14th MEETING OF THE IHO INTER-REGIONAL COORDINATING COMMITTEE
IHO-IRCC14
Denpasar - Bali, Indonesia, 6-9 June 2022

ARCTIC REGIONAL HYDROGRAPHIC COMMISSION

ARHC report to IRCC14

1. Chair

Chair: Dr. Geneviève Béchard, CA from 2021-11-10

Vice-Chair: Mrs. Pia Dahl Højgaard, DK from 2021-11-10

2. Membership

Full Members: Canada, Denmark, Norway, Russian Federation, United States of America

Associate Members: Finland, Iceland, Italy

Observers: IHO Secretariat

3. Meetings:

Following ARHC meetings have taken place:

11th Meeting – VTC hosted by CA 9-10 November 2021

Next meeting: 12th ARHC 12-16 September 2022 in St. John's, Newfoundland and Labrador, CANADA

Arctic Grid Project Team VTC – January 5th 2022

ARHC IHO Strategic Plan Project Team VTC – February 11th 2022

4. Current ARHC Working Groups:

a) ARHC Marine Spatial Data Infrastructure Working Group (ARMSDIWG)
b) Operations and Technology Working Group (OTWG)
c) Arctic International Charting Coordination Working Group (AICCWG)

5. Status of IRCC actions and recommendations to RHCs

a) Status of actions relevant to ARHC:

Actions	ARHC Status
IRCC13 Action 6: RHCs and WGs to include the measurement of the SPI attributed by IRCC in their annual Work Plans (Permanent).	To be discussed under ARHC-11 Agenda Item D1 (see Agenda Items below)

b) Status of Recommendations to RHCs:

Recommendations	ARHC Status
IRCC13 Recommendation 2: RHCs to recommend Member States to Note the information on ECDIS anomalies and support the implementation of the recommendations given by the ENCWG.	Complete. MS informed. See: *ARHC11-A4c Recommendations from IRCC13* *See IHO CL 40 2021 "Possible ECDIS Display Anomalies after ENC Update Procedure"*[1]
IRCC13 Recommendation 3: RHC and MS to advise the IHO Secretariat of any update/change to their position in relation with the CSB questionnaire (IHO CL 21/2020)	Complete. MS informed. See: *ARHC11-A4c Recommendations from IRCC13*
IRCC13 Recommendation 4: RHC to identify regional coordinators to act as a point of contact for CSB/Seabed 2030 and to raise the profile of data gather and provision within their respective Region.	Complete. Evert Flier (NO) is ARHC regional coordinator for CSB & SB2030
IRCC13 Recommendation 5: RHC to encourage MS to participate in the Empowering Women in Hydrography project.	Complete. MS informed. See: *ARHC11-A4c Recommendations from IRCC13* *See: CL 35 2021*[2]*, NOAA OCS letter supporting the project*[3]
IRCC13 Recommendation 6. RHC to encourage MS to submit Articles and Notes for publication in the IHR.	Complete. MS informed. See: *ARHC11-A4c Recommendations from IRCC13*
IRCC13 Recommendation 7. RHCs to consider extend the role of Charting Regional Coordinators for the implementation of the S-100 Implementation Roadmap.	To be discussed under ARHC11 Agenda Item D4 ARHC WG TOR.
IRCC13 Recommendation 8. RHCs to try to plan at least one face-to-face meeting between the 2nd and the 3rd Session of the IHO Assembly.	Planned ARHC-12 (Sept 13-15, 2022) in St. John's, Newfoundland and Labrador, Canada (CA)
IRCC13 Recommendation 9. RHCs to coordinate the efforts on the implementation of S-100 and promote the cooperation and exchange of experiences.	To be discussed under ARHC11 Agenda Item D4 ARHC WG TOR.
IRCC13 Recommendation 10: RHCs to apply Resolution 1/2005 in case of disasters occurred to support the affected States in their regions.	To be discussed under ARHC11 Agenda Item D4 ARHC WG TOR.

[1] https://iho.int/uploads/user/circular_letters/eng_2021/CL40_2021_EN_v1.pdf

[2] https://iho.int/uploads/user/circular_letters/eng_2021/CL35_2021_EN_v1.pdf
https://iho.int/uploads/user/circular_letters/eng_2021/CL20_EN_2021_v1.pdf

[3] https://iho.int/uploads/user/Inter-Regional%20Coordination/IRCC/IRCC12/IRCC12-06D.2_2020_NOAA_Support_EWH.pdf

IRCC13 Recommendation 11: RHCs to invite relevant Member States to report to the IMO Secretariat and the Chair of the EGC Coordinating Panel on the progress and status of implementation of newly recognized mobile satellite services by MSI providers.	Complete. MS informed. See: *ARHC11-A4c Recommendations from IRCC13*
IRCC13 Recommendation 14: RHCs to encourage all Member States to actively contribute with new data to GEBCO and to discuss how MS can share existing data.	Ongoing And further addressed in context of ARHC-11 Agenda Item C4
IRCC13 Recommendation 15: Encourage RHCs and relevant Bodies to contribute to the recommendations provided by Shell to increase the cooperation between HO's and Natural source Regulators and reduce permitting requirements for transits through countries EEZ's.	Ongoing And further addressed in context of ARHC-11 Agenda Item C4

6. Agenda Items:

The following documents from ARHC11 are available from the ARHC web page:
Agenda
List of Participants
Summary Report
IHO Bulletin Report

Highlights from the Agenda

6.1 ARHC Statutes

After a two-year effort involving all ARHC Member States, ARHC approved Edition 3.0 of the ARHC Statutes by a majority vote. The statutes can be found here on the ARHC web site and they came into effect on 2021-11-10.

This revision, in addition to general edits and standardizing the language in the document, allows for greater flexibility in the conduct of business. In addition, more comprehensive definitions were added and the process for associate membership was clarified. The new edition of the Statutes reflect the strong desire of the ARHC to remain a collegial and dynamic group.

6.2 ARHC-PAME MOU It was discussed how the recently endorsed MOU with the Arctic Council's Working Group on the Protection of the Arctic Marine Environment (PAME) could be put into action to produce meaningful results for both PAME and ARHC.

6.3 IHO Report

The IHO Secretary-General provided a report that highlighted three overarching themes: a. the continued development of the S-100 ecosystem; the implementation of the IHO Strategic Plan; and, the standing up of the IHO-Singapore Innovation and Technology Laboratory aka "The Lab". All of these items were revisited throughout the meeting.

6.4 National Reports

The National Reports from the attending Full and Associate Members were presented and provided great insight to the activities and plans in the region. Selected items from the National Reports can be found

in Annex A of this Report.

6.4 International Charting Coordination

The Arctic International Charting Coordination Working Group (AICCWG) reported that all outstanding instances of overlaps, or potential overlaps between ENC's in the region have now been successfully resolved by the producing nations.

Building on a report sponsored by CA on the options of a pan-Arctic ENC schema, ARHC discussed possible next steps. It was concluded that new project team be established to focus on this subject. This PT did meet virtually and a statement of work was developed for more in-depth investigation. A contract was let for this work, and the results, delivered on 31 March 2022, are still being evaluated however work has continued on testing real ENC data with each of the scheme options and a demonstration website for sample grids is being developed. This work will continue and outcomes will be discussed at the next ARHC meeting. The IHO Secretariat noted that there could be a positive intersection of this proposed ARHC work and the work of the WENDWG project team on S-101 Scheming Guidelines.

6.5 Marine Spatial Data Infrastructure

The Chair of the ARHC Marine Spatial Data Infrastructure Working Group (ARMSDIWG) reported on the highlights of the group's activities for the past five years and a the reassessment of the WG's work plan based on that experience and the emerging trends and technologies in the MSDI domain. Proposed changes to the WG's TOR, which are more reflective of the current situation were approved by the ARHC.

ARHC MS and this working group have been quite engaged in MSDI, however the ARMSDIWG report did make the following statement:
"***The truth today is that an Arctic user still does not currently have a central or common way to find authoritative Arctic marine spatial data from ARHC's HOs, nor do they have a total set (i.e. gaps in coverage) of usable web services available to them for the majority of themes they've asked for in various studies and surveys***".
To this end, ARMSDIWG pushed ARHC to continue to work towards a truly federated Arctic MSDI and to consider adopting the MSDI Aggregated Data Web Service Checklist for the ARHC as a standard mechanism to report annually the progress towards individual HO provisioning of data web services to support an Arctic federated MSDI approach in response to the various user-driven activities identified by ARHC MS. The recently initiated Federated-MSDI Pilot organized by OGC will be an opportunity to demonstrate applied technologies along with the practical use of OGC and IHO standards through Marine SDI. This project builds upon the foundation of the OGC-IHO MSDI Concept Development Study (CDS) that included the participation of several ARMSDIWG member organizations.

6.5a UN-GGIM IGIF-Hydro

(US-NOAA) introduced this topic by giving a high-level summary of the Integrated Geospatial Information Framework (IGIF) that continues to develop under the auspices of the UN initiative on global geospatial information management (UN-GGIM)
Anchored by nine Strategic Pathways, the IGIF is a mechanism for articulating and demonstrating national leadership in geospatial information, and the capacity to take positive steps. As the Framework is adopted, it will reduce institutional barriers that currently hinder the exchange and use of geospatial information that could contribute to the achievement of the UN Sustainable Development Goals (SDGs).
The Working Group on Marine Geospatial Information (WG-MGI) is developing the Operational Framework for Integrated Marine Geospatial Information Management (also known as IGIF- Hydro or IGIF-H) to ensure alignment between the land and sea data frameworks.
The IGIF-H document has two parts. Part 1 contains background, challenges, and a value proposition for the marine domain. Part 2 is broken down by IGIF Strategic Pathways for the water domain. The

scope of IGIF-H includes oceans, seas, rivers, waterways/watercourses, lakes inland waters, wetlands, glaciers, etc.
The next steps in the IGIF-H development include worldwide workshops for each pathway. A briefing (MACHC) and a workshop (BSHC) have already been planned.
It was noted that the WG-MGI works closely with the MSDIWG and ARMSDIWG and, indeed, there are many of the same people involved. Naturally, the ARMSDIWG will be looking at the challenges from the Arctic perspective. The advantage of these close ties is that efforts will not be duplicated and experiences (e.g. OGC Arctic SDI project) can be shared.

6.6 Operational and Technical Issues

The report of the Operational and Technical Working Group (OTWG) noted that the ARHC hydrographic/chart adequacy risk assessment was last completed in 2018 and the next iteration is scheduled for 2023. To this end, a call for updated bathymetric data to ARHC MS will be made early in 2022. It is hoped that data from the PAME/Arctic Council Arctic Ship Traffic Data (ASTD) database can be used in this latest assessment.
A call was issued to ARHC members for interest in collaborative mapping missions in which remote systems could be tested and where collective successes and lessons learned could be compiled into a comprehensive report. MS were requested to consider whether or not they would be interested in such an endeavor.

6.7 GEBCO and Seabed 2030

The ARHC GEBCO and Seabed 2030 Coordinator in their report reminded the participants that worldwide efforts to improve bathymetry data is largely reliant on volunteer efforts. They went on to highlight the intersection of GEBCO and Seabed 2030 activities with the UN Sustainable Development Goal (SDG) 14 –Life below water – target to "Increase scientific knowledge, research, and technology for ocean health" and the outcomes of the UN Decade of Ocean Science for Sustainable Development (the Ocean Decade) that will lead to "the Ocean We Want".

Much of the seafloor with the geographic area of the ARHC (Region N) is poorly mapped and that using existing mapping technologies, improving the global ocean coverage will be a decades-long and expensive process, that will be demanding in terms of human resources, material resources e.g. ships, and will leave a significant carbon footprint. To this end, the employment of new techniques and new technologies e.g. unscrewed survey vessels (USVs) which offer long endurance, low [environmental] impact (LELI) will greatly aid in making significant progress in ocean mapping.
Creating partnerships and agreements to facilitate third-party data collection, also known as crowd-sourced bathymetry (CSB), and ease of access to this data will also greatly accelerate coverage. The hydrographic community and hydrographic offices must become more accepting of data from these sources and recognize its value beyond just for navigation purposes.

6.8 ARHC Implementation of the IHO Strategic Plan

At ARHC11 the way forward with respect to the implementation of the IHO Strategic Plan (SP) was discussed. After an introduction of the topic and a discussion led by US-USN, it was decided to follow the approach taken first taken by led the South-West Pacific Hydrographic Commission (SWPHC).
A small project team was established and through the early months of 2022 a gap analysis was completed and a report prepared. The compilation of these results can be found in Annex B of this report.

The report generated a great deal of discussion and there are many unanswered questions that should be addressed both internally by the Commission, and in conjunction with the IRCC and the IHO Secretariat. In addition, the analysis recommended a number of actions, listed in the Annex of that report. These will be discussed at the next ARHC meeting and may form the basis of the Commission's work plan in the coming years.

Most ARHC MS participated in one or both of the IRCC workshops on the IHO Strategic Plan. These were very useful to the work of the Commission as it performed its own gap analysis.

7. ARHC cooperation with stakeholders:

Protection of the Arctic Marine Environment (PAME) of the Arctic Council -see Sec 6.2 .

Open Geospatial Consortium (OGC) -see Sec 6.5 .

8. Difficulties and challenges:

One of the largest challenges for the WG and the ARHC will be finding enough human and technical resources to push these efforts forward; that is, from the aspirational to the operational.

The lack of a face-to-face meeting since 2019 has dampened some of the activities of the Commission and it is hoped that the easing of COVID-related restrictions will see engagement rise back to pre-pandemic levels.

9. Achievements and lessons learned:

Three of the key achievements during this period were:

a) The approval of the new edition of the ARHC Statutes;
b) The completion of the first ARHC IHO SP gap analysis; and,
c) The delivery of the pan-Arctic Arctic ENC Schema report.

10. Conclusions:

Some of the key activities of the ARHC in the coming year will include:

a) Continued work towards a pan-Arctic ENC scheme;
b) The update of the ARHC hydrographic/chart adequacy risk assessment;
c) Further implementation of the IHO Strategic Plan; and,
d) Work towards a federated Arctic MSDI.

11. Actions required of IRCC:

The IRCC is invited to:

a. Note this report

ANNEX A

SELECTED HIGHLIGHTS FROM ARHC11 NATIONAL REPORTS

CA reported that in 2021 32,000 km^2 of data was collected which included data from 2 contracted surveys with USVs deployed. All five of the permanent tide gauges in the Arctic had been visited and serviced in 2021, a task that was delayed from previous years due to the pandemic. Over the past 5 years of the Ocean Protection Plan (OPP) the following results have been achieved:

- Increase of approx. 4% of modern and adequate bathymetric coverage within Canada's Arctic NORDREG Area over the course of OPP.
- ~15.8% of the navigable waterways within Arctic's NORDREG area surveyed to modern or adequate standards (CATZOC A1, A2 and B).
- ~42% of the Proposed Primary and Secondary Low Impact Shipping Corridors surveyed to same standard, key aspect of CHS strategy to focus survey and charting efforts in the Canadian Arctic.
- Estimate of the km^2 increase over the 5 years = ~147,000 km^2 (*This is a complete estimate and includes data from other sources and legacy data loaded.)

The Department of National Defence (DND) reported that the new Royal Canadian Navy (RCN) ship – Arctic Offshore Patrol Vessel (AOPV) class- *HMCS Harry DeWolf* completed a Northwest Passage transit in 2021. This was the first transit of those waters by a RCN ship since 1956.
With the continued surveying activities in the CA Arctic, the gaps in ENC coverage are being filled and by March 2022, the entire Northwest Passage will be covered by ENCs for the first time. CA is further developing a gridded ENC schema in the Arctic and is interested in working with other Arctic partners on this implementation.
CA will continue to focus survey assets on shipping corridors in order to expand ENC coverage, at the same time leveraging trusted sources for crowd-soured bathymetry (CSB) and remotes sensing technologies to supplement traditional survey data.
For non-navigation (NONNA) purposes, CHS 100m and 10m (approximate resolution) bathymetric products. See https://data.chs-shc.ca/login for more details.

DK reported on the reorganizing of the agency and preparing of a new strategy. Denmark identified they needed a longer term strategy which will be focusing on the quality assessment and the distribution of their data with the sincere hope that their data will benefit society as a whole. For the organization, this means a shift from product focus to data focus.
This mission divided into three main goals for the hydrographic office:

- Provide modern basis for safe navigation by supplying our maritime users with up to date products and services.
- Create a framework for increased utilization of depth data, which can be used in several contexts while also being easily accessible to themselves and their users.
- Provide easily accessible and reliable hydrographic and marine data for the benefit of users and to support the green transition of the Blue Denmark.

These goals have defined focus areas: Efficient production; new technologies for depth data collection; accessible and targeted data and products for maritime users; coordination and collaboration of marine data; integration of S-100; and, a long term finance model.

IHO Assistant Director Yves Guillam noted that when hydrographic offices (HOs) are considering ENC re-scheming, they should do so in consultation with the WENDWG project team on S-101 Scheming Guidelines.

NO is mid-way through its 'Marine Base Map' pilot project for coastal zones. NHS leads the project and has partnered with the Geological Survey of Norway (NGU) and Institute of Marine Research (HI). The aim of the project, which hopefully lead to a programme in 2023, is to establish a national authoritative foundational data set that is free and accessible for all aspects of marine spatial planning. If the programme is endorsed, the goal is to have 68 datasets supported by data from 16 agencies and organizations. It has been noted that trustworthy, free, and accessible datasets are key to uptake and the programme success. A pending report is expected to indicate that there is 6:1 expected return on investment for the marine base maps.

NO has a Geodata Act (i.e. a law) to support the authoritative nature of digital data, e.g. Marine Base Maps, as well as a national Geodata Strategy and a Digital Agenda. NHS is the national Geodata coordinator.

Geodata act/law.

NO noted the expanded use of the FAIR (findable, accessible, interoperable, reusable) principles for evaluating datasets. For each dataset in the national infrastructure is rated against the principles. The Mareano Status Register dashboard was shown as an example of what this looks like. Each dataset is rated against the FAIR principles as well as several other requirements from the national geographical infrastructure.

There has also been much progress in NO on the standardization and digitalization of port data. The Port Data 2020 project goal is to make it easy to share and update port data through common national infrastructure for spatial information. In response to a question from ARHC11, NO expressed the intention of aligning Port Data with S-131, at some point.

The concepts of the Norwegian Nautilus programme were highlighted. Nautilus is to ensure the reception, management, and dissemination of high-resolution depth data and other hydrographic data to all users. Nautilus 2022 – 2026 is planned to take 5 years to complete, and will cost 12 million euros, funded from national budget. It will focus on organizational and technological changes to meet user requirements and expectations.

US reported on its survey activities in the Arctic, its continues use of USVs in the region, and the Northwest Passage transit of the *USCG Cutter Healy*. NOAA has embarked on a complete re-scheming of its ENC portfolio. At the same time it is transitioning away from its raster products; a process it hopes to complete by 2025. The transition process also includes crafting an S-101 implementation strategy and the continued development of the NOAA Custom Chart Tool for self-serve paper chart generation.

NGA has begun its transition of Vector Product Format (VPF) Digital Nautical Charts (DNC) to S-57 Electronic Navigation Charts (ENCs), and is working on creating a worldwide ENC grid for use in building it future ENC portfolio and in preparation for S-100 transition.

U.S. approved release of global vessel traffic density data to the public in Fall 2021. Access to this data will be via viewer, link to API, or download and was to be made publicly available via URL within days of this report.

In addition, U.S. announced that it has released its new version of the World Port Index which contains physical characteristics, facilities, and services, major ports and terminals worldwide. It is available as a suite of web-based applications via URL and can be accessed via MSI site: https://msi.nga.mil/Publications/WPI or at: https://nga.maps.arcgis.com/apps/MapSeries/index.html?appid=f9515d53e3e24ae7919f02eb8f554c96

There have been some early discussion on the possibility of a conjunction of the WPI structure and data with S-131.

FI In addition to its written report, Finland provided ARHC11 with specific information on its Arctic Policy, chart production, and the national coordination of the S-100 implementation.
The Strategy for Arctic Policy identifies four priority areas:
-Climate change, mitigation and adaptation
-Inhabitants, promotion of wellbeing and the rights of the Sámi as an indigenous people
-Expertise, livelihoods and leading edge research
-Infrastructure and logistics
To address these priorities engagement and cooperation with organizations such as the Arctic Council, the Barents Euro-Arctic Council, and the Barents Regional Council will be essential.
Examples of infrastructure and logistics include leveraging Finish expertise in developing further exchanges between ships, ports, energy efficiency of logistic systems, advancing communication technology and digital services, opening up information systems, and strengthening the development of shipping infrastructure and nautical charting in the Arctic region by means of hydrographic surveys.
FI has implemented a new nautical chart production system and new editions of ENC corresponding to printed charts were released in 2021. Some ENCs e.g. fairway to Port of Vaasa, have been enriched with more depth information which allows for additional depth contour intervals.
Traficom and the Finnish HO are planning to take actions for raising awareness and improving knowledge about S-100 standards among data producers and service providers in Finland.

IS noted that the Hydrographic and Marine Safety Department is situated within the IS Coast Guard and has 8 full-time staff plus three additional personnel for the survey season.
It was reported that in 2020 GNSS RTK positioning was implemented and this has spawned the requirement for IS to re-establish its height models. This is a multi-agency task.
Surveying has continued in several areas and ports where modern surveying has not been conducted. New charts/ENC will follow. New charts (Reykhólar, Brjánslækur) were published from 2017-2020 surveys which replaced some products which date as far back as 1915. Other new charts and updates (e.g. Reykjavík) are planned.
New harbour plans and new editions are planned as part of the updating of 30 year-old sailing directions. Once completed, almost all active ports will be covered.
Other items reported included: As of June 2021, IS transitioned to print-on-demand (POD) only; HMSD is implementing CARIS BE and BDB systems; IS hopes to become more active with MSDI, particularly as it relates to marine spatial planning; C-55 information from IS will be updated next year; and, MSI activities, e.g. NAVTEX messages, was also reported on.

IT reported on its research and hydrographic activities in the Arctic, including where hydrographic surveys were carried out. The prospects for the High North Campaign programme to be extended is promising. Equally exciting was the news that the IT High North Campaign has been recognized by UNESCO as an official UN Decade of Ocean Science for Sustainable Development (UNDoOS) activity.
In support of the action of the UN Ocean decade with ECOP (Early Carrier Ocean Professional), six young researchers were part of the High North 2021 scientific team.
IT reiterated is data policy for its High North surveys that all the collected hydrographic data will be made available to the Norwegian Hydrographic Service, to the IHO DCDB, to the International Bathymetric Chart of Arctic Ocean (IBCAO) Vers.4.0 and to GEBCO Seabed2030 project. All the hydrographic data were collected and will be shared with the ancillary information in compliance with the IHO standards.

ANNEX B

ARHC – IHO Strategic Plan 2021-2026: GAP Analysis
Date of last edit 2022-03-29 (Ref: IHO Strategic Plan 2021-2026)

GOAL 1	Target	Current State	Gap	Actions
Goal 1: Evolving the hydrographic support for safety and efficiency of maritime navigation, undergoing profound transformation	1.1 Deliver standards for hydrographic data and specifications of hydrographic products; support their regular production; and coordinate regional and global services for their provision 1.2 Develop standards, specifications and guidelines in the areas of data assurance, including cyber security and data quality assessment 1.3 Use capacity building and training to develop and increase the ability of Member States to support safety and efficiency of maritime navigation	**n/a**	**n/a**	**Highlights/observations:** -Most ARHC Member States (MS) are active in IHO bodies which are responsible for the development of standards, specifications, and guidelines for products, services, and data quality. -They work with each other, participate in the IHO WENDWG and/or are members of RENCs in an effort to coordinate the production and the secure delivery of quality national, regional and global products and services. -All MS are capable of supporting safe and efficient navigation in most of their waters, however, in many Arctic areas, there still exist shortcomings in the quality and coverage of hydrographic data. -MS are generally well advanced with respect to their capacities for deliver hydrographic services. Several MS are actively support capacity building (CB) efforts both in terms of the IHO 3-phase CB Strategy and other CB-related projects such as e-learning development and the IHO project on *Empowering Women in Hydrography*. -Training (in-person and on-line) is an ongoing activity in all ARHC MS. -Ultimately, a dashboard indicating the progress of the all SPIs in the Strategic Plan should be developed. -MS are promoting the use of S-xxx to other potential data providers.
Strategic Performance Indicators **1.1.1**	Percentage of Member States having operationalized production and distribution of hydrographic data products and services based on IHO Universal Hydrographic Data Model (S-100), under an implementation framework of coordination and agreed timelines **(2026: 100%)**	**40%**	**60%**	**Highlights/observations:** -This SPI requires a better definition (see Questions below). -Most MS have done some preliminary development on products and services for the 'First Step' noted in the *Roadmap for the S-100 Implementation Decade, Annex 2* plan and most are confident they will achieve this goal. -Not all products/services in the Roadmap fall under the authority of the hydrographic offices. -S-101 ENCs will be the highest priority for all MS HOs. -S-102 (bathymetric surface) production will be targeted for

				selected waterways and areas. -One ARHC MS is regularly producing and distributing S-102 data, and two are producing S-111 (surface currents) data. -Some MS are taking the opportunity to improve/review the content of ENCs e.g. CATZOC, uncertainty values, etc. **ARHC outstanding challenge(s):** -Having adequate coverage with S-100 products/services will be critical to the end users' demand. S-101 alone will not likely be enough to convince users to upgrade their systems. -Not all the specifications in the 'First Step' have been completed and fully tested for production environments. -The implementation of S-128, in particular, needs to be better understood. -The line between route monitoring and route planning can be fuzzy and mariners may demand more those planning product/services prior to 2026. -Dual-fuel and backward/forward conversion issues are still being sorted out. -In most MS, domestic inter-agency coordination and collaboration will be required to deliver the entire suite of the S-100 products/services in the Roadmap. **ARHC outstanding question(s):** -As previously stated, this SPI needs a defined and applied consistently across all MS. For example, the numbers given for the 'Current State' is 40% because 2 of the 5 MS are producing some (2) products/services. Is this meaningful? If all 5 MS produce only S-101, does this constitute 100%? -Does 'operational' mean through a RENC, or does any delivery mechanism count? -How can the SPI be modified to capture the 'package' of First Step S-100 products and services? -How can the aspect of coverage be measured? -Is more than one measure required? -Could the IHO on-line catalogue/INToGIS leveraged to generate these measures? -Can the calculation of this SPI be done automatically? **ARHC outstanding action(s):** -Redefine this SPI. This should be coordinated with other RHCs, MS, and HSSC.

				-MS to report annually on this measure.
1.1.2	Number of hydrographic data products and services based on the Universal Hydrographic Data Model that cater for the new requirements: autonomous shipping, reduction of emissions	**TBD**	**100%**	**Highlights/observations:** -IHO has stood up a MASS project team (PT). Four of five ARHC MS participate on this PT. -S-111 data is available globally at small scale. S-102 is available in selected, dynamic, and high-traffic areas, and S-104 data should become available is similar areas beginning in 2022. -This information should be collected and reported by HSSC. HSSC -It is unclear which subset of the Roadmap elements are tied to autonomous shipping and the reduction of emissions. -SPI 1.1.2 is quite similar to SPI 1.2.1 -HSSC (HSSC12 2021 4.3A) indicates that the 7 product specifications of 'Step 1' should be included in this count. **ARHC outstanding challenge(s):** -The S-xxx products and services required for MASS and the reduction of emissions have not been defined and the timeframe for doing this has not been determined. -MASS will require a massive coordinated approach between many domestic and international entities; this includes regulations. The knowledge and understanding of how this system will work is still developing. -A positive business case for implementing a S-100-based system has not been widely acknowledged. -The amount of HO resources required to support these new products and services remains unknown. **ARHC outstanding question(s):** -How are these requirements to be defined? -Does the 'number' refer to the types of data, e.g. S-101, S-102 etc., or the number of datasets for each type of data? -Can the calculation of this SPI be done automatically? **ARHC outstanding action(s):** -ARHC to begin preliminary work on

				determining which routes in the region may be used by autonomous vessels.
1.2.1	Percentage of hydrographic data products and services based on the S-100 model that are covered by IHO standards, specifications and guidelines on cyber security **(2026: 100%)**	**TBD**	**100%**	**Highlights/observations:** -This information should be collected and reported by HSSC. -For several ARHC MS, the implementation of cyber-security will be done at the RENC/VAR level. -HSSC (HSSC12 2021 4.3A) notes, "7 Product Specifications includes cyber security and data quality assessment". **ARHC outstanding challenge(s):** -Establishing cybersecurity measures on all parts of the value chain, including those outside the control of the HO. **ARHC outstanding question(s):** -Have the cyber-security specifications been finalized? -How is the denominator in this equation calculated? -What is the difference between SPI 1.1.2 and SPI 1.2.1? -Does 'covered' mean that the data [during transfer] is supposed to be encrypted? -Do all S-xxx datasets have to be encrypted? -What if an HO (e.g. US) does not wish to encrypt its products and services? Will this measure for them always be 0%? **ARHC outstanding action(s):** -None
1.2.2	Percentage of navigationally significant areas (e.g. charted traffic separation schemes, anchorages, channels) for which the adequacy of the hydrographic knowledge is assessed through the use of appropriate quality indicators **(2026: 100%)**	**25-100 (TBBD*)**	**75-0**	**Highlights/observations:** -The IRCC direction with respect to this SPI is to, "Derive one estimate figure for the RHC in %" (IRCC CL 01/2021 Annex A). -All MS report that the products that they provide have been assessed for adequacy in some systematic way with quality indicators. -For some areas e.g. CA Arctic and Greenland, many of these products may be at a small (offshore) scale. -These factors lead to a wide range in this SPI. (*TBBD -To be better determined.) -The area (km^2) of navigationally significant areas needs to be calculated for some MS. -For MS with large EEZs in the Arctic like CA and DK, the percentages will not be high, e.g. the EEZ of Greenland is approximately 2 000 000 km^2, and the EEZ can be can include areas permanently covered with ice.

				-US & FI (100%) and NO (90%) are at or very close to this target. -In many areas in the Arctic demand for products is user-driven, so the target may keep moving. -This determination of this measure will be supported by HSSC-DQWG/ENCWG/HSWG-CATZOC/Quality of Bathymetry (HSSC12 2021 4.3A). **ARHC outstanding challenge(s):** -In C-55 the coverage of charts is categorized by usage (i.e. Offshore passage/landfall and coastal passage/approaches and ports) and not by navigational significance. That requires some further data distilling to arrive at this SPI. For example, NOAA does have a "hydrohealth model" that governs its assessment of navigationally significant areas. **ARHC outstanding question(s):** -Could this measure can be considered subset of the SPI 2.2.1? -Are there any areas of the high seas that are considered navigationally significant? -Would the IHO consider adding the layer(s) of navigationally significant areas to INToGIS? This could pave the way to using INToGIS to generate this measure. **ARHC outstanding action(s):** -ARHC to come to a common definition of 'navigationally significant', which also considers the IMO definition, if it exists. -Task OTWG to calculate this SPI based on this definition and using any information e.g. CATZOC already captured in INToGIS, if possible.
1.3.1	Ability and capability of Member States to meet the requirements and delivery phases of the S-100 implementation plan **(2026: 50%)**	**80**	**20**	**Highlights/observations:** -From IRCC, "Derive a figure for each region of the percentage of MS, that are capable to provide S-101 and S-102 products data". -It is assumed that the distinction from SPI 1.1.1 that is being sought by this measure relates to the technical capacity to produce as opposed to actual production and delivery. -Four of the five MS of the ARHC report this ability and capability and are confident about meeting the Roadmap timelines. -Most ARHC MS are active in the IHO bodies working on developing the standards, abilities, and capabilities required meet the Roadmap timelines.

				-References to the *Roadmap for the S-100 Implementation Decade (2020-2030)* should be clear, unambiguous, and consistently applied. For example, this SPI refers to the "delivery phases" of the S-100 implementation, but that phrase does not appear in the document itself. Related, it is suggested the Roadmap document be more readily available and easier to find on the IHO web page. **ARHC outstanding challenge(s):** -As mentioned previously, the production of some of the S-xxx products and services are the remit of the HOs; inter-agency coordination will be needed to meet the requirements. **ARHC outstanding question(s):** -Is S-101 data converted from S-57 considered sufficient or must this be native S-101 production? -How is the element of geographic coverage to be reported or integrated into this measure? **ARHC outstanding action(s):** -Ask remaining MS to report on this item.

GOAL 2	Target	Current State	Gap	Actions
Goal 2: Increasing the use of hydrographic data for the benefit of society	• Build a portal to support and promote regional and international cooperation in marine spatial data infrastructures (MSDI) • Promote new tools and methods to accelerate and increase coverage, consistency, quality of surveys in poorly surveyed areas • Apply UN shared guiding principles for geospatial information management in order to ensure interoperability and extended use of hydrographic data in combination with other marine-related data	n/a	n/a	**Highlights/observations:** -The scope and governance of any portal must be clearly defined. -The majority of ARHC MS are active internationally in the areas of spatial data infrastructures e.g. IHO MSDIWG, and the management geospatial data e.g. UN-GGIM. See also SPI 2.3.1. -The majority of ARHC MS are actively testing new technologies, e.g. uncrewed survey vessels (USVs), and methods, e.g. crowd-sourced bathymetry to in data coverage and data quality. **ARHC outstanding challenge(s):** -Due to varying business models, the accessibility to data is challenging to harmonize across agencies and countries. -HOs require IT professionals to implement some of these changes, putting additions stress on resources. -Implications and opportunities of the 'S-100 World' not fully understood, yet. -Building a portal is only one part of the

				equation. Communicating its existence and usefulness to the rest of society is another, equally important part. **ARHC outstanding question(s):** -Does ARHC need strategy (including communications) particular for the Arctic, "…to accelerate and increase coverage…"? -Is ARHC making significant efforts in outreach to Indigenous peoples and Northern communities in the region?
2.1.1	Number of hits downloading data/information from the portal	**In progress**	**TBD**	**Highlights/observations:** -IRCC proposed that the MSDIWG provide a procedure of the development of the portal at the IHO Secretariat. -Currently, there is no regional 'portals'. -Several ARHCMS do have well-developed data/information portal(s) with significant offerings. -Any approach to a portal must be standards-based and the FAIR principles should be applied. **ARHC outstanding challenge(s):** -The design, standing-up, and maintenance of the portal(s) represent a further resource commitment. -There may be technical and policy issues related to consolidated or federated portals e.g. access to, and sharing of, national data. **ARHC outstanding questions:** -Does portal = MSDI in this situation? -What is the scope of the data and the information to be provided to and accessed by or through the portal? -Who (i.e. which MS) will 'own' this portal? -Is this portal to be linked to the IHO e.g. to the IHO online catalogue? -What is the timeline for this SDI? Yearly, would be appropriate. -What analytics should be employed? **ARHC outstanding action(s):** -ARHC to make a concerted effort to develop federated and/or consolidated MSDI(s)/portal(s) for the region.

2.2.1	Percentage of adequately surveyed area per coastal state	**In progress**	**TBD**	**Highlights/observations:** -It is assumed that 'adequately surveyed' equates to the measure described in C-55. -With the exception of Norway, the percentage of adequately surveyed areas in Region N, as reported in C-55, is

				low. -There may be some elements of this SPI that may complement the bathymetric data gap analysis (see 3.2.3). -It is interesting to note that while most MS report excellent chart coverage in the area, adequately surveyed area percentages are generally lower. -IRCC suggested that, using C-55 status of surveys data, areas where the value is less than 50% (33%) [?], be the focus and that the CBSC "derive rough figures from current C-55 and implement a routine procedure to derive percentage per coastal state in a simple manner, using also CATZOV information…". **ARHC outstanding challenge(s):** -The Arctic is a vast area and challenging environment to work in. This means the collection of bathymetric data by traditional hydrographic methods is slow and expensive. -Not all ARHC MS have reported this information to C-55, so regional analysis is not possible. -The methodology for computing adequacy is not the same between HOs. E.g. CA uses the methodology proposed by UKHO and SHOM (Document CBSC16-08.3B (2016)). -Both Seabed 2030 (see SPI 3.2.3) and C-55 request information about 'adequately surveyed' areas, but the parameters for each differ both technically and geographically, which makes the collection of this information quite demanding for HOs. **ARHC outstanding questions:** -Currently, C-55 information is broken down by depth (greater and less than 200m) and quality of coverage (adequate, re-survey required, and never systematically surveyed) so what is the best method to calculate the overall 'percentage'? -Should the SPI be divided into one element for data suitable for navigation and one element suitable for non-navigation uses e.g. Seabed 2030? -Could some C-55 information be captured in INToGIS to facilitate the extraction of this data? **ARHC outstanding action(s):** -ARHC to agree upon a common

				methodology for determining 'adequacy'. -Engage with CBSC on this endeavour. -Ensure all ARHC MS provide or update adequately surveyed area data for Region N in C-55 as soon as possible.
2.2.2	Number of new applications of the new version of Standards for Hydrographic Surveys (S-44)	**TBD**	**TBD**	**Highlights/observations:** -All ARHC MS conduct hydrographic surveys in accordance with, or rely heavily on, the S-44 specifications. Surveys contracted by the HOs must also meet this standard, depending on the purpose of the survey. -S-44 is referenced on MS web sites. -New methods, technologies, and operations for hydrographic surveying are being tested and deployed with the expectation that these innovations will be able to deliver outputs that conform to the S-44 specifications. -HSSC (HSSC12 2021 4.3A) indicated that the HSWG should monitor and report on this measure. **ARHC outstanding challenge(s):** -Continuing to improve the awareness of S-44 throughout the hydrographic communities. -Setting up mechanisms within HOs to track and/or identify data sources and systems that conform to the 'new' S-44 specification. **ARHC outstanding questions:** - What is the connection between this SPI and Target 2. 2 "*Promote new tools and methods to accelerate and increase coverage, consistency, quality of surveys in poorly surveyed areas*"? -What is meant by 'new applications'? Is this data that has been collected to the specifications or systems (hardware, software, or procedures) that utilize S-44 in some way? -Is there a metadata element that could be utilized to assist in this counting? -What is the timeframe for this measure? -Is there a target number? -How would the counting of any of these elements be conducted and who would be responsible for collecting this data? -Does the download of the S-44 standards document constitute an application of the new/current standards? Would this type of counting be done by the IHO Secretariat? -Does 'new version' = 'current version' ? **ARHC outstanding action(s):** -Ask HSSC for clarification on this SPI and work with the HSWG, as required.

2.3.1	Number of HOs reporting success applying the principles in their national contexts **(2026: 70%)**	80% (of ARHC MS)	20%	**Highlights/observations:** -The majority of ARHC MS report success in their national contexts with respect to the applications UN shared guiding principles for geospatial information management . -European MS have also leveraged the INSPIRE principles. -ARHC MS participate in UN-GGIM MDWG. -IRCC proposed way forward is for MSDI WG and UN GGIM HWG to set up definition of what application means. Possibly providing information documents, and that MS (via RHCs) to report figures to IRCC and then to IHO Secretariat annually. -Most MS have implemented some type of open data policy. -The Global Maritime Traffic Density Service (GMTDS) and the World Port Index (WPI) from US-NGA are examples of applied FAIR principles. The latter also allows for the crowdsourcing of some ports-related data. These products are, or soon will be available via the IHO. **ARHC outstanding challenge(s):** -To communicate in a cohesive and understandable manner to the general public, how the UN principles across the Region are being applied. -Integrating the IGIF concepts into existing national hydrographic and topographic structures. **ARHC outstanding action(s):** -Ensure all ARHC MS report on this item and determine the reporting schedule (i.e. report by what date each year). -Follow the work of the MSDI WG and UN GGIM HWG concerning the definition of this measure and engage as required. -Create an ARHC web presence.

GOAL 3	Target	Current State	Gap	Actions
Goal 3: Participating actively in international initiatives related to the knowledge and the sustainable use of the Ocean	• Collaborate with other bodies who deliver capacity-building and training to improve effectiveness of capacity- building activities and programs • Improve knowledge of the world's seafloors • Implement a	**n/a**	**n/a**	**Highlights/observations:** -ARHC has a standing Seabed 2030 and a Crowd-sourced Bathymetry (CSB) coordinator (both NO). -80% of the ARHC Full Members participate in the IHO CSBWG and several have their own national initiatives related to CSB and other data gathering, including engagement with northern communities. -ARHC has a MOU with the PAME working group of the Arctic Council

	comprehensive IHO digital communication strategy in order to enhance its visibility and accessibility to its work			to work collaboratively on matters of mutual interest. **ARHC outstanding challenge(s):** -The provision of data via a consolidated or federated MSDI e.g. Arctic Voyage Planning Guide (AVPG) has yet to be achieved. -ARHC has not developed a strategic plan to engage in the UN Decade of Ocean Science for Sustainable Development (UNDoOS).
Strategic Performance Indicators **3.1.1**	Percentage of Coastal States that are capable to provide marine safety information (MSI) according to the joint IMO/IHO/WMO manual on MSI **(2026: 90%)**	100%	0%	**Highlights/observations:** -All ARHC MS are capable of providing MSI according to the IMO/IHO/IMO manual on MSI. -In some MS the promulgation of MSI is not the responsibility of the hydrographic offices. -The WWNWS should report this annually to IRCC. **ARHC outstanding question(s):** -Could C-55 and INToGIS be redesigned to allow MSI-related status to be drawn automatically from those sources? **ARHC outstanding action(s):** -None
3.2.1	Amount of data received per year by the IHO Data Centre for Digital Bathymetry (DCDB).	**Not applicable to ARHC**	**N/A**	**Highlights/observations:** ARHC believes that this SPI should be reported on by the DCDB. **ARHC outstanding question(s):** -Could SPI 3.2.2 be rolled up under this SPI using the same timeframe and providing a breakdown in contributions and contributors in the ways suggested below for 3.2.2. This may be more suitable for analysis by the RHCs. **ARHC outstanding action(s):** -None
3.2.2	Number of contributors to DCDB who are not hydrographic offices	**Not applicable to ARHC**	**N/A**	**Highlights/observations:** ARHC believes that this SPI should be reported on by the DCDB. **ARHC outstanding question(s):** -What is the timeframe for this measure? E.g. year-over-year; last 10 years; since inception? Suggest using the same timeframe as 3.2.1 -What are the parameters of this measure: E.g. single-beam; multi-beam; all bathy data? -Is there a way for contributions to be

				broken down geographically, that is, by RHC areas? This would be more relevant to RHCs. -Is there value in knowing amount of data delivered to the DCDB from ARHC national HOs? -Is the volume of data received from a contributor relevant? **ARHC outstanding action(s):** -None
3.2.3	Percentage of total sea area that is Seabed 2030 compliant for incorporation into the GEBCO dataset and services	**In progress**	**TBD**	**Highlights/observations:** -ARHC MS are at varying stages of evaluating their coverage vis-à-vis the Seabed 2030 specifications. Those that are not finished the analysis hope to complete the task this year. -NO reported that it has 67% compliance, but only 33% of that is publicly available. -It is assumed that the reporting of this measure will be coordinated by the GEBCO GC. **ARHC outstanding question(s):** -Could more precision be given to the definition of 'Seabed 2030 compliant'? -Could more precision be given to the definition of 'total sea area'? That is, does this mean within coastal state EEZ or within the limits of the RHC limits? What about the high seas within the RHC? Is this the realm of the RDACCs? -Is there any value in the better coordination of the activities of the RHCs and the RDACCs vis-à-vis Seabed 2020 activities. -Should the measure differentiate between what is publicly available and overall coverage? **ARHC outstanding action(s):** -ARHC MS to complete the evaluation of their bathymetric data coverages vis-à-vis the Seabed 2030 specifications in time to report to C6/A3.
3.3.1	Number of visits, likes, re-postings, etc. associated with the IHO social media sites	**Not applicable to ARHC**		**Highlights/observations:** ARHC understands that this SPI, and SPI 3.3.2, are the responsibility of the IHO Secretariat and that the Secretariat will employ the analytical tool(s) that best derive the information desired. **ARHC outstanding question(s):** -What are the goals or objectives of these measures and how do they inform the success of the Strategic Plan? In other words, will this information be used to make adjustments to the implementation of the Strategic Plan? If not, why collect it.

				-Could the data be broken down into Regional (e.g. ARHC) pieces, so that the RHCs could use this information to influence their work plans? **ARHC outstanding action(s):** -None
3.3.2	Volume downloaded from the IHO website and Geographical Information System (GIS)	**Not applicable to ARHC**		**Highlights/observations:** -ARHC understands that this SPI, and SPI 3.3.1, are the responsibility of the IHO Secretariat and that the Secretariat will employ the analytical tool(s) that best derive the information desired. **ARHC outstanding question(s):** -What is the breadth and depth of information for which the IHO Secretariat is considering assuming the role of data provider, particularly from the IHO GIS? Can this be done with the same level of IHO resources? -What are the expectations of MS with respect to contributing data to the IHO GIS? -What are the goals or objectives of these measures and how do they inform the success of the Strategic Plan? In other words, will this information be used to make adjustments to the implementation of the Strategic Plan? If not, why collect it? -Could the data be broken down into Regional (e.g. ARHC) pieces, so that the RHCs could use this information to influence their work plans? **ARHC outstanding action(s):** -None

ANNEX A
ARHC actions identified as part of the IHO Strategic Plan gap analysis.

1. GENERAL
1.1 Develop a schedule or calendar for reporting dates/cycles on SPI by MS to ARHC and for ARHC to IRCC.

GOAL 1 Actions

G1a. Redefine SPI 1.1.1*. This should be coordinated with other RHCs, MS, and HSSC.
** Percentage of Member States having operationalized production and distribution of hydrographic data products and services based on IHO Universal Hydrographic Data Model (S-100), under an implementation framework of coordination and agreed timelines*.

G1b. ARHC to begin preliminary work on determining which routes in the region may be used by autonomous vessels. (In support of SPI 1.1.2.)

G1c. ARHC to come to a common definition of 'navigationally significant', which also considers the IMO

definition, if it exists. (1.2.2)

G1d. Task OTWG to calculate this SPI based on this definition and using any information e.g. CATZOC already captured in INToGIS, if possible. (1.2.2)

G1e. Ask remaining MS to report on SPI 1.3.1: *Ability and capability of Member States to meet the requirements and delivery phases of the S-100 implementation plan.*

GOAL 2 Actions

G2a. ARHC to agree upon a common methodology for determining 'adequacy' for SPI 2.2.1, and engage with CBSC on this endeavour.

G2b. Ensure all ARHC MS provide or update adequately surveyed area data for Region N in C-55 as soon as possible.

G2c. Ask HSSC for clarification on SPI 2.2.2 (*Number of new applications of the new version of Standards for Hydrographic Surveys (S-44)*)
and work with the HSWG, as required.

G2d. ARHC to make a concerted effort to develop federated and/or consolidated MSDIs for the region.

G2e. ARHC to create a web presence to better communicate its activities and the data available from MS that could be of value to society.

G2f. Follow the work of the MSDI WG and UN GGIM HWG concerning the definition of SPI 2.3.1 *Number of HOs reporting success applying the principles in their national contexts* and engage as required.

G2g. Discuss the need for an ARHC strategy (including communications) particular for the Arctic, "…to accelerate and increase coverage…" of hydrographic data.

G2h. Consider adding 'Outreach to Indigenous peoples and Northern communities in the region' as a standing ARHC agenda item as part of the efforts to amplify use of hydrographic data for the benefit of society.

GOAL 3 Actions

G3a. ARHC MS will complete their Seabed 2030 data gap analysis, broken down into publicly and non-publicly available data, working with the RDACCs if possible/practical in time to report to C6/A3.

G3b. ARHC to work with PAME to deliver tangible results under the ARHC-PAME MOU. For example, assist PAME in developing an S-122 layer for marine protected areas (MPAs)

G3c. ARHC to consider if it wants a UNDoOS engagement strategy and what that would look like. This could be related to the previous point and development of a regional MSDI.