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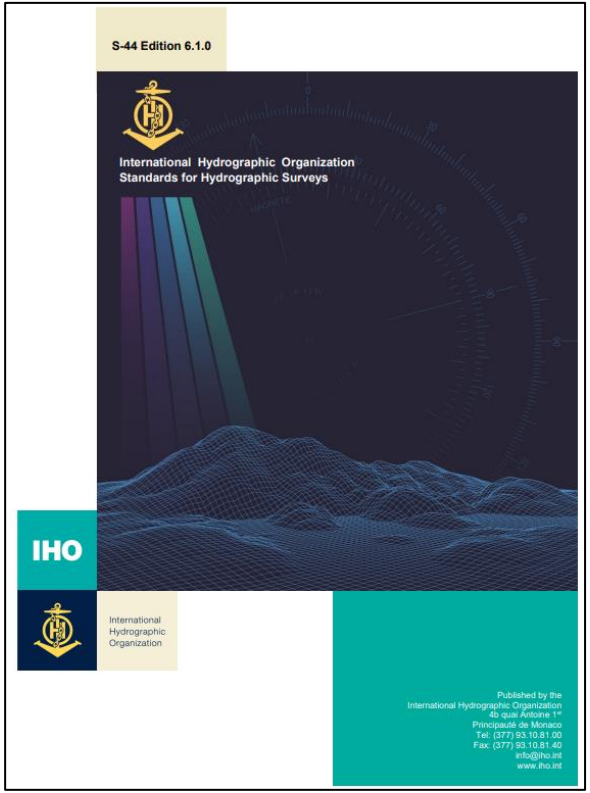
TWCWG7 28 Feb – 2 March 2023

Agenda Item 8.1

Offer by the Hydrographic Surveys WG (HSWG) for TWCWG collaboration to improve tidal observation uncertainty standards within the relevant sections of S-44 (Standards for Hydrographic Surveys)



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Introduction

- S-44 currently holds very limited information about "**tidal observation uncertainties**".
- In Edition 6.1.0, the only tidal observation/measurement uncertainties mentioned are those for '**Water Flow Direction**' and '**Water Flow Speed**'.

(Ref: https://iho.int/uploads/user/pubs/standards/s-44/S-44_Edition_6.1.0.pdf)

7.4 TABLE 2 - Other Minimum Standards for Safety of Navigation Surveys

To be read in conjunction with the full text set out in this document. Standards for Table 2 data types only apply where such measurements are required for the survey.

m = metres. All uncertainties at 95% confidence level. * = Matrix Reference.

Reference	Criteria	Uncertainty Component	Order 2	Order 1b	Order 1a	Special Order	Exclusive Order
Section 5.2	Fixed Objects, Aids to Navigation, Features Above the Vertical Reference Significant to Navigation	THU [m]	5 m *Pa4	2 m *Pa6	2 m *Pa6	2 m *Pa6	1 m *Pa7
		TVU [m]	2 m *Pb2	2 m *Pb2	1 m *Pb3	0.5 m *Pb4	0.25 m *Pb5
Section 5.3	Floating Objects and Aids to Navigation	THU [m]	20 m *Pc2	10 m *Pc3	10 m *Pc3	10 m *Pc3	5 m *Pc4
Section 5.4	Coastline (high, low, MWL water lines, etc.)	THU [m]	10 m *Pd2	10 m *Pd2	10 m *Pd2	10 m *Pd2	5 m *Pd3
Section 5.5	Features Above the Vertical Reference Less Significant to Navigation	THU [m]	20 m *Pe2	20 m *Pe2	20 m *Pe2	10 m *Pe3	5 m *Pe4
		TVU [m]	3 m *Pf1	2 m *Pf2	1 m *Pf3	0.5 m *Pf4	0.3 m *Pf5
Section 5.6	Overhead Clearances	THU [m]	10 m *Pg1	10 m *Pg1	5 m *Pg2	2 m *Pg3	1 m *Pg4
		TVU [m]	3 m *Ph1	2 m *Ph2	1 m *Ph3	0.5 m *Ph4	0.3 m *Ph5
Section 5.7	Angular Measurements	[degrees]	0.5 degrees *Pi4				
Section 4.4	Water Flow Direction	[degrees]	10 degrees *Wa1				
Section 4.4	Water Flow Speed	[knots]	0.1 knots *Wb5				

- For both criteria, there is a **single value of uncertainty** measurement across all the Survey Orders (i.e. 10 degrees and 0.1 knots across all Orders *2, 1b, 1a, Special* and *Exclusive*).

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TWCWG need to consider the following:

Criteria

- Are '**Water Flow Direction**' and '**Water Flow Speed**' the correct / relevant terms?
- Should we also include '**Water Flow Time**' as an additional criterion?
- There is no mention of '**Water level Height**' – should this be included?
- There is no mention of '**Water Level Time**' – should this be included?
- Anything else? (For example, uncertainty of the height (or depth) at which 'Water Flows' are collected)?

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TWCWG need to consider the following:

Across the Survey Orders

- Do we need ‘separate’ uncertainty measurements of the agreed Criteria for each Survey Order?
- If so, how do we establish these values? They must be representative at the 2-sigma (95%) confidence level.

As an example, this ***could*** look something like this:

7.2 Table 2
Possible additions to the table for 'Water Flow Time', 'Water Level Height' and 'Water Level Time'

Reference	Criteria	Uncertainty Type	Order 2	Order 1b	Order 1a	Special Order	Exclusive Order
Section 4.4	Water Flow Direction	[degrees]	'a'° to 'b'°	'b'° to 'c'°	'c'° to 'd'°	'd'° to 'e'°	<'e'°
Section 4.4	Water Flow Speed	[knots]	'a' kn to 'b' kn	'b' kn to 'c' kn	'c' kn to 'd' kn	'd' kn to 'e' kn	<'e' kn
Section 4.?	Water Flow Time	[minutes]	'a' min to 'b' min	'b' min to 'c' min	'c' min to 'd' min	'd' min to 'e' min	<'e' min
Section 4.?	Water Level Height	[metres]	'a' m to 'b' m	'b' m to 'c' m	'c' m to 'd' m	'd' m to 'e' m	<'e' m
Section 4.?	Water Level Time	[minutes]	'a' min to 'b' min	'b' min to 'c' min	'c' min to 'd' min	'd' min to 'e' min	<'e' min

(Note: if this approach is taken, additional development of the **Matrix Classes and Descriptions** could then be developed; that is a follow-on activity once the initial additional Criteria discussed above are agreed).

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Other considerations:

Chapter 4 of S-44:

Should this section be much more detailed for both Water level and Water Flow Observations?

CHAPTER 4 WATER LEVELS AND FLOW

4.1 Introduction

In this chapter, water levels are considered in the context of supporting the vertical solution of depth measurements, rather than water level measurements as a discrete dataset to define tidal harmonics etc, which are covered within other IHO documents. Tides and other changes in water levels which impact the TVU of depth data must be considered for any hydrographic survey regardless of the technology used to conduct the survey. Flow observations will often be required to support safe navigation, and when specified in the survey requirement, those observations must meet the parameters presented in this standard.

For requirements to clearly determine chart and land survey vertical datum connections, or relationships, see section 2.5.

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4.2 Water Level (Tidal) Predictions

Water level observations may be required to facilitate generation and maintenance of tidal prediction models and the production of Tide Tables. Water level observations should cover as long a period as possible and preferably not less than 30 days.

4.3 Reductions for Water Level Observations

Whenever surveyed/predicted water levels or tides are used to reduce soundings to a datum, allowance shall be made in the TVU calculations for the uncertainty of the values. Observed values are preferred over predicted.

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4.4 Water Flow (Tidal Stream and Current) Observations

The speed and direction of water flows (tidal streams and currents) which may exceed 0.5 knots should be observed in key areas, if not already defined. For example, at the entrances to harbours and channels, at any change in direction of a channel, in anchorages, and adjacent to wharf areas. It is also recommended to measure coastal and offshore streams and currents when they are of sufficient strength to affect surface navigation.

The water flow (tidal stream and current) at each position should be measured at depths sufficient to meet the requirements of normal surface navigation in the survey area. In the case of tidal streams, simultaneous observations of tidal height and meteorological conditions should be made. It is recommended that the period of observation be at least 30 days.

The speed and direction of the water flow (tidal stream and current) must be measured at 95% confidence level as defined in Table 2. Where there is reason to believe that other factors (e.g. seasonal river discharge) influence the water flows, measurements should be made to cover the entire period of variability.

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Other points to note:

- S-44 is intended to be used by a ‘global audience’; so techniques and methods of data collection could range from simple tide measuring staff and timing a surface float through to the most advanced radar tide gauges and ADCP’s, including Earth Observation (EO) techniques.
- This needs to be reflected in the achievable uncertainties. (So from the “most basic” up to the “best”).
- Uncertainties should be ‘equipment agnostic’ [but as per the above bullet, be adequate to cover all possibilities which could be achieved in the field].
- OEM’s will possibly (probably!) use any such table to advertise the capabilities of their equipment.
- What do mariners want (or need) to achieve from this?

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Timelines

- S-44 Ed. 6.1.0 has very recently been published.
- There is now **an established 2-year 'refresh cycle'** for S-44; so HSWG is already '1 year in' to this cycle.
- HSWG5 occurs in **September / October 2023**. Therefore they would require this work completed by TWCWG ready for them to discuss at that meeting.
- HSWG then have until February / March 2024 to finalise the next Edition of S-44, to propose it to HSSC16 (likely May 2024).....then endorsed by Member States..... then published.