ Date: \_\_\_\_\_  
Helen Stewart,  
Physical Scientist,  
Atlantic Hydrographic Branch

I have reviewed the Base Cell files, accompanying data, and reports. This survey and accompanying Marine Chart Division deliverables meet or exceed NOS requirements and standards for products in support of nautical charting except where noted in the Evaluation Report.

Approved: \_\_\_\_\_ Date: \_\_\_\_\_  
Commander Shepard M. Smith, NOAA  
Chief, Atlantic Hydrographic Branch