NCWG4-07.2A

Paper for Consideration by NCWG

Development of new section V on data quality

Submitted by:	UK Hydrographic Office
Executive Summary:	Progress update on section V development since NCWG3
Related Documents:	NCWG3-11.2A
Related Projects:	None

Introduction / Background

1. UK received following action on Section V development from NCWG3:

   ACTION 3/34: UK to prepare a preliminary draft of INT1 Section V.

2. The INT1 subWG agreed via a teleconference in March 2018 that further discussion regarding content of proposed section V should be conducted by the subWG and that it should also be discussed further at NCWG4.
3. The UK has included a new section V on data quality in its new edition of publication 5011 published August 2018.

Analysis / Discussion

4. A copy of the UKs new section V from publication 5011 has been made available at Annex A. Early versions of this new section were shared with the INT1 subWG. Since then there have been some further amendments by the UK before publication. This included removing a statement that the older the date of the reported depth, the less likely it existed.

   ***"'Rep' Reported (I3)**. Used to chart a reported danger to navigation, the existence of which has not been confirmed by a controlled survey, but there is no reason to doubt the validity. Sometimes called a vigia. It may indicate that a shoal area exists and there may be even shoaler depths in the vicinity. Sometimes a date will be included. ~~the older it is, the less likely the existence of the reported feature~~"*

   A further amendment was to include a reference to celestial observations as fixing methods in the technological horizons table.

Year	Sounding method	Fixing method
Pre 1865	Leadline	Angles to local land marks or celestrial observations if in an offshore location

Conclusions

5. Further discussion needed by INT1 subWG before including a section V in INT1.

Recommendations

6. NCWG and INT1subWG to discuss at NCWG4 and consider section V published by UK.

Justification and Impacts

7. NCWG3-11.2A explained the history of section v development and UK took an action to prepare a preliminary draft for consideration.
8. INT1subWG will need to hold further discussions.
9. If approved INT 1 will require updating.

Action required of NCWG

The NCWG is invited to take notice of this report and consider the recommendation for further discussion on this topic and also the draft produced by the UK.

V Data Quality Indicators

Following a large chart user survey, it became apparent that some mariners are insufficiently aware of the importance of data quality indicators on charts. This section of INT1 aims to provide more detail and clarification of the implications of data quality indicators on paper charts. Mariners should not assume that the information shown on a modern chart, especially depth, is absolutely accurate or precisely positioned. In general, this will largely depend on the age of the source data, how it was obtained and for what purpose. While a vessel with satellite navigation equipment may be able navigate very accurately, dangers on the chart may not be accurately positioned so a wide berth is still advisable.

The most important guide to data quality on most paper charts of 1:500 000 scale and larger is the Source diagram or Source statement in the chart title. Some Source diagrams are based on the ENC Category of Zone of Confidence (CATZOC) but more usually the Sources will be listed by authority (e.g. government, harbour authority, foreign chart), age (see technology horizons table below), and scale (where relevant). Some may also add information about method of data collection (e.g. leadline, multibeam, passage soundings), type of survey (e.g. reconnaissance), % seafloor ensonification. From this, the mariner should be able to assess the likely accuracy of the charted detail.
Note: Not every chart has a source diagram, particularly very large scales which may have a single source; in such cases, the source data will usually be stated under the title.

Data quality on ENC is mainly expressed by Zones of Confidence (ZOC). These provide a more exact guide to the positional accuracy and seafloor coverage of the source survey, compared to the 'clues' to data quality on paper charts from which the mariners will make their own assessment. Initially, ENC were compiled from paper charts. Often there was no time to reassess all source information to apply the different criteria used to establish ZOC, so some areas were marked as U (=unassessed); in such cases, the paper chart is likely to give more information. Some paper chart source diagrams now use ZOCs, sometimes with the addition of a temporal element to allow the mariner to assess how much the survey information may have degraded over time (especially in changeable areas). ZOCs are defined in various places including The Mariner's Handbook and on charts where they are used.

In changeable areas, the contours and depths at the edges of different surveys are unlikely to match. In such cases, a deliberate break may be left to show the edge, sometimes with a legend such as 'Discontinuity between surveys'. The date of the surveys may be shown either side of the break or can be determined from the Source diagram.

Survey technology has changed over the years. Fortunately, there have been relatively few fundamental technology changes and these, once introduced, have tended to rapidly take over for all surveys. Hence, there are a few 'technology horizons' at which survey accuracy took a step change. Between these technology horizons the quality of surveys will have remained relatively static. The dates and reasons for the technology horizons are given in the 'technology horizons' table below.

Year	Sounding method	Fixing method	Remarks
Pre 1865	Leadline	Angles to local land marks or celestrial observations if in an offshore location	Surveys were mainly concerned with recording previously undiscovered lands. More attention was given to fixing the coast than to providing soundings. Soundings, where present at all, tend to be sparse with irregular gaps between them. The quoted scale is largely irrelevant when used to judge likely sounding density.
1865	Leadline	Angles to local land marks or celestrial observations if in an offshore location	Steam replaced sail in British survey ships and regular lines of sounding begin to appear. The scale of survey will give an indication of the expected density of soundings (the larger, the denser). Inshore, where boats were used instead of the ships, oars still remained as the motive power and sounding lines continued to be irregular.
1905	Leadline	Angles to local land marks or celestrial observations if in an offshore location	Steam replaced oars as the power for survey boats allowing regular lines to be extended to all areas and water depths of the survey. The scale of survey gives an indication of the expected density of soundings (the larger, the denser).
1935	Single beam echo Sounder	Angles to local land marks or celestrial observations if in an offshore location	Greater ease of collecting soundings allowed a far greater density to be gathered. The scale of survey gives an indication of the expected density of soundings.
1950	Single beam echo Sounder	Electronic position fixing	Greater accuracy/consistency of position fixing extending further off shore than was possible with sextant angles to shore marks.
1973	Single beam echo sounder and Side Scan Sonar	Electronic position fixing	Side Scan Sonar (SSS) allows surveyors to locate hazards that exist between survey lines. For the first time the survey will have covered the entire sea floor.
1985	Single beam echo sounder and Side Scan Sonar	Satellite position fixing	Introduction of satellite positioning allows surveyors to accurately position ship anywhere in the world to a common datum.
2000	Swathe echo sounder	Satellite position fixing	Swathe (including beam-forming/multibeam, interferometric and LIDAR) replaces single beam and side scan sonar. Swathe allows the surveyor to not only detect obstructions between survey lines but also allows depths to be gathered over them. Scale is irrelevant, % ensonification is important.

Data Quality Indicators V

In addition to the Source diagram, there may be other clues to the accuracy of data. These are listed in various sections of INT1, but a more detailed explanation is given below:

'PA' Position approximate (B7). Used to indicate that the position of a land or water feature has not been accurately determined or does not remain fixed.

'PD' Position doubtful (B8). Used principally to indicate that a wreck, obstruction, shoal, etc., has been reported in various positions and not definitely determined in any (e.g. a wreck or container washed overboard, where the last known position still afloat is the best data available).

'ED' Existence doubtful (I1). Used principally to indicate the reported existence of a rock, shoal, etc., the actual existence of which is considered improbable (e.g. because of doubts about the validity of the data or the context of the position).

'SD' Sounding doubtful (I2). Used to indicate that a depth over a shoal, a rock, etc., may be less than charted, though the position is not in doubt.

'Rep' Reported (I3). Used to chart a reported danger to navigation, the existence of which has not been confirmed by a controlled survey, but there is no reason to doubt the validity. Sometimes called a vigia. It may indicate that a shoal area exists and there may be even shoaler depths in the vicinity. Sometimes a date will be included.

Discoloured water. This legend may indicate the possible existence of shoal water.

Imprecise shoal areas. In areas where reliable hydrographic survey data is very limited or non-existent, it may be possible to identify shoal areas by reference to other sources (e.g. satellite imagery, altimetry, gravimetric data). If confidence in the data is low (including extent and even approximate depth) such areas may be charted by an area of full shallow water blue tint, without limiting line, danger line or contour.

Soundings in fine upright font (I14). are used to draw attention to sources which are considered unreliable for some reason (e.g. enlarged from a small-scale survey, age of source, poor positional control). Usually in such areas, the depth contours will be shown as broken lines (I31) and the Source diagram may provide further information. Odd upright soundings scattered amongst normal soundings usually indicates that they are from older sources but have not been definitely disproved by a more modern survey of the area.

Unsurveyed/Inadequately surveyed (I25). Some areas are surrounded by a bold dashed line (usually black, but on some charts magenta) with a legend warning that the area is unsurveyed or that there is something 'inadequate' about the survey (which should be explained in a note or by reference to the Source diagram). Unsurveyed areas may also be shown by alternating bands of white and blue tint. Such areas are usually shown for comparatively small unsurveyed areas amongst surveyed areas; large unsurveyed areas will be apparent simply from a lack of any soundings.

Sandwaves (J14). The depth in sandwave areas may be less than charted, because surveys were not necessarily conducted at the time of maximum sandwave height.

Swept depths (I24, K2, K27, K42). A 'bracket' ⌙ under a depth indicates that the depth over a feature or within an area has been carefully measured by a physical means (e.g. drag sweep, diver). The depth was therefore accurate at the time of survey but it may have changed since. A date may be given.

Safe clearance depth (K3, K30). A 'bar' over a depth, e.g. $\overline{20}$ must not be confused with the symbol above; it means the opposite! It indicates that the depth has only been estimated, e.g. the depth over a wreck may be estimated by subtracting the height of the wreck from the general depth in the area and applying a safety margin. However, it is possible that the wreck is not lying flat on the sea floor.

Wreck 'not considered dangerous to surface navigation' (K29). ⧺ The draught of surface vessels has increased since the symbol was originally designed (when it was assumed that the greatest draught was 8 fathoms/14.6m). Unfortunately, it cannot be assumed that the symbol has been updated on a later chart (even though the depth criteria for the symbol has been changed over time). Any vessel with a draft greater than 14m is therefore recommended to avoid passing over such wrecks (except where they are in water deep enough to render them completely safe). More details are given in The Mariner's Handbook.

Spoil grounds and extraction areas (N62, N63). Even if marked disused, such areas indicate that depths are likely to have changed since the last survey. It should not be assumed that extraction areas will be deeper; the extraction process may result in material being heaped up in some areas.

After disasters. Sometimes the charted depths covering large areas of seafloor may become suspect as the result of a major disaster (e.g. tsunami, earthquake, hurricane). A cautionary note on the chart and/or a preliminary Notice to Mariners will generally be issued. Emergency surveys completed after the disaster to cover shipping lanes may then be highlighted in some way on the chart, with an explanatory note provided on the chart.