F00656

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Survey

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	F00656

LOCALITY

State(s):	Maryland
General Locality:	Baltimore, MD
Sub-locality:	Baltimore Harbor

2015

CHIEF OF PARTY
LTJG Bart Buesseler, NOAA

LIBRARY & ARCHIVES

Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

F00656

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(s):	**Maryland**
General Locality:	**Baltimore, MD**
Sub-Locality:	**Baltimore Harbor**
Scale:	**5000**
Dates of Survey:	**03/31/2015 to 04/02/2015**
Instructions Dated:	**03/27/2015**
Project Number:	**S-E914-BH2-15**
Field Unit:	**NOAA R/V *Bay Hydro II***
Chief of Party:	**LTJG Bart Buesseler, NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold, red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

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Descriptive Report to Accompany Survey F00656

Project: S-E914-BH2-15

Locality: Baltimore, MD

Sublocality: Baltimore Harbor

Scale: 1:5000

March 2015 - April 2015

NOAA R/V *Bay Hydro II*

Chief of Party: LTJG Bart Buesseler, NOAA

A. Area Surveyed

The survey area is located in Baltimore MD within the sub-locality of Baltimore Inner Harbor. An overview of the geographic location of survey F00656 is shown in Figure 1.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
39° 17' 6" N 76° 36' 42" W	39° 16' 35" N 76° 35' 32" W

Table 1: Survey Limits

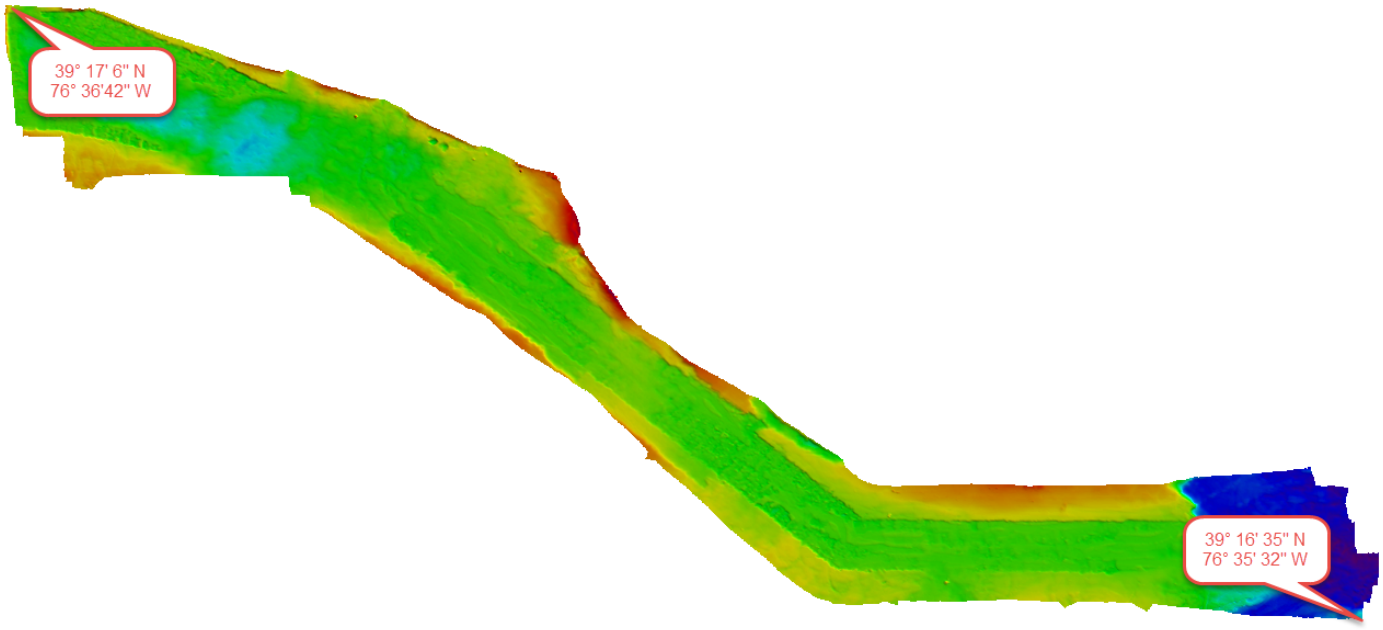

Figure 1: F00656 survey limits.

Survey limits were not met in all cases due to safety concerns for the crew and vessel. These coverage holidays existed near the perimeter of the survey and did not negatively impact the survey's objective. For a detailed holiday discussion see section B.2.9, Holiday Assessment.

A.2 Survey Purpose

The Maryland Pilots Association requested for a hydrographic survey in the Baltimore Harbor. The request in the Inner Harbor is to investigate the existence of a reported shoal area and if verified, define the extents of the shoal. This data will help the MD Pilots on decisions of transiting and docking of large vessels that are visiting the Inner Harbor in the spring of 2015.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired in survey F00656 met multibeam echo sounder (MBES) coverage requirements for object detection, including the five soundings per node data density requirements in Section 5.2.2.2 of the Hydrographic Surveys Specifications and Deliverables (HSSD). In order to extract descriptive statistics of the data density achievements, the finalized surface was queried within CARIS and examined in Excel (Figure 2). Overall, the required data density was achieved in 99.9% of the nodes. A vast majority of the nodes that did not meet the density requirements were due to sparse data in the outer beams at the edges of the survey limits (Figure 3).

Sounding Density of F00656 MBES BASE Surfaces				
Resolution	Depth range	Number of nodes	Fewer than five soundings per node	Percent of nodes with greater than five soundings per node
0.5M	0-10M	1,484,662	1,484	99.9%
	TOTAL:	1,484,662	1,484	99.9%

Figure 2: Summary table showing the percentage of nodes satisfying the 5 sounding density requirements for the entire survey.

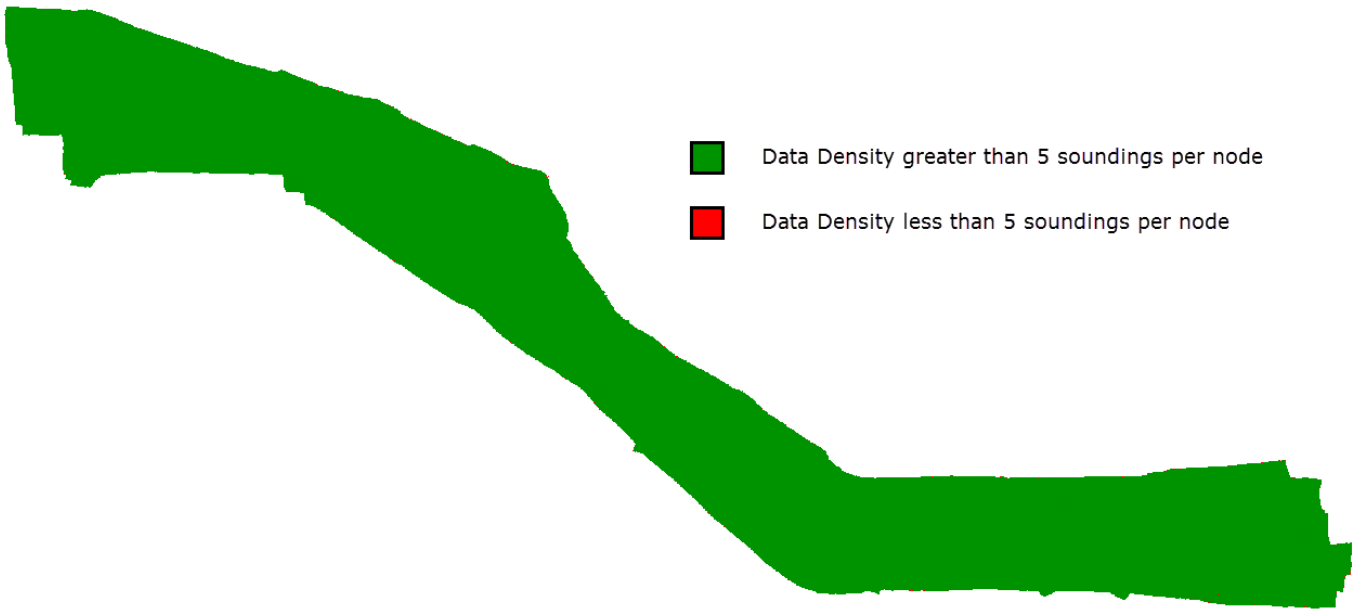

Figure 3: F00656 data density. Nodes with less than 5 soundings are located along the survey limits.

A.4 Survey Coverage

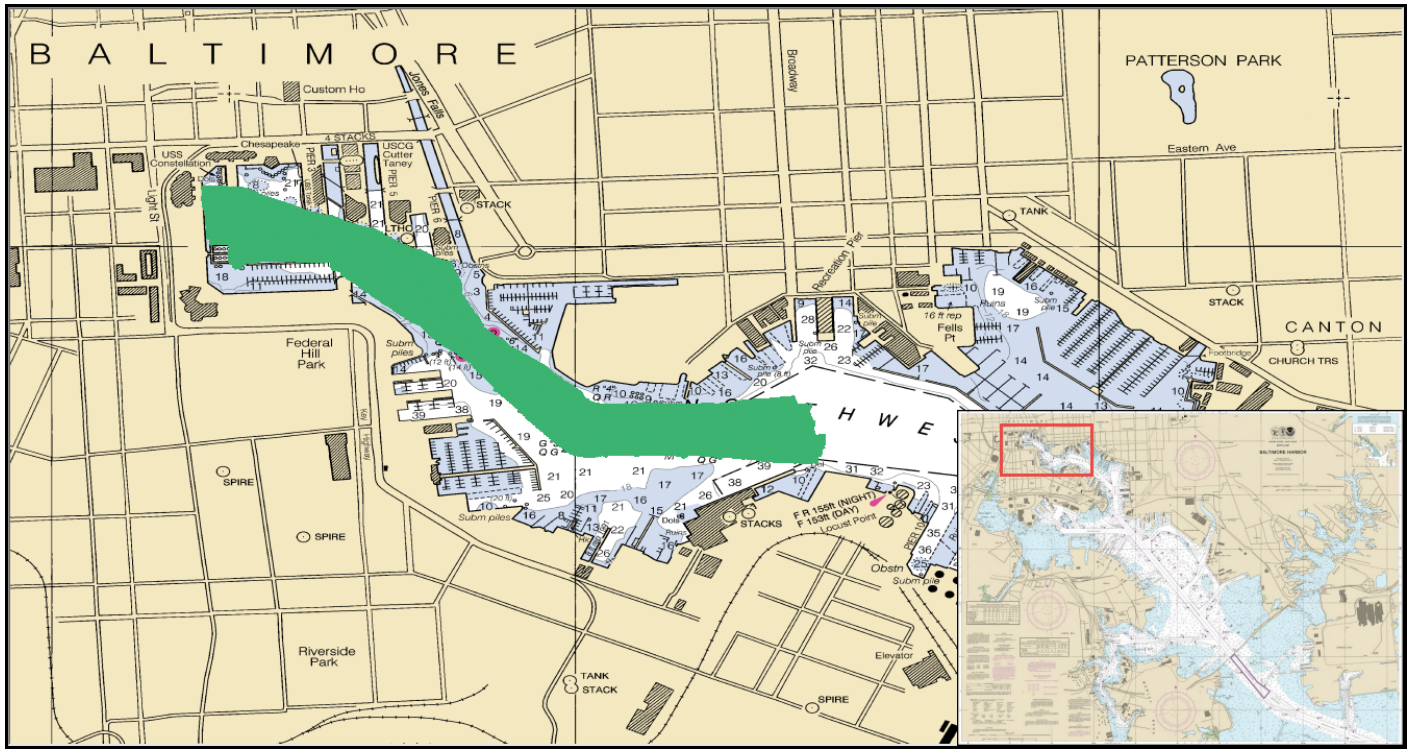

Figure 4: General location of F00656 overlaid onto chart 12281. Subset displays entirety of chart 12281 with the localized F00656 survey area (red box).

Survey coverage was in accordance with the requirements in the Project Instructions and the HSSD.

A.5 Survey Statistics

The following table lists the mainscheme and crossline acquisition mileage for this survey:

	HULL ID	*S5401*	*Total*
LNM	**SBES Mainscheme**	0	0
	MBES Mainscheme	14.25	14.25
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/SSS Mainscheme	0	0
	MBES/SSS Mainscheme	0	0
	SBES/MBES Crosslines	1.47	1.47
	Lidar Crosslines	0	0
Number of Bottom Samples			0
Number of AWOIS Items Investigated			0
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			0.14

Table 2: Hydrographic Survey Statistics

The following table lists the specific dates of data acquisition for this survey:

Survey Dates	Day of the Year
03/31/2015	90
04/02/2015	92

Table 3: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the Data Acquisition and Processing Report (DAPR) for a complete description of data acquisition and processing systems, survey vessels, quality control procedures and data processing methods. Additional information to supplement sounding and survey data, and any deviations from the DAPR are discussed in the following sections.

B.1.1 Vessels

The following vessels were used for data acquisition during this survey:

Hull ID	***S5401***
LOA	17.3 meters
Draft	1.8 meters

Table 4: Vessels Used

BAY HYDRO II collected all multibeam, sound speed, and attitude data for Survey F00656.

B.1.2 Equipment

The following major systems were used for data acquisition during this survey:

Manufacturer	Model	Type
Kongsberg	EM2040	MBES
Applanix	POS M/V V5	Positioning and Attitude System
SonTek	CastAway	Conductivity, Temperature, and Depth sensor
Valeport	MiniSVS	Sound Speed System

Table 5: Major Systems Used

Vessel configurations, equipment operations and data acquisition and processing were consistent with specifications described in the DAPR.

B.2 Quality Control

B.2.1 Crosslines

Crosslines acquired for this survey totaled 10% of mainscheme acquisition.

Crosslines were collected, processed, and compared in accordance with Section 5.2.4.3 of the HSSD. BAY HYDRO II collected a total of 1.47 LNM of crosslines with the Kongsberg EM2014 MBES. Calculating the crossline distance, BAY HYDRO II achieved 10% crossline coverage which exceeds the requirements of 4% coverage for complete coverage MBES.

To evaluate the crosslines, a 0.50 meter CUBE surface was created using strictly mainscheme lines, and a 0.50 meter CUBE surface was crated only using crosslines. From these two surfaces, a difference surface (mainscheme – crosslines = difference surface) was generated at a 0.50 meter resolution (Figure 5). Statistics showed the mean difference between the depths derived from mainscheme and crosslines was 0.03 meters (crosslines being shoaler) with a standard deviation of 0.06 meters (Figure 6).

In addition to the crossline CUBE surface comparison, the CARIS Quality Control (QC) Report was used to compare MBES cross line soundings to depth estimates of the 0.50 meter CUBE surface. The depth differences are calculated between each MBES crossline ping and the mainscheme surface depth. The depth difference is then compared to allowable NOAA uncertainties. The output QC Report classifies the percentage of pings that meet the NOAA orders by beam angle (Figure 7). The QC Report shows well over 95% of the crosslines analyzed were within NOAA Order 1a for the entire swath width. For further discussion of NOAA standards, refer to Section B.2.2, Uncertainty.

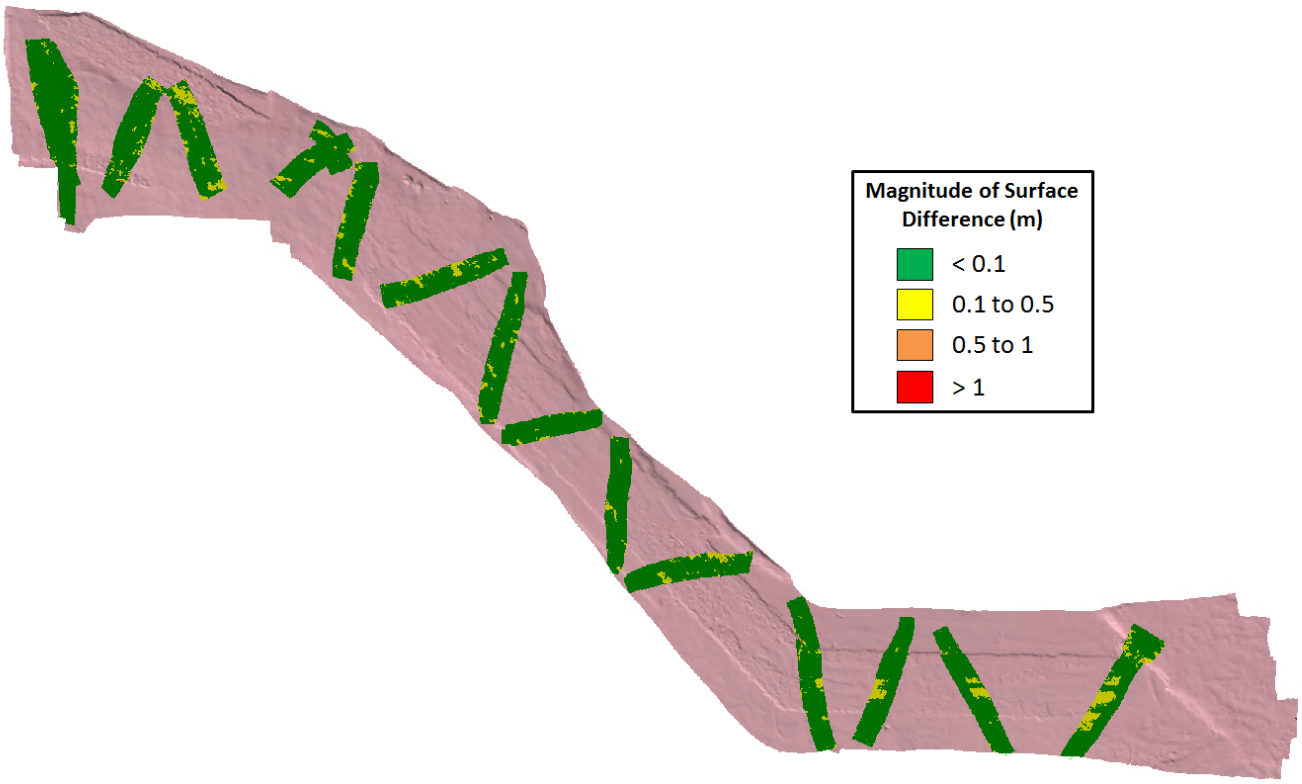

Figure 5: Magnitude of the crossline difference surface, overlaid onto F00656 (pink).

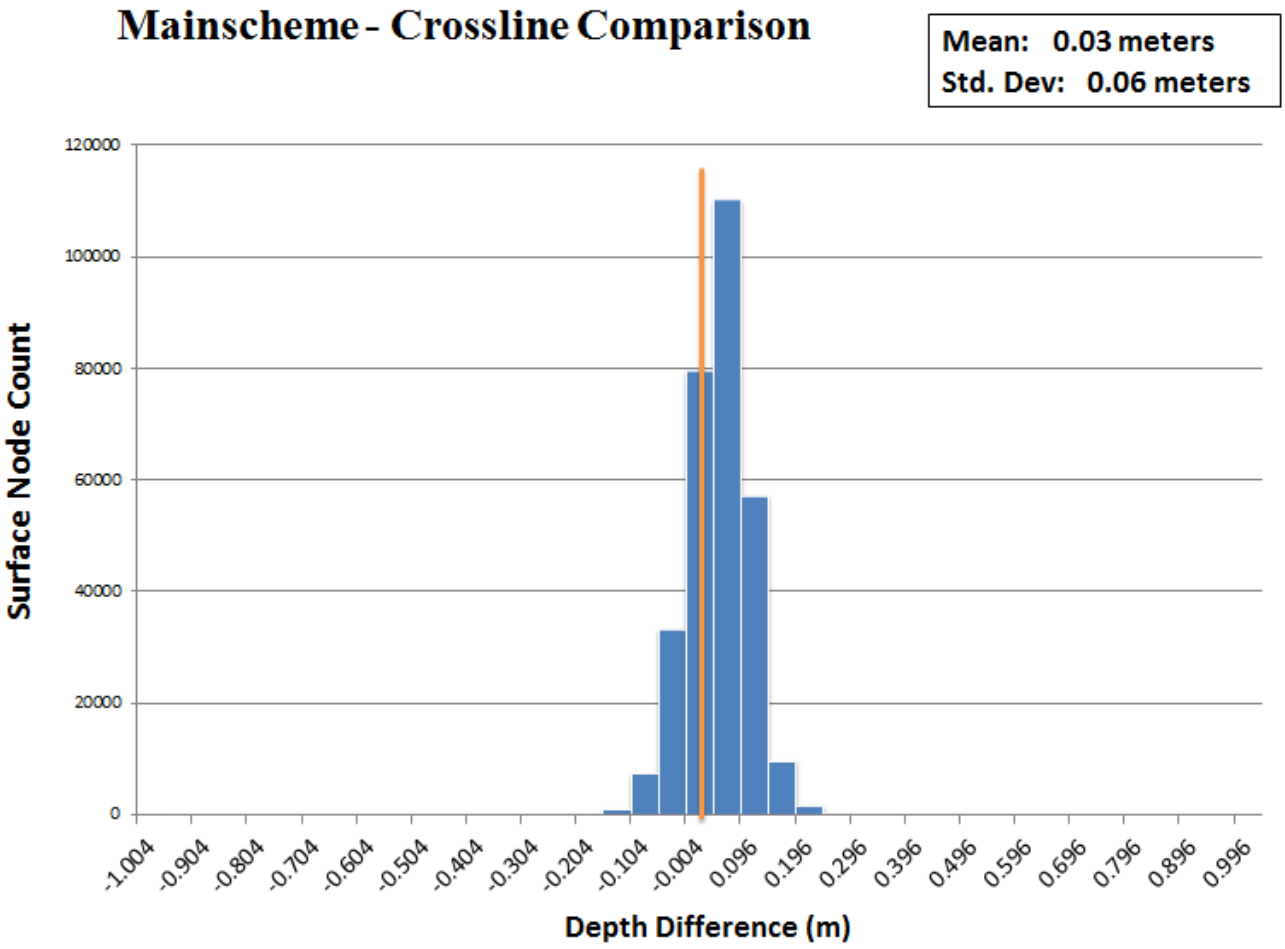

Figure 6: Crossline comparison with mainscheme lines (orange bar represents the zero mark).

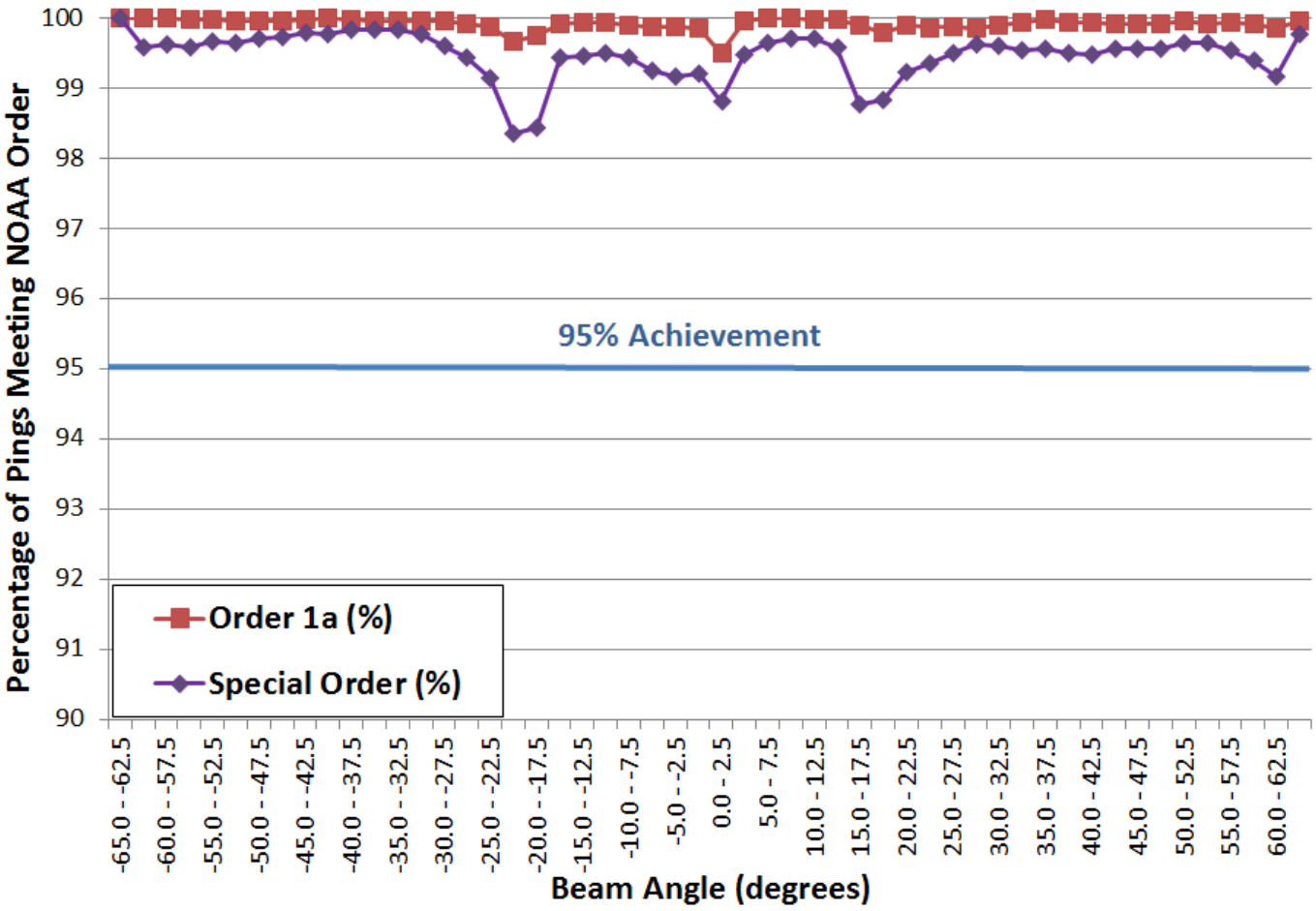

Figure 7: CARIS QC Report for crossline soundings compared to depth estimates.

B.2.2 Uncertainty

Hull ID	Measured - CTD	Measured - MVP	Surface
S5401	4.0 meters/second	N/A meters/second	0.5 meters/second

Table 6: Survey Specific Sound Speed TPU Values

In addition to the a priori estimates of sound speed uncertainty, real-time and post-processed uncertainty sources were incorporated into the depth estimates of survey F00656. Real time uncertainties from the EM2040 were recorded and applied in CARIS. Applanix TrueHeave files were recorded that include an estimate of the heave uncertainty, these were applied in CARIS. Lastly, the post-processed uncertainties associated with vessel roll, pitch, gyro, and navigation were applied where available in CARIS via the SBET's RMS file generated in POSPac.

The uncertainty values of the submitted finalized grid were calculated in CARIS using standard deviation (scaled to 95%). To visualize the locations in which accuracy requirements were met for the finalized surface, a custom predicted NOAA-compliance layer was created. The layer was based on the difference between calculated uncertainty of the nodes and the allowable NOAA uncertainty (Figure 8). To quantify the extent to which accuracy requirements were met, the preceding predicted NOAA compliance layers were queried within CARIS and examined in Excel (Figure 9). Overall 100.0% by node of survey F00656 met the accuracy requirements stated in Section 5.1.3 of the HSSD.

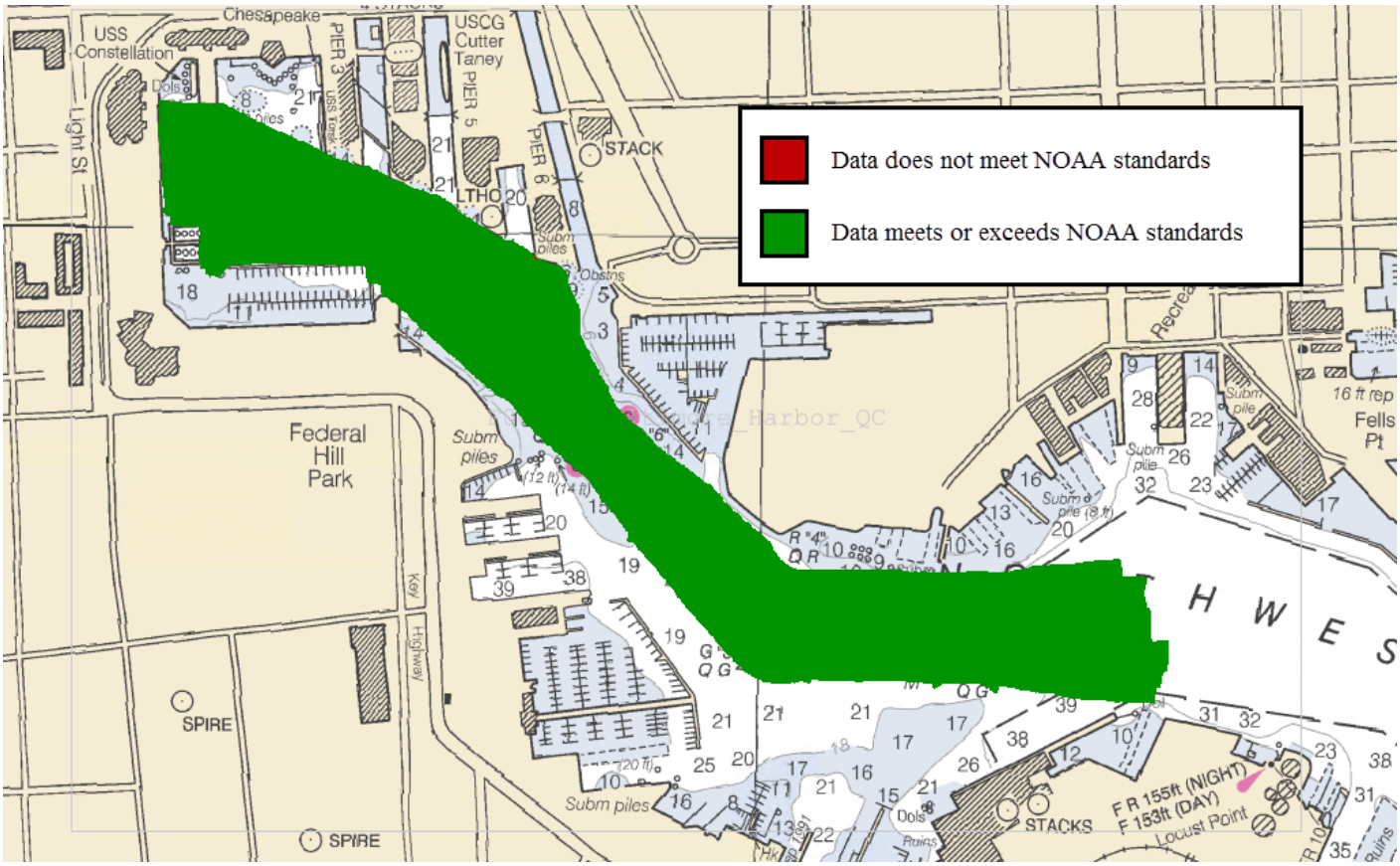

Figure 8: F00656 met NOAA accuracy standards for 100% of the survey area.

Resolution	Depth range	NOAA Order	Number of nodes	Nodes satisfying NOAA	Percent nodes satisfying NOAA
0.5m	0 - 20m	Order 1	1,485,862	1,485,836	100.0%
TOTAL:			1,485,862	1,485,836	**100.0%**

Figure 9: Summary table shows the percent of nodes that satisfy the NOAA accuracy level.

B.2.3 Junctions

There are no contemporary surveys that junction with this survey.

B.2.4 Sonar QC Checks

Sonar system quality control checks were conducted as detailed in the quality control section of the DAPR.

B.2.5 Equipment Effectiveness

There were no conditions or deficiencies that affected equipment operational effectiveness.

B.2.6 Factors Affecting Soundings

There were no other factors that affected corrections to soundings.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Surface sound speed was collected in real time and integrated into the Kongsberg EM 2040 bathymetric data.

Sound speed casts for MBES survey were acquired via CTD profiles. Casts were conduced at the start of the day, the midpoint of the day, and at the end of the day. This resulted in a total of six casts over the two acquisition days for F00656 (Figure 10). Casts were applied using the "Nearest in Time" method in CARIS. This method was found to most accurately reflect the sound speed changes for the survey area.

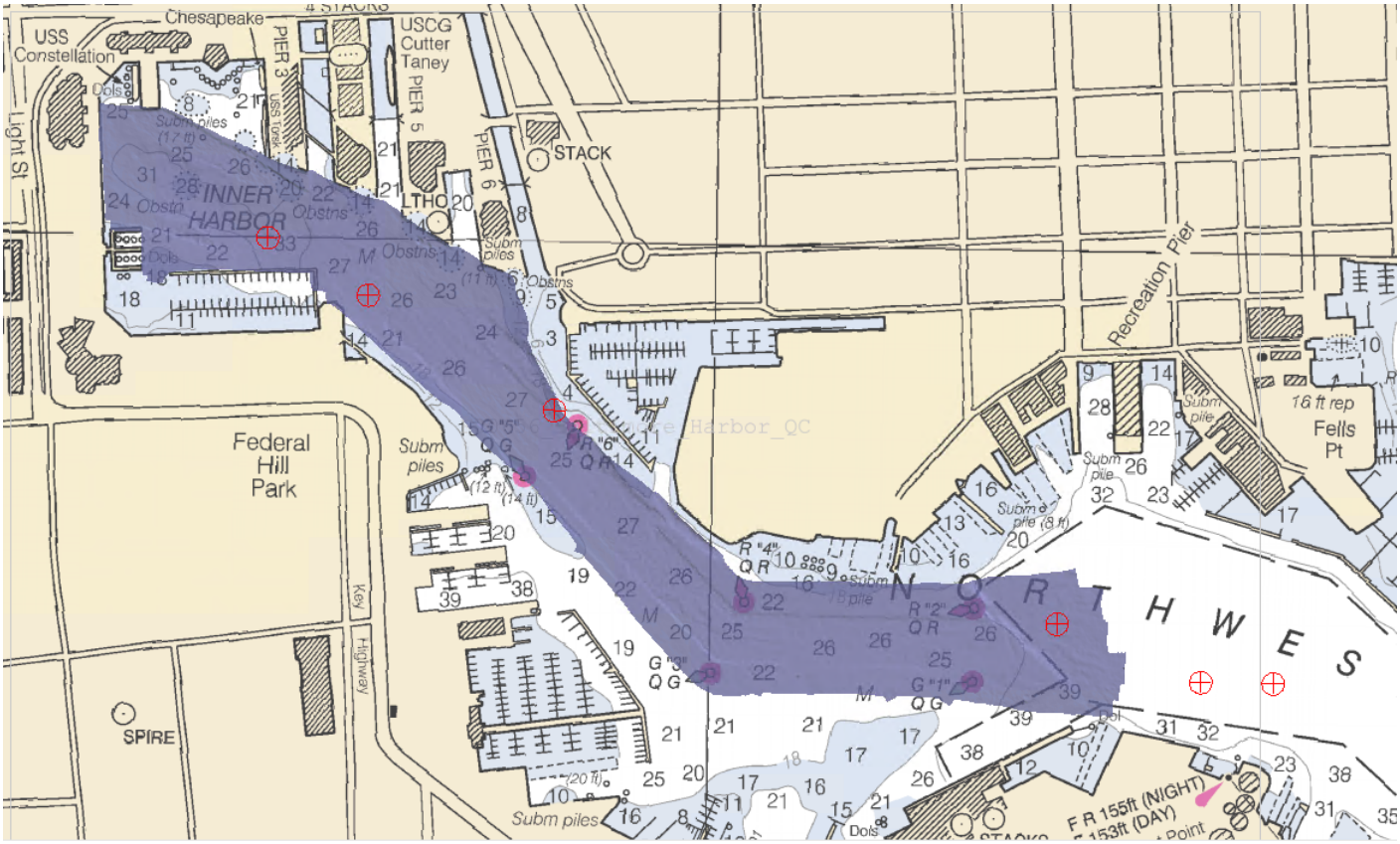

Figure 10: Sound speed profiles acquired for F00656, shown in red.

B.2.8 Coverage Equipment and Methods

All equipment and survey methods were used as detailed in the DAPR.

B.2.9 Holiday Assessment

There were five perimeter holidays where bottom coverage did not meet the survey limits (Figure 11). The largest sheet limit holiday occurred in the northwest section of the survey area where steep shoaling limited BAY HYDRO II's advancement. The holiday stretches 175 meters long and 13 meters wide. All other sheet limit holidays were due to the close proximity to pier faces within the Inner Harbor, making these areas inaccessible to BAY HYDRO II. The inability to collect data in these areas did not negatively impact the survey's objective.

All holidays are identified and digitized in the "F00656_Holidays.000" file accompanying this submission.

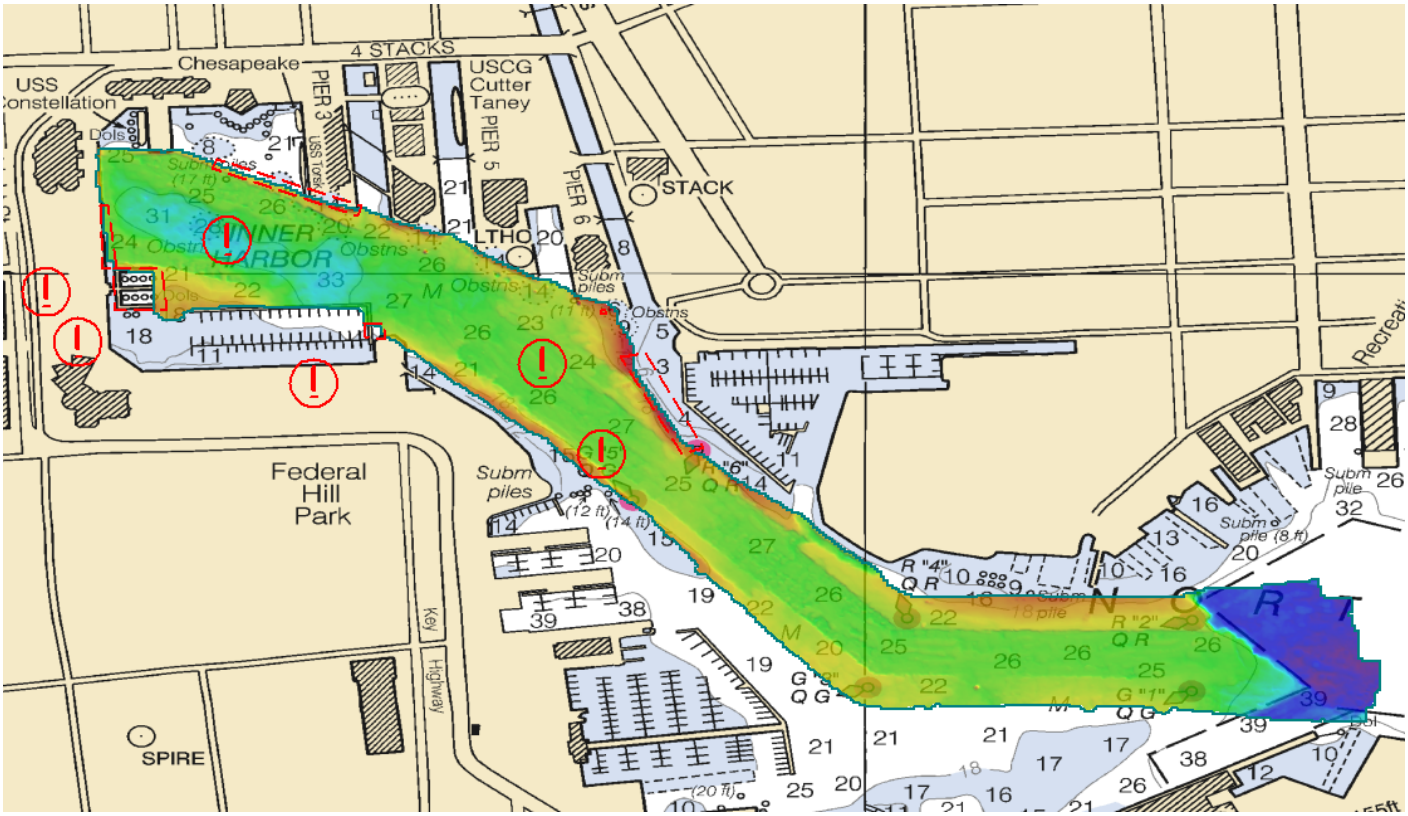

Figure 11: F00656 survey limits (black dashed line) and holiday areas (red boxes) adjacent to the exclamation points.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

All data reduction procedures conform to those detailed in the DAPR.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Raw Backscatter was logged as a .all file for Kongsberg data and has been sent to the Processing Branch. Backscatter was not processed by the field unit.

B.5 Data Processing

B.5.1 Software Updates

There were no software configuration changes after the DAPR was submitted.

The following Feature Object Catalog was used: NOAA Profile V_5_3_2

B.5.2 Surfaces

The following surfaces and/or BAGs were submitted to the Processing Branch:

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
F00656_MLLW_50cm	CUBE	50 centimeters	2.56 meters - 13.69 meters	NOAA_0.5m	Object Detection
F00656_MLLW_50cm_Final	CUBE	50 centimeters	2.56 meters - 13.69 meters	NOAA_0.5m	Object Detection
F00656_ERS_50cm	CUBE	50 centimeters	35.58 meters - 46.74 meters	NOAA_0.5m	Object Detection

Table 7: Submitted Surfaces

The surfaces have been reviewed where noisy data, or 'fliers' are incorporated into the gridded solution causing the surface to be shoaler than the true seafloor. Where these spurious soundings cause the gridded surface to be shoaler than the reliably measured seabed by greater than the maximum allowable vertical uncertainty at that depth, the noise was rejected and the surface recomputed.

In addition, a VDatum evaluation was performed for the survey (see Section B.5.3, VDatum Tidal Reduction Evaluation). Surfaces referenced to the ellipsoid have also been included for evaluation by the branch.

B.5.3 VDatum Tidal Reduction Evaluation

Data from F00656 was reduced to MLLW using VDatum. This was accomplished by using the GPS height determined from the Smoothed Best Estimate of Trajectories (SBET's) file (see Section C.1, Vertical Control). The VDatum surface was then compared to the Zone Tides reduced surface. As both VDatum and Zone Tides reduce depths to MLLW, there should be no difference between the surfaces. Any significant differences would be the result of an error intrinsic to either the VDatum or Zone Tides processing work flow. For example, misprojected SBETs, current-induced dynamic draft, incorrect waterline measurements, corrupt TrueHeave files, or poorly-modeled water levels / separation models are all examples of artifacts that can be identified through the difference of the VDatum and Zone Tides surfaces.

To check these intrinsic errors, a difference surfaces was created in CARIS to compare the VDatum and Zone Tides surfaces. Statistics were then derived form the difference surface. The overall comparison between VDatum and Zone Tides surfaces show close continuity (Figure 12). The VDatum is shoaler by an average of 0.03 meters, with a standard deviation of 0.02 meters (Figure 13). Given the good agreement, no intrinsic errors are likely present, in any substantial amount, for F00656.

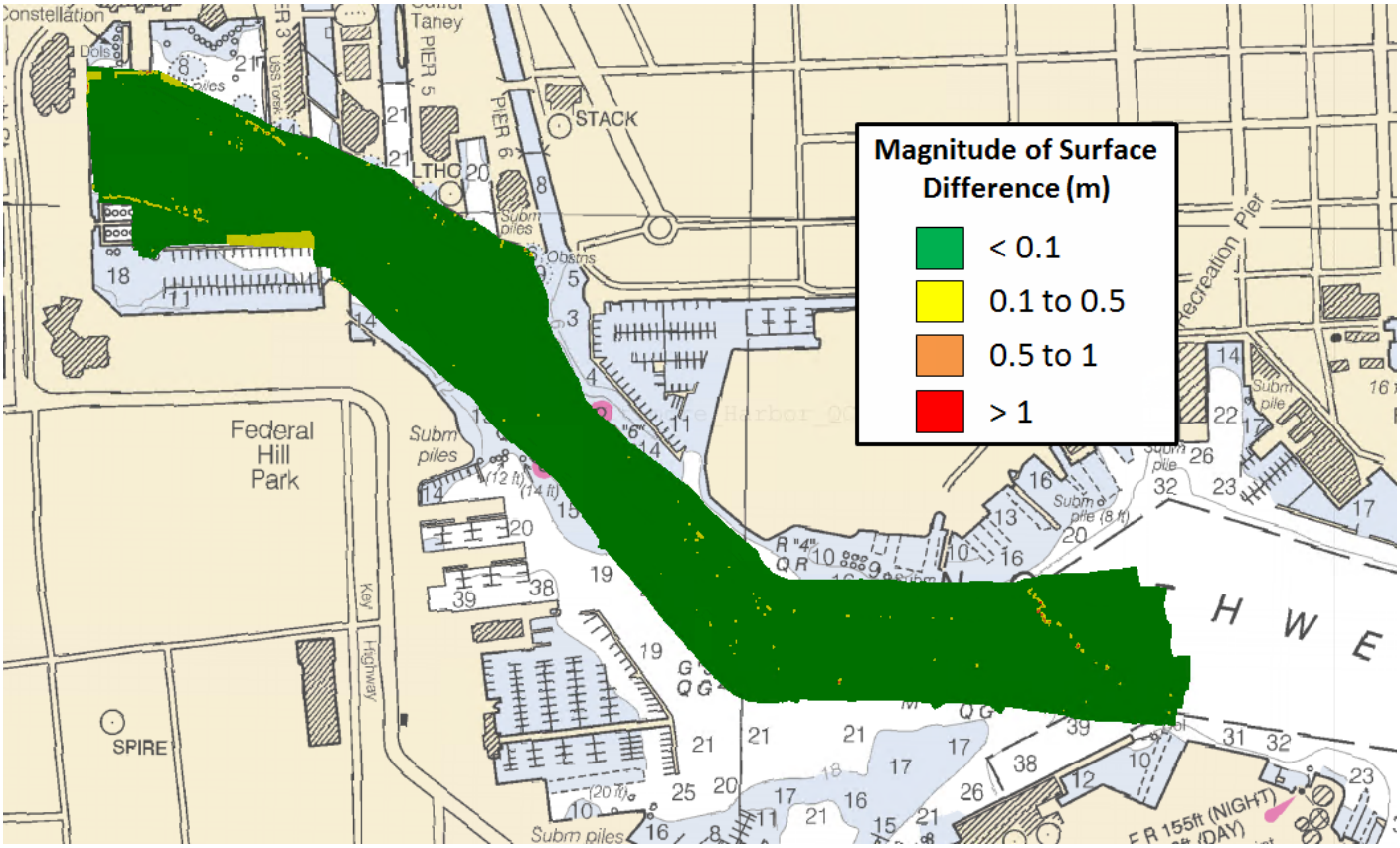

Figure 12: The difference surface between VDatum and Zone Tides surfaces, 50 cm resolution.

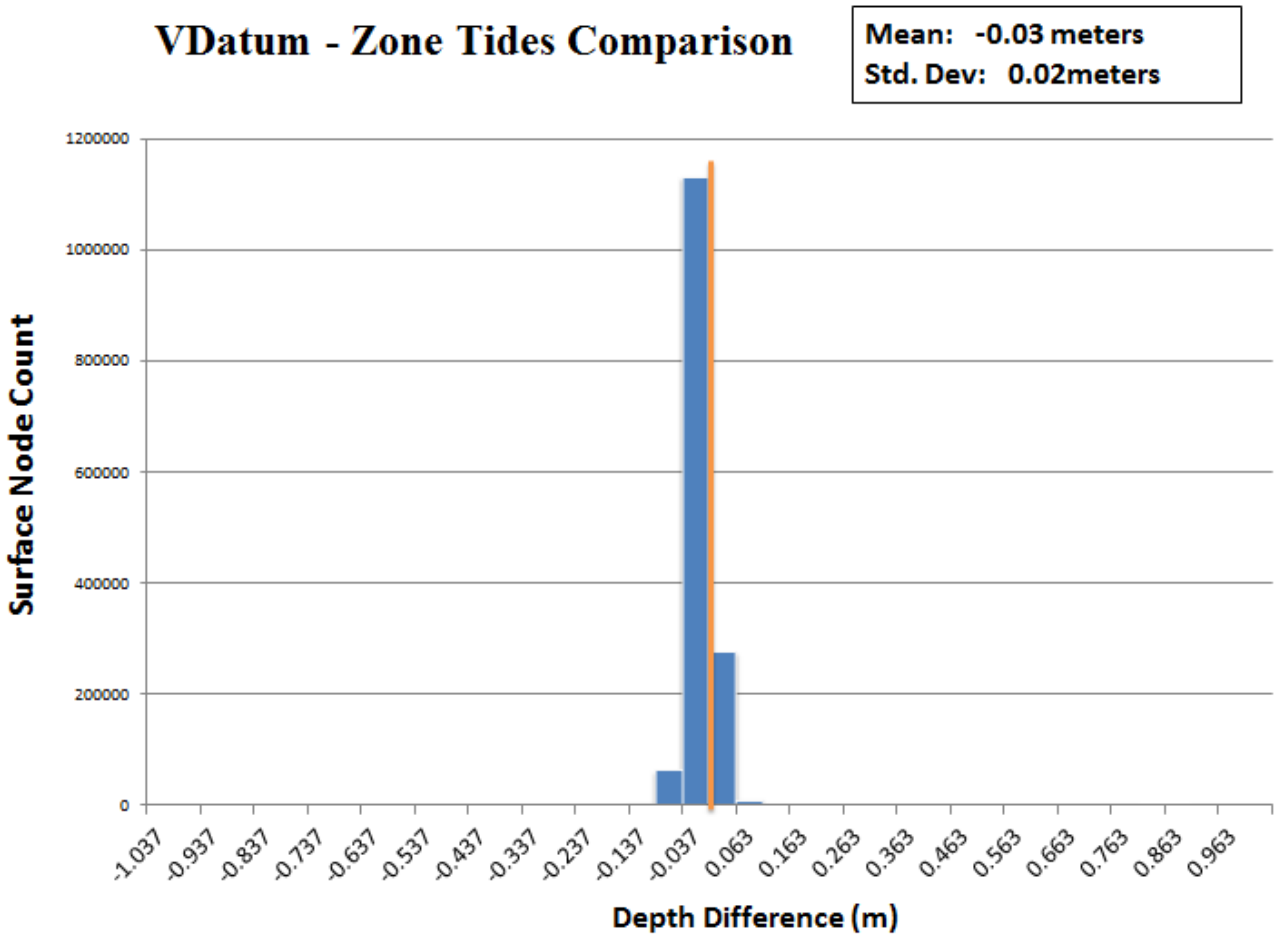

Figure 13: F00656 difference surface statistics between VDatum and Zone Tides surfaces (orange line represents zero mark).

C. Vertical and Horizontal Control

Zone tides were used for vertical control for near real-time data processing and quality control as an initial step towards VDatum. Once SBETS were processed and applied, a GPS tide was calculated using a VDatum separation model to reduce the data to MLLW. The application of SBETS also aided DGPS as a means of horizontal control. No user installed base stations were utilized for F00656.

C.1 Vertical Control

The vertical datum for this project is Mean Lower Low Water.

Standard Vertical Control Methods Used:

Discrete Zoning

File Name	Status
8574680	Final Approved

Table 8: Water Level Files (.tid)

File Name	Status
E914BH22015CORP	Final

Table 9: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 04/06/2015. The final tide note was received on 04/17/2015.

See attached Tide Note dated April 14, 2015

Non-Standard Vertical Control Methods Used:

VDatum

Ellipsoid to Chart Datum Separation File:

2015_E914_VDatum_NAD83Ellip_MLLW.csar

As referenced in Section B.5.3, VDatum was performed for this survey. A separation file was provided to the field within the Project Instructions. The separation file is included with the data submission of the DR.

SBET's were used to calculate ellipsoid heights required for the VDatum process. SBETs were processed using Applanix SmartBase and a QC log can be found in Separates I of the data submission.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD83).

The projection used for this project is UTM-18N.

The following PPK methods were used for horizontal control:

Smart Base

Vessel kinematic data was post processed using Applanix POSPac processing software as described in the DAPR. Smart Base processing was used, which automatically selects local CORS stations to provide best coverage of the survey area.

DGPS was used for primary positioning during acquisition. Following PPK processing, DPS position data was replaced with improved SBET navigation data.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Annapolis, MD (301 kHz)

Table 10: USCG DGPS Stations

D. Results and Recommendations

D.1 Chart Comparison

A sounding selection in feet was created at a scale of 1:15000 meters from F00656 50 cm resolution surface for comparison with Chart 12281 and ENC US5MD11M depths. Chart 12281 and ENC US5MD11M depth soundings are in agreement (see sections D.1.1 and D.1.2 below).

D.1.1 Raster Charts

The following are the largest scale raster charts, which cover the survey area:

Chart	Scale	Edition	Edition Date	LNM Date	NM Date
12281	1:15000	55	05/2014	03/03/2015	03/07/2015

Table 11: Largest Scale Raster Charts

12281

F00656 and is generally 1-2 feet shoaler than soundings from Chart 12281 (Figure 14A). In the central section of the survey near the R“6”QR buoy the difference between charted depths and survey depths extend up to a 3 ft. difference (survey F00656 being shoaler) (Figure 14B).

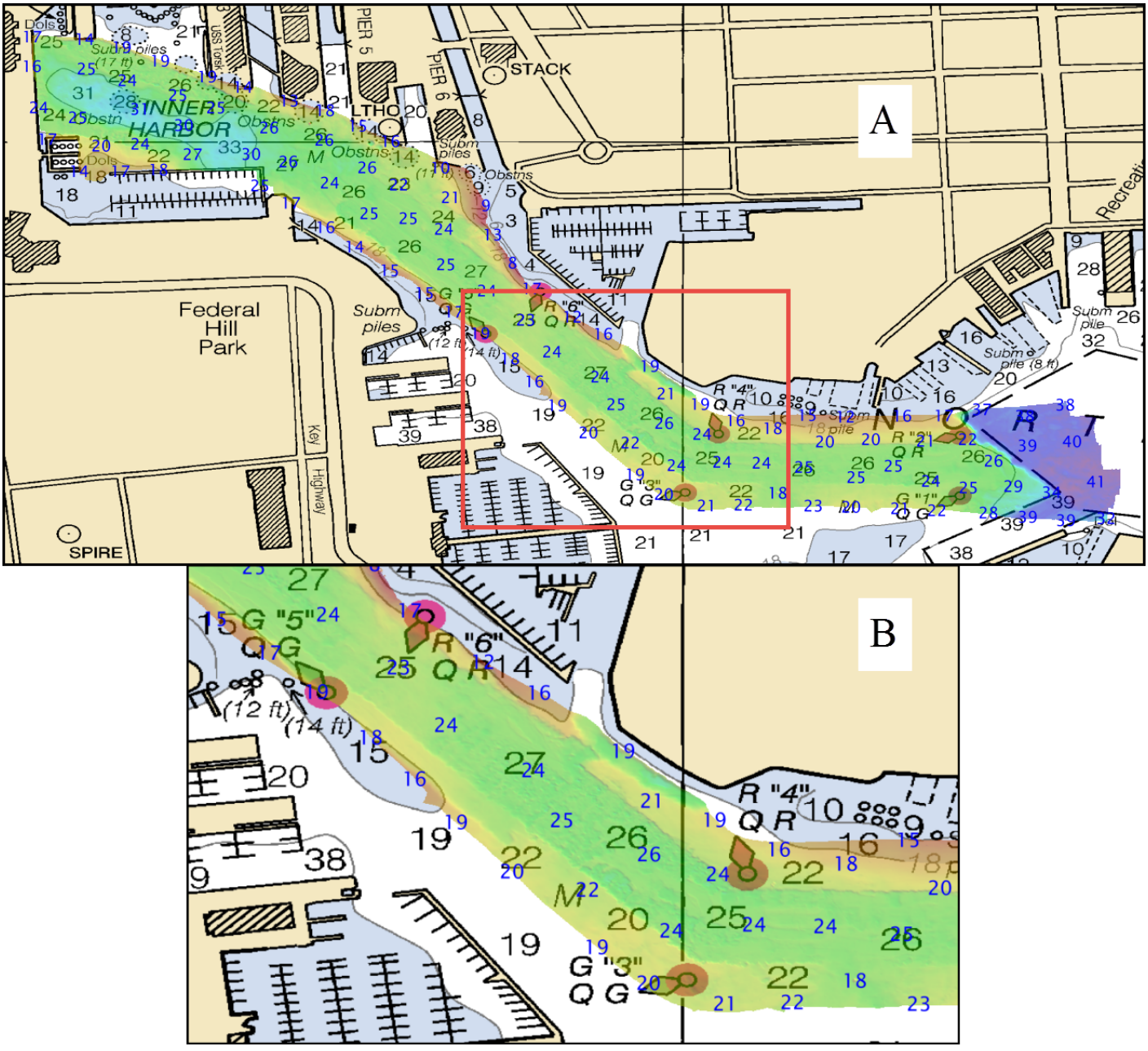

Figure 14: A) Comparison of soundings from F00656 and Charter 12281 (F00656 soundings in blue, Chart 12281 soundings in black). B) Zoomed in area around the R"6"QR buoy (Red box outline from 14A). All Soundings are in feet.

D.1.2 Electronic Navigational Charts

The following are the largest scale ENCs, which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US5MD11M	1:15000	47	04/23/2041	05/01/2015	NO

Table 12: Largest Scale ENCs

US5MD11M

F00656 and is generally 1-2 feet shoaler than soundings from ENC US5MD11M(Figure 15). In the central section of the survey the difference between charted depths and survey depths extend up to a 3 ft. (survey F00656 being shoaler).

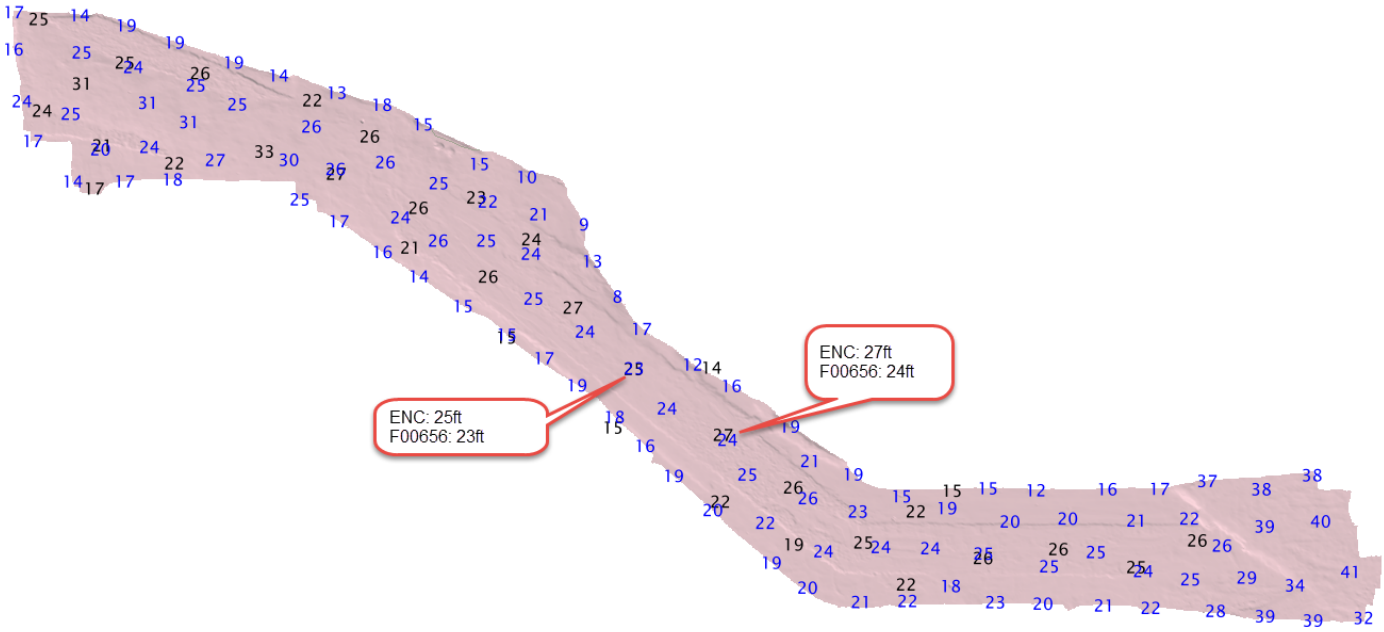

Figure 15: Comparison of soundings from F00656 and Charter 12281 (F00656 soundings in blue, Chart 12281 soundings in black). All soundings are in feet.

D.1.3 AWOIS Items

No AWOIS items were assigned for this survey.

D.1.4 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.5 Charted Features

Charted soundings were investigated during F00656 and the recommendations are incorporated with the Final Features File associated with the survey submission.

The final feature file has been archived and is not appended to this report.

D.1.6 Uncharted Features

Six uncharted features are recorded in the Final Features File accompanying this submission. An example of an obstruction is shown in Figure 16. The obstruction approximately 1 meter long by 1 meter wide protrudes off the surrounding sea floor about 1.5 meters. The obstruction lies outside of the dredge channel limits.

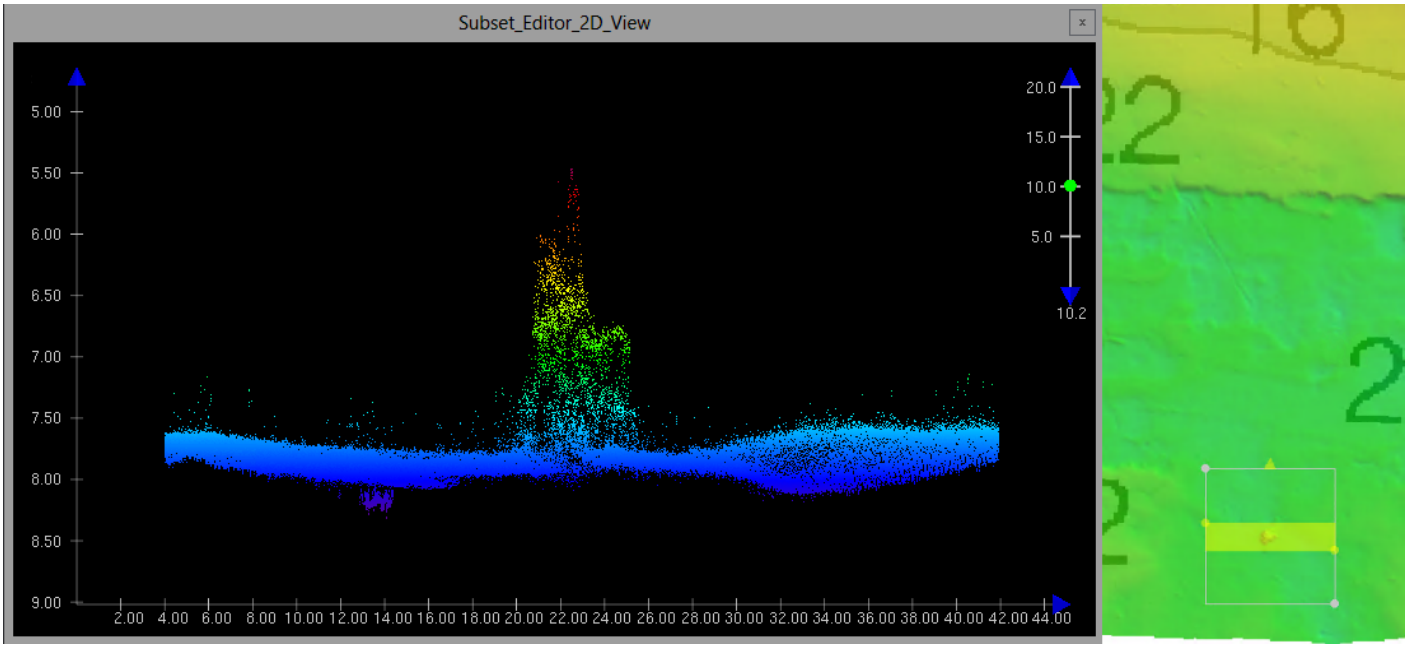

Figure 16: Uncharted feature discovered within F00656. The vertical axis is exaggerated 10x in the image.

D.1.7 Dangers to Navigation

No Danger to Navigation Reports were submitted for this survey.

D.1.8 Shoal and Hazardous Features

As requested in the Project Instructions, all data was investigated for evidence of shoaling. As seen in Figure 17, shoaling was not observed and still closely matches with charted contours on Chart 12281.

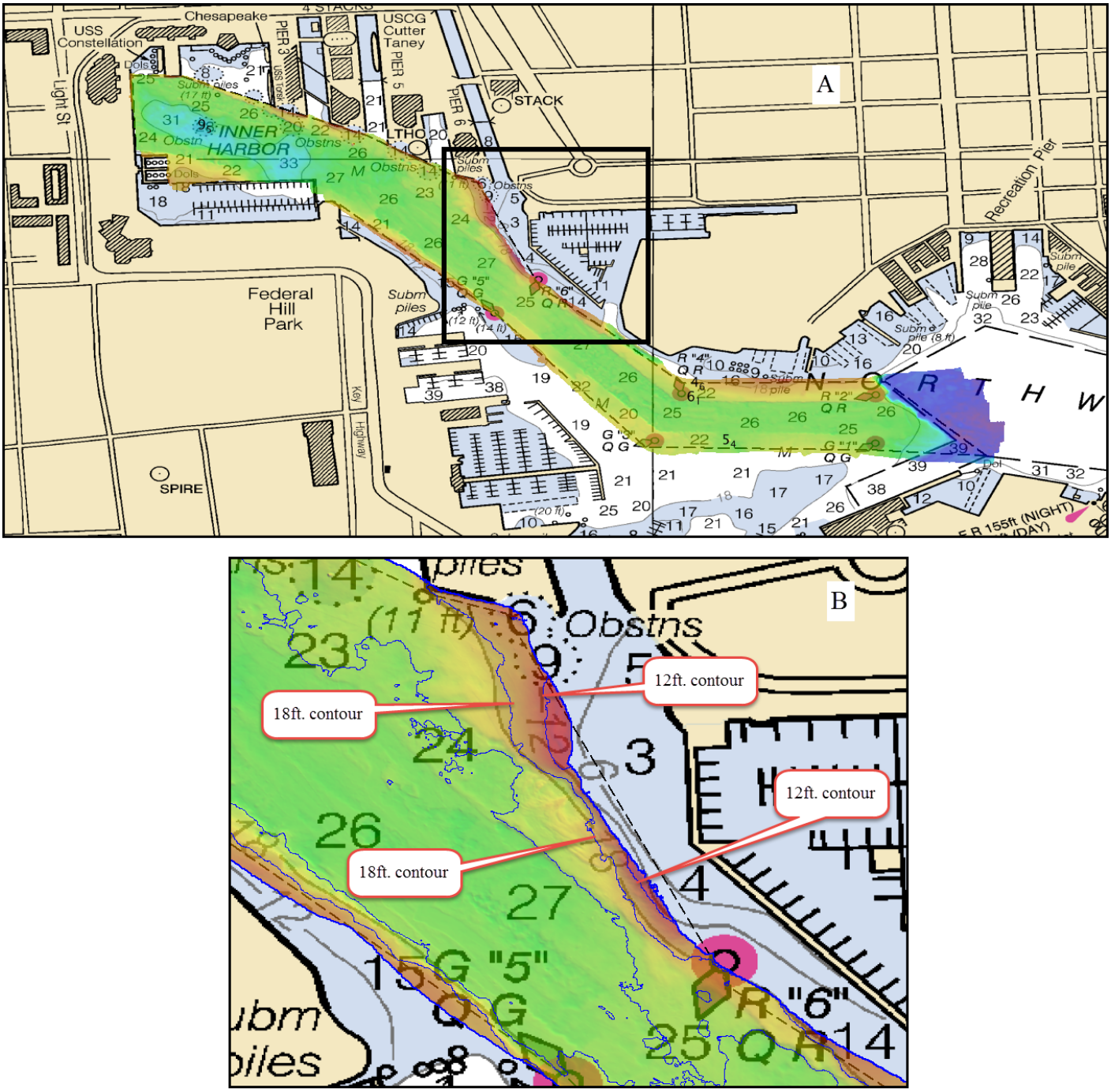

Figure 17: A) Overview of F00656 survey boundaries. B) Subset of potential shoaling area. F00656 contours (blue) are in agreement with Chart 12281 contour lines (black). No significant shoaling in the area.

D.1.9 Channels

Channels, designated anchorages, precautionary areas, safety fairways, traffic separation schemes, pilot boarding areas, and/or channel and range lines exist within the survey limits, but were not investigated.

D.1.10 Bottom Samples

No bottom samples were required for this survey.

D.2 Additional Results

D.2.1 Shoreline

Shoreline was not assigned in the Hydrographic Survey Project Instructions or Statement of Work.

A limited shoreline investigation was required by the Project Instructions. The eight assigned features in the Composite Source File were addressed by the field.

D.2.2 Prior Surveys

Prior survey comparisons exist for this survey and investigated. Survey F00609 was conducted in Baltimore's Inner Harbor in 2012 with sections of the survey that overlap with the current F00656 survey. A 50 cm difference surface was created to compare the 50 cm surfaces from F00656 and F00609 where they overlap (Figure 18). The comparison showed a mean difference of 0.01 meters with a standard deviation of 0.39 meters. This high standard deviation is attributed to the known differences in depth as a result of dredging which can be seen as the red areas in Figure 19. In areas free from dredging, however, F00656 and F00609 show very close agreement.

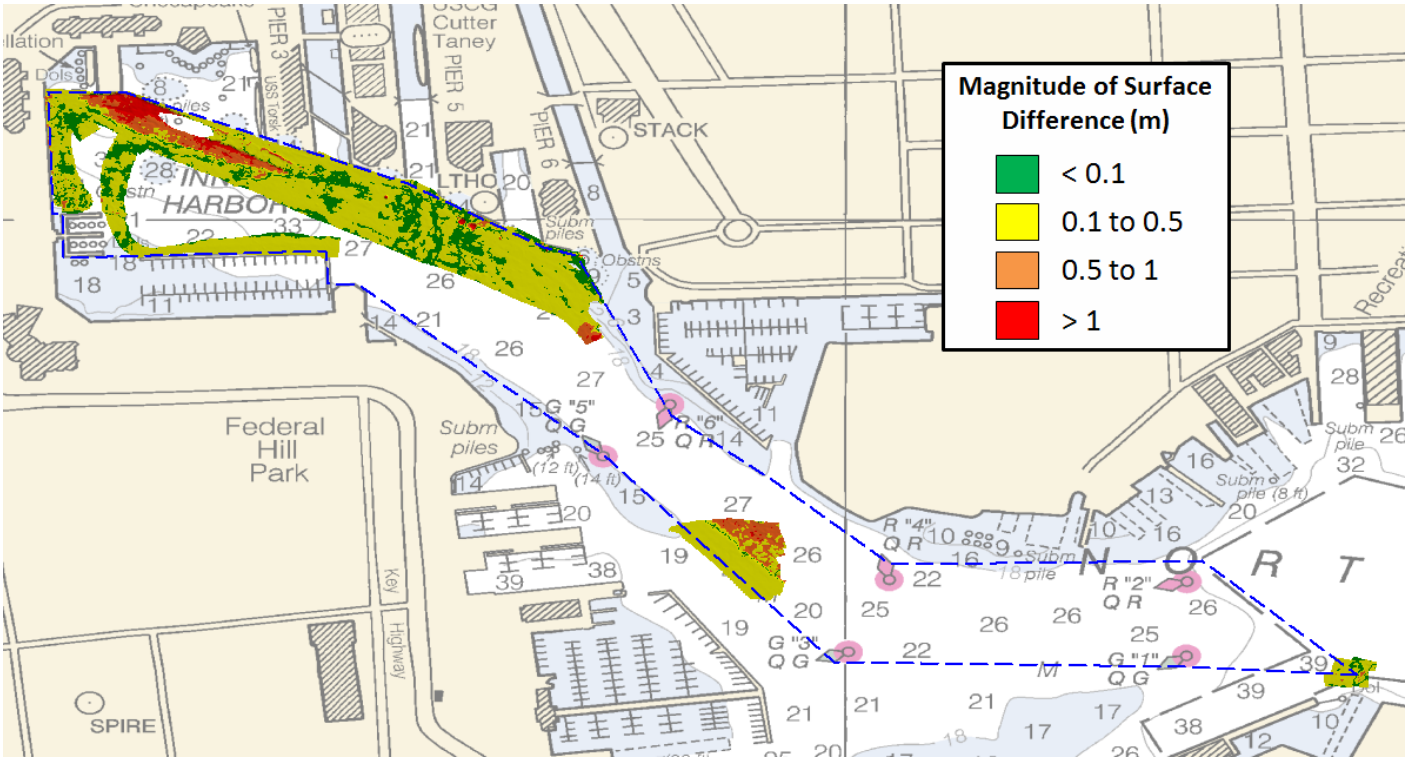

Figure 18: Overview of the difference surface between F00656 and F00609. The greatest difference occurs in the areas impacted by dredging since F00609 was surveyed.

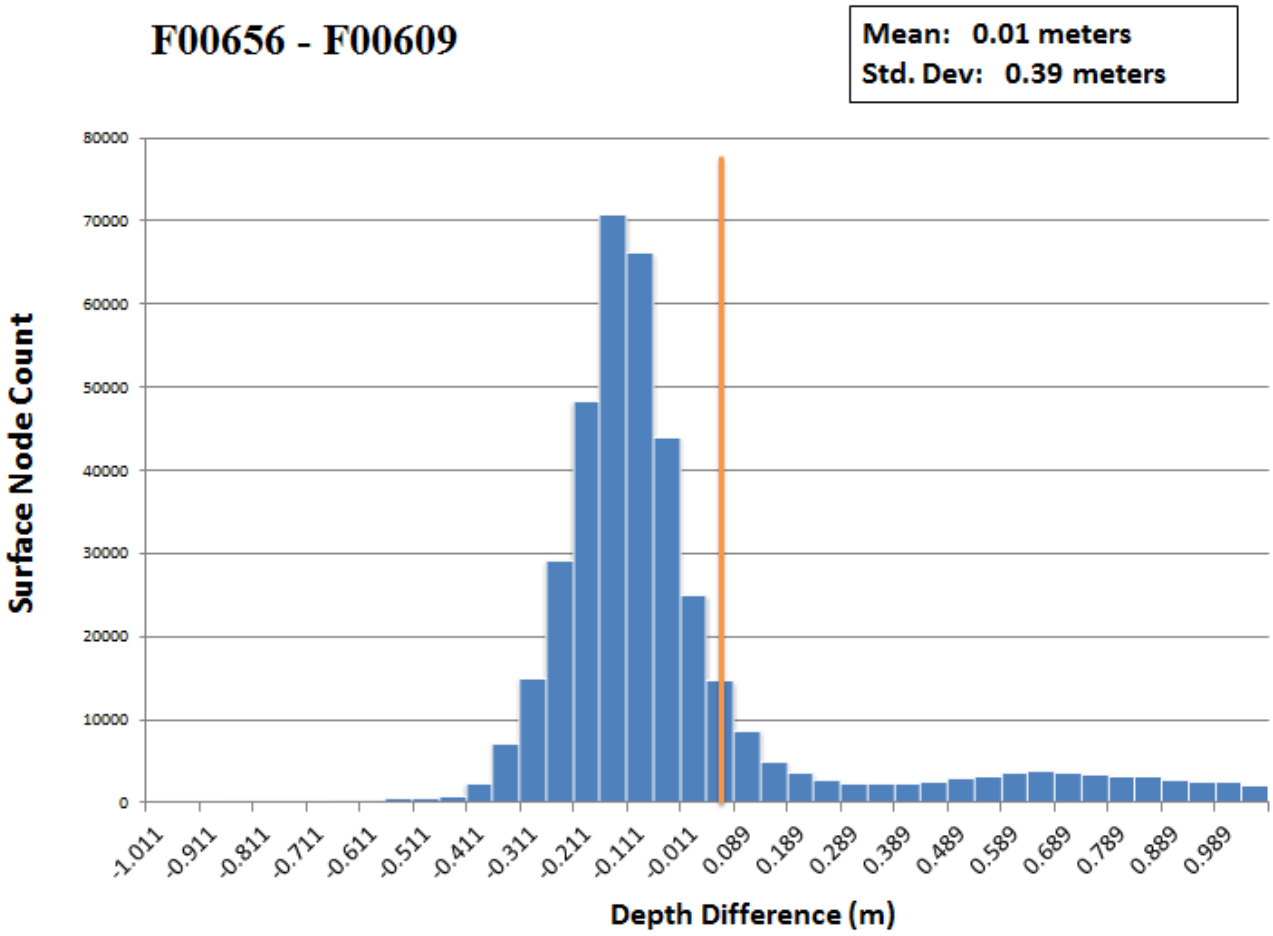

Figure 19: Comparison of F00656 and F00609 surface node count (orange bar represents zero mark). Positive values indicate F00656 is deeper.

D.2.3 Aids to Navigation

ATONS within the survey extents were observed to be in position and serving their intended purpose.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

No submarine features exist for this survey.

D.2.6 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.7 Platforms

No platforms exist for this survey.

D.2.8 Significant Features

No significant features exist for this survey.

D.2.9 Construction and Dredging

No present or planned construction or dredging exist within the survey limits.

D.2.10 New Survey Recommendation

No new surveys or further investigations are recommended for this area.

D.2.11 Inset Recommendation

No new insets are recommended for this area.

E. Approval Sheet

As Chief of Party, field operations for this hydrographic survey were conducted under my direct supervision, with frequent personal checks of progress and adequacy. I have reviewed the attached survey data and reports.

All field sheets, this Descriptive Report, and all accompanying records and data are approved. All records are forwarded for final review and processing to the Processing Branch.

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys and Specifications Deliverables Manual, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Descriptive Report.

Approver Name	Approver Title	Approval Date	Signature
LTJG Bart Buesseler, NOAA	Chief of Party	05/12/2015	
Matthew Carter	Assistant Survey Technician	05/12/2015	

F. Table of Acronyms

Acronym	Definition
AHB	Atlantic Hydrographic Branch
AST	Assistant Survey Technician
ATON	Aid to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BAG	Bathymetric Attributed Grid
BASE	Bathymetry Associated with Statistical Error
CO	Commanding Officer
CO-OPS	Center for Operational Products and Services
CORS	Continually Operating Reference Staiton
CTD	Conductivity Temperature Depth
CEF	Chart Evaluation File
CSF	Composite Source File
CST	Chief Survey Technician
CUBE	Combined Uncertainty and Bathymetry Estimator
DAPR	Data Acquisition and Processing Report
DGPS	Differential Global Positioning System
DP	Detached Position
DR	Descriptive Report
DTON	Danger to Navigation
ENC	Electronic Navigational Chart
ERS	Ellipsoidal Referenced Survey
ERZT	Ellipsoidally Referenced Zoned Tides
FFF	Final Feature File
FOO	Field Operations Officer
FPM	Field Procedures Manual
GAMS	GPS Azimuth Measurement Subsystem
GC	Geographic Cell
GPS	Global Positioning System
HIPS	Hydrographic Information Processing System
HSD	Hydrographic Surveys Division
HSSD	Hydrographic Survey Specifications and Deliverables

Acronym	Definition
HSTP	Hydrographic Systems Technology Programs
HSX	Hypack Hysweep File Format
HTD	Hydrographic Surveys Technical Directive
HVCR	Horizontal and Vertical Control Report
HVF	HIPS Vessel File
IHO	International Hydrographic Organization
IMU	Inertial Motion Unit
ITRF	International Terrestrial Reference Frame
LNM	Local Notice to Mariners
LNM	Linear Nautical Miles
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NAIP	National Agriculture and Imagery Program
NALL	Navigable Area Limit Line
NM	Notice to Mariners
NMEA	National Marine Electronics Association
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRT	Navigation Response Team
NSD	Navigation Services Division
OCS	Office of Coast Survey
OMAO	Office of Marine and Aviation Operations (NOAA)
OPS	Operations Branch
MBES	Multibeam Echosounder
NWLON	National Water Level Observation Network
PDBS	Phase Differencing Bathymetric Sonar
PHB	Pacific Hydrographic Branch
POS/MV	Position and Orientation System for Marine Vessels
PPK	Post Processed Kinematic
PPP	Precise Point Positioning
PPS	Pulse per second

Acronym	Definition
PRF	Project Reference File
PS	Physical Scientist
PST	Physical Science Technician
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPE	Total Porpagated Error
TPU	Topside Processing Unit
USACE	United States Army Corps of Engineers
USCG	United Stated Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDA	Global Positiong System timing message
ZDF	Zone Definition File

UNITED STATES DEPARMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Silver Spring, Maryland 20910

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : April 14, 2015

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: S-E914-BH2-2015
HYDROGRAPHIC SHEET: F00656

LOCALITY: Baltimore Harbor, MD
TIME PERIOD: March 31 to April 2, 2015

TIDE STATION USED: 8574680 Baltimore, MD
Lat. 39° 16.0'N Long. 76° 34.7' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 0.415 meters

REMARKS: RECOMMENDED ZONING

Preliminary zoning is accepted as the final zoning for project S-E914-BH2-2015, F00656, during the time period between March 31 and April 2, 2015.

Please use the zoning file E914BH22015CORP submitted with the project instructions for S-E914-BH2-2015. Zone NCB123 is the applicable zone for F00656.

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 1983-2001 National Tidal Datum Epoch (NTDE).

HOVIS.GERALD.THOMAS.JR.1365860250

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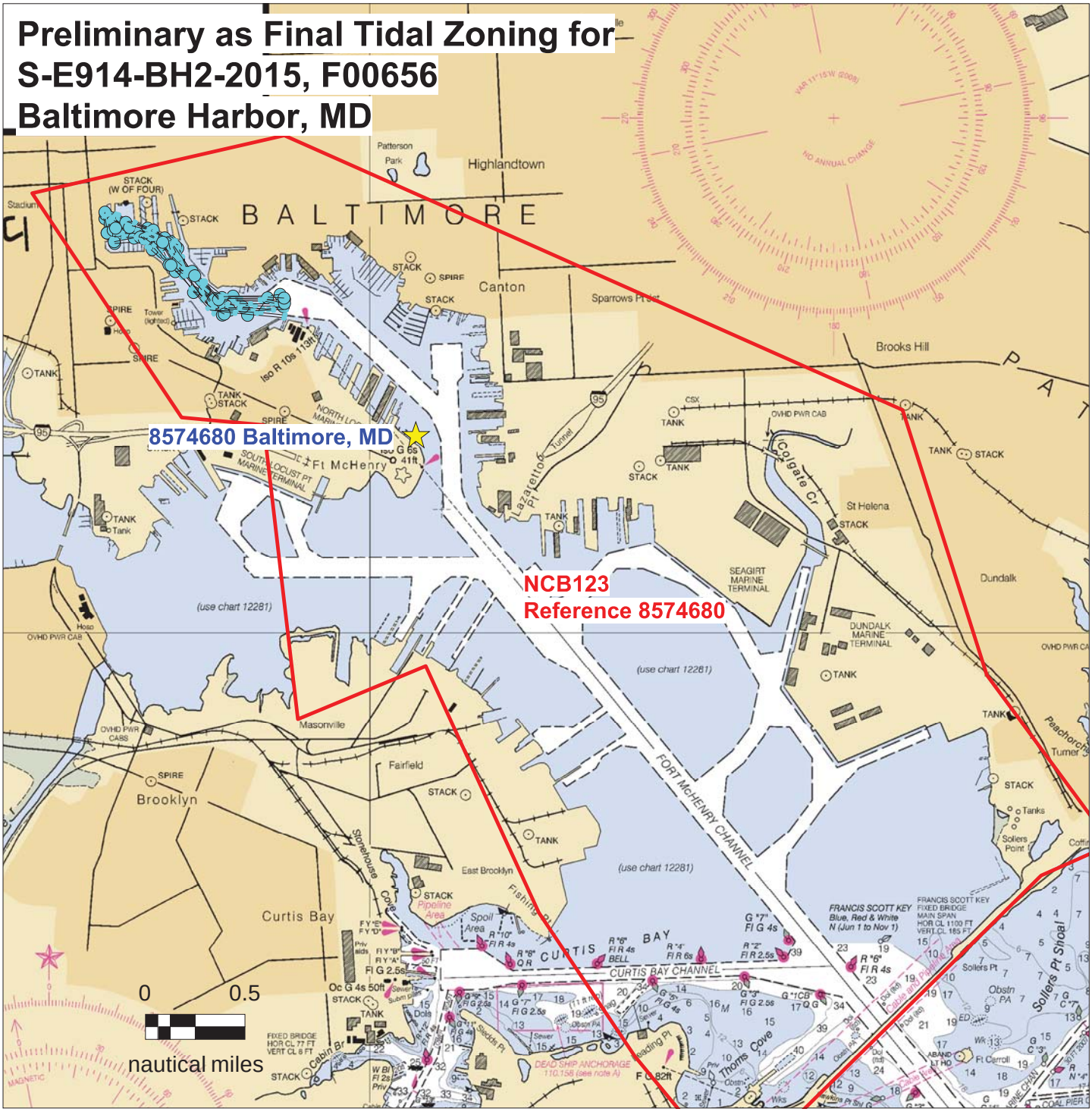
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.JR.1365860250
Date: 2015.04.14 14:33:08 -04'00'

CHIEF, PRODUCTS AND SERVICES BRANCH

Preliminary as Final Tidal Zoning for S-E914-BH2-2015, F00656 Baltimore Harbor, MD



APPROVAL PAGE

F00656

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NGDC for archive

- F00656_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- F00656_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications.

Digitally signed by RESER.KATIE.J.1234228192
Reason: For Peter Holmberg
Date: 2015.10.02 11:13:09 -07'00'

Approved:_____

Peter Holmberg
Cartographic Team Lead, Pacific Hydrographic Branch

The survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Digitally signed by EVANS.BENJAMIN.K.1237217094
Reason: I am approving this document
Date: 2015.10.02 11:16:34 -07'00'

Approved:_____

CDR Benjamin K. Evans, NOAA
Chief, Pacific Hydrographic Branch