Tides, Water Level and Currents Working Group
VTC, 28 February -2 March 2023
Draft Report – (TWCWG7)

(Paragraph numbering is the same as the Agenda Item numbering and does not necessarily reflect the order in which matters were discussed. ISO three letter country codes have been used to identify individual participants)

- **Opening**

.1 **Opening address** – Chair

- The chair opened the meeting and welcomed all delegates. He thanked the dedication of those joining at times well outside of their normal 'working days' owing to time zone differences.
- He noted that, once again, we are holding a VTC meeting - but drew attention again to the significant and valued efforts that the South Africa National Hydrographic Office (SANHO) had put into investigating if they could offer to host TWCWG7 (essentially a repeat of the TWCWG6 situation). Given the need for TWCWG to meet earlier in the year, in order to fit in with the HSSC schedule, SANHO could not commit to this time schedule going forward. (It since transpired that HSSC moved HSSC15 meeting back to June 2023, therefore it may have been possible to meet in SA had this been decided earlier in the year).
- He noted that the date and venue of the next TWCWG8 is yet to be decided and MS will have the opportunity to volunteer during agenda item 10 on day three (and to give it their consideration over the course of the meeting if they may be in a potion to host the next (TWCWG8) meeting).
- He mentioned that Gwenaële Jan (FR / Shom), long standing member of TWCWG (and its previous incarnations), as well as Chair of the group for the past 7 years, was standing down as a group member after this meeting; he thanked her for her huge contribution over the past several years. The chair also mentioned that Dr Neil Weston (USA / NOAA) had retired in 2022 and expressed his gratitude to him for his contributions to the group. He also introduced Ruth Farre, ZAF and Sam Harper, IHO as Vice Chair and IHO Assistant Director respectively.
- Both Ruth Farre and Sam Harper introduced themselves and gave a brief welcome to the proceedings.

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- Sam Harper, IHO, referred to a recent World Meteorological Organization (WMO) meeting he attended, where there was an expression of interest in monitoring developments in S-104 and S-111 Product Specifications (PS). **Action: IHO to invite WMO representative(s) to the next TWCWG meeting.**
- IHO also advised that TWCWG ensures timelines / deadlines are clear and transparent for the continued development of S-104 and S-111 PS. **Action: Chair, GBR, to create a timeline which aligns with the IHO Roadmap.**

- **Administrative Arrangements**

As a VTC meeting, administrative arrangements are not applicable, other than to mention the Agenda Items might be discussed 'out of sequencing order', and that timings were approximate and subject to change. Breaks would be taken as required. The 3 days of the meeting will be recorded, and the chat-log saved, both being made available to delegates as part of the meeting report.

.1 **Adoption of the Agenda and Apologies –** Chair/IHO

Discussion	Decisions	Actions
- The Chair offered the agenda for adoption	- Agenda adopted	
- He noted the full agenda and the limited time that we had. He asked everyone to be mindful of the time limits for presentations and ensuing discussions, so that the timing of the agenda could be met as much as possible.	- Agenda items may not necessarily be discussed / covered in the order of sequence listed in the final agenda; at the discretion of the Chair.	

.2 **Programme and timetable of the Sessions –** Chair/IHO

The draft timetable was introduced, it was explained that this was intended for guidance only and was not intended to be a rigid structure. Where necessary time spent on individual topics would be amended to allow an appropriate discussion; see list of documents at Annex C.
Regarding 'Meeting Administration', see also comments under 2. Administrative Arrangements.

.3 **Report on Intercessional Activities, including HSSC14 –** Chair

Discussion	Decisions	Actions
HSSC14 - The Chair went through the report to HSSC14. - He noted that the report is on the TWCWG website and HSSC14 website. - He went through the actions that relate to TWCWG. - He stated that HSSC had noted the TWCWG6 report summary, as presented at HSS13, commending the TWCWG for their achievements, specifically on the progress made on S-104 and the revision of IHO Resolutions. - He reported that HSSC recommended TWCWG to liaise with International Association for the Physical Sciences of the Oceans (IAPSO) (and GLOSS) to develop synergies between entities. - Finally, the Chair passed on the advice from HSSC to consider the TWCWG meeting schedule in accordance with the HSSC meetings submission deadline.	Noted and agreed by TWCWG	TWCWG future meetings schedule will adhere to this timeline
Intersessional Activities - He ran through the interaction with the other IHO WGs. - **Data Quality Working Group (DQWG)** – TWCWG chair provided a pre-recorded presentation to the chair of DQWG (Lingzhi Wu) at his request to view at the DQWG18 meeting (7-9 February 2023), on the topic of a general overview of the S-104 & S-111 PS. TWCWG chair then received two	Cover DQWG information and questions under Section 4.6	

presentations from DQWG Chair, to discuss at TWCWG7. This discussion was covered under Agenda Item 4.6.		
- **Maritime Autonomous Surface Ships (MASS)** – the chair mentioned he had been approached by the Vice Chair of MASS, Mr Sun Dongli (MSA China), about a 'gap analysis' they had undertaken between the requirements of MASS and the detail of S-104 and S-111. This discussion was covered under Agenda Item 8.4.	Cover MASS Gap Analysis under Section 4.6	
- **Hydrographic Surveys Working Group (HSWG)** – the chair detailed the offer from HSWG to collaborate to improve tidal observation uncertainty standards within S-44. He noted that a presentation would be provided on this topic under Agenda Item 8.1 and would be discussed in detail then.	Cover HSWG S-44 collaboration under Section 4.6	
- **International Association for the Physical Sciences of the Oceans (IAPSO)** Best Practice Study group on Tidal Analysis. The chair recapped some details of this group, which has been established by Dr. Andrew Matthews, National Oceanography Centre (NOC, UK).	Cover IAPSO collaboration under Section 3.3	
- **S-104 & S-111 Developments**. The chair stated that there had been a lot of detailed excellent work going on in the developments of S-104 and S-111, to be briefed on later in the meeting.	Cover S-104 & S-111 developments under Section 4	

.4 **Matters arising from TWCWG6/Review of Action Items –** Chair

Discussion	**Decisions**	**Actions**
Actions from TWCWG6		
Action 1. *The study of long-term data sets for the determination of global sea level rise and changes in tidal range:* **Chair/All** to invoke a discussion on the effect of long-term changes in MSL rise on national vertical datums. (**by TWCWG7**).	To revisit this as part of the continued updates to the **List of Vertical Datums used by Member States** document.	To add information regarding methods of computing reference datums, to be added to the List of Vertical Datums used by Member States document. **Action: Chair (UK) to co-ordinate.** To be discussed in 3.9
Action 2. *Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software (including Application for an IAPSO Best Practice Study group on Tidal Analysis):* **IHO** to investigate how to publish results of analysis on the IHO website. (**by TWCWG7**).	Ongoing	To be discussed in 3.3
Action 3.	Complete	

Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software (including Application for an IAPSO Best Practice Study group on Tidal Analysis): **Chair** to liaise with Dr Andy Matthews, UK/NOC, as to how TWCWG can contribute to the IAPSO work. (**by TWCWG7**).		
Action 4. *Inventory of Tide gauges used by IHO Member States:* **All** to review and pass on updates to IHO Sec for the doc to be updated. (**by TWCWG7**).	Ongoing	To be discussed in 3.7
Action 5. *Actual Tides On-line Link status:* **All** to review and pass on updates to IHO Sec for the doc to be updated. (**by TWCWG7**).	Ongoing	To be discussed in 3.8
Action 6. *List of vertical datums in use to describe Chart Datum:* **All** to review and pass on updates to IHO Sec for the doc to be updated (**by TWCWG7**).	Ongoing	To be discussed in 3.9
Action 7. *Water Level Information for Surface Navigation (S-104) – work done to produce Ed 1.0.0, and towards compliance with S-100 Ed 5.0.0:* **Project Team** to provide specific actions for next steps to TWCWG to facilitate next revisions of S-S-104 (**by TWCWG7**).	Ongoing	To be discussed in 4.1
Action 8. *Surface Current Product Specification (S-111) – towards compliance with S-100 Ed 5.0.0:* **Project Team** to provide specific actions for next steps to TWCWG to facilitate next revisions of S-S-111 (**by TWCWG7**).	Ongoing	
Action 9. *S-104 & S-111 Member State developments, Use cases, etc:* **KHOA** to prepare a list/survey of how MS water level data (S-104) and surface current data (S-111) are created. (**by TWCWG7**).	Complete	To be discussed in 4.4, 8.3
Action 10. *Questions and Discussion on Implementing S-104 into 'products':* **IHO / Chair** to organise a dedicated workshop to tackle this topic, involving OEMS, RENCS etc. (**by TWCWG7**).	Ongoing Engagement in TWCWG by PRIMAR hugely beneficial.	
Action 11. *Questions and Discussion on Implementing S-111 into 'products';* **Raphael Malyankar (RM)** to Prepare a User-case annex for S-111 (**by TWCWG7**).	Ongoing Engagement in TWCWG by PRIMAR hugely beneficial.	

Action 12. *Review of relevant IHO Charting Specifications:* **Ruth Farre (SANHO)** to initiate this work following decision by HSSC on technical resolutions. (**by TWCWG7**).	Complete	Check the status of comments received **Action IHO / Chair**
Action 13. *Capacity Building; Tides and Water Levels Workshop training material:* **IHO** to restore links to Capacity Building (CB) material. (**by TWCWG7**). **China (MSA)** invited to submit to Ruth Farre (SANHO) the PowerPoint of the Mandarin translation of the Tidal Theory course material [to date a PDF copy of the PowerPoint has been supplied] once ready. (**by TWCWG7**). Peter Stone (PS, NOAA) to liaise with Ruth Farre (SANHO) with regard to reinvigorating the Spanish Speaking Tides course (**by TWCWG7)**	 Complete Complete	To be discussed under item 7.1
Action 14. *Request by the Data Quality Working Group (DQWG) for TWCWG to investigate 'data quality' elements of water level and surface current data (including how to determine the "separation vertical uncertainty ratio" to allow use of Crowd Sourced Bathymetry (CSB) data:* **Chair** to liaise with Chair of CSBWG to understand the requirement for TWCWG support. (**TWCWG7**).	No progress	No further discussion on this intersessionally.
Action 15. *Venue and dates of the 7th TWCWG Meeting (TWCWG7):* **Ruth Farre (SANHO)** to investigate the logistics of hosting in 2023. (**TWCWG7**).	Not applicable (n/a)	n/a
Action 16. **All**: all those who have actions to complete should keep the Chair, Vice-Chair and Secretary informed of progress. (**TWCWG7**)	Ongoing	

3. Programme Matters

.1 Standard Constituent List – GBR/Chair

Discussion	Decisions	Actions
- The Chair gave a brief introduction and outline of the Standard Constituent List, highlighting where it could be accessed on the TWCWG website (https://iho.int/en/miscellaneous-6). - He noted that there had been one minor update to the document; a request to include the Semi-Diurnal constituent **beta$_2$ (β_2)** to the list, along with the associated numerical and alphabetical Extended Doodson Numbers (XDO's).	Updated the Standard Constituent List using the advice received. It was felt that some additional	**Chair (GBR)** and **Zarina Jayaswal** (AUS) to work on a suitable introduction.

- Additionally, it was reported that the speeds of $M(SK)_2$ and $M(KS)_2$ were listed 'out of order'. According to the listed arguments, their speeds ought to agree with those of $alpha_2$ and (the new) $beta_2$, respectively.	details, by way of an introduction, would be of use in the document.	**(by TWCWG8)**

.2 **The study of long-term data sets for the determination of global sea level rise and changes in tidal range.** – NOR/USA

Discussion	Decisions	Actions
- The chair introduced the background to the agenda item. - General discussion on the topic occurred. - Ruth Farre (SANHO) mentioned the recent research by Dr Peter Hogarth (UK National Oceanography Centre, Liverpool) on his archival data recovery research for South African locations relating to sea level rise studies. - Relating to the question of "*What is the effect of the long-term changes in MSL rise on national vertical datums?*", the Chair noted the action as described across.	Also discussed under Agenda Items 3.3, 3.4 and 3.9	Chair to request, from Member states, details about their 'epochs' used in their selection / calculation of their national vertical datums and add them to the List of vertical datums in use to describe Chart Datum.

.3 **Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software (including Application for an** International Association for the Physical Sciences of the Oceans **(**IAPSO**) Best Practice Study group on Tidal Analysis)**– USA/NOR/GBR [UK National Oceanography Centre, NOC]

Discussion	Decisions	Actions
- Hilde Sande Borck (NOR) provided a very helpful summary of this agenda item, including the 'history' and previous work undertaken on this topic. - The focus was to recognize the large amount of effort by several Member States to who contributed to this task over the past few years. - She emphasized the need to add these details to the TWCWG website, as the results are important and should be shared, thus encourage continued engagement in this important task. - Hilde went on to comment that the 'extension' of this task into the IAPSO best practice idea is most welcome and a good way forward to progress this activity. - In addition to accessing 'straightforward documents' on the IHO TWCWG website, the bigger question is how best to share the individual analyses undertaken by Member States?	Continue to encourage Member States to take the common data sets and analyse them using their national approaches (software, methodologies etc).	**IHO** to upload, to the TWCWG website, all the latest documents and results relevant to this task. **IHO** to advise on how best to share within TWCWG these 'larger' sets of files and documents which collectively form the 'whole

		analysis results'.
- Dr Andy Matthews (AM, NOC) gave a brief recap of the IAPSO Tidal Analysis Best Practice Study Group, first introduced in TWCWG6, 2022. - The first online meeting of the group occurred on Monday 30th January 1900 UTC. - Items covered at the meeting included a brief overview of the project, the available funding from IAPSO, and the expected outputs from the group. An in-person workshop was suggested to coincide with the IAPSO tide-related sessions at the 28th General Assembly of the International Union of Geodesy and Geophysics (IUGG); this occurs 11-20 July 2023 in Berlin (https://www.iugg2023berlin.org/). - AM will follow up with more details about this in due course. - An initial thought was that by 15th March 2023 a specific date at the session would be fixed. - The ultimate aim is still to produce a practical guide on tidal analysis, a best practice document, in the same guise as, for example, the IOC Manuals and Guides such as the Quality Control of in situ Sea Level Observations (https://repository.oceanbestpractices.org/handle/11329/1348)		**AM** to liaise with the TWCWG IAPSO Group members regarding the specifics of the workshop in July 2023.

.4 **Historical data recovery/data archaeology**– GBR/NLD

Discussion	**Decisions**	**Actions**
- The Chair introduced the topic and stressed the importance of the need to recover, catalogue, conserve and make available historical (largely analogue) tidal and water level records for ongoing research. - Ruth Farre (SANHO) again mentioned the recent research by Dr Peter Hogarth (see 3.2). - Gwenaële Jan (FR, Shom) mentioned some work involving a data recovery project for the Gironde River, and also reminded the group about an IOC Data Rescue Workshop in 2020, the details of which she had circulated during TWCWG4. The reference is here: https://unesdoc.unesco.org/ark:/48223/pf0000373327. - Dr Andy Matthews (AM, NOC) gave a brief recap of the Citizen science project (https://noc.ac.uk/news/over-3800-volunteers-help-noc-record-tide-gauge-data-liverpool) which he covered in TWCWG6 last year. 50 years' data from 2 sites was recovered; he highlighted it as an example of what can be achieved using a 'citizen science' approach. Quality control (QC) of the data is very important. - Elizabeth Bradshaw (EB, NOC), also referenced the IOC Data Rescue Workshop in 2020 and its link with GLOSS. She referred to a paper on "Data rescue process in the context of sea level reconstructions" which provides helpful guidance; see https://rmets.onlinelibrary.wiley.com/doi/epdf/10.1002/gdj3.179. She also stated that the Copernicus website lists data rescue projects, and suggests advice to those who have data in need of rescue through its Data Rescue Service	The following TWCWG members form part of the IAPSO Study Group: Zarina Jayaswal (AUS) Phil MacAulay (CAN) Peter Stone (USA) Andreas Bosch (DEU)	

(https://climate.copernicus.eu/data-rescue-service), although this is chiefly weather & climate orientated. - Jyrki Mononen (FTA, FL) asked if the data archaeology covered only tidal waters, or all water bodies; the response to which confirmed it covers all analogue records. - Thomas Hammarklint (SE) stated that they have rescued 96% of their analogue data.		

.5 **Establishment and Maintenance of VRF for High Resolution Bathymetric Surfaces** – GBR/NLD

Discussion	Decisions	Actions
- The Chair introduced the agenda item, giving a short, high-level overview. - Ronald Kuilman (NLHO, NLD) gave a presentation on the ongoing work of the North Sea hydrographic Commission (NSHC) Tidal Working Group (TWG), regarding comparing LAT, as defined within Member States' Vertical Reference frames (VRF), at the common boundaries in the North Sea region. - He explained that the NLHO is co-ordinating the refinement of the original approach (the original approach used a 1% norm, where the difference in LAT was divided by the charted depth; if the difference was <= 1% of the depth then it was regarded acceptable). This was refined to a norm connected the S-44 Hydrographic Survey Standard, Total Vertical Uncertainty (TVU) Order 1a, which was then proposed to be further refined to ½ TVU (Order 1a). More details can be found in the NSHC TWG25 Minutes at https://www.bshc.pro/wp-content/uploads/TWG25_Minutes.pdf. - Gael Andre (Shom, FRA) mentioned the larger differences between UK and France, which are the subject of more detailed investigations. - Zarina Jayaswal (AHS, AUS) mentioned that AUS are in the process of publishing documentation regarding 'surveying to the ellipsoid', and the necessary checks required as part of this process (across different user groups).		

.6 **Determining ellipsoidal height of MSL at the coast** – NLD

Discussion	Decisions	Actions
- The chair reported that there was no specific update on this agenda item. - He briefly gave an overview of the background and the relevance of this enduring agenda item and how it fitted into other work items, particularly long term study of sea level rise, and the ongoing development and maintenance of VRF.		

.7 **Inventory of Tide gauges used by IHO Member States** – IHO/Chair

Discussion	Decisions	Actions
- The Chair detailed the Inventory of Tide Gauges and explained where the resource is linked on the TWCWG website here. - He invited MS to ensure they review the document regularly and pass any updates to IHO for updating the list. - Discussions also covered the fact that the current format (Word and PDF) might not be the best format to use going forward.	IHO suggested they may be able to explore an alternate format, such as a web-based form which could be routinely updated by Member States.	**All** to regularly review the Inventory and pass on updates to IHO Sec for the doc to be updated.

.8 **Actual Tides On-line Link status** – IHO/Chair

Discussion	Decisions	Actions
- The Chair detailed about the Actual Tides On-Line Link (ATOLL) and explained where the resource is linked on the TWCWG website – under the Miscellaneous Information listed here. - He invited MS to ensure they review the document regularly and pass any updates to IHO for updating the list. - Discussions also covered the fact that the current format (Word and PDF) might not be the best format to use going forward.	IHO suggested they may be able to explore an alternate format, such as a web-based form which could be routinely updated by Member States.	**All** to regularly review the ATOLL and pass on updates to IHO Sec for the doc to be updated.

.9 **List of vertical datums in use to describe Chart Datum** –IHO/Chair

Discussion	Decisions	Actions
- The Chair detailed about the Actual Tides On-Line Link (ATOLL) and explained where the resource is linked on the TWCWG website – under the Miscellaneous Information listed here. - Peter Stone (USA, NOAA) suggested a useful addition would be information about how the datum is calculated, including a reference (epoch).	It could be that a link to relevant online documentation is provided within the list.	**All** to review and pass on updates to IHO Sec for the doc to be updated. **Chair** to contact Member States to request additional details which briefly describe how the datum(s) is / are calculated, epochs, etc.

- Discussions also covered the fact that the current format (Word and PDF) might not be the best format to use going forward.	IHO suggested they may be able to explore an alternate format, such as a web-based form which could be routinely updated by Member States.	

4. Product Specification (PS) Updates & Presentations

.1 Water Level Information for Surface Navigation (S-104) – current draft Ed 1.1.0, and working toward Ed 2.0.0– AUS/USA

Discussion	Decisions	Actions
- Greg Seroka & Raphael Malyankar (NOAA, USA and Portolan Sciences) gave a presentation, updating the group on the developments of the S-104 PS. - The PS has now been developed to Ed 1.1.0, through the dedicated work of the Project Team (PT). S-104 Ed. 1.1.0 is now fully aligned to S-100 Ed 5.0.0 (S-100 Part 17). - He explained the revisions which were common to **both** S-104 & S-111, including: o Full alignment with S-100 Ed 5.0.0. o Specified data type size for HDF5 attributes. o Harmonized enumeration for types of data. o Additional guidance for production. o Requirements for compliance with S 98 (Interoperability). o Guidance for "cell scheming". o Rules for dataset and support file names (allowed characters, length). o Various supporting artifacts. o Annex F describing product specific validation checks ("informative" in this edition). o Temporary removal of screen captures in Annex E. o Updated references. o Minor editorial corrections throughout. - Specific to S-104: o Fill value for waterLevelHeight now has 2 zeroes after decimal point. o Clause on determination of water level trend. - He summarised the intersessional work and thanked those who had contributed to the developments so far.		S-104 developments to be worked on intersessionally, co-ordinated by the S-104 PT.
NOTE: the following comments relate to BOTH S-104 & S-111. - In presentation "**TWCWG7_2023_4.1_EN_S1xxUpdates.pdf**", slide 5, 'encoding of exchange catalogue metadata related to maintenance', Raphael Malyankar (Portolan Sciences) requested assistance with common agreement on what should be done on the metadata and production rules for indicating a new edition of dataset,	Not to delay the release of the new Editions by awaiting screen captures of sample data	

cancelled datasets, when will the next dataset be issued. - Slide 6 – refers to the URL, https://staging.s100dev.net/, for the 'landing page' for the IHO S-100 Schemas. - Slide 11, Summary; it is suggested a review period for the whole of TWCWG to look at the content and provide feedback.	sets; these can be appended at a later date. They are useful but don't actually change the technical content)	**All** to look at the S-104 & S-111 content and provide any feedback to the S-104 / S-111 PT, by 31 March 2023.
- Svein Skjaeveland (PRIMAR) commented that S-100 provides the possibility of fileless cancelation. This means cancellations can be issued as instructions in the CATALOG.XML exchange catalogue without an accompanying dataset file. S-104 and S-111 should probably consider this in addition to the "traditional" file-based cancellation mechanism when developing cancellation strategy. - Raphael Malyankar (Portolan Sciences) responded on the fact that because the ISO metadata is optional in S-100, did PRIMAR propose to leave this option out of S-104 / S-111, i.e. not to include the option to encode ISO metadata?	Svein Skjaeveland (PRIMAR) and Raphael Malyankar (Portolan Sciences) both offered their help for Exchange Catalogue metadata, and to track the evolution of S-100 Part 17. Thomas Hammarklint (SWE) advised that scripts for their S-104 and S-111 creation could be made available, as they are co-ordinating implementation with neighbouring countries.	
- **Toward Edition 2.0.0 for both S-104 & S-111.** There are several key components to consider, given these will be catering for operational data. The aim is for 2024, before the end of the calendar year, and the upcoming S-100 Test Strategy Meeting (TSM) would discuss this further. - Require dedicated volunteers from member states to achieve the goal, to add assistance to the PT's.	Additional member state volunteers to join the PT's: Phil MacAulay, (CAN) Richard Flapper (NLD) (on	

	S-111 development)	
- Discussion also covered the portrayal catalogue, particularly for S-104, and the fact that S-100 Ed 5.0.0 may not be structured to fully support the 'symbol and pick report' proposed in S-104. Some type of portrayal might be covered in S-100 and/or S-98.	Work closely with S-100WG on this aspect.	
- Data Quality (DQ) checks (section 6 of the PS); discussion covered the fact that some additional proposed checks from the DQWG would need to be addressed when working towards Ed 2.0.0, and that the S-104 & S-111 PT's should extend their checks. S-100 Part 4c is being updated by the DQWG.	Work closely with DQWG on this aspect.	
- Test datasets; Greg Seroka (GS, NOAA) advised that existing code developed by the late Kurt Hess was being implemented here, and that the datasets would need to be properly and rigorously created. Testing must be automated and is reliant on S-100WG's generic and product-specific checks. (Tools like HDF5 View are manual visualisation and so cannot be used for this).	Both generic and product-specific testing and checks need to be implemented.	
- Some general discussions followed about how best to develop S-104 and S-111 products, for example Ruth Farre (SANHO) asked are the likes of Caris and dKart providing this type of 'production tooling'? Greg Seroka (NOAA) mentioned they are involved in the S-100WG. Svein Skjaeveland (PRIMAR) advised on the training courses available on S-111 (5 modules; https://primar.learnworlds.com/bundle/primar-s-111-course-bundle).		
- Zarina Jayaswal (AUS) raised the points that it will be necessary to add uncertainty as a feature attribute (and the need to agree how to calculate it) when considering the necessary real-time data requirements for Editions 2.0.0 of both S0194 & S-111.	Add uncertainty as a feature attribute. Calculate uncertainty as a feature attribute.	

.2 **Surface Current Product Specification (S-111) – current draft Ed 1.2.0, and working toward Ed 2.0.0**– AUS/USA

Discussion	Decisions	Actions
- Greg Seroka & Raphael Malyankar (NOAA, USA and Portolan Sciences) gave a presentation, updating the group on the developments of the S-111 PS. - The PS has now been developed to Ed 1.2.0, through the dedicated work of the Project Team (PT). S-111 Ed. 1.2.0 is now fully aligned to S-100 Ed 5.0.0 (S-100 Part 17). - He explained the revisions which were common to **both** S-104 & S-111 (see 4.1 above for items covered).		

- Specific to S-111: o Overview (clause 1) and Dataset identification (clause 3) harmonized with S 104 regarding both structure and content. o New attribute surfaceCurrentTime for use with non-uniform time intervals in DCF 8. o Various alignments with S-104. o Various updates to the values group.		
- Discussion on whether difference codes are required for S-111 [for Observed minus predicted/forecast/hindcast etc.] (as they are for S-104)? It is a more complex issue to provide differences in currents / streams, as there are two variables to consider (speed and direction).	Not to implement difference codes in S-111.	
- In presentation "**TWCWG7_2023_4.1_EN_S1xxUpdates.pdf**", slide 10, 'S-111 specific – 2 – values group', Raphael Malyankar (Portolan Sciences) requested a close review of this information.		**All** to look at the S-104 & S-111 content and provide any feedback to the S-104 / S-111 PT, by 31 March 2023.

.3 **Engagement with S-100WG and other relevant subordinate bodies** – USA

Discussion	Decisions	Actions
Largely covered by previous agenda item.		
- S-100 Part 17 is under revision by the S-100WG. - Some 'bookkeeping changes' are required for S-104 & S-111, but there is no immediate urgency for any other large-scale amendments or changes. - S-100 WG is working on interoperability		

.4 **S-104 & S-111 Member State developments, Use cases, etc**. – All

Discussion	Decisions	Actions
- Svein Skjæveland (PRIMAR) gave a talk relating to use cases, concerning data flow and services of S-104 and S-111 data.		

.5 **S-104 & S-111 Revisions to GI Registry** – USA

Discussion	Decisions	Actions
- Raphael Malyankar (Portolan Sciences) gave a presentation describing the IHO Geospatial Information Registry Proposals. - He explained the DQWG's issue with the definition of the attribute *surfaceCurrentSpeed* where they had requested TWCWG to finalize a clarification (there are two attributes in the registry; *surfaceCurrentSpeed* and *speed;* the existing definition of *surfaceCurrentSpeed* is both too general and too similar to *speed).* - **Three** initial proposed definitions were discussed by the TWCWG by extensive		

correspondence before the meeting (see presentation). - **<u>Two</u>** 'final' proposed definitions were then presented for discussion. - ***1**. Magnitude (or Value?) of current velocity at the water surface, measured or calculated at a depth (or range of depths) consistent with the data product.* - ***2**. Rate of flow of current, measured or calculated at a depth (or range of depths) consistent with the data product.* *Remark: Its units are the units of speed, for example knots.*		Definition 1 was chosen as the preferred option.
- There was also a request to add a time attribute to S-111 for non-uniform time interval data (analogous to the *waterLevelTime* attribute in s-104), i.e. the new attribute, *surfaceCurrentTime*.	The definition has been submitted to the IHO GI Registry and is being processed. A proposal to clarify the Remark for *waterLevelTime* in the same way (insert "Universal Time") as shown across has also been submitted.	The agreed definition is: *surfaceCurrentTime* The time of the surface current data, expressed in ISO 8601 Date time format. Remark: Unit: Years, months, days, hours, minutes, seconds; Resolution: 1 second. Example: 19850412T101530Z denotes 10 hours, 15 minutes, and 30 seconds Universal Time on 12 April 1985.

.6 **DQWG 'cross checks' of the S-104/S-111 Data Quality chapters, and Feature Catalogues with Data Classification & Encoding Guide (DCEG)** – Chair / USA / All

.7 **China Maritime Safety Administration (MSA) paper on testing of S-104 and S-111 datasets** - Chair / USA / All

Discussion	Decisions	Actions
- The Chair opened the discussion, detailing the intersessional correspondence with the Chair of the DQWG (Lingzhi Wu) regarding 'cross checks' of the Data Quality (DQ) Chapters between S-104 and S-111, and also between the S-104 and S-111 Feature Catalogues with the corresponding DCEG document. - See **DQWG_Report_on_the_Cross_check_of_DQ_chapters_ of_ S-104 _and_S-111_TWCWG7_4_6_1.pdf** and **DQWG_Report_on_the_Review of_S-1xx_Feature_Catalogues_TWCWG_4_6_2.pdf** - Additionally he detailed the information received from SHI Jingyuan of the China Maritime Safety Administration, regarding details of their testing of S-104 and S-111 datasets, with suggested recommendations.	- Some of the DQWG comments about *surfaceCurrentSpeed* are already 'on TWCWG's radar' (see 4.5 above) - The DQWG report stated that Edition 1.0.0 of S-111 was checked, which was the edition was prepared in 2018 *before* S-97 Part C (Data Quality)was prepared. - It was decided that cross-checking one S-1xx product's feature catalogue against another is of limited use. - Whether two concepts are over-similar is a IHO GI Registry matter. If two concepts are registered both can be used. Each product has its own FC and each FC	

- See paper "**China MSA Paper for Consideration by TWCWG_4_7.pdf**"	is available to the applications. Further, interoperability (S-100 Part 16 and S-98) does not require different products to use the same feature and attribute names.	

5. IHO Resolutions and Charting Specifications

.1 Review of relevant IHO Resolutions – ZAF

Discussion	Decisions	Actions
- Ruth Farre (RF, SANHO) provided an update on this topic. - Discussion surrounded the need to reflect / reference aspects of the S-104 & S-111 PS's within the appropriate 'tidal' Technical Resolutions (as advised by HSSC). - Stephan Dick (DEU) asked to add the IHO resolutions as a reference in the S-104 / S-111 sub references (specifically to Resolution 3/1919 [as amended).		Include sub references to Resolution 3/1919 [as amended] in S-104 & S-111

.2 Review of relevant IHO Charting Specifications – ZAF

Discussion	Decisions	Actions
- The relevant IHO Charting Specifications were reviewed; no specific issues or actions identified.		

6. IOC Programmes

.1 Update on IOC Global Sea Level Observing System (GLOSS) Programme items and events – USA

Discussion	Decisions	Actions
- The chair introduced Gary Mitchum (GM), the current Chair of GLOSS. - GM gave an update on GLOSS activities, including the 17th Meeting in Paris, 7-10 November, Paris, France. - His update included the following details: - Process – restructuring data access – how they look to the outside world. - Multiple data centres currently – aim to consolidate these into more streamlined access; obtain from "one" source (in the main). - Metadata – overhaul their metadata system. - GLOSS, established in 198, is now establishing a steering group of around 12 reps – to improve their global reach / agility / responsiveness. - Elizabeth (Liz) Bradshaw (UK NOC) will host the meeting of this group in Spring 2023. The aim is to present a draft of an update to the GLOSS implementation plan.		

- GM will possibly be standing down (after 10 years in the role). - Begonia Perez (ESP) / Peter Stone (USA) – mentioned the proliferation of low-cost water level sensors. GLOSS is looking at the role of the sensors, are they fit for purpose for GLOSS requirements? Related to some concerns following a recent meeting in Charlestown where there was a plan to deploy several of these types of meters; concerns over vertical datums, no real coordination, funding…is this a GLOSS-capable network etc. - Much discussion ensued around this point (such as Peter Stone, USA raising a point about communication to data centres regarding updates to the datums, how acoustic gauges perform vs radar etc.). For example their Integrated Ocean Observing System. - Zarina Jayaswal (AUS) referenced https://icsm.gov.au/what-we-do/aushydroid to reinforce the need to connect short term, lower grade water level gauges to known vertical datums, even if not meeting science /research requirements, for the minimum purposes of long term sea level monitoring. - Ruth Farre (ZAF) referred to SA national law – where sea level records are only to be carried out by the Hydrographic Office. Municipal law in local regions allow it but only by SQEP people. They have their OCIMS project. - Jyrki Mononen (FIN) also mentioned national legislation where the Finnish Meteorological Institute provides weather and physical sea services for transportation, safety, industry etc. - Hilde Sande Borck (NOR) explained about private companies deploying the low-cost sensors; this has caused some issues where the Norwegian HO has to field questions about these 'additional networks'. - Gwen Jan (FRA) agreed this is an important topic, and should be considered as an ongoing topic to monitor.		

.2 **Update on IOC Tsunamis & Other Hazards Related to Sea-Level Warning & Mitigation Systems (TOWS) Programme items and events** – CHL

Discussion	**Decisions**	**Actions**
- J Castro (JC) presented on the Global Ocean Observing System (GOOS) Regional Alliance for South East Pacific (GRASP). (He noted in advance that the XVI TOWS annual meeting clashed with this TWCWG7 meeting). - He explained the remit of the Southeast Pacific Tsunami Early Warning Working Group (GT-ATPS), as well as a workshop which "Shared Access to Data on Continuous Observation of Sea Levels: Tool for Effective Regional Response to Tsunami Emergencies". - The aim of the workshop was to enhance the capabilities of the GT-ATPS member countries to share in real time the data from their Sea Level		.

stations as a practical tool for risk management and warning in the event of a Tsunami threat. - It strengthened international cooperation in emergency situations under the intergovernmental coordination of the Pacific Tsunami Warning and Mitigation System (PTWS), and serves as an example for continued cooperation on Tsunami warning in other regions. - He citied the final achievement was the data portal at https://coos.inocar.mil.ec/visores/red_mareografica/ - The portal allows viewing the sea level recorded at 64 sea level stations, located in the Southeast Pacific region (Ecuador, Colombia, Peru and Chile) - See presentation at **TWCWG7_Tsunami_6_2.pdf**		

7. Capacity Building

.1 Tides and Water Levels Workshop training material – ZAF/AUS

Discussion	Decisions	Actions
- Ruth Farre (ZAF) recapped progress to date. - The Chinese translation has been completed. - Peter Stone (USA NOAA) stated he was hoping to set up the Spanish speaking course in November this year (2023). This will be working with IMO and IOC University of Costa Rica. Begonia Perez (ESP, GLOSS) and Cesar Borba (BRA) assisted.		8. China to check on the status of the Chinese language version.

8 Any Other Business

.1 Request by the Hydrographic Surveys WG (HSWG) for TWCWG assistance in revising the relevant sections of S-44 (Standards for Hydrographic Surveys) and C-13 (Manual on Hydrography) –HSWG/Chair/All

Discussion	Decisions	Actions
- David Parker (GBR, Chair of HSWG) was invited to attend this session of the TECWG7 meeting, where he introduced the topic. - He explained there was consensus to enable TWCWG to insert standards for water level height and current measurement into the next iteration of S-44. - S-44 Edition 6.1.0 has just been published (September 2022). - The next Edition is scheduled to go to HSSC in May 2024 for endorsement. - To align with the drafting team programme, HSWG would therefore	- No action yet to look at C-13, Manual of Hydrography, but the intention there is to look at all of the 'tide and water level related' content' and develop existing content, or create separate section(s) / new chapter(s) covering all relevant aspects of	Volunteers to look at this work: - Carl Kammerer (USA NOAA) [*specifically currents*] - Jyrki Mononen (FIN) - Zarina Jayaswal (AUS) [*only if volunteer numbers are limited]*.

need the TWCWG requirements to be provided by October 2023, with a final draft to be completed by Feb 2024. The drafting team are working as a 'sprint' to aim to have everything they need by February 2024. - He explained the requirement is for the TWCWG to look at S-44 and work out how to best fit in the water level height and current measurement 'standards'. - HSWG suggest TWCWG define the uncertainty limits for each survey order, to give you a range of options to apply in the field. - See supporting documents **S-44 TWCWG_HSWG collaboration_TWCWG_8_1.pdf** and **20230228_TWGWG7_Agenda Item 8.1_S-44 Tidal Uncertainties.pdf** - Much discussion occurred following the presentation - David Parker (UK HSWG Chair) mentioned that water level measurement for the TVU can be a component of the vertical uncertainty. These are discrete data sets in their own right; water levels should have a total uncertainty descriptor. - How to deal with meteorological effects was raised by Ruth Farre (ZAF), with Luca Repetti (ITA) stating that met conditions are impossible to factor in (such as seiches etc). - The question was raised if the IOC Manuals on sea level measurement and interpretation covered some of these aspects. - The Chair called for any volunteers to look at the potential to add the necessary data to S-44.	tides, water levels and surface currents. - No specific contact yet with Satellite Derived Bathymetry WG	- Phil MacAulay (CAN) [*not as lead]*. - Colin Shepherd (GBR) - Hilde Sande Borck (NOR) Action; to note the deadline for the S-44 drafting team requirement to gather data for Edition 6.2.0 of S-44 (October 2023) and prepare suitable detail for consideration by the S-44 drafting team, by the 15 October 2023.

.2 **IHO e-Learning center: https://elearning.iho.int/** - Chair / All

Discussion	**Decisions**	**Actions**
- The Chair provided a background to the agenda item. - He noted that there are currently no tides / water levels / currents courses available on this website - There may be the potential for elements of the Capacity Building Tide Course could be made available via this resource. - Ruth Farre (ZAF) mentioned that SAIC countries has used online versions of course material.		

.3 **Survey on tides, water level and currents data production method and data format (S-104 & S-111 products)** –KHOA

Discussion	Decisions	Actions
- Mr Jun-Shik Lee (KOR, KHOA) introduced the topic, providing an excellent in-depth summary of the responses received. - KHOA had prepared a questionnaire / survey, to identify MS's opinion on the production methods and data formats of their respective S-104 & S-111 capabilities and products to date. - 16 responses were received. - The survey provided a very interesting overview of the current state of 'readiness levels' across MS. - A key element was to understand the priorities of relative importance of real time, forecast and predicted water levels and surface currents. - The questionnaire allowed for a better understanding of: a. different vertical datum, numerical models and grid sizes. b. How to set a priority order in the data type and suggest useful guidance on S-104 and S-111 PS. c. What problems do MS have?- do they need additional 'surveys'? d. How does the TWCWG help MS's to develop their capability? - The Chair and TWCWG as a whole expressed their thanks to KHOA for their good work on this important topic.		It was agreed that the questionnaire / survey should be repeated at regular intervals, with a second survey to be completed before TWCW8

.4 **Maritime Autonomous Surface Ships (MASS) – Gap Analysis in S-104 & S-111**– Chair

Discussion	Decisions	Actions
- The Chair introduced the topic. - He went through the work of the MASS PT gap analysis, where they analyzed the gap between S-104 & S-111, and the requirements of MASS. - They provided a document listing all issues relating to S-104 & S-111 accordingly. - The document contained the following headers; a. Issue/Requirement b. Issue addressed? (Y/N) c. More content? d. Gap in standard? e. Potential Solution(s) f. Ease to implement?		

- All of the Issues / Requirements were marked as "Y" in the 'Issue addressed' column. - The main theme discussed in the document was the provision of real-time data, which is considered a key element by the MASS PT. - In correspondence between TWCWG Chair and Mr Sundongli (China MSA and vice chair of MASS PT), with invaluable input from Greg Seroka and Raphael Malyankar (TWCWG S-104 & S-111 PT), the following information regarding real-time data in S-104/S-111 was provided: - *The plan has been/is to wait until S-100 Ed 5.0.0 (Part 14) solves real-time data first before implementing any real-time data solutions in S-104 or S-111.* - *This way, S-104 or S-111 wouldn't implement a "unique solution" that is different or not used by any other PS, but rather will implement whatever S-100 implements for real-time.* - *A member of the TWCWG PT has contacted the Chair of S-100 (Julia Powell) to enquire if there are more definite plans for S-100 Part 14 development in this regard.* - *So we are unsure if everything has been solved for real-time in S-100 Ed 5.0.0 yet.* Regarding real-time water level and surface currents in general, and with their links to MASS: - *In simplest terms, a real-time water level value at a single point (i.e. at the specific location of a water level gauge) is no different, conceptually, to a water level prediction / forecast water level value at a single point. Of course the real-time data is just not available 'in advance' in terms of 'forward planning!'..it hasn't happened yet!.* - *The same applies for a real-time tidal surface current / stream single data point (for example from a moored current meter or ADCP unit telemetering the real-time current information).* - *It could be considered that any "MASS automated decision making" on board a vessel would follow some rules-based processing which assimilates the single point real-time water level, or surface current value (where such sources exist), then compares it to the predicted or forecast value, which it used 'in advance' to plan its arrival (and when the vessel is located sufficiently close enough for the real-time data to be relevant*); then the vessel makes some decision on what to do next if the difference is deemed to be an issue in terms of safety or efficiency.* - *As we understand it, S-100 Part 14 is aimed at handling the transfer of real-time data from the observation platform to the 'consumer' (in this case the MASS vessel), so it itself wouldn't stipulate how that data should be used in an S-104 or S-111 'solution' (*i.e. how that single point real-time water level value is used to amend the predicted or forecast value, and how far from the single point its influence is*		

allowed to extend. The same applies to real-time surface current). - *Transfer (exchange) of the data could involve either AIS (Application Specific Messages, ASM, e.g. https://academy.iala-aism.org/asm/) and / or "tidal zones of influence".* - *We understand that S-100 Port 14 relates to transfer mechanisms such as internet streaming (another way to retrieve real-time data), metadata for time, and other real-time mechanisms (but this may be in development).* - *Within TWCWG, we need to discuss whether we have some 'freedom' to implement real-time solutions in S-104/S-111 or not, e.g. to include both AIS ASM and internet streaming, and also to discuss TWCWG's consensus on "tidal zones of influence" and how to use them.* - *If these are all stipulated in S-100 then S-104 & S-111 could follow S-100's standards.* - *TWCWG will probably need to wait to see if there are definite plans for revising and developing S-100 Part 14 further.* - *TWCWG will also have discussions at our next TWCWG meeting about this topic, particularly the real-time "tidal zones of influence".*		

.5 **Minimum metadata requirements for tide & water level gauges** - GBR [UK National Oceanography Centre (NOC)]

Discussion	**Decisions**	**Actions**
- Andy Matthews (AM, NOC) and Liz Bradshaw (LB, NOC) introduced the topic, stating there are currently not well defined 'minimum metadata' for tide & water level gauges. - Generally the metadata requirements are dependent on the use-case, say for example long term study or near real-time. - He mentioned the idea of "Metadata Crosswalks", so talking to other organisations who also use it as minimum metadata sets, such as the WMO and other Ocean Data websites. - One important example of metadata for PSMSL data is datum information. - Ruth Farre (ZAF) advised the IHO Technical Resolutions does include metadata requirements for water level readings and currents / streams collection. - Peter Stone (USA, NOAA) stated NOAA have Standard Operating Procedures (SOPs) for installing a new tidal station – a whole list of requirements before they declare it operational (for real-time). For		- Ruth Farre (ZAF) to forward the Technical Resolutions to Liz Bradshaw (NOC). - All MS to forward any SOPs on this subject By 31 March 2023

example levelling records etc. They collect 30 days first. Check existing datums. All this is industry standard. - Zarina Jayaswal (AUS) provided a link to the Intergovernmental Committee on Surveying and Mapping - Tide Gauge Survey Instructions and Forms.		

9. Work Plan and ToRs

.1 TWCWG Work Plan 2023-2024 updates – Chair

Discussion	Decisions	Actions
- The chair took the group through the work programme with the various updates and changes - Link to WP		
- Task M minor edit (remove the wording "propose a new"	Agreed	
- Task B2 – next milestone changed from "tbc" to "As directed by the IAPSO/TWCWG contact"; amended the start date to 2023. - Added Andrew Matthews as the IAPSO/TWCWG contact; - Removed the wording "If endorsed by HSSC"	Agreed	
- Task D1 – amended the end date for Issue Edition 1.2.0 to 2023, and the start date from Edition 2.0.0 amended to 2023. - Removed Neil Weston name and replaced with Greg Seroka. - Named Kwang nam HAN as the KHOA rep. - Amended the remarks regarding alignment with S-100 Ed 5.0.0	Agreed	
- Task E1 - similar amendments as above for Task D1.	Agreed	
- Task F1 – removed Neil Weston	Agreed	
- Task M1 – added "All" to the contact person(s) column.		

.2 Review TWCWG ToRs and RoPs – IHO

Discussion	Decisions	Actions
ToRs and RoPs reviewed	Accepted	

10. Venue and dates of the 8th TWCWG Meeting (TWCWG7) – Chair/IHO

Discussion	Decisions	Actions
February 2024 – IHO Monaco		

11. Review of Action Items from TWCWG7 – IHO

Discussion	Decisions	Actions
To be circulated post meeting.		

12. Development of TWCWG7 report to HSSC15 – Chair

Discussion	Decisions	Actions
- Chair to finalise the report. - He advised members that they will only have a short period of time to review in order to get to HSSC in good time.		

13. Draft Agenda for TWCWG7 – Chair/IHO

Discussion	Decisions	Actions
To be circulated post meeting Will reflect the work plan and emerging / ongoing topics such as: IAPSO collaboration Progress on S-104 &S-111		

14. Election of Chair and Vice Chair – IHO

Discussion	Decisions	Actions
Both positions are happy to proceed	Both Chris Jones and Ruth Farre will continue in their respective roles as Chair & Vice Chair	

15. Closing remarks – Chair/All

Discussion	Decisions	Actions
The Chair expressed his thanks to all participants for their valuable contributions, and was especially grateful for the high level of online attendance, given the time zone differences of several delegates.		
The ambitious agenda had covered several important topics and made significant progress.		
Closing remarks from both Ruth Farre (Vice Chair) and Sam Harper (IHO) re-iterated these sentiments.		

Meeting closed at 16:10 GMT Thursday 2nd March 2023