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Using automated cartography to create maritime charts suitable for hard copy printing.

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Abstract:

In November 2019, the Office of Coast Survey (OCS) announced its plan to discontinue the publication of all traditional raster and paper nautical charts by 2025. The rationale cites that the use of paper charts has decreased steadily over time as U.S. and international authorities began permitting the use of only electronic navigational charts (ENCs) for inland and oversea voyages. The time saved by maintaining only one product line would allow OCS to focus on improving ENC products to serve its customers better.

The overwhelming response to OCS's announcement suggested that there was still a market for paper charts, most notably with recreational boaters. Therefore, the need for developing a labor-saving method of creating printable charts was evident.

The inception of the NOAA Custom Chart (NCC) web application occurred well before the announcement to cancel paper charts. It was deemed an acceptable substitute for those not required to follow maritime carriage requirements. The tool applies paper chart symbology and labels to S-57 digital chart data and produces a print-ready multi-page Portable Document Format (PDF) file. The output includes all elements a traditional nautical chart would have: paper chart symbology and labels, a hydrographic survey quality diagram, cautionary notes, and explanatory notes.

The depiction of symbols and labels varies drastically between paper charts and electronic charts. Symbols on paper charts are typically small (less than 4 mm in either dimension) to reduce the likelihood of overprinting symbols at scale. Style rules for paper chart labels involve levels of hierarchy for the omission of information, varied font color, size, slant, weight, and placement angles (for example, a cartographer may place a label diagonally if the horizontal orientation does not fit). Electronic charts are intended to be viewed on a computer display. The interface allows the user to zoom to larger scales and hide unwanted features, so symbols are generally large, with more visual weight to improve visibility on a monitor. Labels on digital charts are simplified to only black, horizontally oriented text. Many features are often left unlabelled because the information about the feature can be read from a pop-up window on the display.

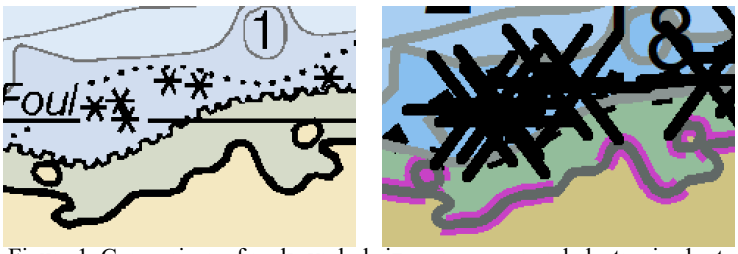

Figure 1. Comparison of rock symbol sizes on a paper and electronic chart. NOAA Chart 16646 ED 14 (left). NOAA ENC US5AK1BM ED 22 (right).

The Esri Maritime Chart Server (MCS), which drives the symbology for the NCC application, initially defaulted to using the electronic chart symbology, also known as S-52 symbology. Due to the prominent, often overlapping symbols and scant labels, the symbology was not suited for a printed chart. In addition to symbol overprints, the original color palette was based on the daytime color scheme used by Electronic Chart Display Information Systems (ECDIS). Some color values were not discernible under red bridge light conditions when printed.

Esri enhanced the MCS to show customized symbology and labels to resolve these issues. The application allows cartographers to build custom Scaleable Vector Graphics (SVG) symbols and program conditional rules to determine when to draw a specified symbol. Feature labels are managed similarly, with a rule on when to place a label, formatting, and text string to display.

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The configuration files are organized as a main Extensible Markup Language (XML) script that calls object-specific subroutines written in the Lua programming language. Symbology SVGs are organized in a “symbol” folder with a subfolder for each geometry type.

NOAA is in the process of customizing the MCS symbology to meet the *NOAA Nautical Chart Manual* and *U.S. Chart No. 1* specifications as closely as possible in an automated environment. There will be some situations where the rules prescribed in our guidance documents will not work. The most notable example is the rule where buoy symbols on traditional paper charts are rotated to point away from the marked channel (*NOAA Nautical Chart Manual*.) The rotation angle is different in every situation and is not encoded as an attribute in the dataset.

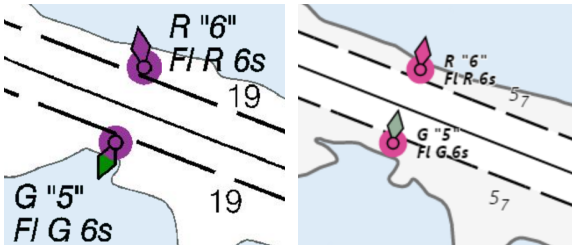

Figure 2. Comparison lateral buoy symbols in a manual environment (left), and an automated environment (right). NOAA Chart 12281 ED 57 (left). Customized Maritime Chart Service web map (right)

Finally, there are opportunities for automated cartography. The system is no longer bound by a limited lithographic printing color palette. This would allow cartographers to add additional colors or transparency to the chart to improve the distinction of different features. Automation enforces consistency, and outputs from the NCC could be used to help review compilation in regards to appropriate feature selection at scale or encoding values.

In conclusion, although the steps necessary to automate paper chart production are complex and time-consuming, the result will lead to a streamlined product that uses symbology familiar to the intended user.

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References

United States. National Oceanic and Atmospheric Administration. “Aids to Navigation, Location.” *NOAA Nautical Chart Manual, Volume 1.* Version 2022.3. National Oceanic and Atmospheric Administration, Office of Coast Survey. 2022, pg. 718.

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