IALA GUIDELINE

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HARMONIZED WATERWAY DATASETS

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DOCUMENT REVISION

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1. INTRODUCTION

Harmonizing waterways is a necessary development for the application of e-navigation to all segments of maritime, especially those segments which operate outside the SOLAS domain and are unlikely to adopt S-100 compliant systems. The transition of marine safety information providers to the S-100 framework necessitates the creation of harmonized waterways datasets to:

- provide access to S-100 product specification data to mariners who will not use S-100 compliant systems;
- enable marine safety information producers to leverage MSI production enhancements made possible by the S-100 geospatial framework; and
- provide access to S-100 datasets for use by communities beyond the maritime industry.

1.1 RELATED DOCUMENTS

IALA G1143 Unique Identifiers for Maritime Resources

IHO S-97 IHO Guidelines for Creating S-100 Product Specifications

ISO 19115-1:2014 - Geographic information — Metadata

2. BACKGROUND

Development and implementation of S-100 product specifications will result in obsolescence and possible discontinuation of traditional marine safety information (MSI) formats and dissemination mechanisms. Reference to human accessible marine safety information spatially organised by paper nautical chart extents will be replaced by geospatial marine safety information displayed on S-100 ECDIS in SOLAS-class shipping. Many segments of maritime that are not required to comply with SOLAS regulations will not adopt S-100 ECDIS. These mariners will need a method to obtain MSI that allows human discovery and use. A harmonized waterway dataset provides a mechanism for binning and accessing geospatial MSI for discovery and use by mariners that use navigation systems such as S-57 ECDIS, electronic chart systems, and traditional paper charts. It provides efficiency and accuracy by minimizing human error during the creation of MSI by national authorities. At its core, a harmonized waterway dataset is an authoritative, cadastral, geospatial dataset that defines well-known named waterways and sea areas according to geographic principles and enables spatial relationship (harmonization) with other geospatial data layers.

A harmonized waterways dataset provides additional value beyond the primary objective to ensure MSI is accessible to mariners who are not compelled to comply with SOLAS. These value-added benefits include:

- Establishing authoritative non-political boundaries for waterways
- Ensuring unique and persistent identification of waterways
- Unified datum and coordinate reference system
- Improved waterways management coordination
- Use of authoritative geographic names
- Cataloguing various national methods for binning sea areas
- Extensibility allowing additional methods of binning sea areas
- Custom user-defined electronic navigational chart production

This Guideline describes the necessary design components and considerations to construct a harmonized waterway dataset.

3. DISCUSSION

National authorities may choose to create boundaries (or bins) that define waterways and/or areas in the sea to address national requirements, such as exclusive economic zones, territorial seas, mineral extraction areas, fisheries areas, military training areas, and others. A harmonized waterway dataset uses spatial relationships to relate, or harmonize, the many ways to bin the sea to a single, authoritative, primary spatial framework layer. The primary spatial framework layer is a critical component of the harmonized waterway dataset, a type of spatial "Rosetta Stone" that enables harmonization of any number of geospatial maritime datasets used to define or delineate features in the sea.

4. REQUIREMENTS

4.1. HARMONIZED WATERWAY DATASET COMPONENTS

A harmonized waterway dataset is a geospatial dataset comprised of:

- A primary spatial framework (PSF) feature class
- Geospatial data layers containing national requirements for identifying features in the sea
- A geospatial ontology
- A harmonized waterway maritime resource name (MRN) registry
- A data governance plan
- Metadata

4.2. PRIMARY SPATIAL FRAMEWORK

4.2.1. MANDATORY CHARACTERISTICS

The PSF feature class is the foundation upon which the harmonized waterway dataset concept is built. PSF features:

- are topologically coterminous;
- are formed by surface (polygon) geometry;
- are constrained by the exclusive economic zone except where a responsibility for Worldwide Met-Ocean Information and Warning Service area (METAREA) or a Worldwide Navigation Warning Service area (NAVAREA) exists;
- represent well-known geographic areas; and
- contain at least the following attributes for each feature:
  - authoritative name (authoritativeName)
  - Maritime Resource Name (maritimeResourceName)

4.2.2. SPATIAL DESIGN CONSIDERATIONS

Determination and delineation of well-known geographic areas may be derived by consensus or a scientific approach. An example of the scientific approach utilizes hydrography to determine watershed basin and sub-basin boundaries on land to create PSF polygon features. Examples of a consensus approach may involve the adoption of Uber H3 hexagons[1] or might be based on the application of a buffer to hydrologic features such as rivers, streams, and bays with the delineation of boundaries between features using professional mariner opinion.

It is important to note that the PSF feature class is not intended to be the authoritative definition of navigable waterways. The purpose of the PSF feature class is to provide the unifying spatial framework upon which other national requirements for identifying features in the sea are spatially related for the purpose of discoverability.

4.2.3. PRIMARY SPATIAL FRAMEWORK MRN TAXONOMY

Creating valid MRNs for the PSF feature class requires a taxonomic approach. Taxonomy ensures:

- efficiency for the authority responsible for maintaining the harmonized waterway dataset; and
- a simple, high-level, logical framework for organizing sea areas.

The elements of the PSF MRN taxonomy include:

- a spatially inclusive parent-child spatial relationship applied to each level of the managed name spaces (mns) where large areas may be subdivided into subsequently smaller areas within the larger area's boundaries. Figure 1 provides two examples of how a parent area (Green Bay) may contain more than one child area (Dead Horse Bay in the southern extent, Big Bay De Noc in the northern extent.);
- guidelines for the general size of each area defined by a managed name space;
- a lower limit for the smallest area of a feature identified in an mns; and
- identification of the PSF feature class in the first mns (https://h3geo.org/).

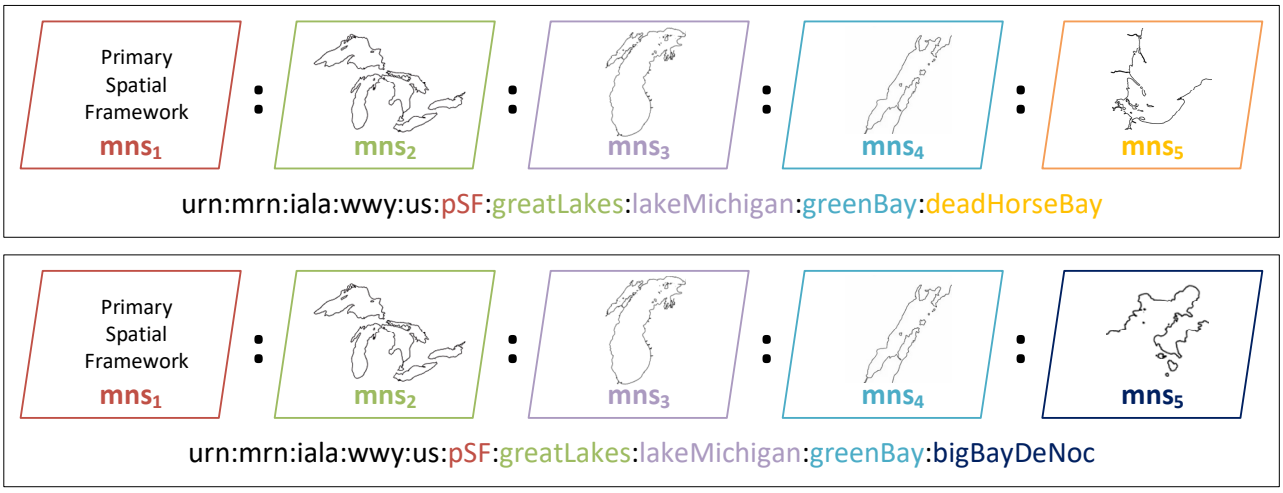

Figure 1 Example parent-child spatial hierarchy and MRN construction

In addition to the taxonomy described above the following best practices should be considered:

- When a linear spatial relationship is desired, such as linear segmentation of rivers into miles, ordination should be included in a separate national requirement for identifying features in the sea

and not incorporated into a PSF feature MRN. MRNs containing sections of rivers segmented by a distance unit are a linear relationship that does not comply with the PSF parent-child taxonomy.

- Administrative names may be assigned to subdivide a higher-level feature within a nation's interior waters into smaller units. For example, some large features like San Francisco Bay may be subdivided into Northern San Francisco Bay and Southern San Francisco Bay.
- In accordance with IHO S-97 IHO Guidelines for Creating S-100 Product Specifications, A-6.1.2 CamelCase and its use in S-100, use of camel case in the mns data elements is recommended. For instance, instead of MediterraneanSea, use mediterraneanSea.
- mns_2 should be used to capture major ocean areas or river systems. For instance, the Arctic Ocean, the Atlantic Ocean, the Amazon River system. The MRN construct urn:mrn:iala:wwy:<ISO 3166 Country Code> enables the reuse of well-known names for seas and oceans common to more than one country. The reuse of well-known names is encouraged.
- Ocean areas should be defined by a lower areal threshold. For example, the lower threshold value for designation as an "ocean area" in the United States is any sea area greater than 1 million square kilometres. The Bering Sea is approximately 2 million square kilometres, therefore "beringSea" is included in as a valid mns_2 domain value in the United States' implementation of harmonized waterways. National authorities are encouraged to establish their own thresholds.
- Subdivision of mns_2 ocean areas should utilize maritime-centric geographic references. For instance, subdividing an ocean should strive to use integer values of degrees and minutes of latitude and longitude and should also be aligned with prominent land features such as capes, points, or islands. Bathymetric features may be used to create ocean subareas (mns_3) when determined to be well known and significant in terms of size or hazard to navigation.
- Tributary rivers may be defined in subsequent mns levels for river systems, such as the Amazon River System (amazonRiver.) For example, an MRN for the Putumayo River may take the form of:

  urn:mrn:iala:wwy:br:pSF:amazonRiver:putumayoRiver

  Further subdivision of tributary rivers may result in the next child-level mns which could provide the identification of tributary creek and stream basins.

4.3. NATIONAL REQUIREMENTS FOR IDENTIFYING FEATURES IN THE SEA

4.3.1. EXAMPLES OF NATIONAL REQUIREMENTS FOR IDENTIFYING FEATURES IN THE SEA

There are numerous requirements for identifying features in the sea. Some examples of these requirements include, but are not limited to:

- Marine Safety Information
- Navigable waterways
- Channel frameworks
- Aids to Navigation
- Marine place names
- Mineral extraction lease areas
- Energy extraction lease areas
- Military exercise areas

- Fishery areas
- Marine protected areas
- Pollution control areas
- Maritime limits and boundaries
- Political subdivisions and boundaries

The number and types of feature classes containing national requirements for identifying features is finite but does not have an upper limit. These feature classes must be maintained by an authoritative source and may be points, curves (lines), or surfaces (polygons) as well as attribute fields.

4.3.2. THEMATIC CONSISTENCY

Each feature class containing a national requirement for identifying features in the sea should maintain thematic consistency within the feature class. For example, a polygon feature class containing particularly sensitive sea areas should not also contain features defining mineral extraction areas.

4.4. ONTOLOGY

The harmonized waterway dataset ontology relies upon spatial relationships between feature classes containing national requirements for identifying features in the sea and the foundational PSF feature class. These spatial relationships may optionally exist between individual national requirements for identifying features in the sea as well. For example, a relationship may exist between an MSI feature class (i.e., S-124) and a national requirement for identifying navigable channels to enable precise spatial filtering of applicable marine safety information than that provided by the larger area features contained in the PSF feature class.

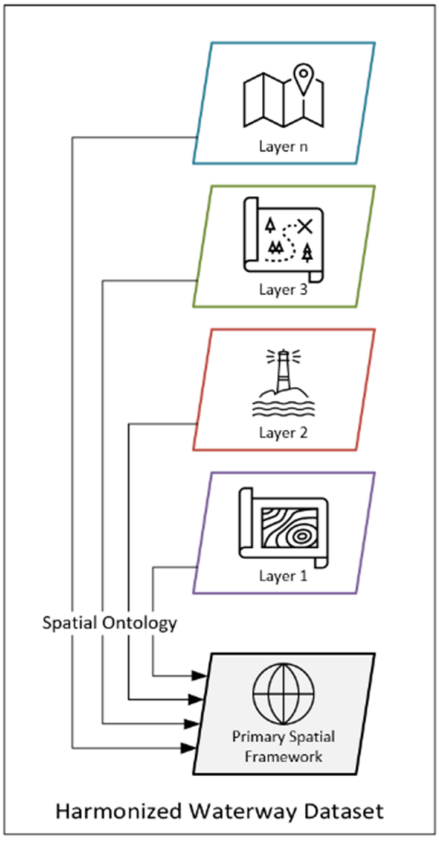

Figure 2 Harmonized Waterway Dataset Architectural Concept

4.5. MANAGED NAME SPACE REGISTRY

Every feature contained in a feature class in a harmonized waterway dataset must have an MRN. National authorities are encouraged to use the first managed name space (mns_1) to identify the specific national requirement for identifying features in the sea which helps ensure that the MRN remains a persistent and unique identifier for every feature contained in a feature class within the harmonized waterways dataset. A registry of the feature class identifiers allocated to the first managed name space should be established and managed by a national authority.

4.6. GOVERNANCE

A harmonized waterway dataset requires governance to provide sufficient maintenance and relevance. National authorities should develop publicly available standards that include the roles and span of authority and control for each feature class contained in the dataset. These roles and responsibilities should include:

- identification of the national authorities and their datasets;
- identification of the national authority for maintaining the harmonized waterway MRN registry;
- procedure for registering a dataset and receiving a managed name space (mns) dataset identifier; and
- mechanism to report improvements or discrepancies.

4.7. METADATA

Metadata complying with ISO 19115-1:2014 - Geographic information — Metadata is highly recommended to improve discoverability, usability, data quality management, and to enable novel uses of harmonized waterways datasets beyond the maritime domain.

5. DEFINITIONS

The definitions of terms used in this Guideline can be found in the *International Dictionary of Marine Aids to Navigation* (IALA Dictionary) and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

6. ABBREVIATIONS

mns	Managed Name Space
MRN	Maritime Resource Name
MSI	Marine Safety Information
PSF	Primary Spatial Framework