F00437

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey ..... SIDE SCAN SONAR

Field No. RU-10-6-97

Registry No. FE-437

LOCALITY

State ..... DELAWARE

General Locality ..... DELAWARE BAY

Sublocality ..... 7NM NORTH OF CAPE HENLOPEN

19 97

CHIEF OF PARTY
LCDR D. A. COLE, NOAA

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DATE ..... APR 23 1998

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NOAA FORM 77-28 (11-72)

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

REGISTER NO.

FE-437

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.

RU-10-6-97

State Delaware

General locality Delaware Bay

Locality 7 nm north of Cape Henlopen

Scale 1:10,000 Date of survey 10 - 17 November 1997

Instructions dated 26 November 1997 Project No. S-D907-RU-97

Vessel NOAA Ship RUDE, EDP 9040

Chief of party Lieutenant Commander David A. Cole, NOAA

Surveyed by LCDR DA Cole, LT JM Klay, LT JL Riley, LT EJ Sipos, ST MT Lathrop

Soundings taken by:(echo sounder,hand lead,pole) SeaBat 9003, Raytheon DSF-6000N echo sounder

Graphic record scaled by JLR, EJS, MTL

Graphic record checked by JMK, JLR, MTL

Protracted by _____ Automated plot by Hewlett Packard Design Jet 350c plotter (AHB)

Verification by Atlantic Hydrographic Branch Personnel

Soundings in (~~fathoms~~, feet, ~~or meters~~ at ~~MLW~~ or MLLW) ~~meters~~ Feet at MLLW

REMARKS:

Notes in the Descriptive Report were made in red during office processing.

AWOIS & SURF ✓ by MBH 4/8/98

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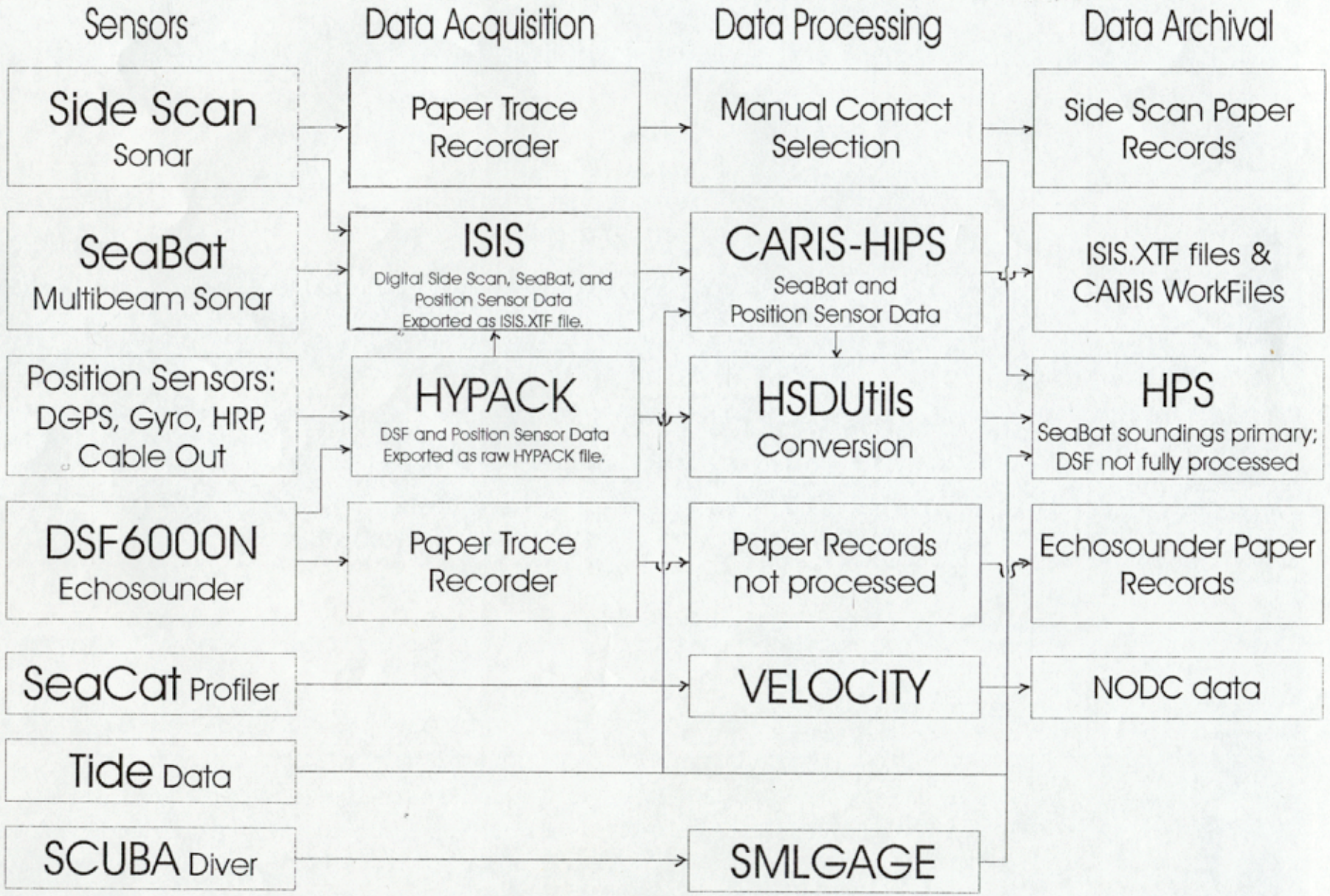
* Data filed with original field records

NOAA Ship RUDE: July - December 1997 Data Flowchart



A. PROJECT

A.1 This survey was conducted in accordance with Hydrographic Project Instructions S-D907-RU, Delaware Bay, Delaware, Vicinity of Big Stone Anchorage Area (CY 1997 Operations).

A.2 The original instructions are dated November 26, 1997.

A.3 There are no amendments to the instructions.

A.4 This survey is designated FE-437.

A.5 This survey responds to an urgent request from Maritrans GP Inc. of Philadelphia, PA, to perform a full-bottom coverage hydrographic survey of two newly charted fish havens restricting oil lightering operations in the Big Stone Anchorage Area in Delaware Bay. The U.S. Army Corps of Engineers, Philadelphia District, has been requested to immediately and indefinitely suspend permission to actively dump any material in the FE-437 survey area.

Prior to being designated as fish havens, the areas were last surveyed in 1971 and 1994. Survey H-9202 (1971, scale 1:20000) encompassed both areas, and survey H-10234 (1994, scale 1:10000) covered a small portion of the presently-charted northern fish haven area.

B. AREA SURVEYED

B.1 Survey FE-437 is comprised of two fish havens centered around a location approximately seven nautical miles (nm) north of Cape Henlopen, DE; the northern fish haven is located around 38°57.9'N 075°09.6'W, and the southern fish haven is located around 38°52.1'N 075°08.6'W.

B.2 The limits of the project are indicated on a chartlet attached to the S-D907-RU Project Instructions. The total project is comprised of two fish havens divided into five Priority Areas. Survey FE-437 (CY 1997 operations) provides complete survey coverage, as defined in the Project Instructions, for Priority Areas #1 and #2, and all of Priority Area #3, except for the wreck investigation originating from Chart Letter #974 in 1971.

The northern boundary of Fish Haven #8 as defined by the U.S. Army Corps of Engineers lies approximately 100 meters south of the conservatively charted boundary on NOAA Chart 12304, 38th edition. Because the 38th edition

of Chart 12304 was not yet available at the time of the survey, acquisition was based upon a scaled position of the Corps of Engineers boundary. As a result, a small area of deep water on the northern boundary of Fish Haven #8 is not covered by this survey.

B.3 Data acquisition for this survey began on November 10, 1997 (DN 314) and ended on November 17, 1997 (DN 321). Over 30 million soundings were processed for the survey.

C. SURVEY VESSELS

C.1 All hydrography, side scan, and multibeam investigations were conducted from NOAA Ship RUDE, S-590, EDP# 9040.

C.2 The transducer for the multibeam sonar was deployed on a pivoting pole mounted on the port side of RUDE, approximately amidships. The multibeam transducer was rotated into the water only during times of data acquisition.

D. AUTOMATED DATA ACQUISITION AND PROCESSING

See also Evaluation Report

D.1 The following programs were used to acquire and process the sounding data and the side scan sonar contact data:

Program	Version	Date	Program	Version	Date
CARIS HIPS	4.2.7	01/17/97	HYPACK	6.4B	04/17/97
" HDCS	4.2.7	05/09/97	ISIS	2.35	03/25/97
" HDCSMERG	4.2.7	05/09/97	HSDUTILS	3.51	05/28/97
" HIPSCVRT	4.2.7	03/18/97	HPS	None	04/14/97
" VCFEDIT	4.2.7	03/17/97	MAPINFO	4.00	11/15/95
" SWATHEDIT	4.2.7	01/17/97	HPS-MI	--	05/06/97

D.2 The following programs were used to acquire and process the sound velocity data:

Program	Version	Date	Program	Version	Date
CAT	3.00	02/26/97	SEACON	3.3M	11/27/89
VELOCITY	3.00	02/26/97			

D.3 The following programs were used for data quality assurance:

Program	Version	Date	Program	Version	Date
MAPINFO	4.00	11/15/95	SHIPDIM	2.1	04/17/95
HPS-MI	--	05/06/97	MONITOR	3.0	03/13/95

E. SIDE SCAN SONAR EQUIPMENT

E.1 All side scan sonar data were acquired with an Edgetech (EG&G) model 272 towfish and an Edgetech Model 260-TH slant-range correcting side scan sonar recorder. Additionally, all side scan sonar data were recorded digitally using the Triton ISIS software and archived in the Extended Triton Format (XTF) files.

E.2 The side scan towfish used a 50° vertical beam width tilted down 20° from horizontal.

E.3 A side scan sonar frequency of 100 kHz was used throughout the survey.

E.4a The 75-meter range scale was used at a line spacing of 120 meters. In deeper areas, the range scale was switched to 100 meters.

E.4b Confidence checks were obtained continually while on-line. Obstructions, changes in bottom texture, and sand waves were periodically annotated on the sonar records to verify side scan sonar coverage.

E.4c One hundred percent side scan sonar coverage was completed for this survey, in accordance with project instructions. Holiday lines were run to fill in any gaps. All coverage was checked with on-screen zoomable coverage displays in MapInfo to ensure proper overlap between lines.

E.4d Any data degraded by towfish instability, thermocline, prop wash, etc., were rejected and reacquired.

E.4e The towfish was deployed exclusively from the stern.

E.5 Sonar records were monitored on-line and reviewed by two persons during processing to identify contacts. Contact offsets and shadow heights were measured on sonar paper records, checked, and entered into the HPS Contact Table to compute contact heights and positions.

E.6 All side scan contacts with measurable shadows and all contacts which appeared manmade were deemed significant. All significant contacts were developed with one hundred percent multibeam sonar coverage. All coverage was checked with on-screen zoomable coverage displays in CARIS HIPS and MapInfo, and holiday lines were run to fill in any gaps.

F. SOUNDING EQUIPMENT

F.1 Single-frequency (455 kHz) multibeam data were acquired with a Reson SeaBat 9003 (SN 10496-447020) shallow-water sonar system. The 9003's combined transmit and receive beams yield forty (40) soundings per ping, each formed from a 3° crosstrack x 1.5° alongtrack bottom footprint. During multibeam data processing, the outermost two beams on each side of the swath (beam numbers 1, 2, 39, and 40) were not processed, reducing the effective swath width to 108° (3° x 36 beams). Proper overlap between multibeam sonar coverage lines was verified using a conservative swath width assumption of 100°.

Dual-frequency (24 and 100 kHz) vertical beam echo sounding data were acquired with a Raytheon DSF-6000N Digital Survey Echosounder (SN A107).

F.2 No diver investigations were performed for this survey.

F.3 There were no observed faults in sounding equipment that affected the accuracy or quality of the data.

F.4 SeaBat (455 kHz) multibeam data were continuously recorded during data acquisition and served as the primary source for hydrographic digital soundings.

SeaBat depth data were monitored using ISIS during acquisition and processed using CARIS HIPS multibeam data cleaning programs. Digital multibeam depth profiles were visually reviewed and fliers were identified and manually flagged as "rejected"; no SeaBat quality flags were used to automatically "reject" data. Vessel navigation data from DGPS and attitude data from heave, pitch, roll, and gyro sensors were also displayed and manually cleaned (see Sections G and I).

After hydrographer review and cleaning, the depth, navigation, and attitude data were merged with sound velocity, tide, and vessel configuration data to compute the true depth and position of each sonar beam footprint. All of the processed data were excessed by selecting shoal soundings at a nominal density of 2 meters x 2 meters. These excessed field sheet soundings were used in CARIS Workfile Processing for cross-data comparisons (see Section K.2). Finally, the CARIS Workfile Processing soundings were shoal-bias excessed at 15 meters x 15 meters and transferred into HPS (using HSDUTILS) and MapInfo databases.

Both high (100 kHz) and low (24 kHz) frequency vertical beam DSF data were recorded during data acquisition. DSF echograms were monitored on-line. Anomalous DSF echogram traces were immediately cross-referenced to the ISIS multibeam acquisition display online.

No manual edits were made to the DSF data. Vertical correctors were applied to only the raw DSF digital soundings (see Section G); the corrected high frequency (100 kHz) DSF soundings were compared to the SeaBat soundings (see Section K). The archived HPS fixes of DSF soundings do not represent the entire character of the seafloor because shoal bias inserts were not selected.
Inserts were made during office processing.

G. CORRECTIONS TO SOUNDINGS

G.1a Sound velocity and refraction were computed from conductivity, temperature, and depth measurements acquired with a SeaBird SBE19 SEACAT Profiler (S/N 196723-1251). Data quality assurance tests using the CAT program were performed for each cast. The profiler is calibrated at the beginning and end of each field season. See Separate IV for data records. *

Sound velocity and refraction effects were applied to the SeaBat data in HIPS (incorporating the Nautical Charting Development Lab REFRACT algorithm). *Sound velocity correctors for the vertical beam soundings were computed using VELOCITY and applied to the DSF data using HPS.

G.1b A DSF-leadline direct comparison was conducted on June 05, 1997. DSF and leadline soundings compared satisfactorily. *See Separate IV for data records. DSF and SeaBat soundings compared satisfactorily (see Section K.2).

G.1c Sensor offsets and transducer static drafts were measured during the December 1996 dry-dock period. Sensor offsets were stored in the HIPS Vessel Configuration File and HPS Offset Table for use in data processing. *See Separate IV for data records.

G.1d Transducer dynamic draft was measured on February 20, 1997. Dynamic draft correctors were stored in the HIPS Vessel Configuration File and HPS Offset Table for use in data processing. *See Separate IV for data records.

* Original data filed with field records.

G.1e Heave, pitch, and roll data were acquired with a TSS Model 335B Motion Sensor (s/n 542). A preseason checkout of the sensor was successfully conducted in accordance with the TSS-335B Operating Manual. Heave, pitch, and roll data were applied to SeaBat multibeam data. Heave data were applied to DSF vertical beam data.

G.1f Vessel heading data were acquired with a Sperry Mark 32 Gyrocompass (s/n 224). Heading data were used to compute multibeam transducer azimuth and position.

G.1g Multibeam heave, pitch, roll, and heading sensor data were adjusted using biases as determined during a patch test completed on April 02, 1997. *See the HIPS Vessel Configuration File in Separate III for data records.

G.2 No unusual or unique methods or instruments were used to correct sounding data.

G.3 Tide zoning for this project is consistent with the Project Instructions. Tide correctors were developed by applying a +0 minute time correction and a x1.0 range ratio to the unverified tides from the permanent NOS tide gage installation at Lewes, DE (855-7380). Unverified tides were downloaded from the NOS World Wide Web site: www.opsd.nos.noaa.gov/prelimwl.html

G.4 The diver least depth gage was not used for this survey.

G.5 No significant systematic errors were detected.

G.6 The vertical reference surface for this survey is Mean Lower Low Water (MLLW). A request for verified tides was mailed on November 24, 1997. These data will replace the unverified tide data during verification by N/CS33. Approved tides and zoning were applied during office processing.

In HPS, only tide reapplication processing is permissible on multibeam data. All other vertical correctors and horizontal offsets should be reapplied (if necessary) to multibeam data using the CARIS HIPS software.

H. CONTROL STATIONS See also Evaluation Report

The horizontal reference surface for this survey is the North American Datum of 1983 (NAD 83). No horizontal control stations were established for this survey.

* Data filed with original field records.

I. HYDROGRAPHIC POSITION CONTROL

I.1 Positioning for this survey was obtained from the NAVSTAR Global Positioning System (GPS) augmented with the U.S. Coast Guard Differential GPS (DGPS) service. The following USCG reference station beacons were used:

SITE A (Primary): Cape Henlopen, DE (288 kHz, 100 bps)
SITE B (Check): Cape Henry, VA (316 kHz, 100 bps)

I.2 Accuracy requirements were met as specified by the Hydrographic Manual, sections 1.3 and 3.1, and Field Procedures Manual, section 3.4.

I.3 GPS and DGPS signals were acquired with the following hardware equipment:

System A (Primary System, port antenna mount):
Ashtech GPS Sensor, s/n 700417B1083, Firmware 1E89D-P
Magnavox DGPS Receiver MX50R, s/n 078

System B (Check System, starboard antenna mount):
Ashtech GPS Sensor, s/n 700417B1003, Firmware 1E89D-P
Magnavox DGPS Receiver MX50R, s/n 160

Hardware System A was used exclusively during survey FE-437.

I.4 The Horizontal Dilution of Precision (HDOP) was recorded during survey operations and manually checked via the Detailed Data Abstract in HPS. The computed maximum allowable HDOP value of 3.3 was rarely exceeded.

Anomalous position data were either manually smoothed or flagged "rejected", depending on the extent of the affected data. Instantaneous vessel speed was checked with a 2.5 knot speed jump detector in HIPS to aid in the manual cleaning of multibeam navigation data.

DGPS performance checks were conducted using program SHIPDIM. A 12-hour monitor of the USCG DGPS beacons (listed in Section I.1) was conducted, also using program SHIPDIM. *See Separate III for data records.

I.5 Calibration data are not required for differential GPS.

I.6a There were no unusual methods used to operate the positioning equipment.

I.6b There were no positioning equipment malfunctions.

* Data filed with original field records.

I.6c There were no unusual atmospheric conditions noted which might have affected data quality.

I.6d No significant systematic errors were detected.

I.6e Offsets for the GPS antenna were applied from the CARIS HIPS Vessel Configuration File (VCF) to compute the position of the SeaBat transducer. * See Separate III for data records. **Horizontal positions of the DSF vertical beam echosounding data were not corrected for GPS antenna offsets during field processing.** The horizontal inverse distance between the DSF transducer and the GPS antenna is approximately 2.3 meters.

I.6f A-frame position (tow point), cable length, towfish height, and depth of water were applied to ship's navigation data in HPS to compute the position of the side scan towfish.

J. SHORELINE

No shoreline is contained within the survey boundaries.

K. CROSS COMPARISONS

K.1 A total of 4.6 nm of crosslines were acquired for this survey, equating to over 17% of the mainscheme 100% side scan sonar coverage lines and approximately 4% of the mainscheme 100% multibeam sonar coverage lines. Although the total linear nm of crosslines is less than 5% of the total linear nm of mainscheme multibeam lines, over 27,000 crossline multibeam soundings were compared.

K.2 For each of the two fish haven areas, processed SeaBat crossline soundings excessed at 2 meters x 2 meters (see Section F.4) were compared to 3 meter x 3 meter binned Digital Terrain Model (DTM) surfaces in CARIS Workfile Processing. Each fish haven DTM comparison surface was built from processed SeaBat mainscheme soundings, excessed at 2 meters x 2 meters. Averaged across the statistics, computed as a function of beam number, the mean difference between **SeaBat crossline and SeaBat mainscheme soundings** is approximately +0.18 meters for the northern fish haven and +0.08 meters for the southern fish haven (27,673 comparisons, crossline soundings were deeper, due to shoal-biased DTM surface, * see Separate IV for records).

* Data filed with original field records.

For each of the two fish haven areas, all of the high frequency (100 kHz) DSF digital soundings (see Section F.4) were compared to 3 meter x 3 meter binned multibeam digital terrain model (DTM) surfaces, built as described above. The mean difference between **DSF and SeaBat soundings** is approximately +0.17 meters for the northern fish haven and +0.09 meters for the southern fish haven (5,513 comparisons, SeaBat soundings were deeper). The standard deviation of the difference between DSF and SeaBat soundings is approximately 0.21 meters for the northern area and 0.16 meters for the southern area. Because of the horizontal uncertainty in the positions of DSF soundings relative to SeaBat soundings, as well as a wide DSF beam footprint, DSF-to-SeaBat comparisons are more favorable in flatter and/or shoaler areas. The northern fish haven contained many large, irregular sandwaves, while a large percentage of the southern fish haven was relatively flat.

K.3 No anomalous cross comparisons were noted.

K.4 The mainscheme and crossline data were collected with the same suite of survey equipment.

L. JUNCTIONS

There are no survey junctions within project S-D907-RU-97.

M. COMPARISON WITH PRIOR SURVEYS See Evaluation Report

A comparison with prior surveys will be performed by N/CS33.

N. ITEM INVESTIGATION REPORTS

All side scan contacts with measurable shadows and all contacts which appeared manmade were deemed significant. All significant contacts were developed with one hundred percent multibeam sonar coverage. Notable results from these developments are summarized below:

Obstruction in Fish Haven Site #6

INVESTIGATION CONDUCTED:

- 100% side scan coverage
- 100% SeaBat coverage

INVESTIGATION RESULTS:

A large debris field, scattered over an area measuring approximately 475 meters x 50 meters, was located in the northern fish haven (Fish Haven Site #6, see S-D907-RU Project Instructions). The long axis of the debris field was oriented north-northeast x south-southwest, and was situated near the central eastern edge of the charted fish haven. Least depths on obstructions in the debris field ranged from 27 to 36 feet. Two obstructions had least depths of 27 and 27 feet and were situated approximately 20 meters apart, 135 meters south-southwest of the northern edge of the debris field. The least depths on these two obstructions represent the least depths for the entire northern fish haven.

Least Depths	Fix #	(m) Depth	(ft)	Latitude(N)	Longitude(W)
SeaBat	42621	8.40	27	38°57'46.55"	075°09'19.92"
SeaBat	42695	8.43	27	38°57'46.27"	075°09'20.69"
Side Scan*	1392.3S	--	--	38°57'46.6"	075°09'20.0"

* Side scan contact positioned nearest to the ~~two~~ 27 and 27 foot obstructions

CHARTING RECOMMENDATION:

Chart representative depths from this survey (see Section O.1). Chart the SeaBat least depth from fix number 42621, listed in the table above. See Section O for general charting recommendations for the northern fish haven. Concur with conditions.

********** COMPILATION NOTES **********

Do not chart obstructions. Update charted soundings with present survey depths. Retain charted Fish Haven limits

Wreck "MARGARET" - AWOIS #8880

INVESTIGATION CONDUCTED:

- 100% side scan coverage
- 100% SeaBat coverage

INVESTIGATION RESULTS:

A large obstruction surrounded by scattered debris was located approximately ~~330~~ 25c meters southwest of the currently charted position for AWOIS #8880 (fishing vessel "MARGARET"), 38°52'01"N 075°07'53"W (chart 12214 40th Ed., NAD83 scaled position). The least depth on this obstruction represents the least depth for the southern fish haven (Fish Haven Site #8, see S-D907-RU Project Instructions). The large obstruction located is believed to be the significant remnants of the wreck "MARGARET". Additional survey lines were run over the wreck to ensure 100% ensonification and verify the accuracy of the least depth. Only small, widely-scattered fish haven dumpings were located near the currently charted position of the "MARGARET".

Least Depths	Fix #	[m] Depth	[ft]	Latitude(N)	Longitude(W)
SeaBat	55925	6.50	21	38°51'54.36"	075°08'03.98"
Side Scan	4931.7S	--	--	38°51'54.5"	075°08'03.6"

CHARTING RECOMMENDATION:

Chart representative depths from this survey (see Section O.1). Delete the Dangerous Sunken Wreck symbol at 38°52'01"N 075°07'53"W. Chart the SeaBat least depth as listed in the table above, surrounded by a Danger Curve and accompanied with the text "Wk". See Section O for general charting recommendations for the southern fish haven. Concur with conditions

********** COMPILATION NOTES **********

No dangerous sunken wreck symbol is charted in 38°52'01"N Lat, 75°07'53"W Lon. Do not chart a 21 wk, but update the presently charted depths with soundings from the present survey. Retain charted Fish Haven limits

Wreck "Golden Eagle"

AWOIS# 10015

INVESTIGATION CONDUCTED:

- 100% side scan coverage
- 100% SeaBat coverage

INVESTIGATION RESULTS:

A large wreck, previously uncharted, was located approximately 100 meters east of the reported position of the 70' commercial tugboat "Golden Eagle", 38°52.085'N 075°08.164'W (reference the S-D907-RU Project Instructions: PA, assumed to be NAD83 - transcribed position from Maritrans Inc.). Additional survey lines were run over the wreck to ensure 100% ensonification and verify the accuracy of the least depth.

Least Depths	Fix #	(m) Depth	(ft)	Latitude(N)	Longitude(W)
SeaBat	56051	6.~~75~~	2~~8~~1	38°52'05.05"	075°08'05.72"
Side Scan	5230.7P	--	--	38°52'05.4"	075°08'06.2"

CHARTING RECOMMENDATION:

Chart representative depths from this survey. Chart the SeaBat least depth as listed in the table above, surrounded by a Danger Curve and accompanied with the text "Wk". See Section O for general charting recommendations for the southern fish haven. Concur with conditions.

********** COMPILATION NOTES **********

Do not chart a 21wk. Update the charted soundings with depths from the present survey. Retain charted Fish Haven limits.

O. COMPARISON WITH THE CHART

O.1 Two charts are affected by this survey:
Cape May to Fenwick Island
- Chart 12214, 40th Ed., 09 August 1997 1: 80,000 scale
Delaware Bay
- Chart 12304, 38th Ed., 09 August 1997 1: 80,000 scale

O.2 One Danger to Navigation report containing one (1) depth change was submitted for this survey. See Appendix I for a copy of the report.

O.3a Five charted soundings are contained within the FE-437 survey limits; all five charted soundings are located in the northern fish haven survey area. The table below lists the charted soundings, the approximate position of the charted soundings, the range of FE-437 survey depths found within the printed limits of the charted soundings (the printed area of each charted sounding covers approximately 200 meters x 150 meters), and the location of shoal sounding(s) from survey FE-437 relative to the approximate position of each charted sounding:

Charted	Latitude	Longitude	FE-437	Location of Shoal Sounding(s)
20 ft	38°58.0'N	75°10.2'W	**21-28 ft**	20 ft sdng 170 m to the NW
25 ft	38°57.6'N	75°09.9'W	**24-29 ft**	24 ft sdng 75 m to the SW
27 ft	38°57.7'N	75°09.0'W	**25-30 ft**	23ft sdngs* 130m to the S
28 ft	38°57.3'N	75°09.5'W	**26-34 ft**	26ft sdng 75 m to SW
28 ft	38°57.2'N	75°09.2'W	**26-35 ft**	26ft sdng 75 m to W

* See Danger to Navigation Report, Appendix I

Note that shoaler depths were found near all of the charted soundings.

CHARTING RECOMMENDATION:
Delete the blue tinting from the fish havens where not warranted by the actual survey depths. Retain dotted perimeters centered around the approximate positions: 38°57.9'N 075°09.6'W, and 38°52.1'N 075°08.6'W. Chart representative depths from this survey and change the charted text:

REPLACE	WITH
"Obstn Fish Haven (auth min 15ft)"	"Obstn Discontinued Fish Haven Depths from 1997 survey"

Retain the fish haven as currently charted in the portion of site 8 not surveyed by RUDE. Do not concur. Retain Fish Haven as charted until review and decision by U.S. Corps of Engineers who established them.

O.3b In general, the 30 foot and 60 foot survey depth contours shown on the chart have migrated slightly to the southwest. Concur

P. ADEQUACY OF SURVEY

This survey is complete and adequate to supersede prior surveys in common areas.

Q. AIDS TO NAVIGATION

Q.1 There were no aids to navigation within the survey area.

Q.2 There were no submarine or overhead pipelines, cables, tunnels, bridges, or ferry routes in the survey area.

R. STATISTICS

R.1a	No. of Processed Multibeam Soundings	30,243,389
R.1b	No. of Multibeam Soundings Transferred to HPS	16,118
R.1c	Lineal Nautical Miles of Sounding Lines	147
R.2a	Square Nautical Miles of Hydrography	2
R.2b	Days of Production	5
R.2c	Detached Positions	0
R.2d	Bottom Samples	0
R.2e	Tide Stations	1
R.2f	Velocity Casts	12
R.2g	SEABAT Item Investigations	2

S. MISCELLANEOUS

No evidence of silting, unusual submarine features, anomalous tide or tidal current conditions, or magnetic anomalies were detected during this survey. The sandwaves in the northern fish haven have migrated slightly to the southwest.

T. RECOMMENDATIONS

Additional fieldwork is required to complete the remainder of the Priority Areas as defined in the S-D907-RU Project Instructions (see Section B.2). Concur

U. REFERRAL TO REPORTS

A copy of the Coast Pilot Report will be included in the Separates.

This report and the accompanying field sheets are respectfully submitted.

Jack L. Riley, LT, NOAA
NOAA Ship RUDE

APPENDIX III

LIST OF HORIZONTAL CONTROL STATIONS

Differential GPS was employed for all positioning. The following differential beacons were used:

SITE A (Primary):	Cape Henlopen, DE	38°47'N, 075°05'W
SITE B (Check):	Cape Henry, VA	36°56'N, 076°00'W

FAXED 11/21/97

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of NOAA Corps Operations
NOAA Ship RUDE S-590
439 W. York Street
Norfolk, VA 23510-1114

November 21, 1997

Commander
First Coast Guard District
Aids To Navigation Office
408 Atlantic Avenue
Boston, Massachusetts 02110-3350

REPORT OF DANGER TO NAVIGATION

Dear Sir:

The NOAA Ship RUDE has recently finished a hydrographic survey of Delaware Bay:

Hydrographic Survey Registry No....F-00437
State.....Delaware
General Locality.....Delaware Bay
Sublocality.....7 nm north of Cape Henlopen, DE
Project Number.....S-D907-RU-97
Surveyed by.....NOAA Ship RUDE

During the course of multibeam sonar operations, a ridge featuring large sand waves was discovered to have a least depth shoaler than the depth currently shown on the charts of the area. This new depth information merits immediate publication in the Local Notice to Mariners. The updated depth affects the following charts:

CHART NUMBER	CHART EDITION NO.	CHART EDITION DATE	DEPTH *	LATITUDE (NAD 83)	LONGITUDE (NAD 83)
12214	40	Aug. 9, 1997	23 ft	38° 57′ 35.7″ N	075° 09′ 01.3″ W
12304	38	Aug. 9, 1997			

*** Updated depths are reduced to feet at MLLW using unverified tides and should be viewed as preliminary information, subject to office review.**

Contact either of the following personnel for further information:

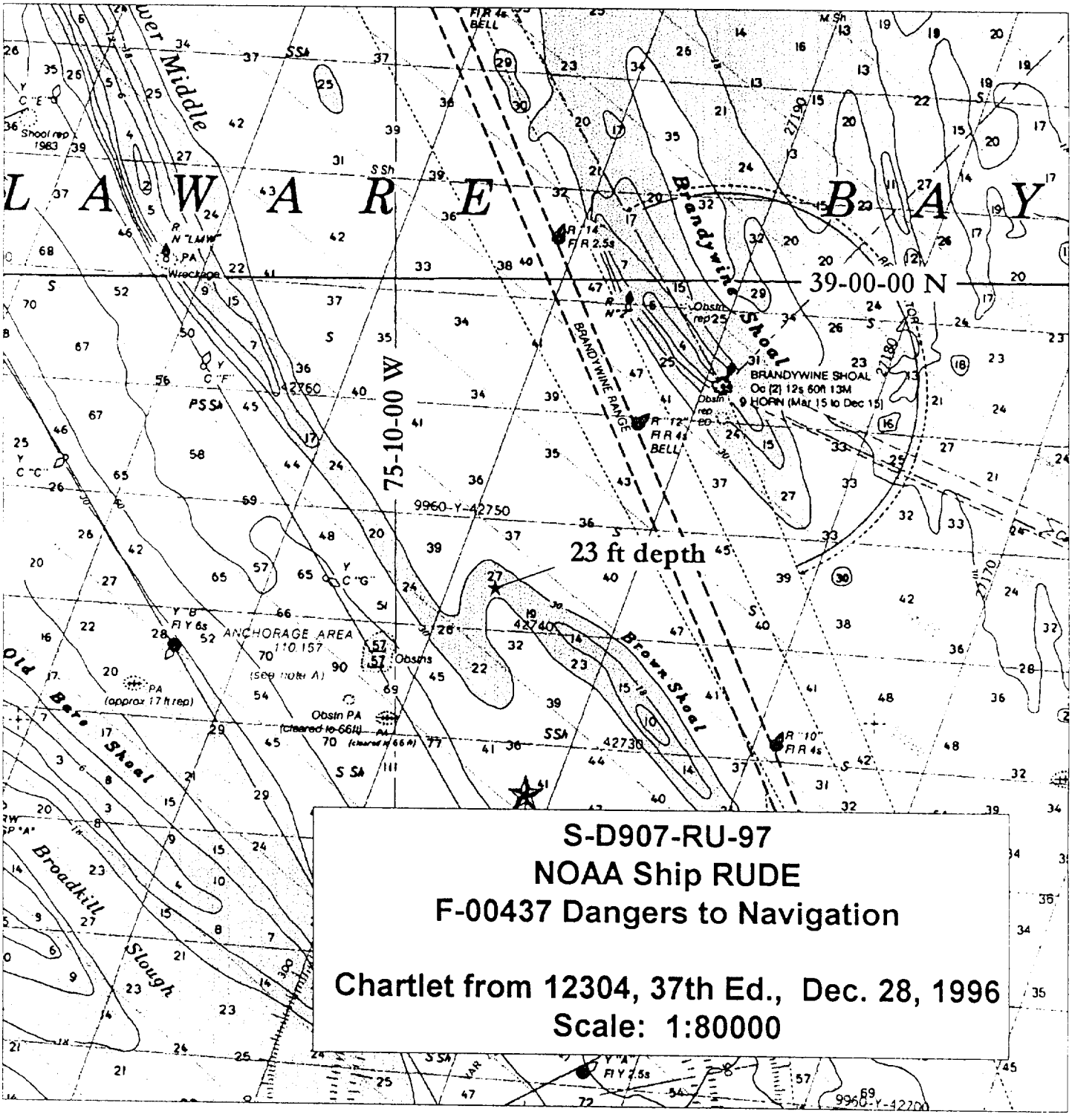
Commanding Officer
NOAA Ship RUDE (757) 441-6386
439 West York Street
Norfolk, VA 23510

Chief, Atlantic Hydrographic Branch
Atlantic Marine Center (757) 441-6746
439 West York Street
Norfolk, VA 23510

Sincerely,

David A. Cole, LCDR, NOAA
Commanding Officer, NOAA Ship RUDE

cc: AHB, NIMA



S-D907-RU-97
NOAA Ship RUDE
F-00437 Dangers to Navigation

Chartlet from 12304, 37th Ed., Dec. 28, 1996
Scale: 1:80000

APPENDIX VII

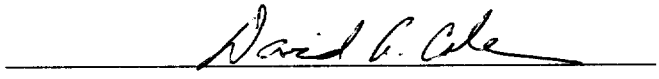
APPROVAL SHEET

LETTER OF APPROVAL

REGISTRY NO. FE-437

Field operations contributing to the accomplishment of this Navigable Area survey were conducted under my direct supervision with frequent personal checks of progress and adequacy. All field sheets and reports were reviewed in their entirety and all supporting records were checked as well.

This survey was completed with 100% multibeam sonar coverage and should supersede all prior surveys in common areas. Due to time constraints, there were a few small gaps in 100% multibeam coverage where no side scan contacts were found. The survey is considered complete and adequate for nautical charting.



David A. Cole, LCDR, NOAA
Commanding Officer
NOAA Ship RUDE

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE: March 3, 1998

HYDROGRAPHIC BRANCH: Atlantic

HYDROGRAPHIC PROJECT: S-D907-RU-97
HYDROGRAPHIC SHEET: F-00437

LOCALITY: Delaware Bay

TIME PERIOD: Nov 10 - Nov 17, 1997

TIDE STATION USED: 855-7380 Lewes, DE
Lat. 38° 47.0'N Lon. 75° 07.1'W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 1.314 meters

REMARKS: RECOMMENDED ZONING
Use zone(s) identified as: DB11, DB12, DB13, DB16, DB17, DB18 & DB19
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.

CHIEF, OPERATIONAL ANALYSIS BRANCH

Final tide zone node point locations for S D907-RU-97, F-00437.

Format: Longitude in decimal degrees (negative value denotes Longitude West),
Latitude in decimal degrees
Tide Station (in recommended order of use)
Average Time Correction (in minutes)
Range Correction

	Tide Station Order	AVG Time Correction	Range Correction
Zone DB11			
-75.067579 38.889774	855-7380	0	1.04
-75.186082 38.878245			
-75.219607 38.830479			
-75.20604 38.823697			
-75.200032 38.816567			
-75.195103 38.811923			
-75.190316 38.805342			
-75.104939 38.829521			
-75.107588 38.838388			
-75.067579 38.889774			
Zone DB12			
-75.03966 38.925547	855-7380	0	1.08
-75.130466 38.9267			
-75.172436 38.897653			
-75.186082 38.878245			
-75.067579 38.889774			
-75.03966 38.925547			
Zone DB13			
-75.021741 38.948482	855-7380	0	1.13
-75.095624 38.950797			
-75.130466 38.9267			
-75.03966 38.925547			
-75.021741 38.948482			
Zone DB16			
-75.219607 38.830479	855-7380	+12	1.05
-75.233506 38.843407			
-75.257325 38.871307			
-75.186082 38.878245			
-75.219607 38.830479			
Zone DB17			
-75.285297 38.893701	855-7380	+12	1.08
-75.257325 38.871307			
-75.186082 38.878245			
-75.172436 38.897653			

-75.130466 38.9267
-75.275235 38.928538
-75.285297 38.893701

Zone DB18

-75.110092 38.95125	855-7380	+12	1.13
-75.264145 38.966817			
-75.275235 38.928538			
-75.130466 38.9267			
-75.095624 38.950797			
-75.110092 38.95125			

Zone DB19

-75.042714 38.978644	855-7380	+12	1.18
-75.133121 38.976485			
-75.255997 38.994967			
-75.264145 38.966817			
-75.110092 38.95125			
-75.095624 38.950797			
-75.068834 38.969367			
-75.042714 38.978644			

NOAA FORM 76-155
(11-72)

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

GEOGRAPHIC NAMES

SURVEY NUMBER

FE-437

Name on Survey	A ON CHART NO. 12304 12214	B ON PREVIOUS SURVEY NO.	C ON U.S. QUADRANGLE MAP	D FROM LOCAL INFORMATION	E ON LOCAL MAPS	F P.O. GUIDE OR MAP	G RAND MCNALLY ATLAS	H U.S. LIGHT LIST	K	
DELAWARE (title)	X		X							1
DELAWARE BAY (title)	X		X							2
CAPE HENLOPEN (title)	X		X							3
										4
										5
										6
										7
										8
										9
										10
										11
										12
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										24
										25

Approved

Director, Office of Coast Survey

APR 7 1998

NOAA FORM 76-155 SUPERSEDES C &GS 197

This form was electronically produced by Elite Federal Forms, Inc.

NOAA FORM 61-29
(12-71)

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

REFERENCE NO.
N/CS33-27-98

LETTER TRANSMITTING DATA

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

☐ ORDINARY MAIL ☐ AIR MAIL
☐ REGISTERED MAIL ☒ EXPRESS
☐ GBL *(Give number)* _____

TO:

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

DATE FORWARDED
APR 1, 1998

NUMBER OF PACKAGES
ONE TUBE

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.

FE-437

DELAWARE, DELAWARE BAY, 7NM NORTH OF CAPE HENLOPEN

1 (ONE) TUBE CONTAINING THE FOLLOWING:

1 ORIGINAL DESCRIPTIVE REPORT WITH 2 SMOOTH SHEETS ENCLOSED
H-DRAWING FOR NOS CHART 12304
COMPOSITE DRAWING FOR NOS CHART 12304
1 DRAWING HISTORY (NOAA FORM #76-71) FOR NOS CHART 12304
1 RECORD OF APPLICATION TO CHART (NOAA FORM #75-96) FOR SURVEY FE-437

FROM: *(Signature)*
Deborah A. Bland Deborah A. Bland

RECEIVED THE ABOVE
(Name, Division, Date)

Return receipted copy to:

ATLANTIC HYDROGRAPHIC BRANCH
N/CS33
439 WEST YORK STREET
NORFOLK, VA 23510-1114

NOAA FORM 61-29 SUPERSEDES FORM C & GS 413 WHICH MAY BE USED.

*U.S.GPO:1983-0-664-006/1192

04/01/98

HYDROGRAPHIC SURVEY STATISTICS
REGISTRY NUMBER: FE-437

NUMBER OF CONTROL STATIONS	2
NUMBER OF POSITIONS	16118
NUMBER OF SOUNDINGS	16118

	TIME-HOURS	DATE COMPLETED
PREPROCESSING EXAMINATION	85	02/19/98
VERIFICATION OF FIELD DATA	66	03/16/98
EVALUATION AND ANALYSIS	21	
FINAL INSPECTION	14	03/24/98
COMPILATION	13	04/01/98
TOTAL TIME	199	

ATLANTIC HYDROGRAPHIC BRANCH APPROVAL 03/18/98

ATLANTIC HYDROGRAPHIC BRANCH
EVALUATION REPORT FOR FE-437 (1997)

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:

Hydrographic Processing System
NADCON, version 2.10
SiteWorks version 2.01
MicroStation 95, version 5.05
I/RAS B, version 5.01

The smooth sheet was plotted using an Hewlett Packard Design Jet 350C plotter.

H. CONTROL STATIONS

7. 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 datum move the projection lines 0.404 seconds (12.470 meters or 1.25 mm at the scale of the survey) north in latitude, and 1.338 seconds (32.222 meters or 3.22 mm at the scale of the survey) east in longitude.

All geographic positions listed in this report are on NAD 83 datum unless otherwise specified.

M. COMPARISON WITH PRIOR SURVEYS

A comparison with prior surveys was not conducted. This is in accordance with section 4. of the memorandum titled "Changes to Hydrographic Survey Processing", dated May 24, 1995.

O. COMPARISON WITH CHART 12214 (40th Edition, AUG 9/97)
12304 (38th Edition, Aug 9/97)

The charted hydrography originates with the previously discussed prior surveys and requires no further consideration. The hydrographer makes adequate chart comparisons in Section O. of the Descriptive Report. The following should be noted:

1. Fish Haven Site#6 was established by the U.S. Army Corps of Engineers and originates with Chart Letter #172 of 1997 (CL172/97). The present survey disproved the existence of any 15ft (4^{6}m) depths within the charted limits of the fish haven. Depths ranged from 31ft (9^{4}m) at the southern limits of the fish haven to 43ft (13^{1}m) at the northern limits. An uncharted obstruction with a least depth of 26 feet (8^{1}m) was found in latitude 38°57'46.55"N, longitude 75°09'19.92"W. It is recommended that soundings from the present survey be used to update the charted depths surrounding the fish haven limits.

2. Fish Haven Site#8 was established by the U.S. Army Corps of Engineers and originates with Chart Letter #174 of 1997 (CL174/97). The uncharted wreck of the fishing vessel "MARGARET" was found in latitude 38°51'54.36"N, longitude 75°08'03.98"W with a least depth of 21 feet (6^{5}m), approximately 250 meters southwest of its reported position. An uncharted wreck of the tugboat "GOLDEN EAGLE" was found in latitude 38°52'05.34"N, longitude 75°08'05.99"W with a least depth of 21 feet (6^{5}m), approximately 100 meters east of its reported position. No changes in charting are recommended.

AWOIS Item #~~330~~ 10014, dangerous sunken wreck (15 feet rep), charted in latitude 38°52'12"N, longitude 75°09'25"W originates with Chart Letter #974 of 1971 (CL974/71). This item falls within the limits of Fish Haven Site#8 but was not investigated by this survey. It is recommended that this item be retained as charted.

It is further recommended that soundings from the present survey be used to update the charted depths surrounding the fish haven limits.

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

P. ADEQUACY OF SURVEY

This is an adequate hydrographic survey. No additional work is recommended except as recommended in section O of this report.

S. MISCELLANEOUS

A secondary 24 foot curve was added to this smooth sheet to better define the bottom in the survey area. This added curve also better defines the 24 foot shoal that is now migrating toward a northwest direction on the northwest portion of the survey area.

Sandwave limits have been noted on the page size smooth sheets with dashed black limit lines. Chart compilation using the present survey was done by Atlantic Hydrographic Branch personnel in Norfolk, Virginia. Compilation data has been forwarded to Marine Chart Division, Silver Spring, Maryland.

AHB Processing Team

for **Douglas V. Mason**
Cartographic Technician
Verification of Field Data
Evaluation and Analysis

APPROVAL SHEET
FE-437

Initial Approvals:

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

Deborah A. Bland Date: March 25, 1998
Deborah A. Bland
Cartographer,
Atlantic Hydrographic Branch

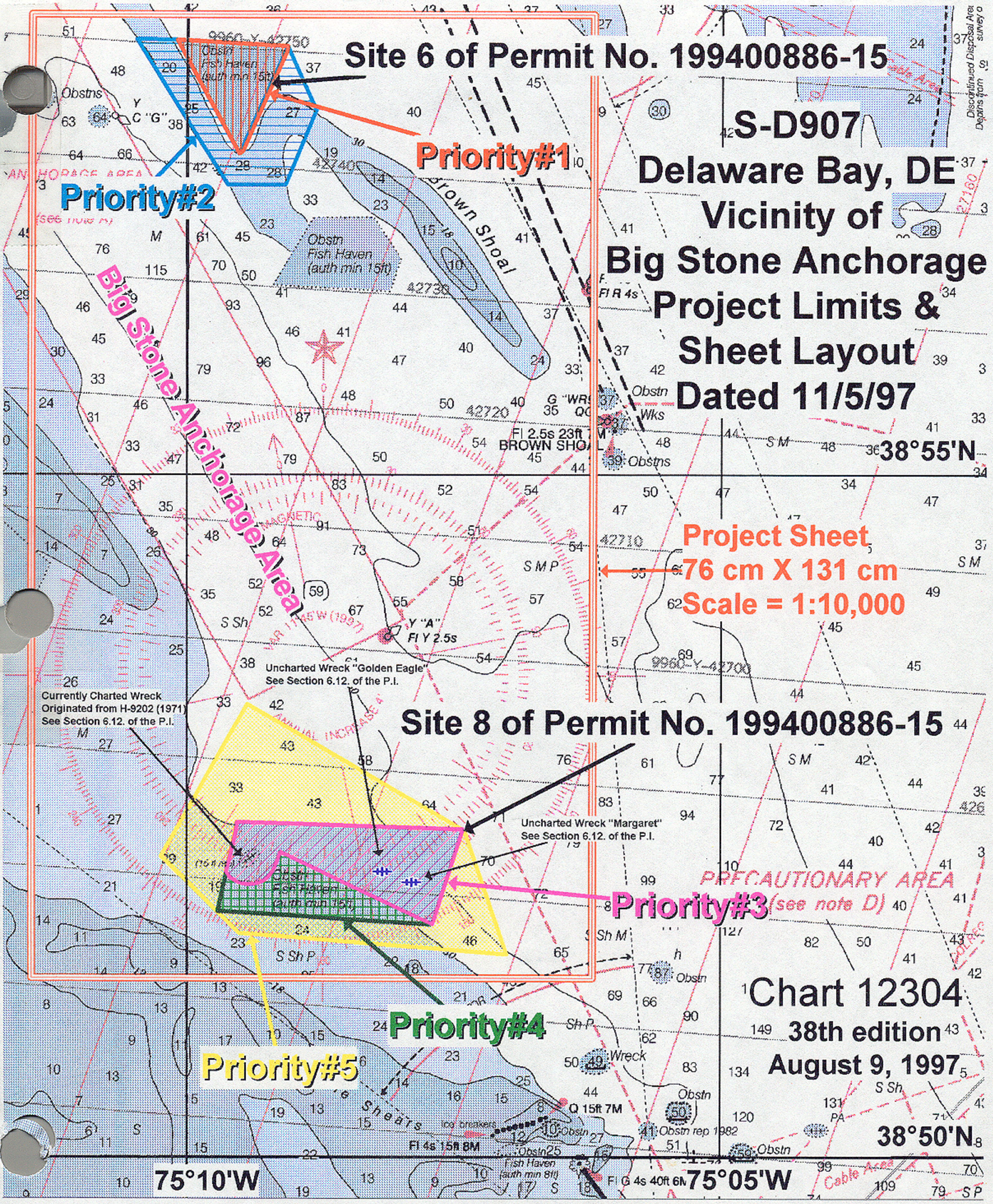
I have reviewed the smooth sheet, accompanying data, and reports. This survey and accompanying digital data meet or exceed NOS requirements and standards for products in support of nautical charting except where noted in the Evaluation Report.

Nicholas E. Perugini Date: March 25, 1998
Nicholas E. Perugini,
Commander, NOAA
Chief, Atlantic Hydrographic Branch

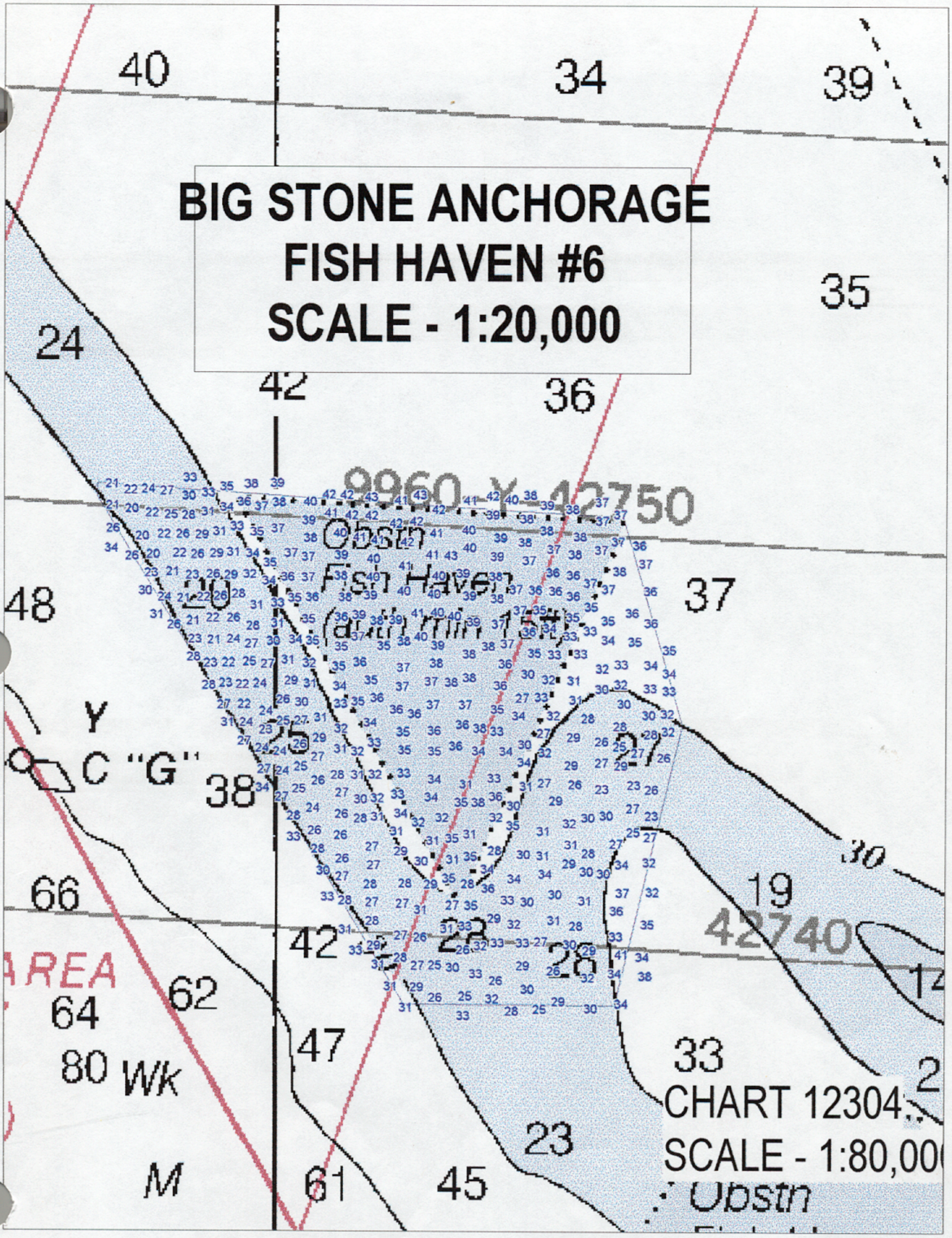
****

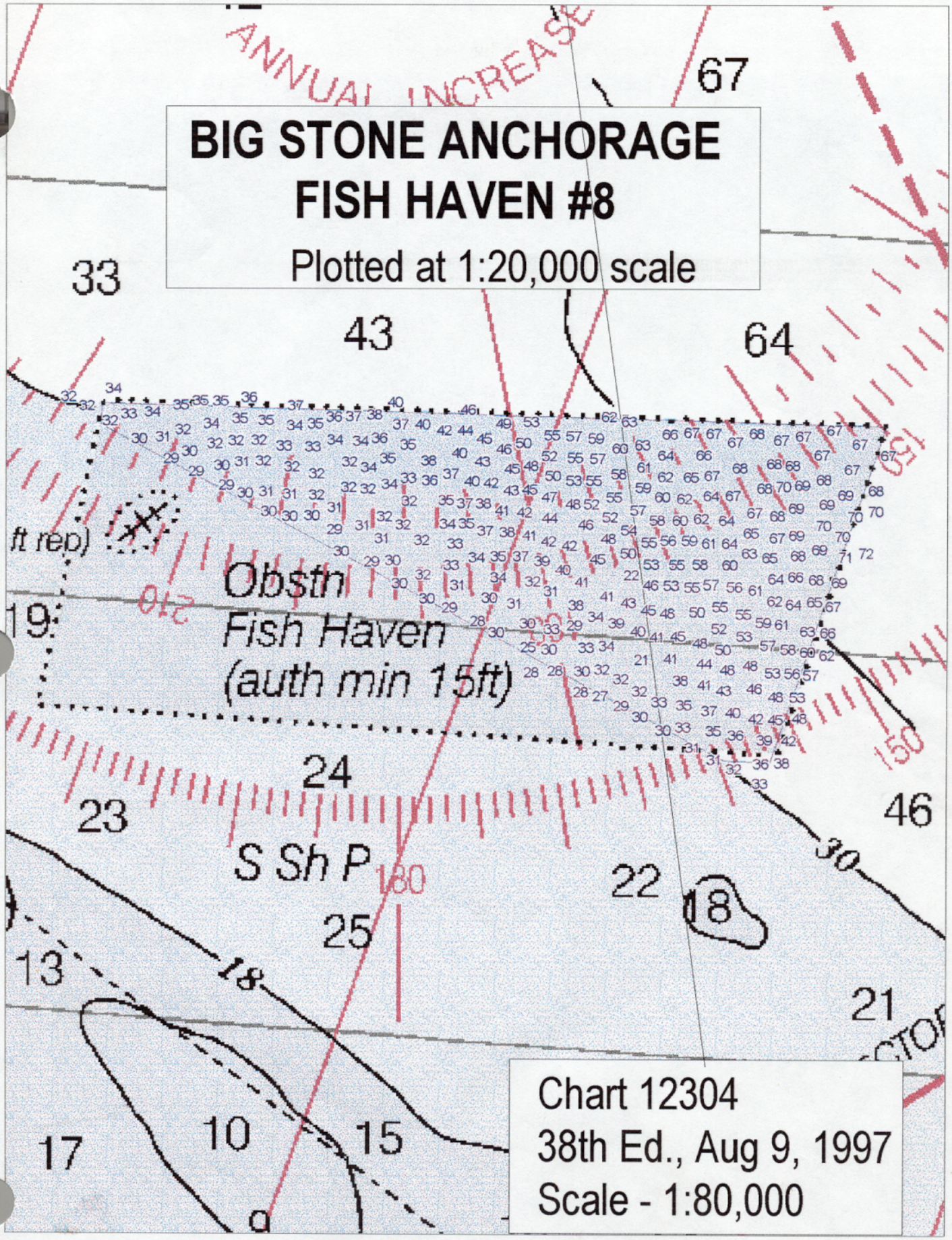
Final Approval:

Approved: Jack L Wallace ACTG for Date: April 23, 1998
Andrew A. Armstrong, III
Captain, NOAA
Chief, Hydrographic Surveys Division


Site 6 of Permit No. 199400886-15
Priority#1
Priority#2
S-D907
Delaware Bay, DE
Vicinity of
Big Stone Anchorage
Project Limits &
Sheet Layout
Dated 11/5/97
Big Stone Anchorage Area
Brown Shoal
Obstn Fish Haven (auth min 15ft)
38°55'N
Project Sheet
76 cm X 131 cm
Scale = 1:10,000
Uncharted Wreck "Golden Eagle" See Section 6.12. of the P.I.
Currently Charted Wreck Originated from H-9202 (1971) See Section 6.12. of the P.I.
Site 8 of Permit No. 199400886-15
Uncharted Wreck "Margaret" See Section 6.12. of the P.I.
PRECAUTIONARY AREA (see note D)
Priority#3
Priority#4
Priority#5
Chart 12304
38th edition
August 9, 1997
38°50'N
75°10'W
75°05'W

FE-437 (1997)

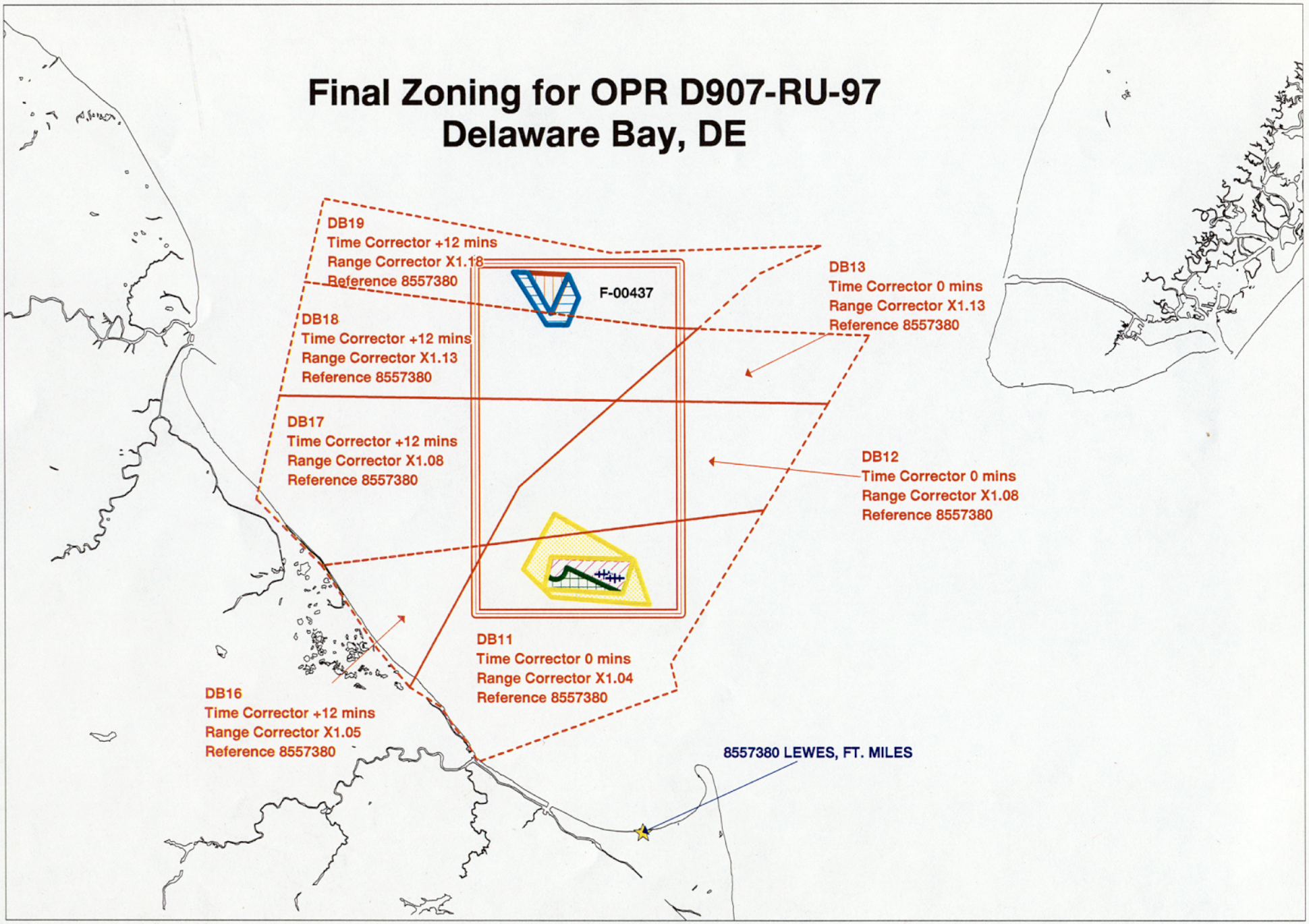

BIG STONE ANCHORAGE
FISH HAVEN #6
SCALE - 1:20,000
9960-Y-42750
Obstn
Fish Haven
Y
C "G"
AREA
80 Wk
M
42740
CHART 12304
SCALE - 1:80,00
Obstn



BIG STONE ANCHORAGE
FISH HAVEN #8

Plotted at 1:20,000 scale

Final Zoning for OPR D907-RU-97
Delaware Bay, DE



75° 11' 00" 75° 10' 30" 75° 10' 00" 75° 09' 30" 75° 09' 00" 75° 08' 30"

38° 57' 30"

38° 57' 00"

75°08'30"W
NAD 27
38°58'00"N
CHECKED BY: DVM
02/10/98

Obstr (debris)

sand waves

sand waves

sand waves

sand waves

FE-437
DELAWARE
DELAWARE BAY
7 NM NORTH OF CAPE HENLOPEN
10 NOV TO 11 NOV 1997
SCALE: 1:10,000
SOUNDINGS IN FEET AT MLLW
HORIZIONAL DATUM: NAD 83
SHEET 1 OF 2
ITEM - FISH HAVEN SITE#6

75° 09' 30"

75° 09' 00"

75° 08' 30"

75° 08' 00"

75° 07' 30"

38° 52' 00"

38° 51' 30"

75°07'30"N

NAD 27

38°52'30"W

CHECKED BY: DVM
02/10/98

sand waves

Wk "GOLDEN EAGLE"

Wk "MARGARET"

sand waves

sand waves

FE-437
DELAWARE
DELAWARE BAY
7 NM NORTH OF CAPE HENLOPEN
12 NOV 1997 TO 17 NOV 1997
SCALE: 1:10,000
SOUNDINGS IN FEET AT MLLW
HORIZIONAL DATUM: NAD 83
SHEET 2 OF 2
AWOIS ITEM NUMBER 880 AND FISH HAVEN SITE#8

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. FE-437

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
12304	3/31/98	D.A. Bland [initials]	Full ~~Part Before~~ After Marine Center Approval Signed Via Full Application
			Drawing No. of soundings and curves
12214	4/30/98	SSohert [initials]	(Full) Part Before (After) Marine Center Approval Signed Via
			Drawing No. appd in full thru 12304
			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
			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.

SUPERSEDES C&GS FORM 8352 WHICH MAY BE USED.