Paper for Consideration by the S-100 TSM

Proposed Alerts and Indications Model for S-100

Submitted by:	NIWC Atlantic
Executive Summary:	A proposed model for S-100 alerts and indications is presented
Related Documents:	S-100 Part 9, TSMAD28_DIGWG6_12.4A, TSM3 5.3, S-100WG01-10.12A, TSM6-4.4, MSC.302(87), IMO A.1021(26), IEC 61174:2015, IEC 62288
Related Projects:	Development of S-100 and S-1XX product specifications

1 Introduction / Background

As presented by Hannu Peiponen / Furuno Finland at TSMAD28 and TSM3, there is a need for an alert model defined within S-100 which will allow fielded ECDIS systems to conform to changing alert requirements without software upgrades. Some examples include:

- A new S-100 based product type which should participate in alert processing
- New feature type(s) added to an existing product where the new feature type(s) should participate in alert processing (feature catalog updated)
- Changes to the alert processing rules for an existing feature type within an existing product type (new alert catalog)

This paper is a continuation of work presented at TSM6 in paper TSM6-4.4. That paper presented an alert model based on the existing portrayal model, leveraging the commonalities between generation of alerts and portrayal of features.

Whereas a portrayal catalog translates an encoded dataset into drawing instructions, an alert catalog will translate an encoded dataset into alert instructions. These alert instructions will identify which spatial elements from an encoded dataset should be evaluated by the alert processing implemented within an ECDIS, and will provide the necessary information for ECDIS to raise the alert. The ECDIS will be responsible for implementing unchanging aspects of the alert processing, to include the spatial evaluation.

Changes to the alert catalog are managed as updates to the portrayal catalog, allowing the ECDIS to update machine-readable files in-lieu of software upgrades.

2 Requirements

As an initial step in developing an Alerts and Indications model, the following references were reviewed:

- IEC 61174:2015 – ECDIS performance requirements
- IEC 62288:2008 – Presentation of navigation information on shipborne navigational displays (*note: IEC 62288:2014 is the current edition*).
- IMO A.1021(26) – Code on alerts and indicators, 2009
- MSC.232(82) – Revised performance standards for ECDIS
- MSC.252(83) – Revised performance standards for INS
- MSC.302(87) – Adoption of Performance Standards for Bridge Alert Management

The following references are also relevant but were not part of the review:

- IEC 62616:2010 – Bridge navigational watch alarm system (BNWAS)

IEC 61174 ed4.0 provides some changes to previous requirements for alerts. In particular, the alert classification of Appendix 5 of IMO MSC.252(83) is used; ref. IEC 61174:2015 Table D.1 – Alerts and indications resulting from IMO requirements.

IEC 61174 also defines / requires alerts and indications in addition to those resulting from IMO requirements; ref. IEC 61174:2015 Table D.2 – Alerts and indications defined in [the IEC 61174] standard.

Table 1 contains definitions from MSC252(83) applicable to this paper.

Table 1: Applicable definitions from MSC252(83)

Alert	Alerts are announcing abnormal situations and conditions requiring attention. Alerts are divided in three priorities: alarms, warnings and cautions.
Alarm	An alarm is the highest priority of an alert. Condition requiring immediate attention and action by the bridge team, to maintain the safe navigation of the ship.
Warning	Condition requiring no-immediate attention or action by the bridge team. Warnings are presented for precautionary reasons to make the bridge team aware of changed conditions which are not immediately hazardous, but may become so, if no action is taken.
Caution	Lowest priority of an alert. Awareness of a condition which does not warrant a alarm or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information.
Indication	Display of regular information and conditions, not part of alert management.
Category A alerts	Alerts where graphical information at the task station directly assigned to the function generating the alert is necessary, as decision support for the evaluation [of] the alert related condition.
Category B alerts	Alerts where no additional information for decision support is necessary besides the information which can be presented at the central alert management HMI.

2.1 Required Alert Model Components

In order to model an alert the following components are required:

- Identification of the condition which triggers the alert
- Mechanism to disable the alert trigger
    - e.g. Date Dependent feature
- The priority of the alert
- The category of the alert. One of:
    - Category A
    - Category B
- The alert message - displayed when the alert is active
    - A location for the message
        - e.g. Alerts management dialog
    - Optionally, an icon to display with or instead of the message
- A graphical highlight to display when the alert is active

    - A fill symbol (for areas)
    - A line style (for areas and lines)
    - A point symbol (for points)
    - The geometry of the highlight – e.g. "Intersection with feature and route"
    - *Note: Display plane and drawing priority could be included here, but are not currently. In order to prevent chart redrawing highlights will be drawn above all drawing instructions in the top-most display plane*.
- Mechanism to disable the graphical highlight
    - A message to display when / while the highlight is disabled
- Display on demand components
    - e.g. crossing safety contour requires that "feature and highlight" be displayed on demand.

In the model presented, an indication is treated as an alert priority and therefore inherits all the components of an alert.

3 Design

3.1 Goals

The primary goal of the model presented is to enable ECDIS to incorporate changes in alert requirements without fielding software upgrades.

The model presented in TSM6-4.4 provided for cataloging of all alerts within ECDIS, to include those not associated with dataset features. Examples of such alerts include “Positioning system failure” and “Deviation from route”. TSM6 deemed such alerts to be out of scope; this updated model simplifies the model presented in TSM6-4.4 by restricting itself to alerts associated with dataset features.

Secondary goals of the simplified model presented include:

- Minimize changes to S-100
- Simplify population of alert catalogs
- Facilitate simple implementation within ECDIS
- All text generated by the model and intended for presentation to the user should be language independent.
- Icons should be available for use instead of or along with any text.

3.2 Limitations

Many alert model components were not modeled based on TSM6 direction to limit the models scope. The model only includes those components used by alerts arising from dataset features. The following components were not modeled:

- Trigger condition
    - Can be determined from context - trigger condition is always route monitoring look ahead or route planning safety check.
- Mechanism to disable the alert trigger
    - No specific mechanism to disable checks associated with a particular alert catalog entry is provided. Individual features can have alerts disabled based on date dependency as described in paper TSM7-5.4.
    - The generation of alert instructions can be disabled without model support via a portrayal context parameter if desired.

- Category of the alert.
    - Alerts generated from dataset features are always category A.
- Location for alert messages.
    - Can be determined from context – route monitoring alerts go to alerts management, route planning alerts go to the route planning interface.
- Graphical highlight styles and/or symbols
    - Graphical highlighting style is constant (per IEC 61174). ECDIS can style its highlighting without catalog support.
    - Including this component would complicate population of the portrayal catalogue
        - Requires providing highlight color tokens, styles, and symbols in the portrayal catalog of all products that implement alerts.
- Display on demand
    - Alerts arising from dataset features are always required to display the feature and highlight on demand. ECDIS can implement this requirement without catalog support.
- Audible alert component
    - Audible signals are out of scope. They are addressed within the higher-level alert framework.
- Interoperability
    - This paper does not address interoperability.
    - Interoperability may need to modify alerts and / or highlights. This should be possible given the implementation presented, but has not been analyzed.

3.3 Design Approach

The approach presented in TSM6-4.4 proposed implementing alerts as part of the portrayal (notionally: the alert package). In order to avoid having disparate Lua and XSLT models an alerts catalog referenced from the portrayal catalog provides as much of the model as possible. The design is similar to the implementation of interoperability.

The TSM6 approach has the following advantages:

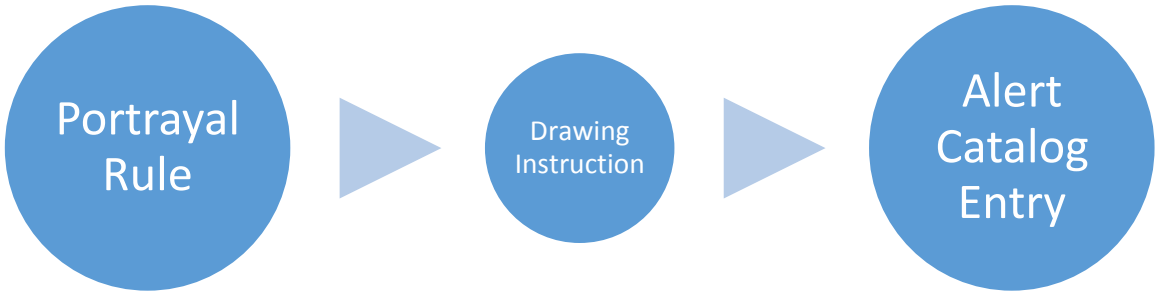
- Ensures synchronization between portrayal and alerts.
- Does not require a new S-100 part.
- Leverages the portrayal for delivery of the alert catalog.
- Generation of alert instructions requires only minor additions to existing portrayal rules.
- Does not require a new builder tool; minor changes to the portrayal catalogue builder are needed to associate a feature with an alert catalog entry.
- Requires only minor differences in the model for XSLT and Lua (only the alert instruction is different).

As recommended by TSM6, the design approach was carried forward for development of the simplified model presented below.

3.4 Overview

All alerts, indications and required components are specified in an alert catalogue provided as part of the portrayal catalogue. The portrayal rules generate drawing instructions, each of which can be associated with an

alert catalog entry.



Alert catalog references are emitted within the drawing instructions during portrayal. Each alert is associated with geometries via either the feature reference, spatial reference, or augmented geometry specified in the drawing instruction. Each alert catalog reference is an association to a catalog entry; the entry provides all the information necessary for the ECDIS to implement the alert.

The alert can be restricted to specified time intervals via date dependency as described in paper TSM7-5.4.

In addition to the alert catalog reference, two viewing group references (supporting graphical highlighting in route monitoring and route planning) are provided in the alert component of the drawing instruction. This leverages the existing portrayal mechanism for controlling the presentation. It allows graphical highlighting to be enabled or disabled on a per feature type basis, supporting the S-101 requirement for alerting on areas with special conditions (ProhAre).

Minor changes to the portrayal schema are needed to provide the alert catalog as part of the portrayal catalog. The portrayal drawing instruction schema is modified to optionally include a reference to an entry in the alert catalog.

3.4.1 Changes to Part 9 XSLT Portrayal

Part 9 redlines are provided separately and are summarized here.

- Add *alertCatalog* to *FileType* enumeration
- Add *alertCatalog* to *PortrayalCatalog*
  - References the alert catalog from the portrayal catalog
  - Describes the name of the alert catalog
- Add *alertReference* to the *DrawingInstruction* class
  - Allows any drawing instruction to reference an alert
  - Associates the specified alert catalog entry with the geometry of the *DrawingInstruction*
- Add class *AlertReference* to 9-11.2 Model of the Drawing Instruction Package *(S100Presentation.xsd)*
  - Contains the following attributes:
    - *reference* – a reference to an alert catalog entry
    - *plan* – A viewing group reference for controlling the alert highlight
    - *monitor* – A viewing group reference for controlling the alert highlight
- Add new section / package: Model of the Alert Catalog
  - Described below

3.4.2 Changes to Part 9a Lua Portrayal

Part 9a redlines are provided separately and are summarized here.

- Update references to Part 9 based on Part 9 changes above (TBD)
- Add new state command type: Alert
    - Add *AlertReference* command
        - Analogous to Part 9 *alertReference*
        - Specifies an alert catalog entry to be associated with the geometry of a drawing command
        - Optionally references viewing groups for controlling the alert highlight in route planning and route monitoring

3.5 Model of the Alert Catalog

The alert catalog provides all required components. There are two trigger conditions for alerts: route monitoring look ahead, or route planning safety check. The trigger conditions can be associated with any number of catalog entries based on rules implemented within the portrayal.

Figure 1 - Model of the Alert Catalog presents the UML model of the alert catalog.

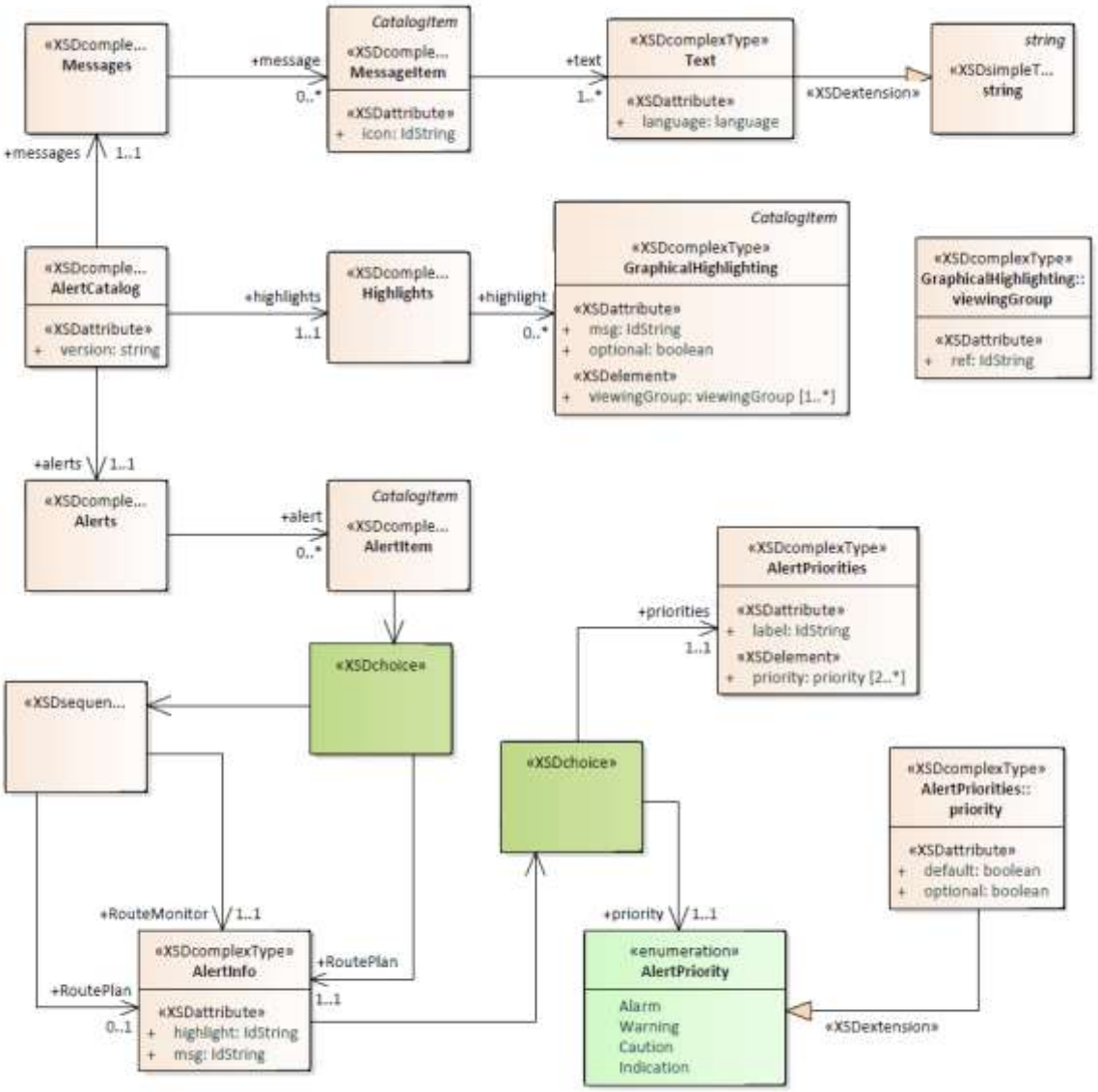


Figure 1 - Model of the Alert Catalog

3.5.1 AlertCatalog

Role Name	Name	Description	Mult.	Type
Class	AlertCatalog	A container of all the catalog items	-	-
Attribute	version	The version of the catalogue	1	string
Role	messages	Container of messages	1	Messages
Role	highlights	Container of highlights	1	Highlights
Role	alerts	Container of alerts	1	Alerts

3.5.2 Messages

Role Name	Name	Description	Mult.	Type
Class	Messages	A container of MessageItems	-	-
Role	message	Definition of a message	0..*	MessageItem

3.5.2.1 MessageItem

Role Name	Name	Description	Mult.	Type
Class	MessageItem	Defines a language independent message	-	-
Subtype of	CatalogItem	See *CatalogItem*	-	-
Attribute	icon	Reference to a symbol in the portrayal catalogue	0..1	string
Role	text	The language independent text of the message.	1..*	Text

3.5.2.2 Text

Role Name	Name	Description	Mult.	Type
Class	Text	Language specific string	-	-
Subtype of	string			
Attribute	language	Identifies a language, default is eng. ISO 639-2/T alpha-3 code (eng – English, deu – German)	0..1	string

3.5.3 Highlights

Role Name	Name	Description	Mult.	Type
Class	Highlights	A container of GraphicalHighlighting items	-	-
Role	highlight	Definition of a highlight	0..*	GraphicalHighlighting

3.5.3.1 GraphicalHighlighting

Role Name	Name	Description	Mult.	Type
Class	GraphicalHighlighting	Associates viewing groups with alert information	-	-
Subtype of	CatalogItem	See *CatalogItem*	-	-
Attribute	optional	Allowing the highlight to be turned off is not required. Default is false.	0..1	boolean
Attribute	msg	A reference to a message to be displayed while any of the viewing groups are disabled.	0..1	string
Role	viewingGroup	References viewing groups used to control graphical highlighting	1..*	ViewingGroupReference

3.5.3.2 ViewingGroupReference

Role Name	Name	Description	Mult.	Type
Class	ViewingGroupReference	A reference to a viewing group	-	-
Attribute	ref	The identifier of the viewing group	1	string

3.5.4 Alerts

Role Name	Name	Description	Mult.	Type
Class	Alerts	A container of AlertItems	-	-
Role	alert	Definition of an alert	0..*	AlertItem

3.5.4.1 AlertItem

Role Name	Name	Description	Mult.	Type
Class	AlertItem	Describes a single alert	-	-
Subtype of	CatalogItem	See *CatalogItem*	-	-
Role	routeMonitor	The alert behavior in route monitoring	0..1	AlertInfo
Role	routePlan	The alert behavior in route planning	0..1	AlertInfo
Role	priority	A single alert priority. If present, precludes use of *priorities*.	0..1	AlertPriority
Role	priorities	A set of alert priorities. If present, precludes use of *priority*.	0..1	AlertPriorities

3.5.4.2 AlertPriority

Role Name	Name	Description
Type	AlertPriority	The priority of an alert
Enumeration	Alarm	Indicates conditions requiring immediate attention and action by the bridge team (ref. MSC.252(83) 19.1.2)
Enumeration	Warning	Indicates changed conditions and should be presented for precautionary reasons which are not immediately hazardous but which may become so, if no action is taken (ref. MSC.252(83) 19.1.3)
Enumeration	Caution	Indicates a condition which does not warrant an alarm or warning condition, but still requires attention and out of the ordinary consideration of the situation or of given information (ref. MSC.252(83) 19.1.4)
Enumeration	Indication	Display of regular information and conditions (ref. MSC.252(83) appendix 1)

3.5.4.3 AlertPriorities

Role Name	Name	Description	Mult.	Type
Class	AlertPriorities	A set of alert priorities	-	-

Attribute	label	Reference to a message used to label the UI component which allows selection of the desired alert priority	1	string
Role	priority	An alert priority	2..*	AlertPrioritySelection

3.5.4.4 AlertPrioritySelection

Role Name	Name	Description	Mult.	Type
Class	AlertPrioritySelection	Adds information to an alert priority	-	-
Subtype of	AlertPriority	See AlertPriority	-	-
Attribute	default	Identifies the default priority selection. Default is false.	0..1	boolean
Attribute	optional	Indicates allowing the user to choose this priority is optional. Default is false.	0..1	boolean

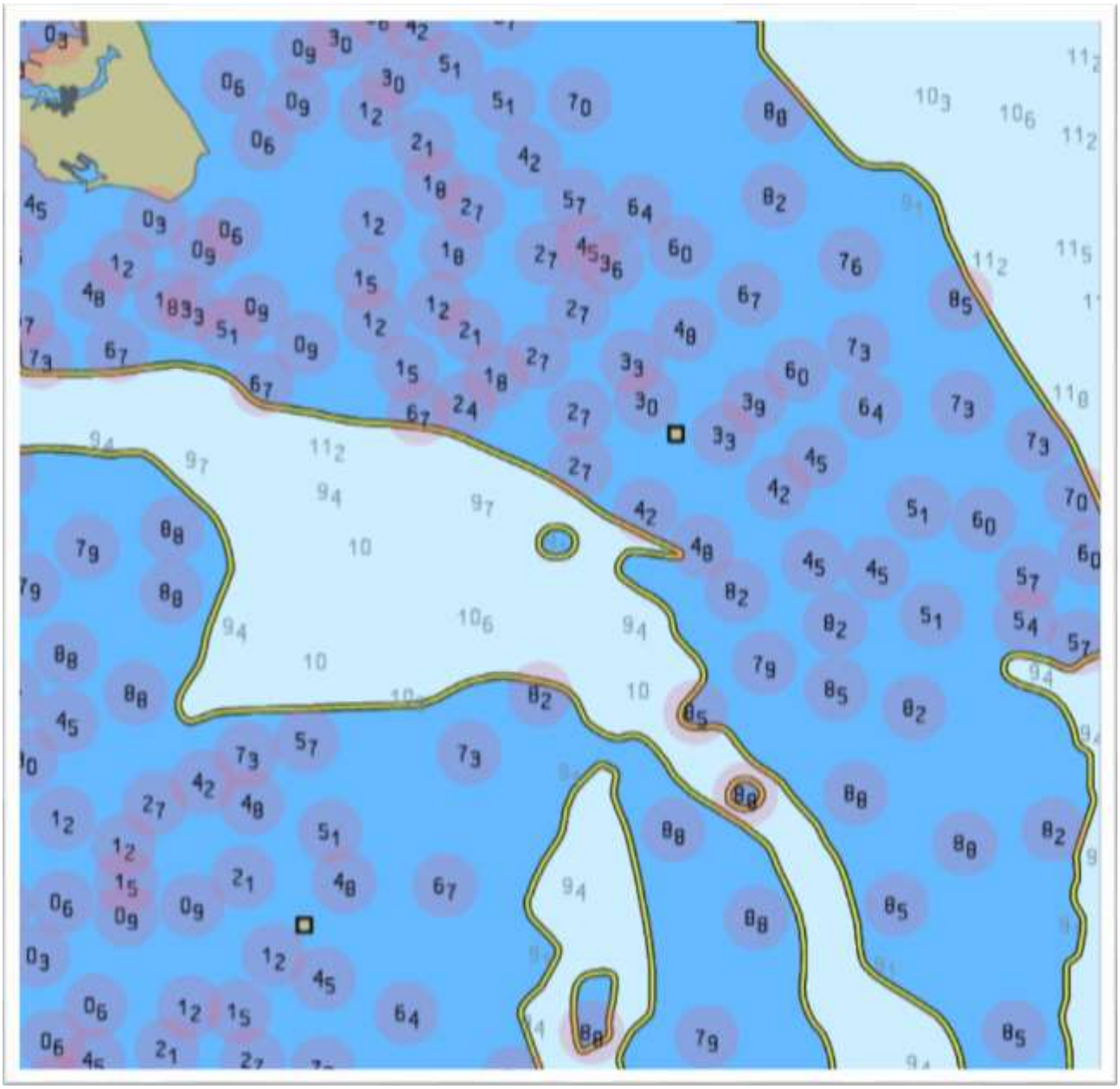
3.6 Supporting Documents

The following are provided separately to assist in model definition, understanding, and implementation:

- XML schema definitions
  - AlertCatalog.xsd - Defines the model of the alert catalog as presented in 3.5.
- XML files
  - AlertCatalog-Sample.xml – A simple alert catalog for demonstrating the concepts presented.
  - AlertCatalog-S101.xml – Sample implementation of an S-101 alert catalog.
- Documents
  - Part 9 redlines
  - Part 9a redlines

4 Discussion

Partial support for the model has been prototyped within the NIWC testbed. The S-101 portrayal rules were modified to generate alert instructions for soundings and the safety contour. In the following figure, geometries identified by alert instructions are highlighted using a red dot (dangerous soundings) or a yellow and black line (safety contour).



4.1 Work Remaining

The following actions remain to complete development of an S-100 alerts model, update the required infrastructure, and provide an initial S-101 alert capability:

- Complete change forms and redlines
- Update registries to support alert catalog as needed
    - Register alert catalog in its entirety as component of portrayal catalog?
    - Will require changes to S-100 Part 2
- Update portrayal catalog builder
- Assign viewing groups to alert highlights
    - Assign display mode (Base, Std, Other)
        - Resolve conflict if assigned to Base – policy dictates base layers cannot be turned off.
    - Assign a viewing group layer to alert highlights (optional)
- Update S-101 Portrayal Catalog
    - Add alert instructions to portrayal rules
        - Safety contour

        - ProhAre
        - Navigational Hazards
    - Deliver / register updated catalog

4.2 Action Required

The group is invited to:

a. provide feedback on the proposed model

b. provide direction supporting presentation of a model for endorsement at S-100WG5