

NORDIC HYDROGRAPHIC COMMISSION
65th Meeting, Hybrid/in-person/video conference, 26 - 27 April 2022

Report of the IHO Secretariat

Submitted by: Secretariat of the IHO

Executive Summary: This paper reports on activities of the IHO Secretariat that may impact the work of the Nordic Hydrographic Commission.

1. One of the main changes resulting from the entry into force of the revised IHO Convention is that, for States wishing to join the IHO that are already Member States of the United Nations, there is no requirement to seek the approval of existing Member States of the IHO. Since the last NHC Conference Kenya, Iraq and Angola acceded to the IHO Convention and the IHO membership now stands at 97. Unfortunately, Serbia, Syria and Vanuatu remain suspended from Member States rights.

Regional Applications for Membership of the IHO

2. All coastal States in the NHC region are IHO members. However, the Secretariat was assisted in approaching prospective new IHO members by numerous NHC members; the IHO Secretariat would like to thank Norway in particular for their support.

3. Recommendation: *NHC is invited to further assist the Secretariat in promotion of membership to those States not yet IHO Member States.*

IHO Council Activities

4. Due to COVID-19 restrictions, the fifth meeting of the IHO Council (C-5) took place on 19-21 October 2021 via hybrid in-person/video conference.

5. Among the items discussed at C-5, were the proposals from HSSC, IRCC and the Secretariat for delivery of the Strategic Performance Indicators (SPIs) assigned to each of those bodies for the implementation of the IHO Strategic Plan, as well as the Roadmap for the S-100 Implementation Decade (2020-2030) for the development of digital products and services. Member States stressed the need for IHO to support basic Capacity Building while also supporting the migration to S-100. The role of the RENCs has been a subject of discussion, and RENC representatives were therefore invited by the Chair to attend the session as observers.

6. The actions in progress within HSSC for the development of a governance document in support of the 'dual fuel' concept and associated actions were noted. A consolidated draft governance document on the 'dual fuel' concept will be considered by HSSC-14 and subsequently submitted to C-6. To develop a guidance document on the dual fuel concept, the S-100 WG, under HSSC, conducted a series of workshops that included discussions on the subject as well as on the future continuation of the system-ENC (SENC) delivery. A HSSC Drafting Group was established to conduct a revision of the International Maritime Organization (IMO) ECDIS Guidance for Good Practice and ECDIS Performance Standards (MSC 232(82) that will be considered by the IMO Sub-Committee on Navigation, Communications and Search and Rescue (NCSR-9) in June 2022.

7. C-5 noted the report and commended the IRCC, the RHCs, and IRCC Sub-Committees for their achievements as well as the outcome of the IRCC October 2021 Workshop on the IHO Strategic Plan. The Council, acknowledging the need for further recommendations on the realization of the Strategic Plan

in RHCs by Member States and invited the IRCC to provide these recommendations to the RHCs as a matter of priority. A 2nd IRCC Workshop on the IHO Strategic Plan is planned on 28th April 2022 (see IHO CL 12/2022).

8. The Empowering Women in Hydrography project was launched with a kick-off meeting via virtual teleconference held on 28 September 2021. Funded by Canada until 2024, and with dedicated support from the IHO Secretariat, the goals of the project include providing opportunities to gain exposure to the field of hydrography and to increase gender diversity in the hydrographic community. Lines of action for the first year (2021) of the project include outreach, contact and learning, including internships, at-sea experiences and train-on-the-job activities (see IHO CLs 47/2021, 07/2022 and 09/2022). A specific webpage (<https://iho.int/en/basic-cbcs-ewh>) has been set up under the Capacity Building Sub-Committee (CBSC) for this project.

9. The Project Team has been established for the IHO e-Learning Center at KHOA, along with terms of reference and rules of procedure. Operational tests with IHO Member States are expected to begin in 2022. However, the success of the e-learning initiative is dependent on contributions of online learning material from Member States and partners.

10. Recommendations:

10.1. *NHC is invited to continue on the implementation of the IHO Strategic Plan, elaborate on the gap analysis and support IRCC in identifying measures and values to measure those SPI of regional interest allocated to IRCC, in accordance with IRCC CL 01/2021, and attending at the 2nd IRCC Workshop.*

10.2. *NHC members to note the appropriate HSSC's governance document on the 'dual fuel' concept.*

10.3. *NHC members are invited to participate at the EWH project and provide proposals via the specific webpage (<https://iho.int/en/basic-cbcs-ewh>) has been set up under the Capacity Building Sub-Committee (CBSC) for this project.*

10.4. *NHC members are invited to provide contributions of online learning material to the Project Team established for the IHO e-Learning Center at KHOA.*

NHC Statutes

11. Among other items, IHO ACL 26/2020 noted the positive vote of the Member States on the approval of the Revision of the IHO Resolution 2/1997 – Establishment of Regional Hydrographic Commissions (RHC) (Assembly Document A2_2020_PRO3-1_EN_Res_21997_cc_v1).

12. Recommendation. *NHC is invited to adapt their respective instruments to the recommendations of the revised IHO Resolution 2/1997.*

INT Chart and ENC Production Coordination

13. The latest WENDWG12 acknowledged that the combined effort by the RHCs (possible nomination of a S-100 Coordinator by Region for instance and development of IGIF / per RHCs / per S-1-xx Product) is an important way forward to contribute to the Roadmap for the S-100 Implementation Decade to reach a worldwide coverage soon after the standards are adopted in their operational version.

14. Following the joint proposal of Australia and UK promoting the urgent production of HD ENCs now, since the S-1xx products and S-100 ECDIS will unlikely be operational before 5 to 10 years, the WG invited Member States to consider the role that HD ENCs can play before S-100 ECDIS becomes widely

available as well as S-102.

15. *Recommendations: NHC member to discuss*

15.1 *if the nomination of a S-100 Coordinator would be sensible or if this should be distributed between NSHC and BSHC.*

15.2 *consider the enhanced production of HD ENC's of focus on S-102.*

Capacity Building Programme

16. In 2021 the activities to build hydrographic capacity as planned in the annual Work Programme Part III were low; due mainly to the COVID-19 pandemic and the postponement of some of the earmarked CB activities (i.e. Cat A and Cat B courses). The Secretariat received 517,731€ from the Republic of Korea, and 405,549€ from Japan. The total expenditure was 339,493€, and the balance at the end of 2021 is 1,666,790€. The IHO Secretariat reaffirms the strong engagement to increment the Budget allocated to CB from 2022 onward. The level of activity of the IHO Capacity Building (CB) Programme remained clearly affected in 2021 by the COVID 19 Pandemic. Decision 5 of the CBSC19 intersessional meeting approved that the 2021CBWP funded activities not executed in 2021 can be moved to the 2022CBWP. NHC had four funded CB projects in the 2021CBWP. The two projects included in the 2022CBWP are subject to the approval of the budget assigned to 2022:

- CBWP 2021 P-05 - Webinair on Using AI as Sonar Noise Classifier;
- CBWP 2021 P-21 - Workshop on Cartographic Data Management
- CBWP 2021 P-23 - Online Workshop on Airborne Lidar Bathmetry
- CBWP 2021 P-26 - Online Workshop on Transition to S-1xx Products
- CBWP 2022 P-XX - Workshop on Cartographic Data Management (carried over from 2021)
- CBWP 2022 P-XX - Remote Workshop on the Implementation of LoTS and S121

17. A Project Team under the CBSC to draft a revised Capacity Building Strategy, adapted to the new IHO Strategic Plan and aligned with the IHO Strategic Goals, and to deal with the prioritization of the S-100 and how MSI is faced. Member States who have experience in developing and providing e-Learning contents should consider actively sharing contents, resources, and experience with the e-Learning PT.

18. In terms of courses/activities managed at IHO Secretariat level, 2 candidates were selected for 2022/2023 Cat A course at USM sponsored by the Republic of Korea, whilst a new call for candidates for 2023/2024 Cat A course will be issued in August 2022; 12th Course GEOMAC Cat B course sponsored by Nippon Foundation is underway, whilst 13th and 14th courses are under selection process in accordance with the IHO CL 8/2022; 2022 Cat B course sponsored by ROK will be announced later on this year. Finally, the Empowering Women in Hydrography (EWH) project is in its full implementation phase. Evert Flier (Norway) (Chair CBSC) is the NHC CB Coordinator for planning and implementing the regional CB activities.

19. *Recommendation. NHC members are invited to continue follow and evaluate the possibility to contribute to the CB Programme.*

Maritime Safety Information Services

20. Work by the International Maritime Organization (IMO) on the modernization of the Communications and Global Maritime Distress and Safety System (GMDSS) continues with the on-going review and updating of the SOLAS chapters III and IV and on the related and consequential amendments

to existing instruments. The consequential changes as a result of the recognition of the Iridium SafetyCast service as a recognised mobile satellite service (RMSS) provider in the GMDSS continue to be implemented. The Iridium SafetyCast service became SOLAS carriage compliant from 1 January 2020. Good progress has been made with implementation with a number of NAVAREAs due to become operational in 2022, with more entering the formal testing phase. However, there is still a number of NAVAREAs that need to commit to beginning implementation before the service can be declared fully operational. Member States are reminded of the resources required and the responsibilities for their national Coordinator to perform their functions as part of the GMDSS. The national Coordinators should have established sources of information relevant to the safety of navigation within national waters, effective communications with the NAVAREA Coordinator and adjacent national Coordinators, if needed, to pass relevant information to all authorities and organization that need to be made aware and access to broadcast systems for transmission to their area of national responsibility.

21. Recommendations:

The NHC Chair is requested to encourage all NHC members to:

21.1. Encourage all information providers (NAV and MET Area Coordinators and RCCs) to complete agreements with all RMSS and commence the necessary testing of the SafetyCast system to progress towards declaring full operational status.

21.2. Establish and maintain effective communications with the relevant NAV and MET Area Coordinators to ensure the timely provision of MSI.

21.3. Use and follow the guidance provided in S-53 – Joint IMO/IHO/WMO Manual on Maritime Safety Information – to ensure the necessary facilities and capabilities are provided and maintained for the gathering and communication of MSI within their area of national responsibility.

Crowdsourced Bathymetry

22. The Crowdsourced Bathymetry Working Group (CSBWG) has been tasked by IRCC to revise the IHO publication B-12 which provides guidance on the collection and use of Crowdsourced Bathymetry (CSB), and to investigate ways to increase participation in data gathering activities. CSBWG is progressing on the revision of IHO publication B-12, and the 12th CSBWG meeting consolidated the draft of the new edition of Publication B12 to submit to IRCC14 in June for endorsement, and the to the approval of the IHO Member States via IHO CL.

23. The Circular Letters (IHO CL 21/2020 and IRCC CL 1/2020) to request MS to indicate their positions on the provision of CSB data received 30 replies (available at the link: https://iho.int/uploads/user/Inter-Regional%20Coordination/CSBWG/MISC/B-12_2020_FR_Acceptance_of_CSB_Data_in_NWJ_v3.0.pdf), showing that the engagement with the RHC and HO can be improved. It was highlighted that many coastal States continue to misunderstand the objectives and focus of the CSB initiative, which are to collect data in poorly surveyed or unsurveyed areas.

24. The CSB-GEBCO-Seabed 2030 Regional Coordinators revealed both increasing levels of engagement on CSB, as well as some of the recurring barriers cited by potential contributors. The network of Regional Coordinators would be the principle means of engaging with IHO Member States to advocate for open data access and CSB activities. In fact, there continues to be concern over the apparent lack of dedicated resources available within national HOs to process data available via DCDB. The importance of liaison with other IHO bodies, as well as appropriate engagement with industry to progress the work items, continues to be a key enabler for the project. Norway was appointed as Seabed 2030/CSB Coordinator for NHC.

25. The quality of data has grown considerably in the last years having now more than 60TB. The Centre has about 25 GB of CSB data from 185 contributing vessels. DCDB implemented a geographic filter considering MS positions on the collection of CSB data in the areas of jurisdiction. The result is that data from only 13 CSB-supporting countries are currently discoverable and accessible via the DCDB. Among them are the following NHC members: Denmark, Iceland and Norway.

26. DCDB now hosts the GEBCO Gazetteer, a web tool that allows the public to search for, view, and download information. IHO MS and stakeholders were invited to contribute and encourage the provision of bathymetric data regardless of its origin or reason for gathering.

27. The CSBWG has identified the importance of much closer cooperation and coordination with GEBCO and Seabed 2030 in communication and outreach to avoid duplication of effort, to ensure a harmonised message is maintained, and to leverage the momentum generated by the UN Decade and the SDGs. Seven sector specific two page information briefs had been produced with the intention that they be used to support 'first contact' engagements with potential CSB contributors. These briefs (covering cruise shipping, super yacht owners/operators, fisheries, hydrographic offices, marine contractors, the marine science community and marine navigation equipment manufacturers) are now available at the following link: <https://iho.int/en/communication-material>.

28. Recommendations

28.1. *NHC members and associate members are encouraged to officialise and/or review their positions on the conduct of CSB in their waters of national jurisdiction (iaw IHO CL 21/2020 and IRCC CL 1/2020) and to identify further potential sources of bathymetric measurements and survey data providers to facilitate the further completion of the DCDB data holdings, as well as to make data openly available for inclusion in the DCDB and the widest possible use, in accordance with IHO Resolution 1/2017.*

28.2. *NHC is invited to continue with its active participation in the initiatives such as UN Oceans Conference, UN Decade for Ocean Science (Calls for Decade Actions) and Seabed2030.*

GEBCO support through Seabed 2030

29. The Nippon Foundation (NF)-GEBCO Seabed 2030 (Seabed 2030) project builds on more than 100 years of GEBCO history; the project has established regional connections to all corners of the World and benefits from the human network of ocean mapping capacity built over 15 years through the Nippon Foundation – University of New Hampshire (UNH) ocean mapping training programme. Through Seabed 2030, GEBCO's role is recognized and reinforced as the authoritative international initiative for mapping the World Ocean, from the coasts to the deepest trenches. Seabed 2030 has established a South West Pacific Regional Center located at the New Zealand National Institute of Water and Atmospheric Research. The Antarctic and Southern Oceans are covered by the Southern Ocean Regional Center located at Alfred Wegener Institute, Bremerhaven, Germany. Each centre focuses on discovering, gathering and assembling all available bathymetric data from their region to produce regional datasets and resulting products. A global centre will merge the regional datasets to generate the production of the annual GEBCO grid as well as other products. Within this structure, the IHO-DCDB will remain the central GEBCO repository for all raw bathymetric data.

30. In 2021, Dr Geoffrey Lamarche, Associate Professor (Hon) of Auckland University was appointed by the IHO to the GEBCO Guiding Committee (GGC) following an international recruitment campaign. GGC considers that the minimum acceptable data coverage developed from 6% to 21.6%, which is still not comparable with the 100% 10m DEM coverage of all landmass. UN Decade of Ocean Science for sustainable development clearly stated the need to complete a comprehensive map of the ocean floor.

The importance to invest in future generations of ocean scientists and hydrographers and the GEBCO Training Program with the University of New Hampshire were enhanced. It was decided to establish a new Sub-Committee on Education and Training to liaise with this successful existing program and to identify and connect with other ocean mapping programs. The core of GEBCO activities is building partnerships, regionally and nationally and some examples were mentioned. GEBCO's two biggest challenges are: how to get governments, institutions, private industry and their contractors to share more existing bathymetric data; and, how to get the remaining ~80% of our planet's unmapped ocean seafloor mapped.

31. Nippon Foundation GEBCO-Seabed 2030 project was endorsed as an Action of the UN Decade of Ocean Science for Sustainable Development. The complex network of this project was explained along with the data ingestion in the system and mapping coverage that now stands at 21.6% (December 2021). The project is focused on mapping the gaps with three different initiatives: the Ocean Frontier Mapping, Crowd Sourced Bathymetry and Technology Innovation. It is necessary to promote the need to map the entire seabed and to encourage organizations to make their data available.

32. From September 2020 to March 2022, Seabed 2030 announced new partnerships with Woods Hole Oceanographic Institution (WHOI), EOMAP, TCarta Marine and ARGANS, Map the Gaps, Pan American Institute of Geography and History, Global Oceans, NLA International, International SeaKeepers Society London, the UKHO and SEATRAC, signing Memorandum of Understandings in recognition of the organisations' work to advance the understanding of ocean bathymetry, and to complement the goals of the United Nations Decade of Ocean Science for Sustainable Development. Besides, new global survey calls for greater coordination of seabed mapping activities were launched in London, 15 October 2021 to give a major boost to efforts to map the entire seafloor by the end of the decade. The survey aimed to develop a more consolidated global view of seabed mapping needs in order to move towards an agreed list of strategically important priority areas for further action. It also achieved its secondary aim of finding new data that could immediately feed into the emerging global map. Seabed2030 project looks forward to forming new partnerships and strengthening existing ones, as working collaboratively can greatly help fill in the gaps, as in the case of FUGRO, that in 2021 delivered to Seabed 2030 more than 2 million km² of high-resolution in-transit bathymetry data, collected by Fugro vessels, which a data coverage roughly equivalent to the size of Mexico.

33. Recommendations:

33.1. *NHC members are encouraged to become actively involved in the GEBCO programme and its subordinate projects, to support the collection of data within their waters, and to make more detailed and comprehensive seabed data available, in particular deep ocean data from transit or commercial/scientific surveys.*

33.2. *NHC members to continue inviting GEBCO programme and Seabed 2030 project representatives to NHC meetings to discuss options for deepened cooperation and support, in order to make more people aware of the importance of gaining a complete picture of the seabed.*

IHO GIS and Databases

34. Work has continued on the IHO internal systems. Especially, two components are to be mentioned:

- IHO Country Information system, and
- IHO Online Form system.

35. The IHO Country Information system has been progressively upgraded to include administrative information and facilitate the maintenance of the IHO publications such as Yearbook (P-5) and Status of Hydrographic Surveying and Charting Worldwide (C-55) posted on the IHO website. The IHO Online Form system has been used since March 2019 and has been widely accepted by the Member States for the Circular Letter responses and the updating of P-5 and C-55 (CL20/2019 and CL03/2020 refers). Countries in the NHC Region are invited to review their entry in the publications on an annual basis and provide the IHO Secretariat with the appropriate updates through the IHO Online Form system. The status of the data in the IHO Country Information Database concerning the NHC Countries, including those provided for C-55.

36. An Esri-based GIS solution has been implemented for the efficient visualization of geospatial data stored in the Country Information System. This Cloud-based service has enabled access to various layers and functions through the IHO website such as the IHO ENC Catalogue. Currently, five WebGIS applications are available to the public in this new environment.

37. Work has continued on developing a GIS database application to support C-55 - Status of Hydrographic Surveying and Charting Worldwide and the work of the IHO. In response to the request to complement C-55 composite data (percentage of areas adequately surveyed / requiring re-survey / not surveyed) with CATZOC information. The CBSC established the C-55 Review Project Team (C-55RPT) to deal with this task, but now it is put on hold, as further work is dependent on the development of the S-100 products.

38. Recommendation. Countries in the NHC Region are invited to review their entry in the IHO Yearbook and C-55 and to provide the IHO Secretariat with the appropriate updates or to report no change (CL 20/2019 refers).

Joint IHO-IHO Singapore Technology & Innovation Laboratory

39. Singapore and the International Hydrographic Organization (IHO) launched the Joint IHO-Singapore Innovation and Technology Laboratory on 26 October. The Laboratory seeks to optimise the resources of IHO Member States to harness and develop emerging technologies in the hydrographic domain that support safe maritime navigation and the protection of the marine environment.

40. In accelerating innovation in the field of hydrography, the Laboratory aims to (i) conduct research and testing of projects proposed by IHO Member States, IHO organs and other stakeholders; (ii) grow knowledge and foster collaboration on global standard-setting for the development and application of technologies enhancing safety at sea; and (iii) promote a multidisciplinary and collaborative environment to drive innovative solutions and develop pioneering technologies through active partnerships.

41. For a start, the Joint IHO-Singapore Innovation and Technology Laboratory will embark on the following two pilot projects:

- Investigate the automated conversion of the IHO S-57 Electronic Navigation Chart (ENC) to the IHO S-101 ENC. This project supports the development of the S-100 Electronic Chart Display and Information System.
- Develop a digital Infrastructure to improve information exchange between harbours and hydrographic office. The outcome of this project will inform the IHO S-131 Marine Harbour Infrastructure product specifications.

42. The Laboratory is overseen by a Governing Board chaired by Mr Abri Kampfer, the IHO Director in charge of the IHO Work Programme II. Its General Manager, Dr Parry Oei, Adviser (Hydrography) of the Maritime and Port Authority of Singapore (MPA), leads the day-to-day operations.

43. Recommendation: *Take note and apply the anticipated results of the Lab's current project activities and contribute to new project ideas in continuation of the items addressed by the two pilot projects.*

IHO Outreach

World Hydrography Day

44. As announced with IHO CL 01/2022, the theme for WHD 2022 is "Hydrography - contributing to the United Nations Ocean Decade". The theme is designed to highlight the relevant contribution of hydrography as a discipline of applied sciences to the United Nations Decade of Ocean Science for Sustainable Development (2021 – 2030). The deliberations at the 5th Council meeting confirmed that several hydrographic offices have already engaged nationally in supporting the United Nations Ocean Decade and in the efforts to reverse the cycle of decline in ocean health. The theme offers the opportunity to emphasize the competencies of hydrographers in the gathering and management of marine data and their strengths in technical collaboration on a global scale.

Ocean Decade S-100 Webinar

45. The IHO's S-100 "An all-embracing data model" webinar as part of the Ocean Decade Laboratories framework named "A Predicted Ocean" was organized by IOC and held as a remote event, on 16 September 2021. The event brought together 44 attendees from around the world.

46. The webinar discussed how the IHO S-100 universal data model can ensure data from different sources is consistent and interoperable, thereby amplifying its impact and increasing the capacity to undertake informed predictions how oceanic parameter will develop.

IHO Centenary Celebrations (IHO-100)

47. The years 2019 and 2021 are important in the history of the International Hydrographic Organization. 2019 marked the centenary of the 1st International Hydrographic Conference, which was held in London in 1919 and 2021 will be the centenary of the establishment of the International Hydrographic Bureau (IHB) in 1921 in Monaco as precursor of the modern IHO.

48. The IHO Secretariat has already organized an exhibition on "Historical Nautical Charts and Mediterranean" which was displayed at the Monaco Yacht Club from 1 to 14 April 2019, an international Symposium on "A Historical Approach for Measurements and Protection of Oceans and World Waters" at the Oceanographic Museum of Monaco from 20 to 21 June 2019 (in conjunction with the World Hydrography Day), has published an IHO Prestige Book on "100 Years of International Cooperation in Hydrography" (English and French versions have already been delivered to H.S.H. Prince Albert II of Monaco and distributed to the IHO Member States), the "Peak-of-the-peak" was held in conjunction with the World Hydrography Day (WHD) on 21 June 2021, and a Conference on "The celebration of IHO centenary" was held at Yacht Club Monaco on 17 November 2021. The centenary events could also be linked with the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) which has been coordinated by the IOC of UNESCO.

International Hydrographic Review (IHR)

49. Twice a year, the IHR provides an opportunity for Member States to publicize technical and other achievements in their region. An editorial board comprising a representative from each region has been established. As it was announced through IHO CL 03/2022, since 5 January 2022 the IHR has a new editor Dr Patrick Westfeld from Germany.

50. Papers for consideration for publication in the IHR should be forwarded directly to the editor (ihr.review@iho.int, copy to ihr.editor@iho.int.com). The deadlines are:

- end of January for the May Edition
- end of July for the November Edition

51. The IHO Secretariat worked with the University of New Brunswick (UNB), Canada, in a project to develop a digital repository of the complete library of the IHR. As a result, volumes from the entire collections (1923 to 2018) are available online at: <https://journals.lib.unb.ca/index.php/ihr>.

52. To promote and modernize the distribution of the content of the IHR the IHO Secretariat has worked out a new IHR website with Geomares. Ihr.iho.int

53. Recommendations. *NHC Members are invited to submit papers for publication in the IHR.*

Preparations of the third IHO Assembly 2023

54. The forthcoming third IHO Assembly is scheduled as in person event to 24 – 28 April 2023. The Council is requested to discuss, endorse and finally forward the triennial Work Plan for 2023 – 2026.

55. Recommendation: *The NHC is invited to discuss and put forward its view for strategic directions on the portfolio if work items to be incorporated into the plan.*

56. Action Requested of NHC:

- a) **Note** this report.
- b) **Consider** the recommendations proposed in this report.
- c) **Review** entries related to IHO C-55 and P-5 (Yearbook) at least annually.
- d) **Consider** submitting papers for publication in the International Hydrographic Review
- e) **Note** the need for contributions to IHO's forthcoming triennial work plan 2023 – 2026.
- f) **Take any other actions as considered appropriate.**