INTERNATIONAL HYDROGRAPHIC ORGANIZATION

ORGANISATION HYDROGRAPHIQUE INTERNATIONALE

IHB File No. S3/8151/CHRIS

CIRCULAR LETTER 64/2007
13 July 2007

CONSISTENT ENCODING OF ENCs

Reference: a) IHB CL 32/2007 dated 14 March 2007.

Dear Hydrographer,

1 Reference a) requested, *inter alia*, that Member States approve the codification of a set of recommendations for consistent encoding of ENCs into the IHO Technical Resolutions to increase their visibility and encourage their use. To date, thirty-two Member States have replied with only one dissenting response; however, a few Member States have made substantive comments within their negative response or qualified approvals. Specifically, there were concerns over the assignment of compilation scale based on radar ranges, variation between M-4 defined usage bands and those noted in the recommendations, and the SCAMIN assignment procedures. Member States' comments are contained in **Annex A**. Furthermore, as foretold in the response from the UKHO, IC-ENC presented to the TSMAD and C&SMWG meetings in May/June 2007 a new procedure for assigning SCAMIN that can be automated and produces a greater degree of consistency between ENC cells. This procedure received consensus support from TSMAD, who recommended that CHRIS consider it and submit it to Member States for approval. This recommendation is provided in **Annex B** for your review in advance of the next CHRIS meeting (Rotterdam, 4 - 9 November 2007).

2 The IHB proposes to suspend the voting for the proposed Technical Resolution annexed to reference a) until CHRIS can review this new procedure, the comments of Member States and formulate its recommendation. It should be noted that the recommendations for consistent encoding of ENCs were initially presented to Member States in July 2004 and remain, by and large, effective methods of increasing the consistency between ENC cells. The new procedure at **Annex B** impacts the currently proposed recommendations under paragraph 2. Member States are invited to explore the usability and effectiveness of this method of assigning SCAMIN.

On behalf of the Directing Committee
Yours sincerely,

Rear Admiral Kenneth BARBOR
Director

Encls: Annex A - Member States' Comments
Annex B - Proposasal for the Consistent Use of the Attribute SCAMIN

Member States' Comments in response to IHB CL 32/2007

1. The following Member States voted, without comment, in favour of adopting the *Recommendations for Consistent ENC Data Encoding* as an IHO Technical Resolution:

Belgium, Brazil, Colombia, Denmark, Estonia, Finland, Germany, Iceland, Italy, Netherlands, Norway, Pakistan, Peru, Poland, Singapore, Slovenia, South Africa, Spain, Tunisia and Ukraine.

2. The Member States provided the following comments in addition to their vote in favour of adopting as an IHO Technical Resolution the *Recommendations for Consistent ENC Data Encoding:*

- **Argentina** - This HO agrees that "the Recommendations for Consistent ENC Data Encoding" contained in Annex A of the Circular Letter No. 32/2007 become the new IHO Technical Resolution A 3.14, without including item 2 about SCAMIN criteria.

  In this respect, this HO is currently setting SCAMIN through an automated procedure which enables the software we are using to produce ENCs, by means of a look-up table which we have been using since 2004, according to IHO recommendations. For example, for the objects which should be displayed for a longer time (buoys and beacons).

  To comply with item 2 would imply a manual setting, object by object, or by small groups, involving a longer procedure time and the risk of making a larger number of mistakes.

- **Australia** - While efforts to promote ENC consistency are strongly supported by the AHS there are concerns that a Technical Resolution may not achieve the desired visibility and status amongst technical staff involved in encoding activities. It is therefore considered that this matter should also be raised as an ENC Encoding Bulletin to more directly support and clarify the existing specifications, with the Bulletin maintained by TSMAD.

- **Colombia** - The Hydrographic Service of Colombia considers that legalizing all the recommendations through an IHO Technical Resolution is positive, as it contributes to obtaining an homogeneous final product of a better quality. That means that the editor must also apply these recommendations to the ENCs.

- **Ecuador -** We should ensure that the navigational purposes scale bands coincide, both for paper and electronic charts and for paper charts, which are mentioned in Publication M-4, section B 126.

- **India** - The recommendations for Consistent ENC data encoding will greatly facilitate resolving boundary cell data problem and would lead to improving ENC consistency.

- **Japan** - All ENC should meet these recommendations as soon as possible.

- **Oman** - The more guidance the IHO can provide in this regard the better.

- **Papua New Guinea** - Papua New Guinea does not produce its charts as yet; the Australian Hydrographic Office has been our great supporter in our region. We fully support recommendations for consistent ENC Data Encoding.

- **Portugal** - IHPT fully supports that the '*Recommendations for Consistent ENC Data Encoding*', as contained in Annex A to IHB CL 32/2007, be made a new IHO Technical Resolution A3.14. As stated several times by IHPT before, we agree that every step taken to improve the consistency will make the product more user friendly for the end user. IHO has created ENC encoding good practices, has produced publications like ENCs PRODUCTION GUIDANCE and can make technical resolutions about ENC consistency. This proposed technical resolution is a further contribution.

- **Sweden** - The recommendations must remain recommendations even as an IHO Technical Resolution.

- **United Kingdom** - Although it is the intention for these recommendations to form part of S-101 in the future, UKHO agrees that ENC consistency is an urgent issue and therefore a Technical Resolution will be of use in the short term.

  Further work on SCAMIN is currently underway within IC-ENC to provide a more detailed and structured framework for those Member States who wish to go beyond the minimum approach described in bullet 2. para. 2 of the current recommendations. IC-ENC will be presenting this to the next TSMAD. IHB may therefore wish to consider awaiting the outcome of TSMAD meeting before finalizing the Technical Resolution, as a suitable cross-reference to these additional guidelines may be beneficial.

- **United States** - Guidelines need to change agilely. Making them a TR would involve an unnecessary level of bureaucracy to update them as new encoding issues are identified and guidelines issued. An alternative that would be acceptable would be a TR that says "Following the encoding guidelines (published elsewhere)".

  Further, the Guidelines as they are presently written have the following weaknesses.
  Guideline 1:
  - Setting the compilation scale of ENC to values in the table, and indicating the next larger scale as the compilation scale for ENCs in between tabulated values causes the accuracy of too many ENCs to be overstated. For example, the many 1:40,000 compilation scale ENCs in the USA would be encoded as having a compilation scale of 1:20,000 implying a higher accuracy than exists. USA (NOAA) would not encourage such an overstatement of accuracy.
  - Guideline 1, second bullet: The situation in this bullet is incorrectly described. Indicating a larger scale would cause clutter to be reduced, not increased.
  - Table 1 - Radar range/standard scale table, the problem being addressed is partly a display issue and partly a data issue. Those issues should be separated and addressed separately.

  Guideline 2:
  - This guideline is out of date. NAV 52/MSC 82 changed the content of the Display Base/Standard Display by moving "Beacons and Buoys" from the Base Display to the Standard Display.

3. **Bangladesh** - Abstained from voting commenting that, "As ENC production capability could not yet be adopted by Bangladesh and we do not possess the desired level of expertise

to evaluate the 'Recommendations for Consistent ENC Data Encoding'. Hence no vote could be rendered in this regard.

4. **France** - Voted against adopting the recommendations as an IHO Technical Resolution with the following comment:

France does not approve the inclusion of the recommendations related to consistent encoding of ENCs in the Technical Resolutions. France recommends that the CHRIS Committee be invited to make an objective analysis of the respective advantages and disadvantages of adapting the ECDIS display standard, on the one hand, and, the ENC product specification, on the other in order to attain the consistency objective, at least cost. This analysis should involve the representatives of the ENC producers and ECDIS manufacturers and be undertaken keeping in mind the ambitious objective that the IHO Member States have set themselves in adopting Proposal 23 at the 17th International Hydrographic Conference related to achieving an adequate ENC coverage.

Annex B to IHB CL 64/2007
IHB File No S3/8151/CHRIS

Proposal for the consistent application of the attribute SCAMIN

April 2007

1. Background

In October 2003, IC-ENC published a paper entitled “SCAMIN”, describing the importance of the consistent use of the attribute SCAMIN by data producers. At the time, many HOs were not making use of this attribute and those that were encoding it used different methods. This paper was subsequently submitted to TSMAD for review and was used as the basis for the SCAMIN recommendation in IHO CL 47/2004 (see Annex A).

These IHO recommendations define a minimum application of SCAMIN, which is to apply a global SCAMIN value linked to the compilation scale of the next available ENC. Whilst this approach provides a simple and cost effective method of populating this important attribute, it has a number of inherent weaknesses - most importantly:

- No account is taken of the relative importance of individual occurrences of an object or object class.
- Where there are large gaps in the scales of coverage available, this method will not achieve a sufficient degree of de-cluttering.
- Features common across navigational purposes will have different SCAMIN values causing them to disappear and reappear as the user zooms out.

The IHO recommendations go on to describe the optional use of intermediate SCAMIN values for certain object classes to address these issues, but does not offer guidance on how to determine these intermediate values.

More recent research by IC-ENC has highlighted that HOs are now either:

- Relying on the automated SCAMIN functions available within their ENC production software (which varies from system to system);
- Using only the minimum approach outlined in the IHO recommendations;
- Going beyond this minimum approach by determining the intermediate value based on the smallest scale depiction of an object (but only a few);
- Seeking more definitive guidance before applying SCAMIN (the majority).

IC-ENC has therefore developed an updated set of proposals designed to:

- Improve the current IHO minimum approach so that many of the inherent weaknesses are addressed without needing significant additional resources to achieve.
- Offer the guidance necessary to give HOs who wish to apply a more refined application of SCAMIN the confidence to do so in a consistent and logical manner.

These proposals are now submitted for wider consideration following a period of consultation with Production software manufacturers, OEMs and Hydrographic offices.

2. Proposals

2.1. Compilation Scale

As already stated in the IHO recommendations, it is very important that HOs follow the recommendation to set compilation scale for ENCs from the list of fixed standard scales below as this then acts as the reference point for SCAMIN attribution.

Standard scale
1:3,000,000
1:1,500,000
1:700,000
1:350,000
1:180,000
1:90,000
1:45,000
1:22,000
1:12,000
1:8,000
1:4,000

An example to illustrate this:
An ENC produced from a 1:25,000 paper chart has a nearest larger standard scale of 1:22,000, so should normally have a compilation scale of 22,000. Exceptionally, however, the compilation scale for such an ENC may be set to 12,000, but only if the source material for the paper chart is from surveys of a scale larger than 1:12,000.

2.2. Application of SCAMIN – Revised minimum approach

IC-ENC now proposes the following rules for the revised minimum application of SCAMIN:

1. SCAMIN values used must be selected from the following list:-

1:19,999,999
1:9,999,999
1:4,999,999
1:2,999,999
1:1,499,999
1:699,999
1:499,999
1:349,999
1:259,999
1:179,999
1:119,999

1:89,999
1:59,999
1:44,999
1:29,999
1:21,999
1:17,999
1:11,999
1:7,999
1:3,999
1:1,999
1:999

Note that additional SCAMIN values have been added midway between the recommended compilation scales in order to take advantage of the wider range of display scales available on many ECDIS systems. These additional values will enable a more refined approach to the setting of SCAMIN resulting in a more subtle reduction of the data displayed.

The list has also been extended to include SCAMIN values for ENCs with compilation scales greater than 1:4,000 and smaller than 1:3,000,000.

2. SCAMIN values for features within an ENC must be set to either 1, 2, 3 or 4 steps smaller scale than the compilation scale of the ENC.

For example a point ACHBRT object depicted on an ENC with a compilation scale of 8,000 would have a SCAMIN value of 11,999 (i.e. 1 step smaller scale than 8,000)

3. Annex B lists the step values (i.e. 1, 2, 3 or 4) that must be applied for specific object classes together with any relevant conditions.

An example to illustrate this: when setting the SCAMIN value for a conspicuous BUISGL object in a Harbour cell (CS = 12,000), the value of SCAMIN would be determined as three steps smaller than 12,000 which would be 29,999.

4. Linear & area objects that extend beyond the coverage of a cell into an adjacent cell must be assigned a SCAMIN value based on the compilation scale of the smaller scale cell.

An example to illustrate this: when setting the SCAMIN value for a linear CBLSUB object in a Harbour cell (CS = 8,000) that extends into an adjacent Harbour cell with a compilation scale of 12,000, the value of SCAMIN would be determined as three steps smaller than 12,000 which would be 29,999.

2.3. Application of SCAMIN – Optional Advanced approach

The revised minimum approach described above offers an automated solution which addresses many of the current limitations, such as:

- Account is taken of the relative importance of different object classes rather than switching off all objects at the same scale.
- Sufficient de-cluttering will occur even where there are large gaps in the scales of coverage available.

However, this revised minimum approach still takes no direct account of the relative importance of individual occurrences of an object, and may still result in the unsettling situation where an object disappears and then reappears as the user zooms out.

To address these remaining issues, IC-ENC now proposes the following optional rule which replaces rule 2 described above:-

5. The SCAMIN value of an individual occurrence of an object must be set to either 1, 2, 3 or 4 steps smaller scale than the compilation scale of the smallest scale ENC that the specific geometric depiction of that object appears on.

For example a BUISGL object may be depicted as an area in ENCs with compilation scales of 2,000 and 8,000 but as a point in an ENC with a compilation scale of 22,000. Its SCAMIN value would therefore be set to 11,999, 1 step smaller scale than 8,000 not 45,000.

Setting SCAMIN based on the scale of the smallest scale product that a particular object appears on will ensure that the most significant features remain on display longer and ensure consistent display as the user zooms in and out.

This approach will require significant manual intervention where ENC production is based on digitising paper charts. However it will become more feasible in the future with the advent of “Hydrographic Database” solutions, since a single value of SCAMIN can be set for all objects stored in the database to achieve the desired outcome.

2.4. S-52 Conditional Symbology Procedures

In drafting the steps proposed in Annex B, IC-ENC has taken into account the fact that the rules for ECDIS “Base Display” will change following the adoption of a revised ECDIS performance standard by IMO. This change means that objects which appear in “Base Display” will become dependent on the safety contour set by the user.

The new rules define that Display Base (i.e. to be permanently shown on the ECDIS display) will consist of:

1. Coastline (high water);
2. Own ship's safety contour;
3. Isolated underwater dangers of depths less than the safety contour which lie within the safe waters defined by the safety contour;
4. Isolated dangers which lie within the safe water defined by the safety contour, such as fixed structures, overhead wires, etc.,
5. Scale, range and north arrow;
6. Units of depth and height;
7. Display mode

In order to ensure safe and optimal de-cluttering, it is therefore proposed that the Colours and Symbols Maintenance Working Group review the Conditional Symbology Procedures to ensure that underwater hazards, and isolated dangers that fall into the categories listed under 3 and 4 above, will remain displayed regardless of any SCAMIN value encoded. This review should form part of the development of the planned new edition of S-52.

3. Conclusions

This review of the current situation has highlighted the wide variety of different solutions that have been adopted by various HOs for the encoding of SCAMIN since the publication of the IHO recommendations. In many cases, HOs have already identified the limitations of the minimum approach proposed in the IHO recommendations and have introduced more detailed approaches; a few have adopted the minimum proposal in the IHO recommendations, whilst many others await more detailed guidance. This inconsistent approach across data producers was raised as a major concern at the 2nd ECDIS Stakeholders Forum and 10th WEND meeting (Sept 2006).

IC-ENC has, therefore, proposed a more detailed minimum approach. This proposed method takes into account the relative importance of individual occurrences of an object class and will achieve a sufficient degree of de-cluttering even when there are large gaps in the scales of data available. By applying the optional advanced option, HOs with Hydrographic databases can also ensure a consistent display as the user switches between usage bands.

If this proposal is approved at the RENC level, IC-ENC recommends that it is forwarded to TSMAD for consideration as part of its work to develop the new ENC product specification (S-101).

Richard Fowle IC-ENC, Taunton, March 2007

ANNEX A

IHO Circular Letter 47/2004 - IMPROVING ENC CONSISTENCY

SCAMIN values should be determined using a method that reduces the number of individual objects displayed and ensures clarity, using the standard rounded display scales listed in the above table:

- SCAMIN should be applied to all SCAMIN-attributable objects and also to buoys and beacons which belong to the display category “base display” of the IMO Performance Standards for ECDIS. SCAMIN should not be applied to any other base display objects.

- As a minimum, a single standard value should be applied to all SCAMIN-attributable objects. This single standard value should be set to the compilation scale minus 1 of the next available smaller scale ENC covering the area, e.g. for an ENC with a compilation scale of 12000, where the next available smaller scale ENC has a compilation scale of 90,000, this standard SCAMIN value should be set to 89,999.

- In order to achieve clarity of display as the user zooms out, intermediate SCAMIN values should be applied to those individual objects in SCAMIN-attributable object classes that the HO considers are less important and that are contributing to clutter. These values should be set to one of the rounded standard scales (minus one) between the compilation scale of the cell and the compilation scale of the next smaller scale ENC available. For instance, for an ENC with a compilation scale of 12,000, where the next available smaller scale ENC has a compilation scale of 90,000, a SCAMIN value of 44,999 could be applied to such objects.

- If it is desired to continue displaying navigationally important objects of the ENC at zoom levels beyond the compilation scale of the next smaller scale ENC available, other smaller scale SCAMIN values should be applied to such individual objects. These values should be set to one of the rounded standard scales (minus one) beyond the compilation scale of the next smaller scale ENC available. For instance, in the example above, a SCAMIN value of 179,999 may be applied to such objects. The number of upward steps in rounded standard scales will differ for different objects/object classes of differing importance for navigation, e.g. selected soundings may possibly have SCAMIN values of two steps beyond, whereas aids to navigation (buoys, beacons etc.) may possibly require three or more steps beyond.

For the purposes of consistency, and to support a seamless transition between ENC cells, it makes sense if the objects selected for smaller scale SCAMIN values broadly correlate with the objects which appear on the next smaller scale ENC available.

- If there is currently no smaller scale ENC available, it is recommended that the starting point for use of SCAMIN be set at two steps beyond the compilation scale. The values should be set to one of the rounded standard scales (minus one) beyond the compilation scale of the ENC as described above.

- If the above recommendations are used to apply SCAMIN values, the last bullet point of UOC clause 2.2.7 recommending the use of the same SCAMIN value for all navigational purposes no longer applies.

- In order to ensure consistency of display at their boundaries, it is essential that HOs liaise with their neighbouring HOs, RENC and/or Regional Hydrographic Commission when defining these SCAMIN values.

ANNEX B

Specific SCAMIN step values for Object and attribute combinations

In the following table, group 2 objects have been sub-divided into the following sub-groups:-

2M Meta objects.
2B Group2 objects that are always part of base display.
2CB Group 2 objects that are part of base display dependent on safety contour setting.
2S Group 2 objects in standard display

The final column **SCAMIN STEPS** indicates the number of steps above (smaller scale) the compilation scale that SCAMIN values should be set to.

NB. Producers should be prepared to deviate from the step values specified when the significance of the feature dictates, e.g. the recommended number of steps for a LIGHTS object is 4, but there will be circumstances where a LIGHTS object is so important that no SCAMIN value be applied; alternatively, the light could be so minor that a step value of 1 can be applied.

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
ACHARE	Point	2		2
ACHARE	Area	2S	If RESTRN defined	3
ACHARE	Area	2		2
ACHBRT	Point	2		1
ACHBRT	Area	2		1
ADMARE	Area	2		1
AIRARE	Point	2S	If CONVIS = 1(visually conspicuous)	3
AIRARE	Point	2		1
AIRARE	Area	2S	If CONVIS = 1(visually conspicuous)	2
AIRARE	Area	2		1
ARCSLN	Area	2S		4
ASLXLN	Line	2S		4
BCNCAR	Point	2S		3
BCNISD	Point	2CB		4
BCNLAT	Point	2S		3
BCNSAW	Point	2S		3
BCNSPP	Point	2S		3
BERTHS	Point	2		1
BERTHS	Line	2		1
BERTHS	Area	2		1
BOYCAR	Point	2S		3
BOYINB	Point	2S		3

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
BOYISD	Point	2CB		4
BOYLAT	Point	2S		3
BOYSAW	Point	2S		3
BOYSPP	Point	2S		3
BRIDGE	Point	2CB	Over navigable water	4
BRIDGE	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
BRIDGE	Point	2		1
BRIDGE	Line	2CB	Over navigable water	4
BRIDGE	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
BRIDGE	Line	2		1
BRIDGE	Area	2CB	Over navigable water	4
BRIDGE	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
BRIDGE	Area	2		1
BUAARE	Point	2S	If CONVIS = 1(visually conspicuous)	3
BUAARE	Point	2		1
BUAARE	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
BUAARE	Area	2		1
BUISGL	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) or FUNCTN = 33	3
BUISGL	Point	2		1
BUISGL	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) or FUNCTN = 33	3
BUISGL	Area	2		1
C_AGGR	N/A	2		NOT SET
C_ASSO	N/A	2		NOT SET
CANALS	Line	2		1
CANALS	Area	2		2
CAUSWY	Line	2		2
CAUSWY	Area	2		2
CBLARE	Area	2S	If RESTRN defined	3
CBLARE	Area	2		2
CBLOHD	Line	2CB	Over Navigable Water	4
CBLOHD	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
CBLOHD	Line	2		1
CBLSUB	Line	2		3
CGUSTA	Point	2		1
CHKPNT	Point	2		1
CHKPNT	Area	2		1
COALNE	Line	2B		NOT SET
CONVYR	Line	2CB	Over Navigable Water	4
CONVYR	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
CONVYR	Line	2		1
CONVYR	Area	2CB	Over Navigable Water	4
CONVYR	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
CONVYR	Area	2		1
CONZNE	Area	2		2
COSARE	Area	2		1
CRANES	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
CRANES	Point	2		1
CRANES	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
CRANES	Area	2		1
CTNARE	Point	2S		4
CTNARE	Area	2S		4
CTRPNT	Point	2		1
CTSARE	Point	2		1
CTSARE	Area	2		1
CURENT	Point	2		3
CUSZNE	Area	2		2
DAMCON	Point	2		1
DAMCON	Line	2B	If sharing geometry with LNDARE & DEPARE or DRGARE	NOT SET
DAMCON	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
DAMCON	Line	2		1
DAMCON	Area	2B	Making up part of coastline	NOT SET
DAMCON	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
DAMCON	Area	2		1
DAYMAR	Point	2S	If Slave SCAMIN must match that of Master	3
DEPARE	Line	2		1
DEPARE	Area	1		NOT SET
DEPCNT	Line	2CB	If VALDCO = 0 (drying line) or 30 (default safety contour ref S-52)	4
DEPCNT	Line	2		2
DISMAR	Point	2		2
DMPGRD	Point	2S	If RESTRN defined	3
DMPGRD	Point	2		2
DMPGRD	Area	2S	If RESTRN defined	3
DMPGRD	Area	2		2
DOCARE	Area	2		1
DRGARE	Area	1		NOT SET
DRYDOC	Area	2		1
DWRTCL	Line	2S		4
DWRTPT	Area	2S		4

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
DYKCON	Line	2B	If sharing geometry with LNDARE & DEPARE or DRGARE	NOT SET
DYKCON	Line	2		1
DYKCON	Area	2B	If sharing geometry with LNDARE & DEPARE or DRGARE	NOT SET
DYKCON	Area	2		1
EXEZNE	Area	2		1
FAIRWY	Area	2S		3
FERYRT	Line	2S		3
FERYRT	Area	2S		3
FLODOC	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
FLODOC	Area	1		NOT SET
FNCLNE	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
FNCLNE	Line	2		1
FOGSIG	Point	2S	If Slave SCAMIN must match that of Master	3
FORSTC	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
FORSTC	Point	2		1
FORSTC	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
FORSTC	Line	2		1
FORSTC	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
FORSTC	Area	2		1
FRPARE	Area	2		2
FSHFAC	Point	2		2
FSHFAC	Line	2		2
FSHFAC	Area	2		2
FSHGRD	Area	2		1
FSHZNE	Area	2		1
GATCON	Point	2		2
GATCON	Line	2B	If sharing geometry with LNDARE & DEPARE or DRGARE	NOT SET
GATCON	Line	2		2
GATCON	Area	2B	If sharing geometry with LNDARE & DEPARE or DRGARE	NOT SET
GATCON	Area	2		2
GENOBJ	Point	2S		4
GENOBJ	Line	2S		4
GENOBJ	Area	2S		4
GRIDRN	Point	2		1
GRIDRN	Area	2		1
HRBARE	Area	2		3
HRBFAC	Point	2		1
HRBFAC	Area	2		1

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
HULKES	Point	2		1
HULKES	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
HULKES	Area	1		NOT SET
ICEARE	Area	2		3
ICNARE	Point	2		1
ICNARE	Area	2S	If RESTRN defined	3
ICNARE	Area	2		1
ISTZNE	Area	2S		3
LAKARE	Area	2		1
LIGHTS	Point	2S	If Slave SCAMIN must match that of Master	4
LITFLT	Point	2S		4
LITVES	Point	2S		4
LNDARE	Point	2		NOT SET
LNDARE	Line	2		NOT SET
LNDARE	Area	1		NOT SET
LNDELV	Point	2S	If CONVIS = 1(visually conspicuous)	3
LNDELV	Point	2		1
LNDELV	Line	2		1
LNDMRK	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) or FUNCTN = 33	3
LNDMRK	Point	2		1
LNDMRK	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
LNDMRK	Line	2		1
LNDMRK	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) or FUNCTN = 33	3
LNDMRK	Area	2		1
LNDRGN	Point	2		1
LNDRGN	Area	2		1
LOCMAG	Point	2		3
LOCMAG	Line	2		3
LOCMAG	Area	2		3
LOGPON	Point	2CB	On Navigable Water	4
LOGPON	Point	2		1
LOGPON	Area	2CB	On Navigable Water	4
LOGPON	Area	2		1
LOKBSN	Area	2		1
M_ACCY	Area	2M		NOT SET
M_COVR	Area	2M		NOT SET
M_CSCL	Area	2M		NOT SET

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
M_HOPA	Area	2M		NOT SET
M_NPUB	Area	2M		NOT SET
M_NSYS	Area	2M		NOT SET
M_QUAL	Area	2M		NOT SET
M_SDAT	Area	2M		NOT SET
M_SREL	Area	2M		NOT SET
M_VDAT	Area	2M		NOT SET
MAGVAR	Point	2		3
MAGVAR	Line	2		3
MAGVAR	Area	2		3
MARCUL	Point	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m	4
MARCUL	Point	2		1
MARCUL	Line	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m	4
MARCUL	Line	2		1
MARCUL	Area	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m	4
MARCUL	Area	2S	If RESTRN defined	3
MARCUL	Area	2		2
MIPARE	Point	2S		3
MIPARE	Area	2S		3
MORFAC	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
MORFAC	Point	2S		2
MORFAC	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
MORFAC	Line	2S		2
MORFAC	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
MORFAC	Area	2S		3
NAVLNE	Line	2		2
OBSTRN	Point	2CB	Isolated obstructions	4
OBSTRN	Point	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m	4
OBSTRN	Point	2	The most significant OBSTRN of a group of OBSTRNS within close proximity	NOT SET
OBSTRN	Point	2	For groups of OBSTRNs in close proximity, or within an OBSTRN area	2
OBSTRN	Line	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m	4
OBSTRN	Line	2CB		4
OBSTRN	Area	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m	4
OBSTRN	Area	2CB		4

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
OFSPLF	Point	2CB	Isolated Installations	4
OFSPLF	Point	2S		3
OFSPLF	Area	2CB		4
OFSPLF	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
OILBAR	Line	2CB		4
OSPARE	Area	2CB		4
OSPARE	Area	2CB	If RESTRN = defined or CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	4
PILBOP	Point	2		3
PILBOP	Area	2		3
PILPNT	Point	2CB	Where used to mark position of LIGHTS object in water	4
PILPNT	Point	2S	If CONVIS = 1(visually conspicuous)	3
PILPNT	Point	2		2
PIPARE	Point	2S		3
PIPARE	Area	2S		3
PIPOHD	Line	2CB	Over Navigable Water	4
PIPOHD	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
PIPOHD	Line	2		1
PIPSOL	Point	2	Submarine	3
PIPSOL	Point	2	On land	1
PIPSOL	Line	2	Submarine	3
PIPSOL	Line	2	On land	1
PONTON	Line	2		2
PONTON	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
PONTON	Area	1		NOT SET
PRCARE	Point	2S		3
PRCARE	Area	2S		3
PRDARE	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
PRDARE	Point	2		1
PRDARE	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
PRDARE	Area	2		1
PYLONS	Point	2CB	Bridge supports in navigable water	4
PYLONS	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
PYLONS	Point	2		1
PYLONS	Area	2CB	Bridge supports in navigable water	4
PYLONS	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
PYLONS	Area	2		1
RADLNE	Line	2		3
RADRFL	Point	2	If Slave SCAMIN must match that of Master	3
RADRNG	Area	2		3
RADSTA	Point	2	If Slave SCAMIN must match that of Master	2
RAILWY	Line	2		1

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
RAPIDS	Point	2		1
RAPIDS	Line	2		1
RAPIDS	Area	2		1
RCRTCL	Line	2S		3
RCTLPT	Point	2S		3
RCTLPT	Area	2S		3
RDOCAL	Point	2S		3
RDOCAL	Line	2S		3
RDOSTA	Point	2	If Slave SCAMIN must match that of Master	1
RECTRC	Line	2S		3
RECTRC	Area	2S		3
RESARE	Area	2S		3
RETRFL	Point	2S	If Slave SCAMIN must match that of Master	3
RIVERS	Line	2		1
RIVERS	Area	2		4
ROADWY	Point	2		1
ROADWY	Line	2		1
ROADWY	Area	2		1
RSCSTA	Point	2		3
RTPBCN	Point	2S	If Slave SCAMIN must match that of Master	3
RUNWAY	Point	2S	If CONVIS = 1(visually conspicuous)	3
RUNWAY	Point	2		1
RUNWAY	Line	2S	If CONVIS = 1(visually conspicuous)	3
RUNWAY	Line	2		1
RUNWAY	Area	2S	If CONVIS = 1(visually conspicuous)	3
RUNWAY	Area	2		1
SBDARE	Point	2		1
SBDARE	Line	2		1
SBDARE	Area	2		1
SEAARE	Point	2		1
SEAARE	Area	2		1
SILTNK	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1(radar conspicuous) or Representative of a group of SILTNKs	3
SILTNK	Point	2		1
SILTNK	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1(radar conspicuous) or Representative of a group of SILTNKs	3
SILTNK	Area	2		1
SISTAT	Point	2	If Slave SCAMIN must match that of Master	1
SISTAW	Point	2	If Slave SCAMIN must match that of Master	1
SLCONS	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
SLCONS	Point	2		1
SLCONS	Line	2B	If sharing geometry with LNDARE & DEPARE or DRGARE	NOT SET
SLCONS	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
SLCONS	Line	2		2

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
SLCONS	Area	2B	If sharing geometry with LNDARE & DEPARE or DRGARE	NOT SET
SLCONS	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
SLCONS	Area	2		2
SLOGRD	Point	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
SLOGRD	Point	2		1
SLOGRD	Area	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
SLOGRD	Area	2		1
SLOTOP	Line	2S	If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
SLOTOP	Line	2		1
SMCFAC	Point	2		1
SMCFAC	Area	2		1
SNDWAV	Point	2		3
SNDWAV	Line	2		3
SNDWAV	Area	2		3
SOUNDG	Point	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m	4
SOUNDG	Point	2	Critical Depths over sand bars etc where EXPSOU < 30m	3
SOUNDG	Point	2		1
SPLARE	Point	2S	If RESTRN defined	3
SPLARE	Point	2		1
SPLARE	Area	2S	If RESTRN defined	3
SPLARE	Area	2		1
SPRING	Point	2		1
STSLNE	Line	2		1
SUBTLN	Area	2S		3
SWPARE	Area	2		3
T_HMON	Point	2		1
T_HMON	Area	2		1
T_NHMN	Point	2		1
T_NHMN	Area	2		1
T_TIMS	Point	2		1
T_TIMS	Area	2		1
TESARE	Area	2S	If RESTRN defined	3
TESARE	Area	2		2
TIDEWY	Line	2		1
TIDEWY	Area	2		1
TOPMAR	Point	2S	If Slave SCAMIN must match that of Master	3
TS_FEB	Point	2		3
TS_FEB	Area	2		3
TS_PAD	Point	2		2
TS_PAD	Area	2		2
TS_PNH	Point	2		2
TS_PNH	Area	2		2

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
TS_PRH	Point	2		2
TS_PRH	Area	2		2
TSELNE	Line	2S		NOT SET
TSEZNE	Area	2S		NOT SET
TSSBND	Line	2S		NOT SET
TSSCRS	Area	2S		NOT SET
TSSLPT	Area	2S		NOT SET
TSSRON	Area	2S		NOT SET
TS-TIS	Point	2		2
TS-TIS	Area	2		2
TUNNEL	Point	2		1
TUNNEL	Line	2		1
TUNNEL	Area	2CB	If Navigable	4
TUNNEL	Area	2		1
TWRTPT	Area	2S		3
UNSARE	Area	1		NOT SET
UWTROC	Point	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m	4
UWTROC	Point	2	Not within an OBSTRN area	3
UWTROC	Point	2		2
VEGATN	Point	2S	If CONVIS = 1(visually conspicuous)	3
VEGATN	Point	2		1
VEGATN	Line	2S	If CONVIS = 1(visually conspicuous)	3
VEGATN	Line	2		1
VEGATN	Area	2S	If CONVIS = 1(visually conspicuous)	3
VEGATN	Area	2		1
WATFAL	Point	2S	If CONVIS = 1(visually conspicuous)	3
WATFAL	Point	2		1
WATFAL	Line	2S	If CONVIS = 1(visually conspicuous)	3
WATFAL	Line	2		1
WATTUR	Point	2		3
WATTUR	Line	2		3
WATTUR	Area	2		3
WEDKLP	Point	2		3
WEDKLP	Area	2		3
WRECKS	Point	2CB	If EXPSOU = 2(shoaler than range of the surrounding depth area) & VALSOU ≤ 30m or CATWRK = 2,4 or 5	4
WRECKS	Point	2S	CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
WRECKS	Point	2	For groups of WRECKSs in close proximity, the most significant should not have SCAMIN	2

OBJECT	PRIMITIVE	GROUP	CONDITION	SCAMIN STEPS
WRECKS	Area	2CB	If EXPSOU = 2 & VALSOU ≤ 30m or CATWRK = 2,4 or 5	4
WRECKS	Area	2S	CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous)	3
WRECKS	Area	2		2