



INTERNATIONAL HYDROGRAPHIC ORGANIZATION
NATIONAL REPORT FROM UNITED STATES TO THE
ARHC-08

Submitted by:



National Oceanographic & Atmospheric Administration
<http://www.nauticalcharts.noaa.gov>



National Geospatial-Intelligence Agency
<http://msi.nga.mil/NGAPortal/MSI.portal>



United States Navy
<http://www.navmetocom.navy.mil>

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¹ Based on “Structure for National Reports to Regional Hydrographic Commissions.” See http://iho.int/mtg_docs/rhc/templates/Struct_NationalReports_Eng.pdf

1. HYDROGRAPHIC OFFICE/SERVICE

This National Report provides specific information pertaining to individual products and services of primary interest to the Arctic Regional Hydrographic Commission (ARHC). Four government agencies are responsible for the management of U.S. domestic and international hydrographic products, services, and maintenance.

1.1 Government Agencies with hydrographic responsibilities in the Arctic Region

- 1.1.1 National Oceanic and Atmospheric Administration's (NOAA)² conducts hydrographic surveys and produces nautical charts and related hydrographic information within the nation's Economic Exclusion Zone (EEZ).
- 1.1.2 National Geospatial-Intelligence Agency (NGA)³ provides nautical charts and related hydrographic information and is the mapping and charting authority for the U.S. Department of Defense (DOD) and commercial mariners in areas outside the U.S. where the U.S. is the designated charting authority.
- 1.1.3 The U.S. Navy⁴ conducts oceanographic, bathymetric, and hydrographic surveys worldwide to satisfy DOD and national security requirements.
- 1.1.4 The United States Coast Guard (USCG)⁵ provides multifaceted SOLAS support with the responsibility of care and maintenance of maritime aids to navigation used for nautical charting, publishing Local Notice to Mariners for hazard avoidance, search and rescue, security, and ice operations in the Arctic. Coast Guard District 17 serves the US Arctic.⁶

For more information on NOAA, NGA, and NAVY hydrographic activities, see [IHO Publication 5](#).

1.2 United States Strategies for the Arctic

The U.S. envisions an Arctic that is stable and free of conflict, where nations act responsibly in a spirit of trust and cooperation. We have implemented a strategic approach to the Arctic Region, outlined by a national strategy that focuses on three lines of effort: advance U.S. security interest, pursue responsible Arctic region stewardship, and strengthen international cooperation. The Implementation Plan for the National Strategy for the Arctic Region⁷, the Department of Defense

² Primarily the Office of Coast Survey

³ Primarily Source Operations and Management Directorate, Foundation Group, Maritime Safety Office (MSO).

⁴ Primarily, Commander, Naval Meteorology and Oceanography Command (COMNAVMETOPCOM) and the Hydrographer of the Navy

⁵ Primarily, United States Coast Guard, District 17

⁶ <https://www.pacificarea.uscg.mil/Our-Organization/District-17/>

⁷ National Strategy for the Arctic Region. (2013). Retrieved from https://obamawhitehouse.archives.gov/sites/default/files/docs/nat_arctic_strategy.pdf

Arctic Strategy⁸, the U.S. Coast Guard Arctic Strategy⁹, the U.S. Navy Arctic Roadmap (2014-2030)¹⁰, and the National Oceanic and Atmospheric Administration Arctic Action Plan¹¹ are the primary guidelines for the regional strategy. These documents acknowledge the importance of international partnerships in addressing common challenges.

1.3 United States Open Data Policy – Managing Information as an Asset

Access to data and services, usable to the public, can help fuel entrepreneurship, innovation, and scientific discovery – all of which improve lives and contribute significantly to job creation¹² is the foundation of the [U.S. Open data policy](#). The open data policy has led to the public availability of hydrographic data, products, and services produced by U.S. Hydrographic Offices (HO's) for data downloads at no cost.

2. SURVEYS

2.1 Surveys in U.S. Waters

NOAA provides nautical charts and related hydrographic information for the safe and efficient navigation of maritime commerce as well as providing basic data for engineering, scientific, and other commercial and industrial activities within the nation's 3.4 million square nautical mile EEZ ([US EEZ](#)) and along its 95,000 miles of shoreline.

NOAA is in the process of re-defining how hydrographic survey plans are generated to and survey priorities are identified in federal waters. NOAA hydrographic in-house field units or external contractors then conduct surveys to meet these priorities. Data acquired from these surveys must meet the NOS Hydrographic Surveys Specifications and Deliverables¹³, an annually updated data specification guide.

The main component of the new hydrographic survey priorities method is the hydrographic health model. The hydrographic health model is a model based on the idea of navigational risk. Navigational risk is the product of the likelihood of an adverse event and the consequence of that event occurring. The model incorporates likelihood parameters such as traffic density, known hazards to navigation, and reported ship groundings to estimate the likelihood of an adverse event. To estimate the consequence of an adverse event, the model incorporates parameters such as proximity to search and rescue stations, proximity to reefs or marine sanctuaries. The model also considers the necessary quality of data to support modern traffic relative to what is currently available, explicitly recognizing that the seafloor changes over time. Seafloor changeability takes into account the frequency of storms, current speed, and accumulation of marine debris, where the quality of data in highly changeable areas decreases faster than the quality of

⁸ Department of Defense Arctic Strategy. (2013). Retrieved from http://www.defense.gov/Portals/1/Documents/pubs/2013_Arctic_Strategy.pdf

⁹ U.S. Coast Guard Arctic Strategy. (2013). Retrieved from https://www.uscg.mil/Portals/0/Strategy/cg_arctic_strategy.pdf

¹⁰ U.S. Navy Arctic Roadmap (2014 – 2030). (2014) Retrieved from http://www.navy.mil/docs/USN_arctic_roadmap.pdf

¹¹ National Oceanic and Atmospheric Administration Arctic Action Plan. (2014).

https://www.afsc.noaa.gov/Publications/misc_pdf/NOAAarcticactionplan2014.pdf

¹² Open Data Policy-Managing Information as an Asset. (2013). Retrieved from <https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2013/m-13-13.pdf>

¹³ Current version is 2018, <https://nauticalcharts.noaa.gov/publications/docs/standards-and-requirements/specs/hssd-2018.pdf>

data in less changeable areas. Using historic knowledge of seafloor changeability, the model can also approximate the future quality of survey data and assess how often an area needs resurveying.

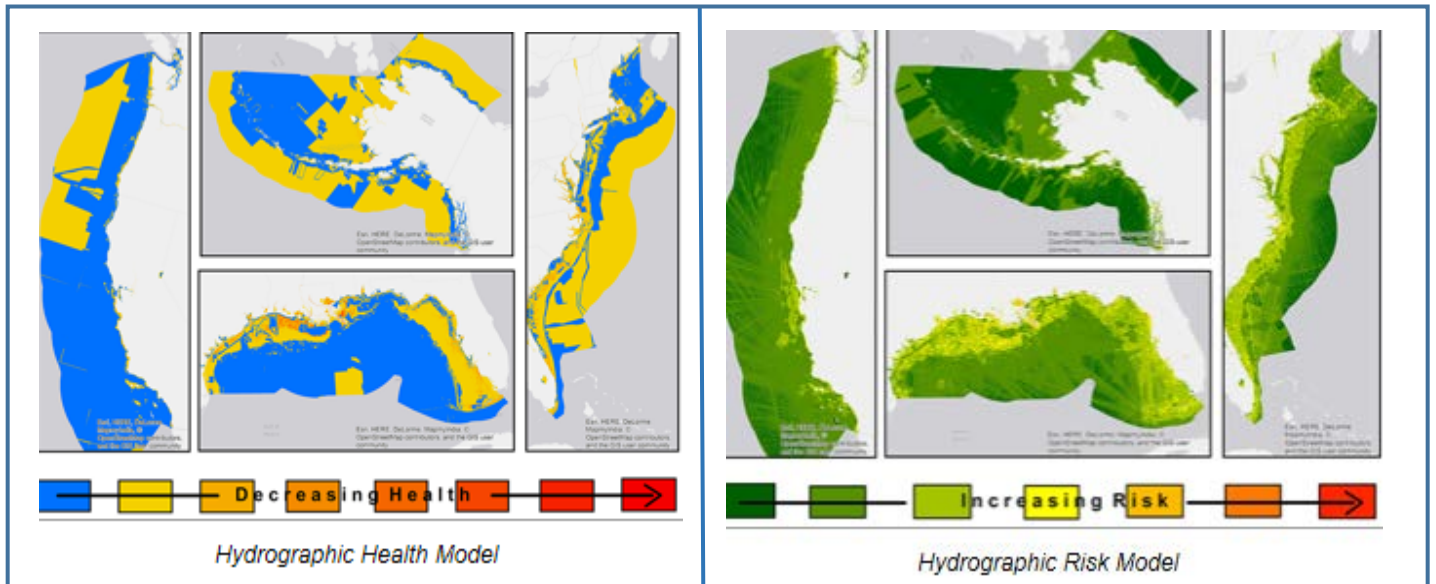


Figure 1: Hydrographic Health and Risk Conceptualization

The results of this model are available online in a geographic information system (GIS) interface and summarized in an annual report made available on the internet in FY18. Current information about the model and survey prioritization can be found at: <https://nauticalcharts.noaa.gov/publications/national-hydrographic-survey-priorities.html>

FY 18 Survey Plan Highlights for ARHC region

- OPR-S347-FA-18, Point Hope and Vicinity (NOAA)
 Planned project dates: June 2018- August 2018
 Planned days at sea: 53
 Area: approx. 565 square nautical miles

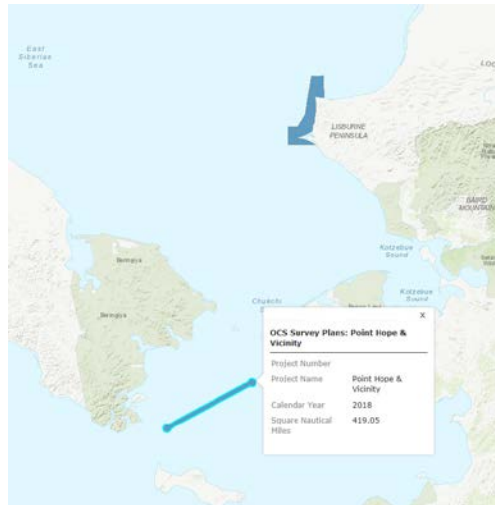


Figure 3: Point Hope and Vicinity (shown in the vicinity of 65.70258N, 169.023408W)

- OPR-P377-RA-18, Morzhovoi Bay (NOAA)
 - Planned project dates: May – June 2018
 - Planned days at sea: TBD
 - Area: approx. 141 square nautical miles



Figure 4: Morzhovoi Bay (shown in the vicinity of 54.997257N, 163.026046W)

2.2 Surveys outside U.S. Waters

The U.S. Navy surveys waters outside the United States and in the territorial waters of other nations through diplomatic channels and international agreements. Hydrographic data and information from

surveys conducted in territorial waters are surveyed by collaboration between the U.S. and the Host Nation.

2.3 U.S Hydrographic Survey Platforms

National Oceanic and Atmospheric Administration (NOAA)

NOAA survey platforms include six 28-foot survey boats, a research vessel, a LIDAR-capable aircraft, and private contractors and the following ships: [NOAA ship *Fairweather*](#), [NOAA Ship *Rainier*](#), [NOAA Ship *Thomas Jefferson*](#), and [NOAA Ship *Ferdinand R. Hassler*](#).

Additional information on NOAA's hydrographic vessels can be found online at:

<https://nauticalcharts.noaa.gov/about/survey-vessels.html>

U.S. NAVY

The Naval Oceanographic Office (NAVOCEANO), a subordinate command of the Naval Meteorology and Oceanography Command COMNAVMETOCOM, currently has [six Pathfinder Class](#) 100-meter multi-purpose survey ships to conduct oceanographic, bathymetric, and hydrographic surveys in deep-ocean and coastal waters. Each ship carries two 10-meter hydrographic survey launches (HSLs).

NAVOCEANO also maintains the Airborne Coastal Survey (ACS) capability with the Optech, Inc., Coastal Zone Mapping and Imaging LIDAR (CZMIL) system. The system is flown on a Basler BT-67, a refurbished DC-3.

NAVOCEANO's subordinate command, Fleet Survey Team (FST), employs various small craft for survey including two 9 meter Workskiff with amidships transducer moon pools and two Sea Arks, fitted with multi-beam and rapid littoral survey vehicles (RLSVs) which are personal water crafts fitted with a single beam echo sounder and side scan sonar. All FST craft can be transported aboard C-130 aircraft for rapid deployment. FST also maintains a year round stand by Fly-Away Team consisting of four personnel and survey gear to outfit boats of opportunity. This capability is used to address standard Navy survey requirements, but has also been employed to ensure clear approach corridors in support of humanitarian aid and disaster relief.

NAVOCEANO's survey ships, ACS aircraft, and FST have all been utilized in the past to conduct cooperative hydrographic surveys through Memoranda of Agreements (MOA) with countries in the region.

3 NEW CHARTS AND UPDATES

3.1 National Charting Plan (NCP)

On November 1, 2017, NOAA released the National Charting Plan¹⁴, a strategy to improve NOAA

¹⁴ National Charting Plan. (2017). <https://www.nauticalcharts.noaa.gov/mcd/docs/NationalChartingPlan.pdf>

nautical chart coverage, products, and distribution. It describes the evolving state of marine navigation and nautical chart production, and outlines actions that will provide the customer with a suite of products that are more useful, up-to-date, and safer for navigation. It is not a plan for the maintenance of individual charts, but a strategy to improve all charts.

3.2 U.S. Arctic Nautical Charting Plan (2016)

The U.S. Arctic Nautical Charting Plan (2016)¹⁵ provides information about existing, recently added, and proposed new raster (paper) charts and ENC coverage in U.S. Arctic waters. The plan consists of existing ENC coverage shown in a series of graphics depicting the extent of different navigational purpose (or scale) bands. The NOAA currently maintains 1,181 ENCs in U.S. domestic waters and 308 (figure 5) in waters in an around Alaska and, the plan provides information regarding 15 new or proposed charts in U.S. Arctic waters. Recently added and newly proposed ENC coverage is based on existing or proposed raster chart footprints. The final extent and display scale of the ENCs may vary slightly from their corresponding raster chart counterparts. The primary purpose of the plan is to improve new chart coverage in the Arctic based on feedback from stakeholders regarding scales and extents.

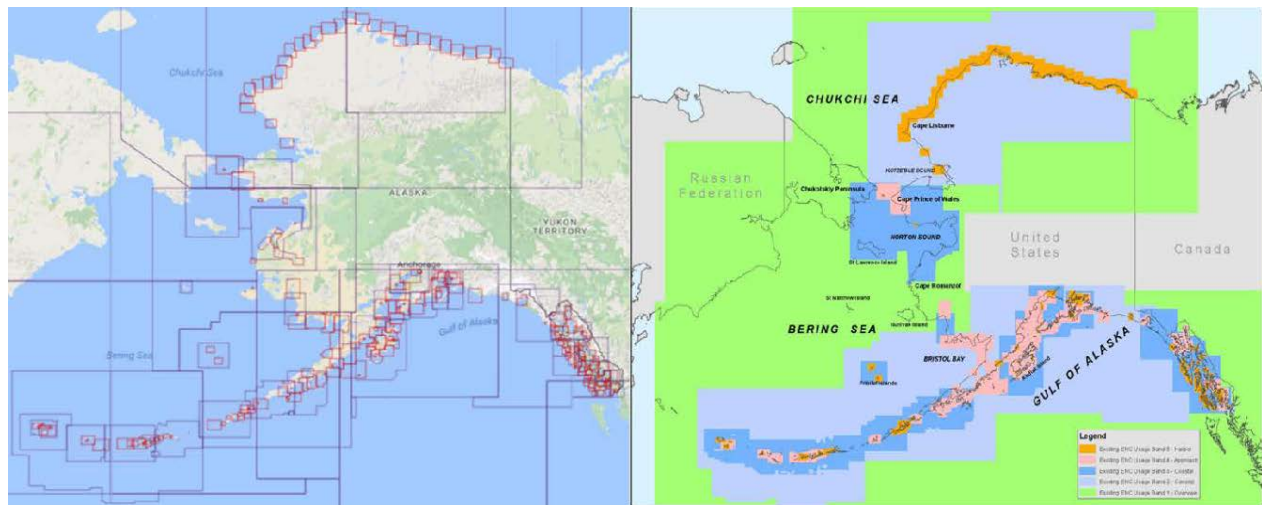


Figure 5: Existing 308 ENC's in Alaska (U.S. Arctic Charting Plan, 2016)

3.4 Raster Navigational Charts (RNC) & Electronic Navigational Charts (ENC) Distribution

NOAA provides nautical products, services, and web deliveries of digital versions of most data, which are available free to the public.

For access to survey data: <http://www.nauticalcharts.noaa.gov/hsd/hydrog.htm>

For access to RNC Charts: <https://nauticalcharts.noaa.gov/charts/noaa-raster-charts.html>

For access to ENC Charts: <https://nauticalcharts.noaa.gov/charts/noaa-enc.html>

For access to the Coast Pilot: <https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html>

¹⁵ U.S. Arctic Nautical Charting Plan: <https://nauticalcharts.noaa.gov/publications/docs/arctic-nautical-charting-plan.pdf>

NOAA produces 51 RNC and ENC charts in the area of Atlantic Ocean and Great Lakes. NOAA also produces several other charts in the Pacific Ocean and the Arctic that lie within the USCHC region. As of April 2014, NOAA no longer produces lithographic paper charts with traditional print cycles for new editions. All paper charts are updated weekly and available for download as Print-on-Demand (POD) products, or in paper form from one of 17 NOAA-certified chart-printing agents. (See Annex A for NOAA certified chart printing agents).

U.S. ENCs are available as free downloads from the internet. Mariners who wish to download NOAA ENCs directly and use the data to fuel ECDIS or ECS may do so. ENCs, including newly created NGA ENCs, are distributed directly from NOAA on the web at www.nauticalcharts.noaa.gov. They are also available through the International Center for ENC's Distributors, <http://www.ic-enc.org/Distribution.html>.

3.5 Digital Nautical Chart (DNC)

The U.S. produces many DNCs in the ARHC waters. The DNC, produced by the National Geospatial-Intelligence Agency (NGA), is an unclassified, vector-based, digital database containing maritime significant features essential for safe marine navigation.

The DNC uses the Vector Product Format, which is a NATO standard for digital military map and chart data. Additional details can be located at <http://msi.nga.mil/NGAPortal/DNC.portal>.

DNC consists of libraries in a variety of scales for complete worldwide coverage. Arctic data is included in DNC regions 19, 20, 21, 22, 27, and 28. See coverage below.

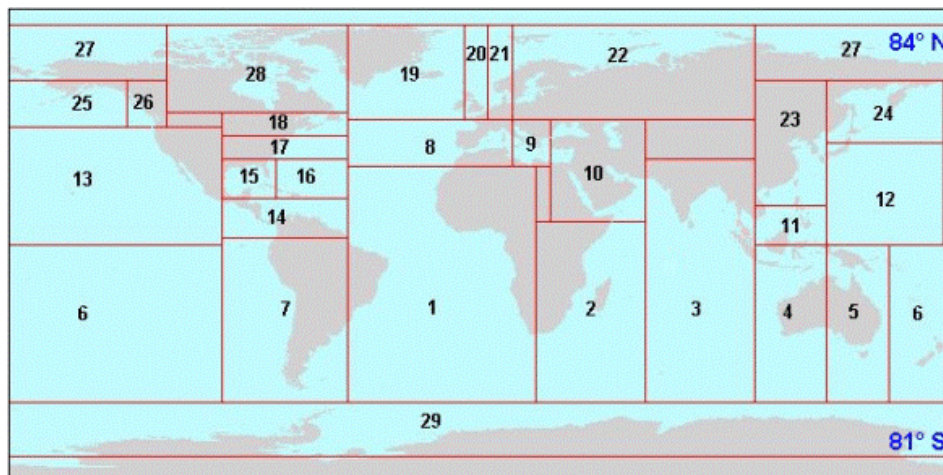


Figure 6: DNC Worldwide Coverage

DNC libraries are maintained with new source information from the U.S. and primary charting authorities (host nations). DNC libraries are considered Limited Distribution products and are not available for public sale or download except for those that are within U.S. territorial waters

or in areas where source data restrictions allow them to be released. However, DNC data is shared with host nations for coverage in their territorial waters through formal bilateral exchange agreements.

For requests regarding DNC data, please contact maritime.international@nga.mil

3.6 Raster Navigational Charts (RNC)

The NOAA RNC® are geo-referenced, digital images of NOAA navigational charts. Because the images are geo-referenced, the end user can display a vessel's position on the chart image if a computer-based navigation system is connected to a global positioning system (GPS). RNCs, developed under the IHO S-61 product specification, are unique to NOAA. NGA does not produce RNCs.

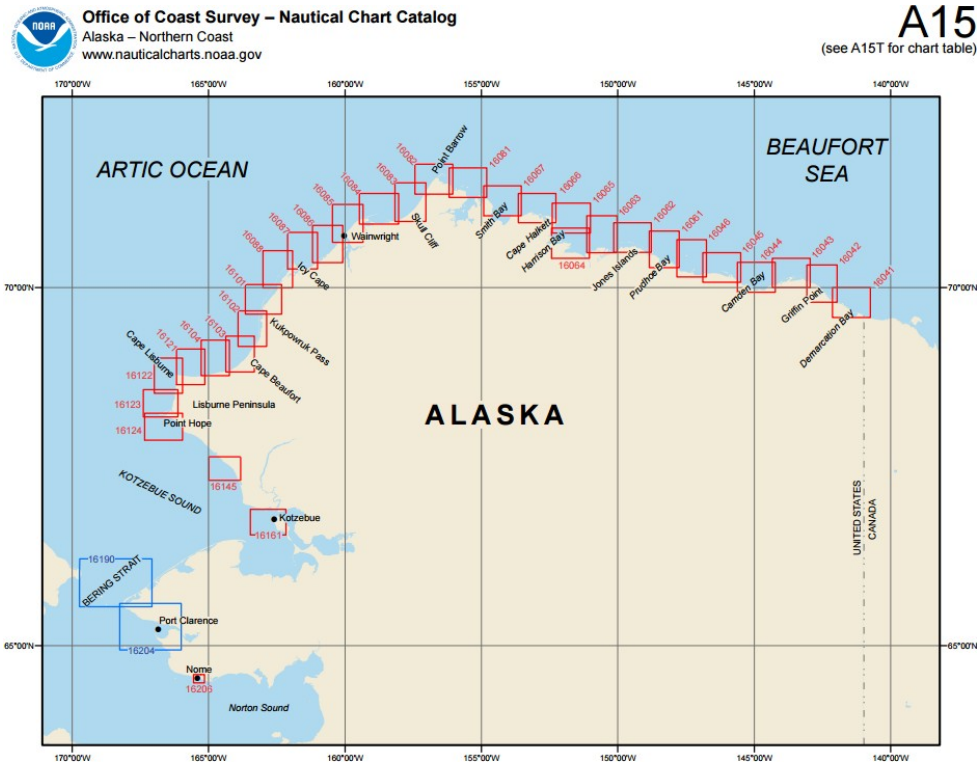


Figure 7: Alaskan RNC Catalog

Shown above is a graphic of the Alaskan RNC catalog, a printer friendly version of the Alaska RNC catalog is at: <http://charts.noaa.gov/ChartCatalog/webimages/pdf/AlaskaCatalog.pdf>

U.S. RNCs are downloadable from a list at <http://www.charts.noaa.gov/RNCs/RNCs.shtml> or through the Coast Survey's Nautical Products Catalog at <http://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml>

3.7 International (INC) Charts

The U.S. does not produce INT charts but does offer “INT Chart Equivalents.” Contributions to the S-11 Region N (Edition 2.0.0 September 2013) coordinated with and provided to Norway as the ARHC

INT Chart Coordinator. NGA does not share INT chart responsibility within the ARHC region. However, NGA does build its chart schemes and DNC library limits from these INT schemes, if practical.

4 NEW PUBLICATIONS AND UPDATES

4.1 New Publications

None for comment.

4.2 Updated Publications

The American Practical Navigator, first published in 1802 describes in detail the principles and factors of navigation, including piloting, electronic navigation, celestial navigation, mathematics, safety, oceanography and meteorology. It also contains various tables used in typical navigational calculations and solutions, including the formulas used to derive the tabular data. The 2017 edition of the American Practical Navigator returns to a two-volume format, which can be downloaded as complete PDF documents from the following website:

https://msi.nga.mil/NGAPortal/MSI.portal?nfpb=true&pageLabel=msi_portal_page_62&pubCode=0002

The following publications are continuously updated in accordance with SOLAS:

- The **United States Coast Pilot** consists of a series of nine regionally- focused nautical books that offer a variety of useful information important to navigators for coastal and intra-coastal waters and the U.S. Great Lakes. For the ARHC region, Coast Pilot 9 covers Alaska (35th ed., 2017). U.S. Coast Pilot now offers completely updated publications every week. U.S. Coast Pilots can be downloaded at: <https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html>
- Produced and maintained by NGA, **Sailing Directions** consists of useful information important to navigators of coastal waters. Information for the ARHC region is contained in Publications 145 – Nova Scotia and the St. Lawrence, 146 – Newfoundland, Labrador, and Hudson Bay, 181 – Greenland and Iceland, 182 – North and West Coasts of Norway, and 183 – North Coast of Russia. Digital updates can be downloaded from NGA at <http://msi.nga.mil/NGAPortal/MSI.portal>.
- **World Port Index (Pub150)** is a publication maintained by NGA. It contains the location and physical characteristics as well as the facilities and services offered by major ports and terminals worldwide. Digital updates are available to the public and posted at the NGA Maritime Safety website, at <http://msi.nga.mil/NGAPortal/MSI.portal>.
- The **NGA List of Lights, Radio Aids and Fog Signals** and their digital updates are available to the public and posted at the NGA Maritime Safety website, at <http://msi.nga.mil/NGAPortal/MSI.portal>. Publications 110 – Greenland, the East Coasts of North and South America, 111 – The West Coasts of North and South America, and 115– Norway, Iceland, and Arctic Ocean cover the ARHC region.

5 MARITIME SAFETY INFORMATION (MSI)

Existing infrastructure for transmission

Maritime Safety Information (MSI) is navigational and meteorological warnings, meteorological forecasts and other urgent safety-related messages broadcast to ships in accordance with the International Convention for the Safety of Life at Sea, 1974, as amended. One component of MSI is the U.S. Notice to Mariners, which provides timely information for the correction of all U.S. Government navigation charts and publications from a wide variety of sources, both foreign and domestic. Information published in Notice to Mariners provides for the correction of unclassified nautical charts, the unclassified NGA/DLIS Catalog of Hydrographic Products, United States Coast Pilots, NGA List of Lights, U.S. Coast Guard (USCG) Light Lists, and other related nautical publications produced by NGA, National Ocean Service (NOS), and the USCG.

Notice to Mariners

The U.S. Coast Guard issues Local Notices to Mariners for NOAA charts, while NGA issues Notices to Mariners for NGA charts in the ARHC region.

Local Notice to Mariners are updated weekly and available for download in several formats. U.S. Coast Guard District 17 is responsible for publishing Notice to Mariners in the Arctic Region and notices are available at: <https://www.navcen.uscg.gov/?pageName=lnmDistrict®ion=17> . Additional information about U.S. Coast Guard District 17 can be found at <https://www.pacificarea.uscg.mil/Our-Organization/District-17/>.

The U.S. Notice to Mariners are posted at the NGA Maritime Safety website at <http://msi.nga.mil/NGAPortal/MSI.portal> .

Navigation Warnings

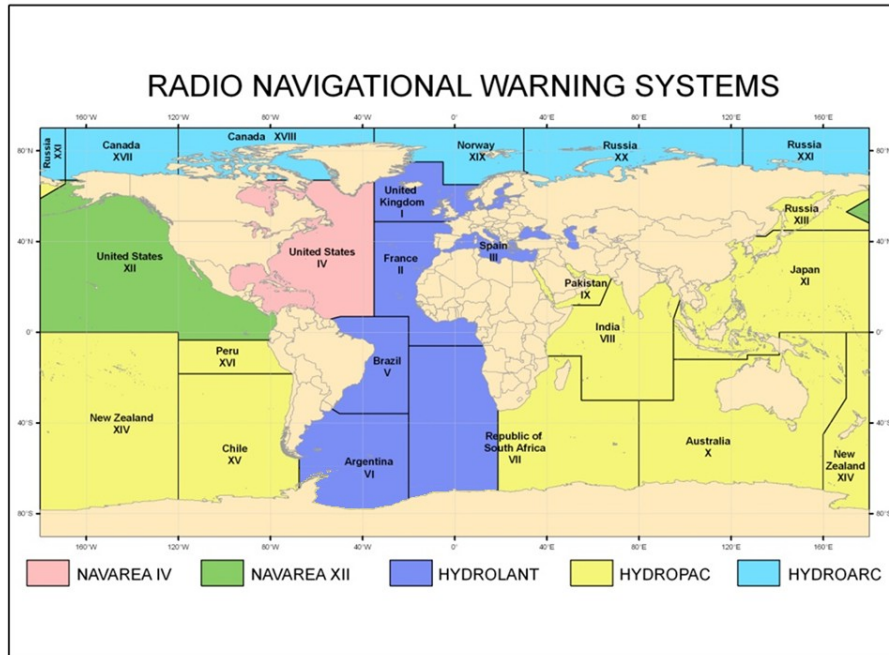


Figure 1: Radio Navigational Warning Systems

As the NAVAREA IV and XII Coordinator, NGA issues the navigational warnings for these areas and are broadcast and uploaded to <http://msi.nga.mil/NGAPortal/MSI.portal>. NGA requests the assistance of all member states within these two NAVAREA regions to relay pertinent maritime safety information for promulgation to navsafety@nga.mil.

The International Maritime Organization has designated NAVTEX as the primary means for transmitting coastal urgent marine safety for instantly distributing maritime navigational warnings, weather forecasts and warnings, search and rescue notices and similar information to ships worldwide. Eleven NAVTEX stations are operational in NAVAREA IV and XII and is broadcasted from Coast Guard facilities in Cape Cod, Chesapeake VA, Savannah GA, Miami FL, New Orleans LA, San Juan PR, Cambria CA, Pt. Reyes CA, Astoria OR, Kodiak AK, Honolulu HI, and Guam. The broadcast coverage area for NAVTEX stations vary between 200 and 500 nautical miles from shore.

The NAVAREA coordinator is the authority charged with coordinating, collating and issuing navigational warnings for a designated NAVAREA within the IMO/IHO World-Wide Navigational Warning Service (WWNWS) (see figure below).

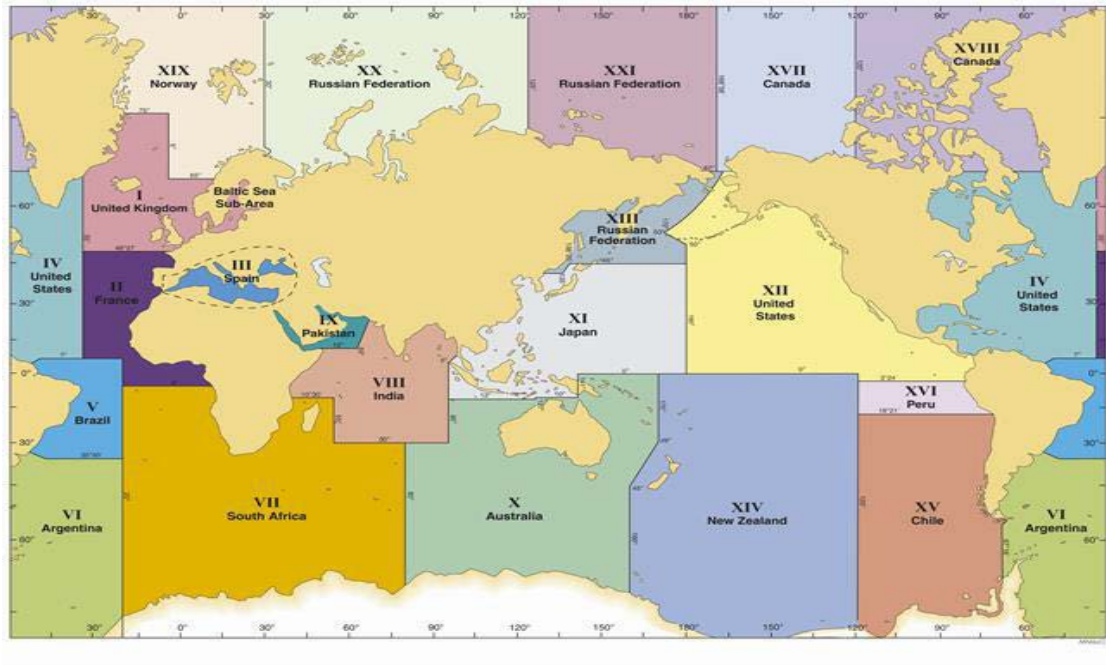


Figure 2: NAVAREAS for coordinating and promulgating navigational warnings under the World-Wide Navigational Warning Service

6. C-55¹⁶

The aim of IHO Publication C-55 is to present a clear picture of the worldwide coverage of surveys and nautical charts and of the extent of effective organizations for the timely promulgation of navigational safety information. The following tables outline the survey and nautical chart coverage in the U.S.

6.1 Hydrographic Coverage Available:

Area: U.S INT Region N – Alaska and Arctic (including Aleutian Islands) (N)¹⁷

	A	B	C
Depths < 200m	18%	28%	54%
Depths > 200m	0%	0%	100%

Table 1: Hydrographic Coverage, Area U.S. INT Region N

¹⁶ Source: March 2018 IHO U.S. C-55. https://www.iho.int/iho_pubs/CB/C-55/c55.pdf

¹⁷ Ibid. page 491. Area is defined by the total hydrographic survey coverage available where A = adequately surveyed, B = Re-survey required, and C = never systematically surveyed.

6.2 Nautical Chart Coverage Available:

U.S. INT Region N – Alaska and Arctic (including Aleutian Islands) (N)¹⁸

	A*	B*	C*
Offshore Passage	100%	100%	100%
Landfall and Coastal Passage	100%	100%	97%
Approaches and Ports	100%	100%	100%

Table 2: Nautical Chart Coverage, U.S. INT Region N

¹⁸ Ibid. page 492.

7. CAPACITY BUILDING

7.1 Offer of and/or Demand for Capacity Building

The United States is an active participant in the IHO Capacity Building Sub-Committee (CBSC). The US (NGA) directly supports the IHO Maritime Safety Information (MSI) training course as well as provides support to nations through on site and remote guidance and advice as they grow their hydrographic capacity.

7.2 Training offered

Training opportunities are available at various institutions in the United States. Two Category A certified hydrographic programs are available through:

- The University of Southern Mississippi (USM)¹⁹
- The University of New Hampshire (UNH)²⁰
- NGA

Category-B Competence Training for Nautical Cartography - The National Geospatial-Intelligence Agency (NGA) commenced training with an IHO/ICA/FIG IBSC approved portable S-8 Category B Nautical Cartography class in 2017. NGA teamed up with IIC Technologies to provide training to analysts with a comprehensive 20-week instructor led course and a six-week final project. Each session will run for one to three weeks at a time over the course of two years. The pilot session started in June 2017 in Springfield, VA and consists of 10 students. The second session started in St. Louis, MO in January 2018, also with 10 students. A combination of lectures, hands-on compilation techniques, and homework assignments will prepare the students for the final project, the creation of a finished ENC product for NGA users. NGA plans on adding several additional sessions throughout the next several years

- NOAA

Category-B Competence Training for Nautical Cartography -- In March, 2017 the IBSC approved the NOAA program for Category B in Cartography. The first class started the end of August 2017 and has 11 NOAA cartographers as the first class. In late 2018, the first foreign national student arrived and is now participating in this one year competence training program.

Capt. Andrew Armstrong, NOAA (ret.), NOAA co-director of the Joint Hydrographic Center at UNH, is a member of the FIG/IHO/ICA International Board on Standards of Competence

¹⁹ <https://www.usm.edu/marine/hydrographic-science>

²⁰ <https://marine.unh.edu/program/center-coastal-and-ocean-mappingjoint-hydrographic-center>

for Hydrographic Surveyors and Nautical Cartographers. As a member of the board, Capt. Armstrong is available to advise institutions on establishing hydrographic training curricula and preparing submissions to the International Board for Category A or Category B recognition. (andy.armstrong@noaa.gov).

Chart Adequacy Workshop
NOAA's Office of Coast Survey hosts an annual week-long workshop on nautical chart adequacy assessment for approximately one dozen students from around the world. The participants receive training in techniques to evaluate the suitability of nautical chart products using chart quality assessment techniques with publicly available information. The fourth annual workshop is scheduled to take place in mid-2018 in Silver Spring, MD. For more information, please contact Dr. Shachak Peeri (shachak.peeri@noaa.gov).

- NAVY

COMNAVMETOCOM and USM are partners in their Category A program and NOAA has a similar arrangement with UNH for their Category A program.

COMNAVMETOCOM also offers a six-month category B International Hydrographic Management and Engineering Program and mobile training via its Naval Meteorology and Oceanography Professional Development Center in Gulfport, Mississippi.

COMNAVMETOCOM's Category A and B programs and mobile training also qualify for Security Cooperation assistance.

8. OCEANOGRAPHIC ACTIVITIES

8.1 General Bathymetric Chart of the Oceans and Seabed 2030

The United States participates on the IOC-IHO Guiding Committee for GEBCO, and hosts the IHO Data Centre for Digital Bathymetry at NOAA's National Centers for Environmental Information (NCEI) (formerly the National Geophysical Data Center, NGDC).

NOAA distributes the International Bathymetric Chart of the Arctic Ocean (IBCAO) digital grid at <http://www.ibcao.org/>. The goal of this initiative is to develop a digital database that contains all available bathymetric data north of 64° north, for use by mapmakers, researchers, institutions, and others whose work requires a detailed and accurate knowledge of the depth and the shape of the Arctic seabed. Initiated in 1997, this undertaking has so far engaged the volunteer efforts of investigators who are affiliated with 24 institutions in 10 countries. ARHC members (Canada, Denmark, Norway, Russia, and the U.S.A) contribute to this initiative, as does the ARHC observer member state Iceland.

At the 33rd meeting of the GEBCO Guiding Committee, the Seabed 2030 Project was approved. [Seabed 2030](#) sets the goal of collecting, using and sharing, data of the world's oceans. The project seeks to encourage the data collectors and data managers of governmental, academic and private

interests to work together to improve the quality of publicly available grids of the ocean floor.

This project is focused on the goal of compiling a high-resolution, openly available, Digital Bathymetric Model (DBM). This DBM should efficiently provide bathymetric information to end users and leave no features of the World Ocean floor smaller than 100 m unmapped by the completion of the program. The Seabed 2030 project has great potential to create partnerships and cooperation between interested parties, significantly improving our understanding of the sea floor and empower sustainable ocean management in the coming century.

8.2 Crowdsourced Bathymetry

Crowdsourced bathymetric data can be used to identify areas where nautical charts are inadequate and proper hydrographic surveys are needed or can be applied to nautical charts when the source and uncertainties of the data are well understood. The key to successful CSB efforts are volunteer observers who operate vessels-of-opportunity in places where charts are poor or where the seafloor is changeable and hydrographic assets are not easily available.

The NOAA provides financial support for the IHO-initiated project to develop a global database for crowdsourced bathymetry hosted by the IHO Data Centre for Digital Bathymetry (IHO DCDB). The IHO DCDB, co-located with NOAA's National Centers for Environmental Information (NCEI), is building the infrastructure necessary to provide archiving, discovery, display and retrieval of global crowdsourced bathymetry data from mariners around the world. The online database can be found at https://maps.ngdc.noaa.gov/viewers/iho_dcdb/.

NOAA is also coordinating with the Association of Arctic Expedition Cruise Operators (AECO) to ingest Arctic data to test the new system. The vision is to tap into the enthusiasm for mapping the ocean floor by enabling trusted mariners to easily contribute data to fill the gaps in our current bathymetric coverage. NOAA and NGA are active participants in the IHO Crowd-Sourced Bathymetry Working Group (CSBWG), and together, with other CSBWG members, they are compiling a CSB Guidance Document for layman mariners who wish to contribute data to the IHO DCDB. This document will provide volunteer collectors with information about CSB, the installation and use of CSB data loggers, data quality issues, and instructions for submitting the data to the IHO data repository.

9. OTHER ACTIVITIES

9.1 Native Outreach: Alaska Region

NOAA's Office of Coast Survey has been in years past and continues to build relationships with local communities and subsistence hunting groups to ensure that traditional knowledge is harnessed and conflict avoidance is ensured. NOAA recognizes that native Alaskans contribute a wealth of hunting, fishing and gathering knowledge to the region as well as key information about navigable waters in local areas. Below is a map that outlines some of the native entities in Alaska.



Figure 3: Native Entities in Alaska

In 2010, NOAA Ship *Fairweather* conducted a bathymetric survey on the eastern side of the International Dateline. This survey was preceded by extensive outreach to the village located on Little Diomedede Island. The outreach included contacting the village elders, the native corporation, the village government, and the borough government. Prior to beginning any work in the area, representatives from the ship went to the village and provided a brief of the anticipated activities. During the operations, ship personnel continually updated the village representatives of anticipated schedules. One evening the village hosted the shipboard personnel to visit the island of Little Diomedede and had a celebration with traditional song and dance. Prior to departure from the area, the ship reciprocated and hosted 12 representatives from the village for lunch and a tour of the vessel. This model carried on through subsequent years of high arctic operations for bathymetric surveying activities.

In following years, additional outreach and communications were sought. During the winter, the Alaska Eskimo Whaling Commission meets regularly to discuss best practices and policies associated with subsistence hunting of the Bowhead Whales that migrate through the Chukchi and Beaufort Seas in Spring and Fall. NOAA has been reaching out to this community to ensure a transparent plan of operations and planning so de-confliction of the waterways is made possible for all users.

In 2015, the Arctic Waterways Safety Committee (formerly the Alaska Marine Mammal Coalition) was formed to bring all maritime operators, subsistence hunters, and oil and gas companies to a discussion about operations and hunting activities. The purpose of this meeting is to identify voluntary programs that all users can agree on to de-conflict the arctic waterways of

the Chukchi and Beaufort Seas. This group has come up with a draft Standard of Care²¹ for Research Vessels. This document is a notification plan for the vessel operators to maintain a transparent plan for conducting operations in the US high arctic. The Standard of Care calls for a brief to occur at the Alaska Eskimo Whaling commission advising the planned operations one year prior to commencing. Additionally, this plan would be communicated at that Arctic Waterways Safety Committee. Prior to entering within 30 nautical miles of a whaling village, 50 nautical miles of Barrow, and 12 nautical miles of the rest of the coast, notification would take place to village and regional leaders to ensure conflict avoidance. Finally, research results and findings would then be shared with the local communities at the following Alaska Eskimo Whaling Commission mini convention in the winter.

This model of communication and notification is dynamic and continues to be refined through trust and commitment from our agency and the other research groups operating in the US arctic Region.

9.2 Proposed Route through the Bering Strait and Bering Sea

At the 99th Session of the IMO Maritime Safety Committee in London in 2018, the IMO approved a joint proposal by the Russian Federation and the United States, with concurrence from Italy and Finland. The proposal²² establishes six two-way routes and six precautionary areas in the Bering Sea and Bering Strait off the coast of Chukotskiy Peninsula and Alaska. The joint proposal derived from the U.S. Coast Guard's Bering Strait Port Access Route Study²³, which assessed the need to create new vessel routing measures in the Arctic Region. The application of this approval is set for December 1, 2018 and is the first internationally recognized measure for navigation in the Arctic Region.

The U.S. and Russian proposal adopted by the IMO divides the route into a system of 6 two-way routes separated by precautionary areas (a precautionary area is a place along the route where ships should navigate with caution).

²¹ Arctic Waterways Safety Committee, Standard of Care, 2017.
<http://nebula.wsimg.com/3f6e3c7518e6de0f4b323a47884e6748?AccessKeyId=4913A243119CE1325FB9&disposition=0&alloworigin=1>

²² https://www.navcen.uscg.gov/pdf/IMO/NCSR_5_3_7.pdf

²³ https://www.navcen.uscg.gov/pdf/PARS/Bering_Strait_PARS_General.pdf



Figure 11: Bering Sea and Bering Strait Routing Measures

Arctic's First Routing Measures Will Improve Safety, Environmental Protection (Image credit: Pew Charitable Trusts)

9.3 Marine Spatial Data Infrastructures (MSDI) Progress

9.2.1 International

The International Hydrographic Organization Data Centre for Digital Bathymetry (IHO DCDB) was established in 1988 to steward worldwide bathymetric data on behalf of the IHO Member States. The Centre provides long term archive of and access to single and multibeam deep and shallow water ocean depths contributed by a range of mariners. The IHO DCDB welcomes bathymetric data and metadata, accepts descriptions and spatial footprints of data that is already online and of data that are not publicly available to provide easy search and discovery. Information can be obtained at <https://www.ngdc.noaa.gov/iho/>.

The U.S. holds active roles in supporting the work of several international MSDI-focused working groups:

- IHO MSDIWG
- UN-GGIM Marine Geospatial Information Working Group (MGIWG)
- Open Geospatial Consortium Marine Domain Working Group (Marine DWG)

9.2.2 National Marine Spatial Data Infrastructures (MSDI) Progress

The Federal Geospatial Data Committee (FGDC) is an organized structure of federal geospatial professionals that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the United States federal government. FGDC works collaboratively with federal, state, tribal, and local governments, non-Federal collaborates, communities, constituents, and professional bodies providing the enabling foundation of standards, data catalogs, partnerships, and tools that make up the National SDI (NSDI). For more information visit: <https://www.fgdc.gov/>.

Related to MSDI in the U.S., “MarineCadastr.gov is an integrated marine information system that provides data, tools, and technical support for ocean and Great Lakes planning.” The team for MarineCadastr.gov continually works “to increase access to data through data and map services. The services are designed to deliver data without replication and directly from the source.” MarineCadastr.gov supports complementary efforts: Digital Coast, Data.gov, and Geoplatform.gov (a FGDC initiative). For more information: <https://marinecadastre.gov/>

Additionally, several U.S.-regional initiatives exist that further develop MSDI within the country:

- Mid-Atlantic Ocean Data Portal (<http://portal.midatlanticocean.org/>)
- Northeast Ocean Data Portal (<https://www.northeastoceanandata.org/>).

NGA manages a public Arctic Support Website²⁴ to support coordination in the Arctic Region. The site hosts webmaps, webservices, map viewers, DEM (Digital Elevation Model) exploratory tools, nautical charts, sailing directions, infographics, and a downloadable Pan-Arctic map with mission-specific data layers. The webpage offers open data for download in several commonly used, geospatial formats for use in GIS applications. The DEMs displayed on the site are the result of the ArcticDEM project. The models was created after a 2015 executive order calling for enhanced coordination of national efforts in the Arctic.

²⁴ <https://nga.maps.arcgis.com/apps/MapSeries/index.html?appid=cf2fba21df7540fb981f8836f2a97e25>

ANNEX A

NOAA CERTIFIED RASTER CHART (PAPER CHART) PRINTERS

Company	Phone Number	Additional Services*
The Copy Shop	770-682-6600	
Frugal Navigator	509-426-4472	FO
Weilbach A/S	+45 33 34 35 60	
Marine Press	514-866-8342	UO
Eagle Enterprises Safety Solutions	800-478-2331	
Bluewater Books & Charts	954-763-6533	WP
Richardson's Maptech (Edgewater Marine Ind., LLC)	508-990-9020	WP
East End Blueprint and Reprographics Services, LLC	631-726-2583	
Pacific Publishers	912-472-4373	WP
TrakMaps	1-877-861-8725	WP
My Nautical Chart	401-499-3842	
The Map Shop	800-532-6675	WP, BC, UO
OceanGrafix	877-562-4278	WP, UO, FO, BC
Map House	Coming Soon	
Maritime Services Ltd.	888-387-8667	
Stanfords	+44 (0)20 7836 1321	
Milwaukee Map Service, Inc. (Meacham Enterprises)	800-525-3822	
East View Geospatial	877-856-6705	BC, FO, UO, WP
William & Heintz Map Corporation	800-338-6228	FO
Captains Charts – Tiger Printing Group, LLC	215-799-0500	UO, WP
Hyannis Marina	508-790-4000 x 2	
Paradise Cay Publications	707-822-9063	WP, FO, BC
Datema Nautical Safety	+31 (0)596 63 52 52	
Granville Printing	203-254-3090	

Additional Services:

Book Chart (BC), Folio Charts (FO), User Overlays (UO), Waterproof Charts (WP)

ANNEX B

US IHO Representation (2018)

Acronym	Name	NGA Rep.	NOAA Rep.	NAVY Rep.
IRCC	Inter-Regional Coordination Committee	Keith Dominic	John Nyberg	Stanley Harvey
HSSC	Hydrographic Services and Standards Committee	Albert Armstrong	Dr. Neil Weston	Rodney Ladner
S-100WG	S-100 Working Group	Josh Clayton	Julia Powell Janice Eisenberg	David Brazier
ENCWG	S-101 ENC (S-101) Working Group	Eric Lee	Megan Bartlett	
S-102 subWG	S-102 Sub Working Group	TBD	Janice Eisenberg	
ENCWG (S-101)	ENC	Albert Armstrong	Megan Bartlett	
NIPWG	Nautical Information Provision	Mike Kushla	Tom Loeper	
NCWG	Nautical Cartography	Sean McGurgan	Colby Harmon	
DQWG	Data Quality	Chris Petrof	Sean Legeer	
MSDIWG	Marine Spatial Data Infrastructure	Sebastian Carisio	Patrick Keown	
TWLCWG	Tides & Water Levels and Surface Currents	Doug Roush	Kurt Hess/Peter Stone	
HDWG	Hydrographic Dictionary	TBD	NA	
ABLOS	Advisory Board on Law of the Sea	John Lowell	Leyland Snyder	
WWNWS	World Wide Navigational Warning Service	Chris Janus	NA	
CBSC	Capacity Building Sub-Committee		TBD	Calvin Martin
WEND	World Wide ENC Database	Gerry Walter	John Nyberg	
IBSC	Int'l Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers		Andy Armstrong	
GEBCO	General Bathymetric Charts of the Ocean	James Ford	Andy Armstrong	Ray Sawyer
CSBWG	Crowd Sourced Bathymetry Working Group		Jennifer Jencks	
SCRUM	GEBCO Sub Committee on regional undersea mapping	James Ford		
SCUFN	GEBCO Sub Committee on Undersea Feature Names	Trent Palmer		