

ZONES OF CONFIDENCE FOR NEW ZEALAND

Improving Hydrographic Information

In July 2004 HSA Systems Ltd (HSA) commenced an 18-month project for Land Information New Zealand (LINZ) to assess and assign Zones of Confidence (ZOCs) to all hydrographic surveys incorporated in 138 hydrographic charts of New Zealand. This article provides an overview of the process to create a detailed picture of the quality and extent of New Zealand's hydrographic survey resource.

The ZOC project required each hydrographic survey to be assessed in relation to the data quality aspects of the International Hydrographic Organisation (IHO) S-57 Standard. The project team assessed in excess of 1,792 hydrographic survey fair sheets and allocated 1,465 ZOCs to survey areas.

Quality Indicators

To date, New Zealand has provided quality indicators on all of its hydrographic charts by way of Source Data Diagrams and Diagrams of Sounding Line Density. To address a need for improved understanding of hydrographic data quality, LINZ required the capture of ZOC information for its hydrographic surveys, and contracted HSA to undertake this project. The objectives were to:

- obtain a detailed understanding of the quality of all hydrographic surveys used in the compilation of New Zealand's larger-scale nautical charts
- improve the survey prioritisation process
- allow for the future depiction of ZOC diagrams on LINZ paper charts and electronic navigational charts (ENCs).

ZOC Concept

The IHO Data Quality Working Group (DQWG) developed ZOCs as a solution for the assessment and display of hydrographic data quality to support safe and efficient navigation. Areas covered by hydrographic surveys are classified by identifying various levels of confidence with respect to depth accuracy, position accuracy, thoroughness of seafloor search, and the characteristics of the survey. Six ZOC have been developed - A1, A2, B, C, D and U. ZOC A1, A2 and B are typically for modern surveys, with A1 and A2 requiring full-area sea-floor search; C and D reflect low accuracy, low density and/or poor quality data, whilst U represents data not assessed at the time of publication.

Process Overview

LINZ's requirement was to capture, document and present ZOC information for surveys used in the compilation of New Zealand's hydrographic charts. ZOC assessments were undertaken on a survey basis as opposed to a chart basis; that is, ZOC diagrams for individual charts were not a specific product of this project. A desktop study was undertaken to ascertain the number of potential hydrographic surveys used in compilation of each hydrographic chart. LINZ identified 138 large to medium-scale charts requiring assessment, each with its own chart index. The chart index is the key document providing an indication as to which surveys were used to compile each chart. The chart index is the document from which the Source Data Diagram is compiled and portrayed on the printed paper and raster chart. The desktop assessment indicated the use of approximately 484 surveys consisting of 1,946 fair sheets in the production of these charts. With the approximate volume of fair sheets identified the process for assessing the survey sheets for ZOC classification was determined and refined.

The process required the largest-scale surveys affecting the largest-scale charts to be assessed first. In this way smaller-scale surveys/charts and overlapping charts would require assessment of only those surveys that fell outside of the larger-scale surveys. Each chart index was extracted from the LINZ Hydrographic Data Repository (HDR) along with all of the surveys used in the compilation of that chart. Any ancillary information accompanying each survey, such as reports of survey, tidal-data packs, geodetic-data packs etc were also extracted, as these are required for full ZOC assessment. Each survey was then evaluated and awarded a ZOC classification. This information was recorded in the project documentation and encoded in S-57 databases. The ZOC polygons were then digitised and tagged with the encoded metadata.

New Zealand's large area of charting responsibility mean that three databases were created: New Zealand, Antarctica & Pacific Islands (Figure 1).

At completion of the assessment process, a picture was obtained of the types of surveys undertaken in New Zealand and their approximate ZOC rating. This is summarised in Table 1. As can be seen from Table 2, there is a disparity between the figures obtained

from the desktop study and the total number of surveys actually assessed. This is due to the need for the chart indexes to be a generalisation of the surveys used in the chart production process in order to produce Source Data Diagrams, as opposed to being an accurate archival record.

Tools for the Job

In New Zealand's case, the requirement was for mass assessment, capture and population of a ZOC attribute database or databases. The databases needed to be populated with ZOC metadata in conjunction with the ZOC/survey polygons. A mechanism whereby all of this data could be quickly and readily validated with a high degree of confidence was also required. The ENC Designer application was used to capture ZOC information, as this utilises topologically structured data that is consistent with IHO S-57. The user has the benefit of a single software interface to encode both ZOC attribute data and spatial data (Figure 2). TIFF images were loaded as a backdrop for polygon capture, identifying changes and assisting with quality assurance. The ability to export data as an S-57 v. 3.1 ENC dataset enabled the cells/databases to be easily maintained and disseminated. The ENC cells can be viewed using any of the freely available ENC viewer applications.

An AutoZOC plug-in module was written by HSA to assist in calculation of the ZOC rating. The determination/confirmation of a ZOC rating occurs within the AutoZOC module which reads the parameters (made available in the customised object catalogue) and automatically populates the S-57 CATZOC attribute. AutoZOC reads and writes to the resulting S-57 file. The ZOC metadata can then be exported in XML format. XML is supported by most modern Geographic Information Systems (GIS), hence the ability to easily migrate ZOC data to a platform of choice.

Skill Sets

A key requirement for the project was the need to have qualified and experienced hydrographic survey personnel. A surveyor, qualified to IHO Cat A, was appointed to lead the team. This surveyor's role was to finalise and approve ZOC classifications assigned to surveys, and to ensure that identical assessment logic was applied to all surveys. An IHO Cat B equivalent hydrographic surveyor was responsible for all initial research and assessment of surveys, metadata capture and record keeping. Both surveyors had extensive knowledge of hydrographic surveying practices in New Zealand. An experienced hydrographic cartographer familiar with New Zealand cartographic practices provided input in terms of how surveys were implemented on New Zealand charts.

Quality Assurance

The project was undertaken in accordance with HSA's Quality Management System (QMS), which is certified to ISO 9001:2000. LINZ and HSA implemented detailed contract specifications, project plans and quality plans.

Project Deliverables

At the completion of the project the following deliverables were supplied to LINZ:

- 1 x TIFF file of each index chart (138)
- 1 x ZOC assessment folder for each chart (138)
- 1 x XML file for each cell/database (3)
- populated AutoZOC database (MS Access)
- 1 x S-57 v 3.1 ENC cell for each cell/database (3)
- summary report.

Given the portability of the digital data in XML format, LINZ is able to readily migrate ZOC data to its platform/s of choice for future data-capture, maintenance and distribution. This is demonstrated in the following views, where ZOC boundary data and metadata has been migrated to the freely available Google Earth Web browser (Figure 3).

Conclusion

The project began in June 2004 and was principally completed by late June 2005, approximately five months ahead of schedule. The gain in timing was attributed to the use of:

- experienced hydrographic surveyors
- software which enabled both spatial and attribute data to be captured and managed within the one application
- a well-documented process for ZOC assessment
- clear and concise operational and contract documentation.

The ZOC assessment process required a review of all hydrographic surveys used in New Zealand's nautical charts. The diversity in range of quality and age of the surveys reviewed became clear. Documentation associated with the surveys, including reports of survey, also varied greatly. With modern technologies for hydrographic surveying now readily available, including detailed survey specifications produced by national and international bodies, the quality of metadata accompanying surveys should be high. Most local and national agencies responsible for undertaking hydrographic surveys are now required to manage risk. One method for understanding that risk is the assignment of ZOC ratings to hydrographic surveys.