**United States - Canada Hydrographic Commission**
Halifax, Canada May 16, 2016

# NOAA Nautical Chart Manual Updated for Satellite Derived Bathymetry

**Submitted by:** The United States of America

**Executive Summary:** This Information Paper provides the members of the USCHC with reference documents related to policies and procedures related to US nautical charting. Chapter 4 of the Nautical Chart Manual is provided and readers are directed to note section 4.2.3 Satellite Derived Bathymetry adopted by the US December 2015

**Related Documents:**

- USCHC-38 Meeting Minutes

**Related Projects:**

- none

## Introduction/Background

NOAA's Office of Coast Survey maintains the US Nautical Chart Manual which provides a wealth of information concerning the structure, and layout of nautical charts, covering basic topographic and hydrographic features, aids to navigation, chart symbols and miscellaneous maritime information. The attached volume of the US Nautical Chart Manual covers policies and procedures concerning hydrographic surveys, airborne Lidar bathymetry, Satellite derived Bathymetry and surveys received by other sources outside of NOS, USACE and DOD.

Because the US and Canada have expressed interest in SDB as a resource and tool in charting, including at the USCHC-38 (2015) meeting, NOAA provides the policy it recently adopted and incorporated into its US Nautical Chart Manual in December 2015.

## Conclusions/Recommendations

The USCHC discusses various steps and opportunities that promise to improve navigation safety and marine environmental protection in the US and Canada waters. The Commission is invited to note the new adoption of SDB into the US Nautical Chart Manual and discuss any options or interests on this subject

## Action Required of USCHC

USCHC is invited to:

a. Note the US Nautical Chart Manual and particularly Chapter
b. Discuss and offer feedback
c. Take any steps deemed appropriate

## 4.2 Hydrographic Surveys
**Revised on December 21, 2015 by Cartographic Order 008/15.**

### 4.2.1 NOS Surveys

The principal objective of hydrographic surveys conducted by NOS is to obtain hydrographic data for the compilation of nautical charts. Emphasis is on those features that may affect safe navigation.

Prior to the start of any NOS survey, project instructions are prepared and supplement the general instructions given in the NOS Hydrographic Surveys Specifications and Deliverables Document (HSSD), and the Field Procedures Manual. The details of the project instructions vary from specific to general depending on the nature, the locality, and the unique requirements of the survey.

1. Types of Surveys

a. Basic Hydrographic Surveys (H)

A Basic Survey is a complete and thorough survey that does not need to be supplemented by other surveys. For charting purposes, a basic hydrographic survey must be adequate to supersede all prior surveys of the same area. A basic survey shall verify or disprove the existence of all charted or reported features of significance. Basic Surveys delivered to MCD by HSD meet or exceed the NOS HSSD.

b. Bathymetric Surveys

A Bathymetric Survey is a track-line or multibeam survey run in a systematic pattern of wide-line spacing, e.g., 2 miles. It is used primarily to define bottom topography and as a source of fill soundings. In deep ocean areas, Track-Line or Bathymetric Surveys may constitute the only available information.

c. Chart Evaluation Surveys (CES)

The CES program is designed to accomplish the following:

(1) Resolve all deficiencies in charted hydrography and other selected chart information. (A deficiency is a weakness in charted information that can be corrected through field examination or by similar methods.)

(2) Evaluate the adequacy and accuracy of hydrographic information on existing charts.

(3) Verify or revise information published in the appropriate Coast Pilot.

(4) Conduct user evaluation and public relations efforts to provide a public awareness of NOS and its products, and to obtain user input.

d. Geophysical Surveys (see Track-Line Surveys)

e. Navigable Area Surveys (NAS)

NAS provide hydrographic information in areas where existing chart data is inadequate. By restricting the area of coverage of these surveys, yet retaining the basic hydrography concept within the surveyed waters, there will normally be a more rapid progression of field work and availability of data. The coverage is reduced by normally omitting requirements for: (1) development of the 0-foot curve and foul nearshore areas not considered navigable and (2) complete field edit of the survey area. Prior to 1973, these surveys were called "Corridor Surveys" (CS).

f. Reconnaissance Surveys

Reconnaissance Surveys determine the extent of change in an area since the last survey. Comparison of the results of a Reconnaissance Survey with prior survey provides the information needed to classify and design new survey requirements.

g. Revisory Surveys

A Revisory Survey is similar to a CES, but with emphasis on topography rather than hydrography. Historically, hydrography on such surveys has been of a reconnaissance nature and has usually been limited to verification of charted information in channels, harbors, and approaches.

The primary objective of a Revisory Survey is to field inspect and, when necessary, to revise the topographic and hydrographic features shown on the published charts so that New Editions are as up-to-date and accurate as possible.

h. Special Surveys

A hydrographic survey is classified as a Special Survey if the general requirements or specifications do not logically fall into any of the standard categories. A special survey may cover small areas for limited purposes such as to prove or disprove the existence of reported dangers or obstructions, to provide data for harbor development, or to supplement prior surveys for construction of a large-scale chart. Other surveys,

regardless of size of area, may be classified as special if significant deviations from line spacing or degree of coverage requirements are authorized. Special surveys include the following:

(1) Field Examinations (FE)

These are investigations of specific features, such as obstructions, rocks, and wrecks, or basic hydrographic surveys of limited extent.

(2) Additional Work (Ad. Wk.)

These provide additional development of specified features as a supplement to a basic hydrographic survey.

(3) Tag-Line Surveys

When detailed surveys of important docks, anchorages, or restricted areas are needed, Tag-Line Surveys often prove to be the most efficient and accurate method available. They are generally of large scale (1" = 100') with very closely spaced soundings and sounding lines. This type of survey, if required, will most often be accomplished as part of a basic hydrographic survey or registered as a field examination.

i. Track-Line Surveys

The NOAA survey vessels occasionally obtain soundings along their line of travel on extended voyages from port to project areas for bathymetric mapping or to provide fill soundings for small-scale charts. Track-Line Surveys are obtained when there is a specific need for the data and are controlled using the most accurate positioning system available to the vessel. The track lines are plotted either on Ocean Survey Sheets (OSS series) or on U.S. Navy Bathymetric Charts (as specified in the project instructions).

j. Geophysical Surveys

Geophysical Surveys are occasionally conducted to obtain depths of the bottom sediment layer, gravity and magnetic information, along with soundings, at wide-line spacing. The soundings may be used as a chart source.

k. Side Scan Sonar

Side Scan Sonar surveys are used primarily to supplement conventional echo sounding surveys and to investigate reported dangers to navigation. Side scan sonar is being used for many investigations of reported dangers to navigation.

l. Outside Source (W)

Outside Source surveys that have not been acquired under an official HSD project may be evaluated for use in nautical charting.

m. Airborne Lidar Bathymetry (ALB) Data

Definition: **LIDAR**. (Light Detection and Ranging): An airborne instrument that measures distance to an object by measuring the time difference between of a transmitted laser pulse and the rerun time of the reflected pulses. The measured time interval is converted into distance using the speed of light values characteristic of the medium. Topographic lidar measures elevations on land. ALB use a green laser pulse (typically, 532 nm) to measure water depths. The ability of ALB to detect the bottom and obtain depth information is totally dependent on water turbidity. Depending of the ALB system, bottom detection can range from one to three Secchi Disk Depth.

MCD cartographers shall chart LIDAR data based on the recommendations of HSD provided in the HCell Report. Encoding of features from the HCell, such as the quality of position (QUAPOS) or quality of sounding (QUASOU), may aid in decision making.

When it is unclear to MCD cartographers, whether or not the data provided by HSD is adequate to supersede charted information or whether or not the data meets standards for positional accuracy, depth accuracy or object detection, the Branch Chief or Team Lead shall contact NDB for resolution with HSD and/or RSD.

Hydrographic LIDAR data may be received in MCD from sources other than HSD. In such cases, NDB shall request charting advice from HSD and/or RSD

When assistance from HSD and/or RSD is unavailable in determining the suitability of third party bathymetric LIDAR data for charting, the following policies shall be followed:

- Only depths shoaler than charted depths shall be added to the chart.

- Uncharted offshore or shoreline features shall be added to the chart as the chart scale permits.

- Charted offshore or shoreline features such as rocks or submerged piles, which may have escaped detection, shall not be deleted nor relocated.

2. Processing of NOS Surveys

HSD processes the data gathered from hydrographic surveys at their processing branches located at Atlantic Marine Center and Pacific Marine Center. As a result, NDB now receives only the final approved HCell of the survey along with an HCell Report.

## 4.2.2 USACE Surveys

The USACE administers Federal laws enacted for the protection and preservation of navigable waters of the United States. For work seaward of the shoreline, the USACE is authorized to approve plans and issue construction permits for structures of any kind, establish harbor lines, and remove sunken vessels and obstructions endangering navigation. The navigable waters of the United States over which USACE jurisdiction extends include all ocean and coastal waters within a zone 3 nautical miles seaward from the coastline. Wider zones of 3 leagues (9 nautical miles) are recognized in some areas of the Gulf of Mexico and the Caribbean (see 33 CFR 329.12 - .14 for more details).

Copies of survey data, both sounding plots and channel condition reports, are made available to NOS for application to nautical charts and will generally be accepted and registered as source documents. Suspected significant errors in control data, various limit lines, plotted sounding lines, depths, and other charting data shall be brought to the attention of the USACE for rectification if these errors cannot be resolved unequivocally within NOS. This procedure shall not affect the routine scanning of the registered data for publication of suspected dangers in the NM.

1. Initial Screening and Application

All registered and indexed survey data shall be forwarded to the production branches immediately.

a. Expediting Critical Items

USACE survey data shall be screened for items affecting the safety of navigation immediately upon receipt in the production branches. Survey data on which critical items appear shall be assigned first priority for application to the digital chart files. Critical items must be applied promptly and notice to mariners written.

The production branches must also expedite the processing of USACE surveys and channel depth reports that affect tabulated depths and depth legends on existing charts.

In all cases, critical items must be applied and the corresponding notice to mariners written as quickly as possible.

b. Delineation of Depth Contours and Curves

The placement of depth contours or curves and the avoidance of ½-foot soundings on USACE surveys shall be consistent with the guidelines established for NOS hydrographic surveys (see Section 4.4.2, Depth Contours and ½-Foot Soundings).

2. Classifications of USACE Surveys

The relative degree of chart application required will depend on the status of the USACE hydrographic survey being applied.

a. Reconnaissance -- a general survey to determine whether a channel has shoaled to lesser depths than the approved project or to determine the need for a more detailed survey.

b. Condition and Examination -- a more detailed survey to determine the current condition or the controlling depth of a channel and to plan future maintenance dredging and preparation of channel condition statements to be issued to navigation interests.

c. Preliminary -- a detailed survey to determine the condition of a channel; plans and specifications for future dredging work are based on this survey.

d. Contract drawing -- a survey furnished to a contractor specifying the area and depth to be dredged (or work to be accomplished) to fulfill contract terms.

e. Pre-dredging – a survey made immediately before commencement of dredging to determine the latest condition of the channel.

f. After dredging – a survey made immediately after completion of dredging to determine the latest condition of the channel and to determine whether additional dredging is required to meet the terms of the dredging contract.

g. As-built -- a survey certifying that the channel has been dredged or a structure has been built in accordance with the contract plans. An as-built survey normally is used to show a feature as it was actually constructed.

3. In Galveston Bay and the Houston Ship Channel

Depths (including Channel Tabulations, Channel Legends and Channel Depth Notes) are referenced on nautical charts to a specified vertical datum. In Galveston Bay, the Houston Ship Channel and in the vicinity of Freeport, Texas the vertical datum is Mean Lower Low Water (MLLW). Recent information received from the U.S. Army Corps of Engineers (USACE) is referenced to a local dredging reference - Mean Low Tide (MLT). These two vertical references are not equivalent.

Combined with measured subsidence of the bottom, it has been determined that an approximate conversion value of 1 foot needs to be added (making depths deeper) to USACE hydrography referenced to Mean Low Tide. This information is typically provided by USACE in tabulated form or as channel profile (crosscut) graphics.
DESIGNATED GEOGRAPHIC AREA:

All USACE projects referenced to MLT and located within the following designated area shall subscribe to these specifications. The designated area is as follows:

An area encompassing all of Galveston Bay, from and including the Galveston Bay Entrance Channel and the Houston Ship Channel in its entirety.

Inside Galveston Bay, along the axis of the INTRACOASTAL WATERWAY, the eastern limit includes all USACE projects west of longitude 94°28'00.63"W (which is equal to the western neatline dimension of Chart 11332). The western limit extends to longitude 95°50'01.65"W (which is equal to the western neatline dimension of Chart 11321) and encompasses all of Freeport Harbor, from and including the Freeport Harbor Channel.

DEPTH INFORMATION:

USACE depth information is portrayed on NOS charts as (1) a Channel Tabulation, (2) a Channel Legend/Channel Depth Note, or (3) as Soundings. All USACE sources in the designated

area referencing Mean Low Tide (MLT) shall be applied according to the following specifications.

(1) CHARTED CHANNEL TABULATIONS:

USACE depth information, referenced to MLT, provided in tabular or graphic form shall be applied to the charted channel tabulation as is without the application of the approximate conversion value.

All charted channel tabulations within the designated area shall subscribe to this format. There are no conditions where a charted channel tabulation contains a combination of different datums within the same tabulation.

The header in the tabulation currently reading:

"CONTROLLING DEPTHS FROM SEAWARD IN FEET AT MEAN LOWER LOW WATER (MLLW)"

shall be revised to:

"CONTROLLING DEPTHS FROM SEAWARD IN FEET AT MEAN LOW TIDE (MLT)"

A modification statement shall be added at the bottom of each channel tabulation when MLT data is used.

The following statements, in upper case letters, shall be inserted below the bottom horizontal line of the tabulated data table and above the note:

INFORMATION IN THIS TABULATION HAS BEEN PROVIDED TO NOAA BY THE U. S. ARMY CORPS OF ENGINEERS. DEPTHS ARE REFERENCED TO A LOCAL DREDGING REFERENCE CALLED MEAN LOW TIDE. FOR AN APPROXIMATE CONVERSION TO MEAN LOWER LOW WATER, ADD 1 FOOT TO EACH DEPTH IN THE TABULATION.

NOTE - CONSULT THE CORPS OF ENGINEERS FOR CHANGES SUBSEQUENT TO THE ABOVE INFORMATION.

When the charted tabulation has footnotes, the statement noted above shall be inserted after the last footnote.

(2) CHARTED CHANNEL LEGENDS AND CHANNEL DEPTH NOTES:

USACE depth information, referenced to MLT, provided in tabular or graphic form shall be applied to revise/update a charted channel legend or channel depth note. The approximate conversion value of 1 foot shall be added to the MLT value. The resultant charted value will be 1 foot deeper than the MLT value. Note: When a legend is used to describe a channel, a spot sounding located within a channel must also be converted.

(3) CHARTED SOUNDINGS LOCATED OUTSIDE CHARTED CHANNEL LIMITS:

Soundings referenced to MLT and located outside charted channel limits shall be converted using the approximate conversion value of 1 foot. The resultant charted value will be 1 foot deeper than the MLT value. Note: Depth curves originating on any USACE source referenced to MLT must not be used. Depth curves should be regenerated after applying the approximate conversion value of 1 foot to individual soundings.

4. Charting of Aids to Navigation and Topography

The survey base used by the USACE to plot hydrography usually does not show current topographic information. The USCG aids to navigation, especially fixed aids, generally appear on USACE surveys in their location at the date of the original base even if they have since been relocated or removed. A specific request to the USACE is usually required to obtain current locations of fixed aids. Positions of aids provided by the USACE must be approved by the USCG before they are charted.

NOS cartographers shall compare all fixed aids to navigation appearing on USACE surveys with their charted positions. Any suggested revisions to aids included in a Light List shall be brought

to the attention of the branch's Update Service cartographer, which will seek USCG approval of the recommended charting action which is required before charted aids are changed.

USACE surveys may be used as the charting source for features not listed in the Light List such as privately maintained aids, dredging markers, piles, stakes, and similar objects that can affect surface navigation. This information should be used if it is current.

USACE surveys may also be used as the source for shoreline changes when they are supported by hydrography or when the date of the survey base is more recent than that shown on other available sources. The approximate shoreline symbol C 2 shall be charted in this case unless the shoreline datum is considered to be reasonably well defined.

## 4.2.3 Satellite Derived Bathymetry

Definition: **SATELLITE DERIVED BATHYMETRY (SDB).** A optical remote sensing method for estimating depth analytically using visible bands of satellite imagery. [104]

### Background

Satellite Derived Bathymetry (SDB) is a tool that can be used to map shallow water bathymetry using publicly-available satellite imagery. Main applications where SDB can be used on NOAA charts are: 1) to characterize a coastal area and 2) to monitor seafloor changes that may have occurred since the last hydrographic survey was conducted.

### General Requirements

Satellite Derived Bathymetry (SDB) may be used to revise waterways on nautical charts that have not been recently surveyed by acoustic means, such as MBES, or by Airborne Lidar Bathymetry (ALB) and/or are economically/strategically impractical to survey, such as extremely remote or highly dynamic areas. The use of SDB data is especially useful where vessel traffic or the deployment of aids to navigation indicate that charted data is misleading and there are no recent surveys to update the chart.

- SDB data must be approved by an SDB Analyst designated by the Chief, MCD and the data must be registered as source by NDB before any chart application.
- SDB data is to be typically used in shallow water areas. SDB may be used in deeper water when directed by an SDB Analyst.
- SDB shall not be used where contemporary echo sounder or Airborne Lidar Bathymetry survey data is available.
- SDB shall not be used to update areas with critical under-keel clearance requirements for large (SOLAS) vessels, where high resolution, systematic hydrographic surveys meeting NOAA Hydrographic Specifications are required. (Such as Port of Los Angeles/Long Beach)
- SDB data shall not be used to disprove existing charted shoal depths, but it may be used to improve the position of shoals derived from historical surveys or notes of “Shoal Reported”, unless directed by an SDB Analyst.
- Depth soundings shall be charted from SDB data only upon direction from an SDB Analyst.
- Charted depths within the corresponding depth area after application of SDB data shall be retained on the chart unless deletion is directed by an SDB Analyst. For example, a 15 foot depth sounding charted between an approximate 12 foot depth curve and an approximate 18 foot depth curve charted from SDB shall generally be retained as charted.

- Charted depths deeper than the corresponding depth area after application of SDB data shall be deleted from the chart. For example, a 21 foot depth sounding charted between an approximate 12 foot depth curve and an approximate 18 foot depth curve charted from SDB shall be deleted from the chart.
- Dangers such as wrecks, rocks, obstructions and shoals shall not be deleted from the chart based on the application of SDB data unless directed by an SDB Analyst.
- Areas of interest, where acquisition of SDB data may be advantageous, may be reported to an SDB Analyst by MCD Staff, the Chief of any MCD branch or a Team Lead.
- The Chief, NDB shall notify HSD, RSD or NSD, as appropriate, when analysis of SDB indicates that new hydrographic and/or topographic survey data would be advantageous.

**Feature Recommendation for a Notice to Mariners**

Newly applied, revised or deleted data based on SDB shall be evaluated for a Notice to Mariners or chart update.

**Line Type and Weight**

Depth curves (contours) charted from SDB data shall be considered to be approximate depth curves.

Approximate depth curves applied from SDB data may be extended into deeper charted water but shall not be retracted unless directed by an SDB Analyst.

Coastline from SDB data shall be considered to be approximate shoreline. Approximate shoreline applied from SDB data may be retracted or extended only after consultations with RSD for best available data.

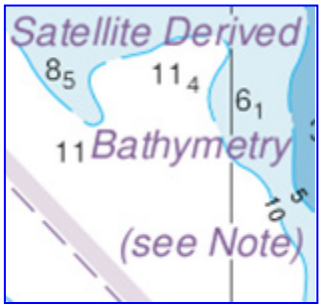
Areas revised from SDB shall be delineated by a boundary consisting of a dashed magenta line. On raster charts, this line is specified as: 0.25/2.00/0.75mm (0.010/0.080/0.030”), Symbol N 1.2, with a magenta screened tint band. The thickness of the magenta band may vary depending on the size of the area.

**Size and Shape**

A Satellite Derived Bathymetry area shall be determined by the geographic extent of the data revised.

**Labels and Notes**

A label shall be placed within or near the limits of the SDB data stating *“Satellite Derived Bathymetry (see note)”*. See Figure below. The label shall be in magenta, preferably 7 point Swiss Light Italic, depending on the size of the area.




A magenta note shall be applied to the chart referring to revisions from SDB. The note must indicate that uncharted dangers may exist. The note shall be 7 point Swiss Light on paper and raster charts.

NOTE _
Satellite Derived Bathymetry
Depths within the area indicated are derived from satellite imagery from *[year]*. Their vertical accuracy is typically ± 2m. Uncharted dangers may exist.

The vertical uncertainty in the note must be converted to the chart unit equivalent of 2 meters (7 feet or 1 fathom) on non-metric charts.

A CATZOC (Category of Zone of Confidence) value of "C" or lower shall be encoded for the ENC product as determined by an SDB Analyst.

**Color and Screening**

The limit of the SDB data and the screened tint band shall be charted in magenta.

SDB area labeling shall be in magenta.

A note referring to Satellite Derived Depths shall be in magenta.

Approximate shoreline charted from SDB data shall be in black.

An approximate depth curve (contour) charted from SDB data shall be in the same color as other depth curves on that chart.

**Feature Removal from Chart**

An SDB area limit, labeling and note shall be deleted when a more recent systematic survey has been applied in the same area.

### 4.2.4 Miscellaneous Surveys

Depth Information is received from many sources other than NOS, USACE, and DOD. This information may range from substantial state and local government surveys to a single uncontrolled line of soundings from an individual without correctors for tide or transducer depth.

All such information must be carefully screened prior to chart application to separate valid and sufficiently complete data from data that should be rejected as inadequate. Every effort shall be made to obtain sufficient additional information to salvage an otherwise useless survey if it is

judged to be potentially useful, for example additional metadata such as provided (horizontal and vertical references, surveyor, and acquisition system. Then this dataset should be further considered for charting application.

Great care must be exercised in the application of private surveys to make certain that all relevant positioning factors involved are considered for adequacy, that the date and time of the survey work are available for construction of a tide curve for derivation of tide correctors, and that all soundings are corrected for the depth of the transducer. Failure to consider parameters, such as the depth of the transducer, can result in charted depths that are different than the actual depths.

Depths charted from non-authoritative sources should include the word "reported" and the date of the survey as a legend or note, as appropriate, until they can be verified by an authoritative survey. Two examples of such disclaimers follow:

*3 ft shoaling rep 1999*

_____ Creek

Hydrography in the _____ Creek from the entrance to the railroad bridge is reported from a private survey of 1999.

#### 4.2.4.1 Depth Wizard (DepthWiz) Surveys

**Revised by on February 1, 2006 by Cartographic Order 002/06 and by a March 30, 2006 Memorandum**

**Definition: DEPTHWIZ**. Is a system that measures depths of water, integrating a Differential Global Positioning System (DGPS) or Wide Area Augmentation System (WAAS) receiver, a

depth sounder, and a PC type computer programmed using time corrections, transducer corrections, tide corrections, etc. that adjusts measured depths to the chart sounding datum. [29]

**General Requirements:**

The Cooperative Charting Program of the United States Power Squadrons (USPS) is conducted in coordination with the Marine Chart Division. Under the program, USPS members supply data to the Marine Chart Division which may lead to corrections to nautical charts and Coast Pilot volumes. Included with this electronically submitted information is data from depth surveys conducted by USPS members. Following the collection and input of specified data, DepthWiz outputs a computer file for transmittal to the Marine Chart Division. DepthWiz provides a consistent procedure and common data set to use in survey reporting. DepthWiz has been

adopted as the approved method for USPS Cooperative Charting participants to obtain and submit depth survey data.

DepthWiz survey data may be represented on charts by soundings, notes, legends, and tabulation footnotes.

DepthWiz surveys shall be evaluated for quality of data by the Nautical Data Branch before application to nautical charts.

Before applying DepthWiz surveys to nautical charts, the area covered by the survey must be researched for sources of a more recent date.

DepthWiz surveys, although considered non authoritative, will be used to supplement these sources in the following manner:

- DepthWiz data shall be considered adequate to chart new shoals and obstructions as reported features.
- DepthWiz data shall not be considered adequate to supersede shallower soundings or disprove charted wrecks, rocks, obstructions or labeled shoals.
- DepthWiz data shall NOT be used to make charted depths deeper.
- Charted hazards and mooring structures, such as piles, platforms, sills, etc. shall not be deleted by DepthWiz data.
- Charted shoreline, islets or dams shall not be deleted or revised by DepthWiz data.

- DepthWiz surveys showing significant changes to depths, shoreline (including islets), hazards, mooring structures or dams shall be referred to NDB to request investigation by authoritative sources.

**Revision of Soundings and Depth Curves**

Soundings and depth curves selected from DepthWiz surveys shall be charted in accordance with Sections 4.3 Soundings and 4.4 Depth Contours and Curves.

**Exception:**

Since natural channels may constitute routes from deep water into shore or harbor areas, the charting of unconfirmed shallower depths from DepthWiz surveys may prohibit the transit of

vessels that use the route. An additional survey may be needed to confirm reported depths. Such conditions shall be reported to NDB if subsequent DepthWiz surveys have not confirmed the reported shoaler depth.

**Revision of Dredged Areas Depths**

When revising dredged area information displayed by tabulations, legends or notes, the selection of DepthWiz data to be charted as depth information shall be in accordance with Section 4.6.1 Tabulations, Legends and Notes; Section 4.6.2 Updated Old Channel Depth Information and Section 4.6.3 Revised Channel Depths.

**Federally Maintained Channels:**

The USPS has been discouraged from surveying in USACE maintained projects. An MCD production reviewer shall notify NDB when the reported depth from a U.S. Power Squadron DepthWiz survey is shoaler than the charted controlling depth. NDB shall request a second DepthWiz survey to confirm the reported shoal depth(s) in the channel. Controlling depths in federally maintained channels shall not be revised from a single DepthWiz survey. NDB shall notify the USACE about the reported depth if confirmed by a second DepthWiz survey.

When a shoal depth in a federally maintained channel has been confirmed by a second DepthWiz survey, the tabulated controlling depth shall not be revised, but a footnote shall be added, such as "SHOALING REPORTED TO 16 FEET AT 41° 30' 00.5" N/ 081° 42' 31.4" W, JANUARY 2006".

When a shoal depth in a federally maintained channel labeled with a controlling depth legend has been confirmed by a second DepthWiz survey, an additional notation such as *"Reported shoaling to 11 feet in channel 2006"* shall be added. The charted controlling depth legend shall be retained.

An MCD reviewer shall notify NDB when a depth in the Intracoastal Waterway, confirmed by a second DepthWiz survey, is less than the controlling depth published in the Local Notice to Mariners. A label such as, *"Shoaling rep 2006"* shall then be added at the location of the shoal if hydrography is currently charted. A shoaling label shall not be charted where hydrography is not shown, but in either case, the shoaling shall be reported to NDB, which shall notify the USACE of the reported shoaling condition.

In **non-federally maintained channels,** where a second DepthWiz survey confirms a shallower depth, the charted depth information shall be replaced by a reported depth. The depth shall be reported to NDB by the reviewer and NDB shall notify the authority for the channel of the reported shoaling condition.

In **non-federally maintained channels**, where a USPS DepthWiz survey reports a deeper depth, the date of charted depth information shall be revised only if the DepthWiz survey adequately covers the entire area to which the legend or note refers.

**Location and Orientation:**

When charting a reported sounding from a DepthWiz survey, the whole number shall be centered on the geographic position of the depth.

When a controlling depth note is charted with depths from a DepthWiz survey, the note shall be placed in the vicinity of the data. A label referencing the note, such as, "*(see note B)"* shall be charted in black at the location of the shoal.

**Size and Shape:** Soundings in traditional units (i.e., feet, fathoms) shall be charted with 7 pt. Swiss Light. On metric charts, soundings shall be charted with 7 pt. Swiss Light Italic.

**Labels and Notes:** The abbreviation "*Rep*" shall be appended to any charted depth that has originated from a DepthWiz survey. The year that the depth was found shall be included:

Example:

7 *Rep (2006)*

The label shall be charted with 7 pt. Swiss Light Italic.

In the case where all charted soundings in a river, creek, small cove or other definable area are reported by a DepthWiz survey, the "*Rep*" label shall be omitted from the soundings. A label "*(see note _)*," in 6 pt. Swiss Light Italic, shall be centered within the area of the revised soundings. When the label cannot be located within the limits, it shall be placed adjacent to the area so that the mariner will associate the label with the extent of the reported hydrography. The

use of an arrow or leader to associate a label with a location, although discouraged, may be necessary.

Examples:

Note __
_____ Creek
Hydrography in _____ Creek, from the entrance to the bridge, is reported from a private survey of 2006.

These note shall be charted with black 7 pt. Swiss Light, set 2" to 3 ½" wide.

**Color and Screening:**

Soundings, labels, legends and notes shall be charted with black.

**Feature Recommendation for a Notice to Mariners**

Newly applied, revised, or deleted depth information (sounding, tabulation, legend or note, etc.) shall be evaluated for a Notice to Mariners.

**Feature Removal from the Chart:**

Charted depth information (i.e. soundings, legends, tabulations and notes) provided by USPS DepthWiz surveys shall be superseded by subsequent data from NOS, USACE, Navy or other authoritative sources.

## 4.2.5 Danger to Navigation Reports

NOS field units (vessels, contractors and navigation response teams) are required to submit a Danger to Navigation Report for:

- Significant uncharted rocks, shoals, wrecks and obstructions.
- Depths which are found to be significantly shoaler than charted depths and features.
- Uncharted or inadequately charted clearances for bridges and overhead cables or pipes.
- Other submerged or visible features, or conditions considered dangerous to navigation.

In general, Dangers to Navigation Reports are no longer submitted directly from NOS field units to the USCG and NGA for inclusion in the NM. NOS policy dictates that in most cases, these reports shall be forwarded immediately to the Marine Chart Division (MCD) through the Atlantic Hydrographic Branch (AHB) or the Pacific Hydrographic Branch (PHB). A copy shall also be sent to the Hydrographic Surveys Division Operations Branch. If a significant danger to navigation is discovered and is an immediate danger to vessel traffic, the field unit or COTR shall submit the information as quickly as possible to the Captain of the Port, USCG and pilots. The information shall also be submitted as described above.

*The necessity for prompt action in evaluating and charting an item from a Danger to Navigation Report cannot be overemphasized.* Immediately upon receipt of a Danger to Navigation Report, the Nautical Data Branch (NDB) shall process the report as a source document and indicate

"priority" status. The report shall then be immediately forwarded to the appropriate production branch for application to all affected charts.

NDB shall notify the chief of the appropriate production branch and the Chief of the Coast Pilot Branch, by electronic mail, that a priority source document is available for chart application. NDB shall forward a copy of the source document to the Coast Pilot Branch.

If corrections are complex, a chartlet may be prepared for issue. Notice to Mariners items generated during application of a Danger to Navigation Report shall be submitted to the appropriate MCD production branch without delay. The reviewer of the priority source document in the production branch shall alert the branch cartographer responsible for Crit review by electronic mail, that one or more priority items are being submitted for inclusion in the NM. The appropriate production branch shall promptly process and transmit the submission to USCG and NGA for inclusion in the next issue of the NM. Danger to Navigation Reports must be processed immediately and every effort shall be made to transmit the submission to USCG and NGA within one week, at most, after receiving a Danger to Navigation Report in MCD. The appropriate production branch shall also forward a copy of the NM submission to AHB or PHB.

Reports of inadequately charted clearances for bridges and overhead cables or pipes shall be referred to the recognized authority by the NDB. Chart application will depend upon the authority's response to the NDB inquiry.

NOS field units are also required to report the following information to the USCG in a timely manner for a "Broadcast to Mariners:"

- Floating wreckage, logs, derelicts or other similar objects that are menaces to navigation.
- A fixed or floating aid to navigation found to be off station to an extent that the aid does not serve its purpose adequately.

- A fixed or floating aid to navigation showing significantly different characteristics than those charted or described in the Light List.

A Danger to Navigation Report will also be prepared for these conditions and it will be forwarded to MCD through AHB and PHB.

Unanchored floating dangers are not charted due to their constantly changing positions and temporary nature. However, such hazards may be of immediate interest to mariners. Therefore, any reports of hazardous unanchored floating dangers received by an MCD production branch

from a Danger to Navigation Report shall be promptly verified by that production branch and shall verify whether or not the unanchored floating dangers were reported to the USCG. The production branch shall notify AHB or PHB when the USCG has been contacted concerning a Danger to Navigation Report.

Reports of aids to navigation that do not adequately serve their intended purposes and aids to navigation showing different characteristics from those shown on the chart, or in the in the Light List, may also be received by an MCD production branch and shall verify whether or not the information was reported to the USCG. The production branch shall notify AHB or PHB when the USCG has been contacted concerning a Danger to Navigation Report.

### 4.2.6 Source and Zone of Confidence Diagrams

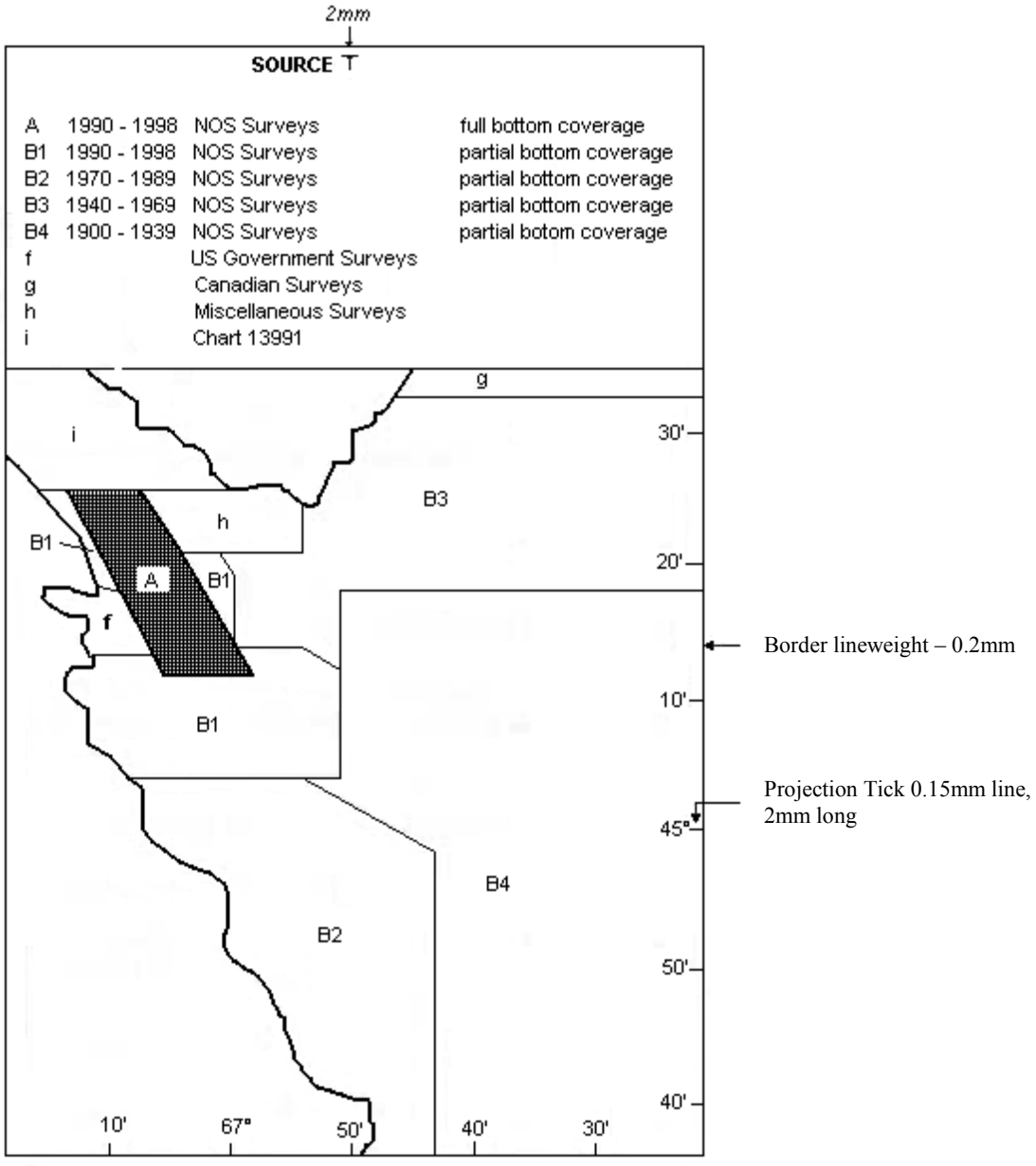
Source diagrams, as used on NOS nautical charts, consist of a graphic delineating the limits of the most recently available hydrographic survey information that has been evaluated for chart application, and the associated textual information. MCD uses two types of source diagrams for charts. Traditional source diagrams (section 4.2.7.1) shall be used on charts that do not fall under the New and Reconstructed Chart policy. Charts that fall under New and Reconstructed Charts shall use the Zone of Confidence (ZOC) diagrams as outlined in section 4.2.7.2

Source diagrams shall be added to all charts 1:500,000 scale and larger unless specifically excluded by the Chief, MCD. Source diagrams shall be revised as subsequent hydrographic source documents are evaluated.

#### 4.2.6.1 Source Diagrams on Existing Charts

The "Authorities" note shall not be used in lieu of a source diagram. Graphic and textual specifications for source diagrams are detailed in the following paragraphs. A typical source diagram is shown in Figure 4-1.

## SOURCE DIAGRAM




Outside Border Dimensions 75mm x 110mm
(for chart with neatlines 750mm x 1100mm)

**Figure 4-1**

An area updated by SDB shall be outlined in a paper/raster chart source diagram. The source date of the imagery shall be shown in the source diagram, not the date of the compilation. The source shall be listed as "Satellite Imagery".

The note reference on the chart and in the corresponding source diagram shall reference the next available note letter.

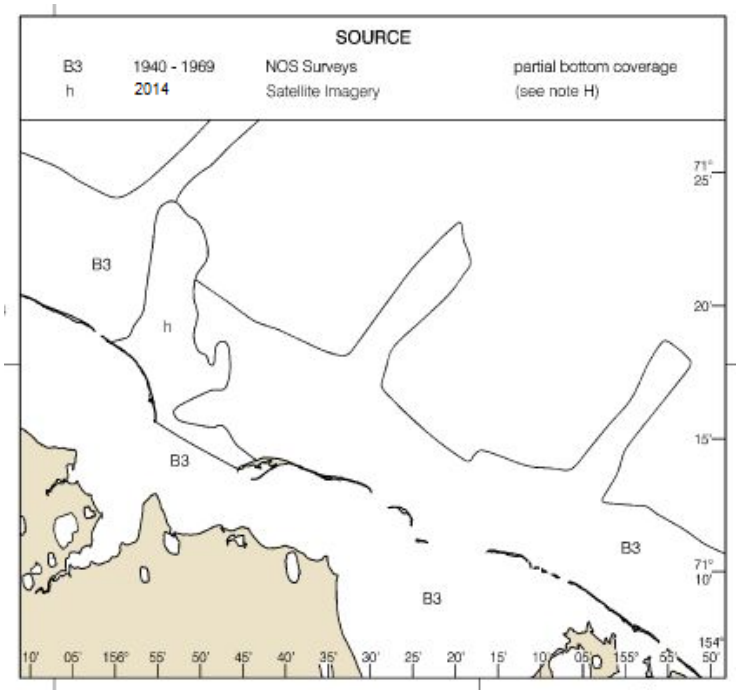



**Figure 4-2**

a. Specifications of Graphics

The overall linear dimensions of the graphic shall be one-tenth of the chart's neatline dimensions. A 0.2 mm black outline shall be used for the diagram's border. The normal coastline (0.2 mm, black) shall be shown within the diagram with all land areas tinted gold. The survey area limits shall be shown by a solid black 0.15 mm line. Identifying letters or references shall be placed in the approximate center of the survey area in 7 pt. Swiss Light.

A screened 25 percent blue tint fill shall be used to identify areas of 100 percent bottom coverage. All other water areas shall be white.

Survey limits shall not be delineated in areas where hydrography is not charted. The limits of large scale charts may be delineated and survey limits omitted within the larger scale chart outlines, in source diagrams shown on charts smaller than 1:100,000 scale. An alpha identifier, in 7 pt. Swiss Light, shall be placed in the approximate center of each outlined larger scale chart. The outline of large scale charts may be used only in congested areas in source diagrams for charts at 1:100,000 scale and larger. The limits of surveys conducted by USACE in maintained channel shall not be included in source diagrams. USACE surveys covering large areas shall be delineated.

The minimum sized feature on a ZOC diagram shall be the size of a 0.3MM circle.. A leader shall be used to connect an alpha identifier with the corresponding minimum size outline.

Projection ticks 2.0 mm in length, 0.15 mm line weight, shall be shown along the inside border and labeled in 6 pt. Swiss Light. The intervals of these ticks shall be such that each projection line on the base chart is represented by a tick on the diagram. Preferred placement of the ticks and labels is along the east and south limits of the diagram. Shoreline and survey limit lines shall be broken for labels and ticks. The projection value labels on the base chart shall be used as a guide for labeling the ticks on the source diagram. For example, if the label on the base chart included degrees and minutes then degrees and minutes shall be used on the diagram (see Figure 4-1).

For charts with insets or extensions: the inset shall be shown in the diagram if it is of substantially larger scale (at least four times larger than the base chart) and the area is covered by more than two surveys. If the area within the inset is covered by one or two surveys only, the diagram for the base chart is sufficient. Extensions shall always be shown in the diagram. The inset or extension limits shall be shown by a 0.2 mm line similar to the diagram border. Procedures for adding graduation ticks and values to insets and extensions are the same as for the base diagram.

b. Specifications of Text

Textual information for source diagrams shall be arranged in tabular form in an area directly above the graphic, under the heading "SOURCE" and outlined by the same 0.2 mm border as the graphic. The heading shall be in 8 pt. Swiss Regular type. All other text shall be in 7 pt. Swiss Light. The height of the bordered text area is variable depending on the number of references but shall extend at least 2.0 mm above the heading.

The minimum width of this tabulation shall be equal to the width of the graphic. In some cases, it may be necessary for the width of the tabulation to exceed the width of the graphic. The tabulation shall print against a white background.

Tabulated text shall include the date band identifier, origin, and whether the bottom coverage is full or partial for each survey or group of surveys referenced to one alpha or alphanumeric identifier. Adjacent surveys, regardless of scale, collected within the same time bands and with the same type of coverage, shall be grouped under one identifier.

Surveys shall be identified according to the following classification scheme:

A. 1990 to the present (where full bottom coverage was achieved). These surveys used side scan sonar or multibeam technology and differential GPS positioning.

B1. 1990 to the present (where partial bottom coverage was achieved). These areas were surveyed using single beam echo sounder technology and may utilize differential GPS positioning.

B2. 1970 to 1989. Partial bottom coverage was achieved using single beam echo sounder technology and primarily electronic positioning.

B3. 1940 to 1969. Partial bottom coverage was achieved using single beam echo sounder technology and primarily visual positioning.

B4. 1900 to 1939. Partial bottom coverage was achieved using primarily lead line technology and visual positioning.

B5. Pre-1900. Partial bottom coverage was achieved using primarily lead line technology and visual positioning.

Actual dates of surveys shall not be used. For example, if surveys used to compile the hydrography on a particular chart were conducted in 1946, 1955, 1956, 1971, and 1976, they could be grouped under two alphanumeric identifiers. One identifier, B2, would label the area covered by the 1971 and 1976 surveys and be referenced in the textual information using the dates 1970-1989. Another identifier, B3, would label the area covered by the 1946, 1955, and 1956 surveys and would be referenced in the textual information using the dates 1940-1969. Surveys from different time bands shall not be grouped together.

If a survey was conducted in more than 1 year and those years transcend time bands, the time band that would apply to the most recent work shall be used.

For time bands dated from 1990, the date of the most recent survey in that category shall be used as the ending date for that time band. For example, if the most recent survey providing full bottom coverage on a particular chart was conducted in 1997, the resulting time band in the tabulated text shall read,1990-1997.

When a time band dated from 1990 is used, the ending date of that time band shall not be advanced with each new edition. If a new edition is produced in the year 2000, and the latest survey providing full bottom coverage is still 1997, the ending date of that time band shall remain 1997.

The ending date of a time band dated from 1990 shall change when more recent hydrographic source is applied to the chart.

The type of coverage for each survey or group of surveys shall be identified in the textual source tabulation according to the following terminology: "full bottom coverage" for surveys that utilized side scan sonar or multibeam throughout the entire survey or "partial bottom coverage" for surveys that utilized single beam echo sounder or lead line. A survey that utilized a single beam echo sounder with side scan sonar within a limited area shall be listed as having partial bottom coverage. Surveys with full bottom coverage shall not be grouped with surveys achieving partial bottom coverage.

A category for miscellaneous surveys may have to be included to cover areas where surveys are too numerous to identifying or to cover areas that would otherwise not be covered. Such areas shall be identified "Miscellaneous Surveys" and the dates shall be omitted. Dates shall also be omitted from references to large-scale charts.

The term "U.S. Government Surveys" shall be used to refer to government sources other than NOS. This term shall include USACE surveys of large areas. Dates and type of bottom coverage shall be omitted from references to these surveys.

Surveys conducted by foreign governments shall be listed separately from U.S. sources. Dates and types of bottom coverage shall be omitted from references to foreign surveys.

Surveys detailing full bottom coverage shall be listed first. All other NOS surveys shall follow, listed chronologically, with the most recent first. References to larger scale charts should appear last.

The following note shall be added to all charts displaying a source diagram.

SOURCE DIAGRAM

The outlined areas represent the limits of the most recent hydrographic survey information that has been evaluated for charting. Surveys have been banded in this diagram by date and type of survey. Channels maintained by the U.S. Army Corps of Engineers are periodically resurveyed and are not shown on this diagram. Refer to Chapter 1, United States Coast Pilot.

The note shall print in black and in 7 pt. Swiss Light. Placement of the note shall be in the following order:

1. Directly above the diagram.
2. Directly below the diagram.
3. Any other location in close proximately to the diagram.

### 4.2.6.2 ZOC Diagrams for New and Reconstructed Charts

For New and Reconstructed Charts MCD uses to Zone of Confidence (ZOC) diagrams that enable mariners to assess the quality of the hydrographic data from which the chart was compiled in a similar yet slightly different fashion.

The use of ZOC diagrams provide consistency in the display of source data between digital and paper charts, as the Category of Zones of Confidence (CATZOC) definitions are derived directly from S-57. The responsibility of assigning the ZOC value resides in HSD.

The quality of the hydrographic source data is assessed according to six categories: five quality categories for assessed data (A1, A2, B, C and D) and a sixth category (U) for data which has not been assessed. If none of the hydrographic sources used on a chart have been assessed, a ZOC diagram indicating only 'U' values should not be added to the chart, as it would not include any information of use to the mariner.

The assessment of hydrographic data quality and classification into zones is based on a combination of:

- Date of Surveys
- Position accuracy,
- Depth accuracy, and
- Sea floor coverage (certainty of significant feature detection).

Where a charted survey is supplemented by occasional soundings from a less accurate source, only the main survey should normally be categorized.

The higher ZOC categories, A1 and A2, demand full sea floor ensonification or sweep and require very high accuracy standards which have only been achievable with the technology available since about 1980. Therefore many sea lanes which have been regarded as adequately surveyed may carry a ZOC B classification. Modern surveys of critical areas can be expected to carry ZOC A2 classification while ZOC A1 will cover only those areas surveyed under exceptionally stringent conditions for very special reasons.

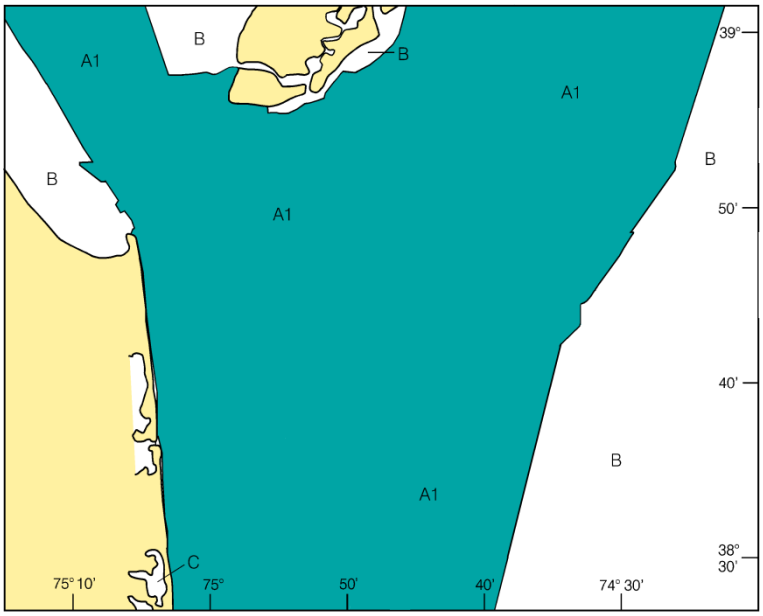
Additional categories to those listed in S-57 may be added to ZOC diagrams for paper charts, e.g.:

> **Maintained Depth** (abbreviation MD) and **Dredged Area** (abbreviation DA). Such areas often do not accurately indicate actual depths, but do indicate minimum depths at the time of dredging.
>
> **Unsurveyed** (abbreviation UNS): this should be evident from the face of the chart, but may also be indicated on the ZOC Diagram. **The date of a survey may be important,** particularly in areas of mobile or unstable sea floor. The survey date may be inserted in parentheses against the ZOC value on the face of the diagram. To avoid too complex a diagram, dates of surveys may be grouped; or a suitable note added to the relevant portion of the chart, rather than complicating the diagram.
>
> **After disaster surveys**. As a result of some disasters, such as: earthquakes, tsunamis, hurricanes, it is possible that large areas of seafloor have moved and/or become cluttered with dangerous obstructions. Emergency surveys may be conducted to cover essential shipping routes and inside harbors. Outside these surveyed areas, much of the existing charted detail may then be considered suspect, however good the previous surveys may have been. Depending on the circumstances, MCD in consultation with MCD may opt to degrade the CATZOC value until the area can be resurveyed.

If additional emphasis is required for after disaster surveys, the newly surveyed area may be highlighted on the Source or ZOC diagram with tint. The tint should be grey but may be another color except green, blue or magenta. On ZOC diagrams, the areas of bathymetry outside the re-surveyed area must be reclassified; usually category ‘D’ will be appropriate, as large depth anomalies and new obstructions may now be expected.

The "Authorities" note shall not be used in lieu of a ZOC diagram. Graphic and textual specifications for source diagrams are detailed in the following paragraphs. A typical ZOC diagram and table is shown in Figure 4-3.

## ZOC DIAGRAM




Border lineweight – 0.2mm

Projection Tick 0.15mm line, 2mm long

Outside Border Dimensions 78.8 x 797.7mm
(for chart with neatlines 797.7mm x 996.1mm)

## ZOC TABLE

| ZOC CATEGORIES (Refer to Chapter 1, United States Coast Pilot) | | | | |
|---|---|---|---|---|
| ZOC | DATE | POSITION ACCURACY | DEPTH ACCURACY | SEAFLOOR COVERAGE |
| A1 | 2010 - 2015 | ± 16.40ft | = 1.64ft + 1%d | All significant seafloor features detected. |
| A2 | 2007 - 2011 | ± 65.62ft | = 3.28ft + 2%d | All significant seafloor features detected. |
| B | 1953 - 1998 | ± 164.04ft | = 3.28ft + 2%d | Uncharted features hazardous to surface navigation are not expected but may exist. |
| C | 1921-1922 | ± 1640.42ft | = 6.56ft + 2%d | Depth anomalies may be expected. |
| D | 1899-1901 | Worse than ZOC C | Worse than ZOC C | Large depth anomalies may be expected. |
| U | Unassessed - The quality of the bathymetric data has yet to be assessed. | | | |

**Figure 4-3**

a. Specifications of Graphics

The overall linear dimensions of the graphic shall be one-tenth of the chart's neatline dimensions. A 0.2 mm black outline shall be used for the diagram's border. The normal coastline (0.2 mm, black) shall be shown within the diagram with all land areas tinted gold. The survey area limits

shall be shown by a solid black 0.15 mm line. Identifying letters or references shall be placed in the approximate center of the survey area in 7 pt. Swiss Light.

A screened 25 percent blue tint fill shall be used to identify areas of 100 percent bottom coverage. All other water areas shall be white.

Survey limits shall not be delineated in areas where hydrography is not charted. The limits of large scale charts may be delineated and survey limits omitted within the larger scale chart outlines, in source diagrams shown on charts smaller than 1:100, 000 scale. An alpha identifier, in 7 pt. Swiss Light, shall be placed in the approximate center of each outlined larger scale chart. The outline of large scale charts may be used only in congested areas in source diagrams for charts at 1:100,000 scale and larger. The limits of surveys conducted by USACE in maintained channel shall not be included in ZOC diagrams. USACE surveys covering large areas shall be delineated.

The minimum sized feature on a ZOC diagram shall be the size of a 0.3MM circle. A leader shall be used to connect an alpha identifier with the corresponding minimum size outline.

Projection ticks 2.0 mm in length, 0.15 mm line weight, shall be shown along the inside border and labeled in 6 pt. Swiss Light. The intervals of these ticks shall be such that each projection line on the base chart is represented by a tick on the diagram. Preferred placement of the ticks and labels is along the east and south limits of the diagram. Shoreline and survey limit lines shall be broken for labels and ticks. The projection value labels on the base chart shall be used as a guide for labeling the ticks on the ZOC diagram. For example, if the label on the base chart included degrees and minutes then degrees and minutes shall be used on the diagram (see Figure 4-1).

For charts with insets or extensions: the inset shall be shown in the diagram if it is of substantially larger scale (at least four times larger than the base chart) and the area is covered by more than two surveys. If the area within the inset is covered by one or two surveys only, the diagram for the base chart is sufficient. Extensions shall always be shown in the diagram. The inset or extension limits shall be shown by a 0.2 mm line similar to the diagram border. Procedures for adding graduation ticks and values to insets and extensions are the same as for the base diagram.

b. Specifications of Text

Textual information for ZOC diagrams shall be arranged in tabular form and placed below the graphic as shown in Figure 4-3 The table is outlined by the same 0.2 mm border as the graphic. The heading shall be in 7 pt. Neue Helvetica type. All other text shall be in 6 pt. Neue Helvetica.

Due to limited space it may be necessary to eliminate some of the fields in the table. If that is the case then the cartographer may eliminate the column for Position Accuracy. If space is still limited then the column for Depth Accuracy may be eliminated.