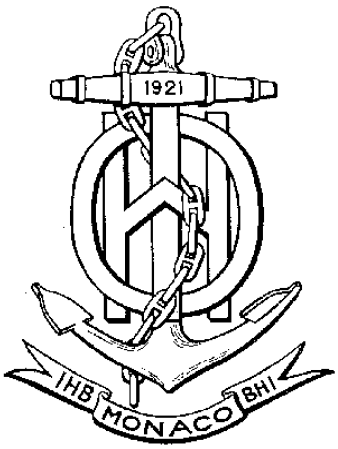
INTERNATIONAL HYDROGRAPHIC ORGANIZATION



S-104 Water Level Information for Surface Navigation Product Specification

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0.0.2	Aug-16	Z. Jayaswal	TWCWG – incorporate feedback on Portrayal and Attributes
0.0.3	Mar-17	Z.Jayaswal	Extract commonality from S-111 v0.1.10 to ensure consistency between standards.

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1 Overview

S-104 is the Water Level Information for Surface Navigation Product Specification, produced by the IHO.

The development of electronic navigation with high resolution bathymetric data, and the drive to increase safety of navigation are now demanding time-sensitive data. IHO has identified the requirement for a product specification for dynamic tidal and water level data.

Tidal height information has traditionally been provided as high/low predictions however with increasing drafts and technology, there has been a move to hourly predictions with major ports providing real-time height information to their pilots and web-sites.

There is now a requirement to supply tidal and water level data as a single point time-series and as a surface time series to manage critical depths and provide tidal windows. This specification should be read with Specification S-112 Dynamic Water Level Data Transfer Product Specification.

1.1 Introduction

This document describes an S-100 compliant product specification for the encapsulation and data transfer of tidal and water level data for use in an ECDIS or any proposed dynamic tide application Tidal and water level predictions have been fundamental in route planning and entry to ports. These have traditionally been supplied as a physical hard copy publication and recently as a separate software installation that may not be integrated with the Electronic Display and Information System. To improve safety of navigation, this product specification will ensure that tidal and water level data supplied for dynamic capability is consistent by all approved authorities.

There are four different dataset sets that can be delivered to an ECDIS.

1.2 References

S-44 *IHO Standards for Hydrographic Surveys,* 5th Edition February 2008

S-100 *IHO Universal Hydrographic Data Model*, version 3.0.0 (June 2017)

S-101 *IHO Electronic Navigational Chart Product Specification*, July 2014

S-102 *IHO Bathymetric Surface Product Specification*, April 2012

S-111 *IHO Surface CurrentsProduct Specification, MM YYYY*

S-112 *IHO Dynamic Water Level Data transfer, MM YYYY*

ISO 8601:2004 *Data elements and interchange formats - Information interchange - Representation of dates and times*

ISO/TS 19103:2005 *Geographic information – Conceptual schema language*

ISO 19111:2003 *Geographic information – Spatial referencing by coordinates*

ISO 19115:2003 *Geographic information – Metadata updated by Corr1 (2006)*

ISO 19115-2:2009 *Geographic information – Metadata: Extensions for imagery and gridded data*

ISO 19123:2005 *Geographic information – Schema for coverage geometry and functions*

ISO 19129:2009 *Geographic information – Imagery gridded and coverage data framework*

ISO 19131:2007 *Geographic information – Data product specifications*

ISO/IEC 19501-1 and 19505-2, *Information technology — Open Distributed Processing – Unified Modelling Language Version 2.4.1*

Note: a summary of UML is given in S.100 Part 1.

1.3 Terms, definitions and abbreviations

1.3.1 Use of Language

Within this document:

- "Must" indicates a mandatory requirement.
- "Should" indicates an optional requirement, that is the recommended process to be followed, but is not mandatory.
- "May" means "allowed to" or "could possibly", and is not mandatory.

1.3.2 Terms and Definitions

Terms and definitions have been taken from the normative references cited in clause 1.3. Only those which are specific to this document have been included and modified where necessary. Additional terms are defined in this document.

1.3.2.1 Coordinate

one of a sequence of numbers designating the position of a point in N-dimensional space [ISO 19111]

1.3.2.2 coordinate reference system

coordinate system which is related to the real world by a datum [ISO 19111]

1.3.2.3 direct position

position described by a single set of coordinates within a coordinate reference system [ISO 19107]

1.3.2.4 domain

well-defined set [ISO 19103]

NOTE Domains are used to define the domain set and range set of operators and functions.

1.3.2.5 Elevation

the altitude of the ground level of an object, measured from a specified vertical datum. [IHO S100 GFM]

1.3.2.6 Feature

abstraction of real world phenomena [ISO 19101]

NOTE a feature may occur as a type or an instance. Feature type or feature instance should be used when only one is meant.

1.3.2.7 Height

distance of a point from a chosen reference surface measured upward along a line perpendicular to that surface. [ISO 19111:2006]

NOTE Height is distinguished from elevation in that is a directional measurement.

1.3.2.8 Record

Finite, named collection of related items (objects or values) [ISO 19107]

NOTE Logically, a record is a set of pairs <name,item>

1.3.2.9 Uncertainty

The interval (about a given value) that will contain the true value of the measurement at a specific confidence level [IHO S44]

NOTE Errors exists and are the differences between the measured value and the true value. Since the true value is never known it follows that the error itself cannot be known. Uncertainty is a statistical assessment of the likely magnitude of this error.

1.3.2.10

1.3.3 Abbreviations

CRS	Coordinate Reference System
ECDIS	Electronic Chart Display Information System
EPSG	European Petroleum Survey Group
ENC	Electronic Navigational Chart
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization

1.3.3.1 Notation

In this document conceptual schemas are presented in the Unified Modelling Language (UML). Several model elements used in this schema are defined in ISO standards developed by ISO TC 211, or in IHO S-100. In order to ensure that class names in the model are unique ISO TC/211 has adopted a convention of establishing a prefix to the names of classes that define the TC/211 defined UML package in which the UML class is defined. Since the IHO standards and this product specification make use of classes derived directly from the ISO standards this convention is also followed here. In the IHO standards the class names are identified by the name of the standard, such as “S100” as the prefix optionally followed by the bialpha prefix derived from ISO. For the classes defined in this product specification the prefix is *“S104”.* In order to avoid having multiple classes instantiating the same root classes, the ISO classes and S-100 classes have been used where possible; however, a new instantiated class is required if there is a need to alter a class or relationship to prevent a reverse coupling between the model elements introduced in this document and those defined in S-100 or the ISO model.

Table 1.3.3-1 – Sources of externally defined UML classes

Prefix	Standard	Package
CI	ISO 19115	Citation and Responsible Party
CV	ISO 19123	Coverage Core & Discrete Coverages
DQ	ISO 19115	Data Quality Information
DS	ISO 19115	Metadata Application Information
EX	ISO 19115	Metadata Extent information
IF	ISO 19129	Imagery Gridded and Coverage Data Framework
LI	ISO 19115	Linage Information
MD	ISO 19115	Metadata entity set information
MI	ISO 19115-2	Metadata entity set imagery
S100	IHO S-100	IHO Standard for Hydrographic Data
SC	ISO 19111	Spatial Referencing by Coordinates
SD	ISO 19130	Sensor Data
S101	IHO S-101	IHO Electronic Navigational Chart Product Specification
S102	IHO S-102	IHO Bathymetric Surface Product Specification
S111	IHO S-111	IHO Surface Currents Product Specification

1.4 General Data Product Description

Title: Water Level Information for Surface Navigation Product Specification

Abstract: Encodes information and parameters for use in making a tidal and water level product.

Content: Describes the Tidal and water level data contained in the product. The specific content is defined by the feature catalogue and schema.

Spatial Extent:

Description: Areas where Tidal Information is available

East Bounding Longitude: 180

West Bounding Longitude: -180

North Bounding Latitude: 90

South Bounding Latitude: -90

Purpose: The data shall be used to produce a dataset to be used for dynamic water level applications, including an ECDIS.

1.5 Data product specification metadata

<This information uniquely identifies this Product Specification and provides information about its creation and maintenance. For further information on dataset metadata see the metadata clause.>

Title: The International Hydrographic Organization Water Level Information for Surface Navigation Product Specification

S-100 Version: 3.0.0

S-104 Version: 0.0.3

Date: March 2017

Language: English

Classification: Unclassified (TBC)

Contact: International Hydrographic Bureau.
4 quai Antoine 1er
B.P. 445 MC 98011 MONACO CEDEX
Telephone: +377 93 10 81 00
Telefax: + 377 93 10 81 40

URL: www.iho.int

Identifier: S-104

Maintenance: Changes to the Product Specification S-104 are coordinated by Tides, Water Level and Currents Working Group (TWCWG) of the IHO and made available via the IHO Publications website. Maintenance of the Product Specification must conform to IHO Technical Resolution 2/2007 (revised 2010)

1.5.1 IHO Product Specification Maintenance

1.5.1.1 Introduction

Changes to S-104 will be released by the IHO as a new edition, revision, or clarification.

1.5.1.2 New Edition

New Editions of S-104 introduce significant changes. *New Editions* enable new concepts, such as the ability to support new functions or applications, or the introduction of new constructs or data types. *New Editions* are likely to have a significant impact on either existing users or future users of S-104.

1.5.1.3 Revisions

Revisions are defined as substantive semantic changes to S-104. Typically, revisions will change S-104 to correct factual errors; introduce necessary changes that have become evident as a result of practical experience or changing circumstances. A *revision* must not be classified as a clarification. *Revisions* could have an impact on either existing users or future users of S-10s. All cumulative *clarifications* must be included with the release of approved corrections revisions.

Changes in a revision are minor and ensure backward compatibility with the previous versions within the same Edition. Newer revisions, for example, introduce new features and attributes. Within the same Edition, a dataset of one version could always be processed with a later version of the feature and portrayal catalogues.

In most cases a new feature or portrayal catalogue will result in a revision of S-104.

1.5.1.4 Clarification

Clarifications are non-substantive changes to S-104. Typically, clarifications: remove ambiguity; correct grammatical and spelling errors; amend or update cross references; insert improved graphics in spelling, punctuation and grammar. A clarification must not cause any substantive semantic change to S-104.

Changes in a clarification are minor and ensure backward compatibility with the previous versions within the same Edition. Within the same Edition, a dataset of one clarification version could always be processed with a later version of the feature and portrayal catalogues, and a portrayal catalogue can always rely on earlier versions of the feature catalogues.

Changes in a clarification are minor and ensure backward compatibility with the previous versions

1.5.1.5 Version Numbers

The associated version control numbering to identify changes (n) to S-104 must be as follows:

New Editions denoted as **n**.0.0

Revisions denoted as n.**n**.0

Clarifications denoted as n.n.**n**

2 Specification Scopes

This product specification outlines the flow of data from inception, through the national Hydrographic Office (HO), to the end user. The data may be observed or modelled. Requirements for data and metadata are provided. This document does not include product delivery mechanisms.

Scope ID: Global

Level:

Level name: Water Level Dataset

3 Dataset Identification

Title: Water Level Data Product

Alternate Title: None

Abstract: This data product is a file containing water level data for a particular geographic region and set of times, along with the accompanying metadata describing the content, variables, applicable times, locations and structure of the data product. Water level data is the height of the water observed or mathematically-predicted values. The data may consist of water level at a small set of points where observations/or

predictions are available or may consist of numerous points organized in a grid as from a hydrodynamic model forecast.

Topic Category: Producing authorities to choose the most appropriate from the list below:

Name	ISO 19115 Domain Code	Definition
Elevation	006	Height above or below mean sea level Examples: altitude, bathymetry, digital elevation models, slope, derived products
Inland Waters	012	Inland water features, drainage systems and their characteristics Examples: rivers and glaciers, salt lakes, water utilization plans, dams, currents, floods, water quality, Hydrographic charts
Oceans	014	Features and characteristics of salt water bodies(excluding inland waters) Examples: tides, tidal waves, coastal information, reefs

Geographic Description: Areas specific to water navigation

Spatial Resolution: Varies (e.g. 0.1 km to 1000 km). The spatial resolution varies according to the model and the size of grid spacing, or on the number of observing locations adopted by the producer (Hydrographic Office).

Purpose: Water level data is intended to be used as a stand-along data or as a layer in an ENC.

Language: English

Classification: Data can be classified as one of the following:
Unclassified
Restricted
Confidential
Secret
Top Secret

Spatial Representation Type: Coverage

Point of Contact: Producing agency.

Use Limitation: Invalid over land

4 Data Content and structure

4.1 Introduction

This section discusses the application schema, which is described in UML; the feature catalogue; dataset types, in which there is an extensive discussion of the water level data; dataset loading and unloading; and geometry.

Water level data consist of the water level at a point of time relative to a vertical datum. The data can be represented as a time series of values for either a single point (i.e. one geographic location) or for an array of points contained in a grid. **Does this paragraph need to mention point features linked to influence polygons?**

4.2 Application Schema

This application scheme shall be expressed in UML. The details of the application schema are given in ANNNEX C.

4.3 Feature Catalogue

4.3.1 Introduction

The S-104 Feature Catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in the product. See ANNEX D – Feature Catalogue

The S-104 Feature Catalogue is available in an XML document which conforms to the S-100 XML Feature Catalogue Schema and can be downloaded from the IHO website.

4.3.2 Feature Types

4.3.2.1 Geographic

Geographic (geo) feature types form the principle content of S-104 and fully defined by their associated attributes and information types.

4.3.2.2 Meta

Meta features contain information about other features within a data set. Information defined by meta features override the default metadata values defined by the data set descriptive records. Meta attribution on individual features overrides attribution on meta features.

4.3.3 Feature Relationship

A feature relationship links instances of one feature type with instances of the same or a different feature type. There are three common types of feature relationship: Association, Aggregation and Composition. In S-104 ??? relationship is used for data option A B and C?.

4.3.4 Information Types

Information types are identifiable pieces of information in a dataset that can be shared between other features. They have attributes but have no relationship to any geometry; information types may reference other information types.

4.3.5 Attributes

S-100 defines attribute as either simple or complex. S-104 uses eight simple attributes; listed in Table 4.1. There are no complex attributes (**Will this hold true for option B1?)**

Table 4.3.5-1 - Simple feature attribute types.

Type	Definition
Enumeration	A fixed list of valid identifiers of named literal values
Boolean	A value representing binary logic. The value can be either *True* or *False*. The default state for Boolean type attributes (i.e. where the attribute is not populated for the feature) is *False*.
Real	A signed Real (floating point) number consisting of a mantissa and an exponent
Integer	A signed integer number. The representation of an integer is encapsulation and usage dependent.
CharacterString	An arbitrary-length sequence of characters including accents and special characters from a repertoire of one of the adopted character sets
Date	A date provides values for year, month and day according to the Gregorian Calendar. Character encoding of a date is a string which must follow the calendar date format (complete representation, basic format) for date specified by ISO 8601:1988. EXAMPLE 19980918 (YYYYMMDD)
Time	A time is given by an hour, minute and second. Character encoding of a time is a string that follows the local time (complete representation, basic format) format defined in ISO 8601:1988. EXAMPLE 183059 or 183059+0100 or 183059Z
Date and Time	A DateTime is a combination of a date and a time type. Character encoding of a DateTime shall follow ISO 8601:1988 EXAMPLE 19850412T101530

4.3.6 Spatial Quality

Spatial quality attribute (Figures 4.1) are carried in an information class called **spatial quality**. Only points, multipoints and curves can be associated with spatial quality. Currently no use case for associating surfaces with spatial quality attributes in known, there fore this is prohibited. Vertical uncertainty is prohibited for curves as this dimension is no support by curves.

Water levels are usually defined at one or more individual locations, so spatial quality applies to these locations.

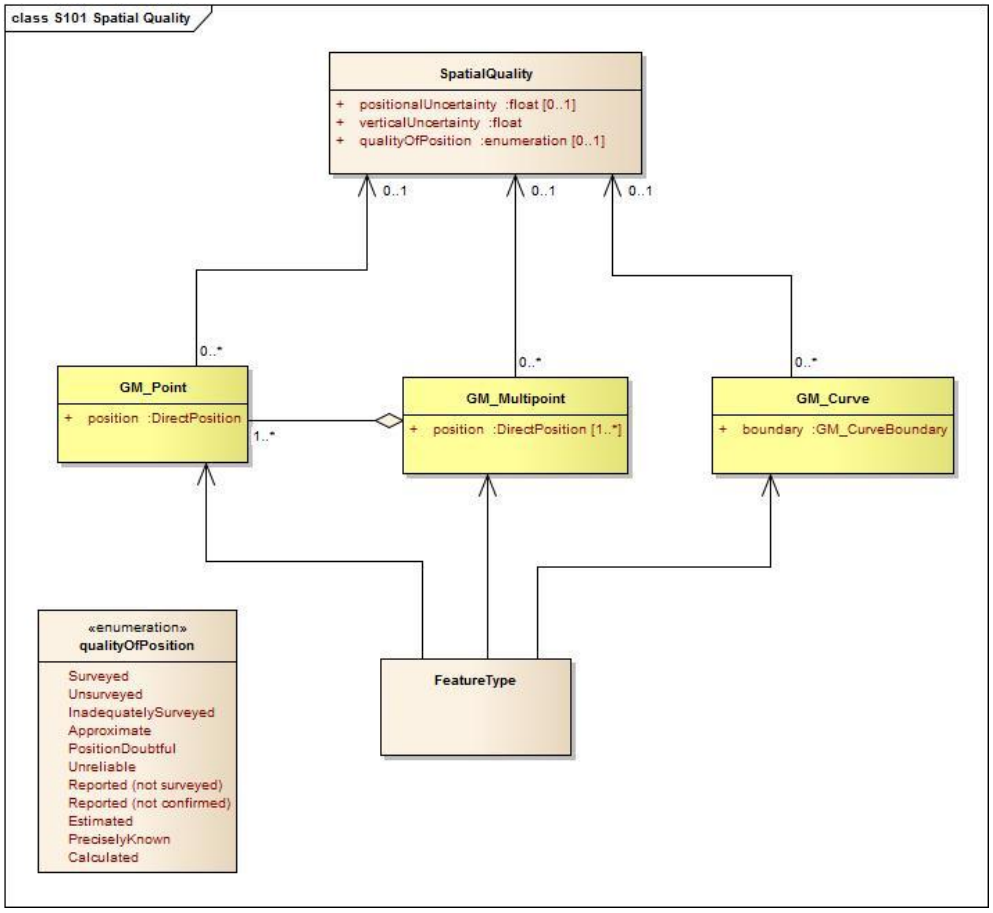


Figure 4.1 - Spatial Quality Information Type

4.4 Dataset Types

4.4.1 Introduction

<There is the capability to have different types of datasets, typically they are classified as complete, scale dependent and scale independent. Most products that are designed to be used with an ENC will be of a complete nature – where it contains the information needed to form a complete picture.>

4.5 Dataset Loading and Unloading

< This section is only needed if the intended product specification has datasets that have multiple scales and would require a loading strategy>

4.6 Geometry **<S-100 Part 7>**

<Geometric representation is the digital description of the spatial component of an object as described in S-100 and ISO 19107. Specify which S-100 Level of Geometry is to be used in the product specification.>

5 Coordinate Reference Systems (CRS)

The location of a feature in the S-100 standard is defined by means of coordinates, which relate a feature to a position. The S-104 CRS is a compound system, with a two-dimensional ellipsoidal horizontal component and a one-dimensional datum-related vertical component (cf. S-100, Part 6 – Coordinate Reference Systems).

5.1 Horizontal Reference System

For an ENC the horizontal CRS must be the ellipsoidal (geodetic) system EPSG:4326 (WGS 84). The full reference to EPSG: 4326 can be found at www.epsg-registry.org.

Horizontal coordinate reference system:	EPSG: 4326 (WGS 84)
Projection:	None
Coordinate reference system registry:	EPSG Geodetic Parameter Registry
Date type (according to ISO 19115):	002 - publication
Responsible party:	International Organisation of Oil and Gas Producers (IOGP)

5.2 Vertical Reference System

The vertical coordinate is directed upwards (i.e. away from the Earth's centre) from it's origin, the vertical datum and has units of metres. That is, a positive value for the level of the water level relative to the vertical datum means that the level is above the vertical datum. This is consistent with the bathymetric CRS in S-102. The vertical datum is not an ellipsoid but is the defined chart datum for the area of interest.

5.3 Temporal reference System

The temporal reference system is the Gregorian calendar for date and UTC for time. Time is measured by reference to Calendar dates and Clock time in accordance with ISO 19108:2002, Temporal Schema clause 5.4.4. A date variable will have the following 8-character format: *yyyymmdd*. A time variable will have the following 7-character format: *hhmmssZ*. A date-time variable will have the following 16-character format: *yyyymmddThhmmssZ*

6 Data Quality

6.1 Introduction

Quality of water level data for navigation consists of quality of the observed/predicted/forecast data, quality of the positional data, and quality of the time stamp. Quality of the observed data depends on the accuracy of the water level gauges and their processing techniques, and is normally available in field survey reports or quality controlled analyses. Quality of predicted/forecast data depends on quality, timeliness, and spatial coverage of the input data as well as the mathematical techniques. Temporal accuracy for observational data is normally available in field survey reports or quality controlled analyses. Temporal accuracy for predicted/forecast data is normally described in technical reports.

6.2 Completeness

A water level coverage data set is complete when the grid coverage value matrix contains height value or null values for every vertex point defined in the grid, and when all of the mandatory associated metadata is provided. See ANNEX E – TEST OF COMPLETENESS (NORMATIVE)

What are the requirements for point data sets?

7 Data Capture and Classification

The water level product contains data processed from sensors or derived from the output from mathematical models. In most cases, the data collected by the HO must be translated, sub-setted, reorganized, or otherwise processed to e made into a usable data format.

7.1 Data Sources

Water level data comes primarily from a few specific sources: observations, astronomical predictions, analyses, and forecast models. When such data are produced and quality-controlled by an HO, they are suitable for inclusion in the Water level data product (may need to confirm the last statement holds true). See ANNEX F – WATER LEVEL DATA

Observational Data: Observational water level data comes initially from *in situ* sensors in the field (.e.g. tide gauges deployed along channel) and are monitored by the HO. After reception, the data are quality controlled and stored by the HO. Some of the observed data may be available for distribution within minutes of being collected and are this described as being 'in real time. Other data may be days or years old, and are called historical data.

Astronomical Predictions: Astronomical predictions are produced when a sufficiently long time series of observed water level has been obtained and the data has been harmonically analyzed by the HO to produce a set of amplitude and phase constants. The harmonic values can then be used to predict the astronomical component of the water level as a time series covering any desired time interval. Data available for single stations or numerous, may be arranged by the HO into a gridded field.

Analyzed Values: Analyzed water level values may be produced from sea-surface topography, data assimilation, statistical correlations or other means. A hybrid method combines two of or more approaches.

Hindcast and Forecast Data: Hydrodynamic models numerically solve a set of fluid dynamic equations in two or three dimensions, and rely on observational data, including water levels and winds, to supply boundary conditions. Model grids may be either regular or irregular. Such models are often run several times per day, and in each run there is usually a hindcast and a forecast. The hindcast is a model simulation that attempts to recreate present conditions by using the most recent observational data, while a forecast is a simulation made for many hours in to the future using predicted winds, water levels, etc. The results are saved for a limited number of times, and are stored as arrays that derive from the model's grid. These models and methods are developed, run and monitored by the HO.

These descriptions are summarized in Tables 7.1.

Table 7.1 – Types of surface current data, based on the source of the data.

Type	Name	Description
1	Historical observation	Observation made hours, days, etc., in the past

2	Real-time observation	Observation no more than a few minutes old
3	Astronomical prediction	Value computed using harmonic constants only
4	Analysis or hybrid method	Calculation by statistical or other indirect methods, or a combination of methods
5	Hydrodynamic model hindcast	Gridded data from a two- or three-dimensional dynamic simulation of past conditions using only observed data for boundary forcing
6	Hydrodynamic model forecast	Gridded data from a two- or three-dimensional dynamic simulation of future conditions using predicted data for boundary forcing

7.2 The Production Process

Nearly all available information on water level from the HO must be reformatted to meet the standards of this Product Specification (Figure 10.1 - the S-104 format). This means (a) populating the carrier metadata block (Clause 12.3) with the relevant data and (b) reorganizing the water level data when using the encoding rules (see ANNEX G – HDF5 Encoding for gridded data). Need encoding rules for non gridded data.

7.2.1 Metadata

Metadata is derivable form the information available from the HO. The following variables will require additional processing:

- The bounding rectangle is computable from either the distribution of stations or nodes, or from grid parameters
- Position uncertainties may be available from the HO's metadata; otherwise they must be calculated
- Water level uncertainty may be available from the HO; otherwise must be calculated

7.2.2 Water Level Data

Observational water level and astronomical water level predictions at a single location and gridded forecast data must normally be reformatted to fit the S-104 standard. The following may require additional calculations:

- For gridded data. If a land mask array is included, the mask value is substituted into the gridded values as appropriate.
- Time stamps, if given in local time, must be converted to UTC.

8 Maintenance

Maintenance and Update Frequency: Water level is always moving, so more-or-less- continual revision or updating of the data is essential. For real-time observations, new values are periodically

collected (e.g. every 6 minutes). For a forecast, the entire field of water levels is created one or more times per day. New issues of real-time observations or forecasts should be considered new editions.

Water level harmonic constant data are updated much less often, typically on an annual basis.

Table 8.1 summarizes this information.

Table 8.1 – Typical update/revision intervals and related information

for S-104 products produced by a single HO.

Data Types	Interval	Number Of Spatial Locations	Number Of Time Values Per Location
Harmonic Constant Tidal Predictions	1 year	100 to 1,000	52560 (10 minute data) or 8,760 (hourly data)
Model Forecasts	6 hr	100,000 to 1,000,000	1 to 24
Real-time Observations	0.1 hr	1 to 10	1 to 240

Data Source: Data is produced by the HO through the collection of observing values, predicting astronomical tides, or running analysis or hindcast/forecast models. These data are typically quality-controlled and reformatted to conform to file size limitations and the S-104 standard encoding.

Production Process: S-104 data sets, including the metadata and the coverages for water level, are updated by replacement of the entire data product. HOs routinely collect observational data and maintain an analysis and/or forecast capability. When new data becomes available (often several times per day), the data is reformatted and made available for dissemination.

9 Portrayal

9.1 Introduction

This section describes means of displaying water level data to support navigation, route planning and route monitoring (is the same as per S-111). Three types of data are discussed in depth. The first is point data, which would apply to historical data, astronomical predictions, and real-time data. The second is regularly gridded data, which would apply to analyses, model-based hindcasts and forecasts. For gridded or point set data, the water level portrayal characteristics used for single-point data can be adapted to displaying data at multiple points.

For example, a point portrayal may be provided to display water level at significant locations such as where real-time observations are available. A gridded portrayal may be provided for voyage planning where a mariner's selection of routes may be influenced by water level at certain way points. Note that not all portrayal categories (point and gridded) may be available for all types of water level data (historical observations, real-time observations, astronomical predictions, and forecast total water level).

All recommended sizes are given assuming a minimum size ECDIS display of 270 by 270 mm or 1020 by 1020 pixels.

Three portrayal options are provided because of the different types of information that could be supplied. *The options listed below are to allow Members State cater for the information that they have available for their countries. Intent is that the mariner will want to use the data for route planning and real-time navigation.*

9.2 Display of Water level at a single point

Portrayal of water level using single point data should be used in instances where the data source is a water level (e.g. a historical or real-time water level measuring device at a single geographic location. All text and line colour will be in black unless stated otherwise.

9.2.1 Symbol

The water level point will be represented by the INT 1 symbol 32.1 Tide scale. The use of INT 1 symbol 32.2 is not recommended due to it sharing the symbol with non water level related information.

Size of symbol should be the same as ENC standard for symbols. Colour of the symbol should be ????? *Note in current metadata – we do not capture water level station type eg Standard or secondary or NA (for gridded)*

9.2.2 Information Displayed

The information displayed within a window (no bigger than 170x220 pixels) will be dependent on water level information type. See Table 9.2 for a break down of information

Table 9.2.2-1 Numerical information displayed at the location of a water level

Water Level Type	Information Displayed
Real-Time Observations	Location, date and time stamp (Ship time zone), water level, trend
The rest	Location, date and time stamp (Ship time zone), water level, trend, additional information

Additional information will be supplied on a priority level

Table 9.2.2-2 Priority for additional information

Priority Level	Additional Information
1	Only that listed in Table 9.2.1-1
2	Data Source, Latitude, Longitude, Graphic plot display, water level type
3	Uncertainty in water level, uncertainty in horizontal position, uncertainty in vertical position, uncertainty in time

The numerical value of the water level is a number in metres in black text on white background (or the inverse for night vision). This display should be made available when the cursor is held

over the data point.

9.2.3 Graphic Plot

The availability of the graphic plot display (605x650 pixels), should be a link in the window mentioned in 9.2.1 that create another window/tab displaying up to 7 days of water level. The mariner will have the option to change between 1 day, 3, 5 or 7 day display.

Transparency must be adjusted according to ECDIS standard (S-57, S-101), see S-111 section 9.3 for guidance.

Title of plot will include Location and the water level type.

Data Type	Plot Colour
Real-Time	Magenta
Predicted	Black
Observed minus Predicted	Blue

This feature will be restricted to route planning only.

9.3 Display of Regularly Gridded data

The display of gridded data depicts a water level surface with each individual point having the qualities described in Clause 9.2. As with single point water level data, the values at individual vectors must be available when the curser is placed over a vector. There is no adjustment of bathymetry data.

NOTE: Water level data cannot be interpolated (in either space or time).

9.3.1 High Resolution

A high resolution display (i.e. zooming in) of regularly gridded data display produces a lower density of data (Figure??). It is not recommended that linear spatial interpolation be used to fill in sparse data. Linear interpolation in space could be used to obtain data points from the model grid to generating additional grid points in the portrayal.

9.3.2 Low Resolution

Displaying at a low resolution (i.e. zooming out) increases the density of symbols (Figure ???) However, by applying a thinning algorithm, the number of points may be reduced (Fig ???). In this case, every ?? was plotted.

Thinning for regularly gridded data is as follows. Suppose that the grid cell's diagonal as displayed has a distance of D mm and represents the grid spacing. Note that D is dependent on the specific geographic area and the size of the viewing monitor. If every n^{th} cell is displayed, the displayed spacing is nD. Next, suppose the length of the arrow representing the maximum speed in the displayed field is L_{smax} mm. Then the ratio of the maximum arrow

length to the displayed grid spacing is constrained to be less than a prescribed maximum value, R_{max}, here taken to be 0.5. Thus

$$R = L_{smax}/(nD) \leq R_{max} \quad \text{[Eqn. 9.2]}$$

If the above inequality cannot be met with increment n equal to 1, then a new value for n is computed by the following formula:

$$n = 1 + fix(L_{smax}/(DR_{max})) \quad \text{[Eqn. 9.3]}$$

where fix() is a function that returns the truncated integer value. For plotting, arrows at every n^{th} column and every n^{th} row are drawn, making sure that the row and column with the maximum vector is drawn (Figure 9.8b).

9.4 Display of water level at point locations with zones of influence

Single point features – plot (layer) on top of chart showing location of tide station(s) and a water level value with zones of influence for each station

1 Is this a mini-map or a layer?

2 If a mini-map, what size is the window to be useful? Should these settings be the same as defined in Option A for consistency?

3 Use same setting for display between standard/major stations and secondary/minor stations per Option A.

4 If treated as a separate layer - how will the water level zones of influence be used? Will the soundings that fall within in each zone be adjusted by the value of the water level for the identified water level station to fall in the zone? Defer all adjustment of soundings for Option C and D or IHO UKMCPT

5 Will zones without a water level station have a ratio relationship to one or more water level stations?

6 Will require documenting the methodology for selecting the zones and for displaying them.

7 How is relationship to areas managed?

7.1 Single station: single polygon area

7.2 Single station: multiple areas with ratio of influence (like a co-tidal chart)

7.3 Multiple stations: multiple area (but each area has a station)

7.4 Multiple stations: single area (method of interpolation)

9.5 Temporal Considerations

The time selected for display (i.e. past, present or future) of the water level by the system will typically not correspond exactly to the timestamp of the input data. For data with only a single record (i.e. the timestamp of the earliest values equals that of the latest value) such as real-time data, the water level

values are displayed only if the absolute difference between the display time and the data timestamp is less that a discrimination interval (e.g. 5 minutes). For a single record, the variable *timeRecordInterval* (see Clause 12.3) can be used to set the discrimination interval.

For data with multiple times, if selected display time is later that the first timestamp and earlier than the last timestamp, then the closest two timestamps (i.e. one earlier and one later) in the data are found and the water level values are linearly interpolated. However, if the selected display time is earlier than the first timestamp or later than the last timestamp, the water level values at the closest time are displayed only if the absolute time difference between the display time and the data time stamp is less than a discrimination interval (e.g. half the value of the variable *timeRecordInterval*).

9.6 Interoperability

Interoperability principles determine priority in display of elements so that important image elements, such as depth numerals, are not obscured by water level values. Water level portrayal will conform to interoperability rules when they are established.

9.7 Sample Representation

10 Data Product format (encoding)

10.1 Introduction

The Water level Data Product must be encoded using one of the listed formats. The structure of the data product is discusses in the next section and in S-112. There will be a minimum of two formats to handle data:

a) Real-time water level data via AIS – See S-112

b) The rest of the types of water level data

Character Set: MD_CharacterSetCode (ISO19115)

Specification: S-100 profile of HDF-5 and S-112

10.2 Product Structure

10.2.1 Real-time water level data via AIS

The information that can be delivered through the AIS system is limited. S-112 described what information can be delivered as part of the AIS FI-32 Tidal Window.

10.2.2 The rest of the water level data types

The key idea at the core of the structure is this: the organization of the information is substantially the same for each of the various types of data, but the information itself will be interpreted differently.

10.2.1 Data Type Definition

The product format is designed to be flexible enough to apply for (a) time series data for one or more individual, fixed stations, (b) regularly-gridded data for multiple times, and (c)

irregularly-gridded data for multiple times. This approach contains, for each type, data in a similar format but which is interpreted differently. Since each type of data will be interpreted differently, the type of data must be identified by the variable *dataCodingFormat,* as shown in Table 10.1.

Table 10.1 - Values of the variable *dataCodingFormat.*

dataCodingFormat	Type of Data
1	Time series data at one or more fixed stations
2	Regularly-gridded data at one or more times
3	Irregularly-gridded data at one or more times

For all data types, the product structure in HDF5 includes (a) a metadata block, which is followed by (b) one or more Groups which contain the actual surface current data. The water level information is saved in arrays that hold either gridded data or a time series.

10.2.2 Sample Types

For regularly gridded data, the water level array is two dimensional, with dimensions *numPointsLongitudinal* and *numPointsLatitudinal*. By knowing the grid origin and the grid spacings, the position of every point in the grid can be computed by simple formulae.

However, for time series data and irregularly gridded data (i.e., when *dataCodingFormat* is 1, or 3), the location of each point must be specified individually. This is accomplished by the data in Group XY, which gives the individual longitude (X) and latitude (Y) for each location. For time series data, the X and Y values are the positions of the stations; the number of stations is *numberOfStations.* For irregularly-gridded data, the X and Y values are the positions of each point in the grid; the number of grid points is *numberOfNodes*.

NOTE: If *dataCodingFormat* is 2, Group XY is not present.

The remaining Groups each contain a title, a date-time value, and the water level array. The title can be used to identify each individual station with time-series data. For *dataCodingFormat* = 2 or 3, the date-time is for the entire grid. The water level array is a two dimensional, with a number of columns (*numCOL*) and rows (*numROW*). For a time series, the water level value will be for each time in the series. For a grid, the water value will be for each point in the grid.

The Groups are numbered 1, 2, etc., up to the maximum number of Groups, *numGRP*. For fixed station data, the number of Groups is the number of stations. For regular and irregular grids, the number of Groups is the number of time records

10.2.3 Generalized Dimensions

To summarize, for non-regularly gridded data only, there is an initial Group with X and Y position, stored in one-dimensional arrays of size *numPOS*. Following that, there are data Groups containing water level data, which are stored in two-dimensional arrays of size *numROWS* by *numCOLS*. The total number of data Groups is *numGRPS*.

The four variables that determine the array sizes (*numROWS*, *numCOLS*. *numPOS,* and *numGRPS)* are different, depending upon which coding format is used. Their descriptions are given in Table 10.2.

Table 10.2 – The array dimensions used in the data product.

Coding Format	Data Type	numPOS	numCOL	numROW	numGRP
1	Fixed Stations	numberOfStations	numberOfTimes	1	numberOfStations
2	Regular Grid	(not used)	numPointsLongitudinal	numPointsLatitudinal	numberOfTimes
3	Irregular Grid	numberOfNodes	numberOfNodes	1	numberOfTimes

The overall structure of the surface current data product is created by assembling the data and metadata. The product structure is compliant with the HDF5 data architecture, which allows multi-dimensional arrays of data to be grouped with metadata. The format of the data product (cf. Figure F.5) described above is portrayed in Figure 10.1. The Carrier Metadata is discussed in Clause 12.3.

NOTE: The name of each Group is the ‘Group n‘, where n is numbered from 1 to *numGRP*. The length of the name is six plus the number of digits in n.

Data Product
Carrier Metadata
Group XY (conditional)
X values array (*m*=0,*numPOS*-1)
Y values array (*m*=0,*numPOS*-1)
Group 1
Title$_1$
Valid Date-Time$_1$
Water level array(*i*=0,*numCOL*-1, *j*=0,*numROW*-1)
Group 2
Title$_2$
Valid Date-Time$_2$
Water level array (*i*=0,*numCOL*-1, *j*=0,*numROW*-1)
Group *numGRP*
Title$_{numGRP}$
Valid Date-Time$_{numGRP}$
Water level array (*i*=0,*numCOL*-1, *j*=0,*numROW*-1)

Figure 110.1 - Schematic of the S-104 data product structure. The four parameters *numPOS, numCOL, numROW*, and *numGRP* are explained in Table 10.2.
Group XY appears only for *dataCodingFormat* = 1 or 3 (Table 10.1).

10.3 Digital Certification Block

Information here is used to certify the validity or integrity of the data.

10.4 HDF5 Encoding

The HDF-5 encoding of the data set is discussed in ANNEX G – HDF5 ENCODING.

11 Data Product Delivery

11.1 Introduction

This section describes how the water level data product is to be packaged by the HO. S-112 covers how the data is delivered to the end user.

Due to the cost of transmitting data via the internet, it is desirable to limit file size and updating frequency whenever possible. The file size, as created by the HO and before compression, is limited to 10 MB.

Updating of files typically means issuing a new forecast, or disseminating the latest observed water level for a specific geographic region. This may occur several times per day. Therefore all files must contain a date time of issuance of the product.

11.2 Exchange Datasets

Datasets, or data products, produced by the HO consist of files containing both the exchange catalogue and one or more data products (of possibly different S-100 types), with each product covering a specific geographic region and specific period of time (Figure 11.1). The Exchange Catalogue lists the products and contains the discovery metadata.

The name of the exchange dataset will have the character string 'S104' somewhere in it (e.g., 'S104_ExchangeDataset'), and this will identify the data as containing water level.

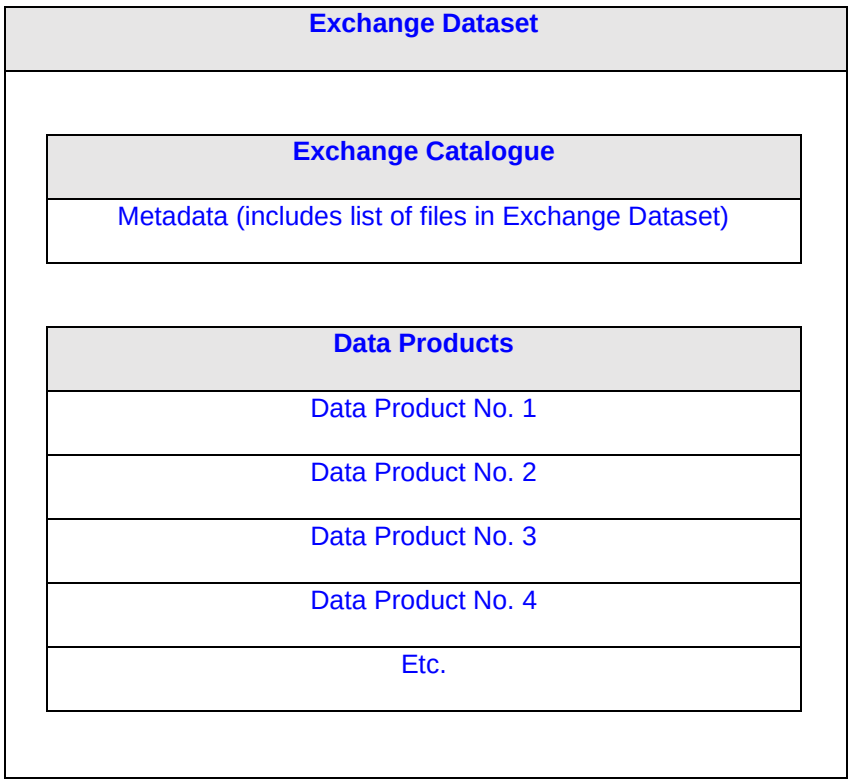


Figure 11.1 – Schematic diagram of the Exchange Dataset.

The dataset size is limited to 10 MB. The size of each file can vary widely, depending on the data. Using the sample HDF5 file (see Figure F.3), a file containing, along with metadata, a single speed array and a single direction array, each with 100,000 grid points would have a

size of approximately 0.21 Mbytes. Exchange files may be compressed using zip methodology. Doing so can reduce file size by 80% or more.

11.3 Exchange Catalogue

The exchange catalogue (normally in XML format) acts as the table of contents for the exchange set. The catalogue file of the exchange set must be named S104ed1.CAT; no other file in the exchange set may have the same name. The contents of the exchange catalogue are described in Clause 12.

11.4 Data Product File Naming

The data product file contains both a metadata block and one or more sets of water level arrays. The file naming convention described here must be used for all water level files from all sources. The file naming convention consists of from 20 to 22 characters. The characters are used to identify the following: the country code (two characters), followed by HO specific characters to uniquely define the dataset (15 characters). The filename extension (e.g., .hdf5) denotes the file format. Characters may be lower or upper case. This is summarized in Table 11.1.

Table 11.1 - Characters used in the file naming convention.

N	DESCRIPTION	LENGTH	EXAMPLE
1	Country Code	2	CA
2	Unrestricted	15	Gulf20141106ABC
3	Extension	3 to 5	.h5, .hdf5
	Total =	20 to 22	

The unrestricted characters may be used to denote geographical region, valid time, source of the data, version numbers, and/or any other relevant information.

11.5 Support Files

This Data Product requires no support files.

12 Metadata <S-100 Part 4>

12.1 Introduction

For information exchange, there are several categories of metadata required: metadata about the overall exchange catalogue, metadata about each of the datasets contained in the catalogue, and metadata about the support files that make up the package. The discovery metadata classes have numerous attributes which enable important information about the datasets and accompanying support files to be examined without the need to process the data, e.g. decrypt, decompress, load etc. Other catalogues can be included in the exchange set in support of the datasets such as feature, portrayal, coordinate reference systems, codelists etc. The attribute “purpose” of the support file metadata provides a mechanism to update support files more easily.

This clause defines the mandatory and optional metadata needed for S-104. For information exchange, there are several categories of metadata required: metadata about the overall exchange catalogue, metadata about each of the datasets contained in the catalogue, and metadata about the support files, if any, that make up the package. In some cases the metadata may be repeated in a national language.

12.2 Discovery Metadata

An outline the overall concept of an S-104 exchange set for the interchange of geospatial data and its relevant metadata is explained in the following figures. Figure 12.1 depicts the realization of the ISO 19139 classes which form the foundation of the exchange set. The overall structure of the S-104 metadata for exchange sets is modelled in Figures 12.2 and 12.3. More detailed information about the various classes is shown in Figure 12.4 and a textual description in the tables at Clause 12.3.

Figure 12.1 - Realization of the exchange set classes. Note that there are no support files.

The discovery metadata classes have numerous attributes which enable important information about the datasets and accompanying support files to be examined without the need to process the data, e.g. decrypt, decompress, load etc. Other catalogues can be included in the exchange set in support of the datasets such as feature and portrayal. The attribute “purpose” of the support file metadata provides a mechanism to update support files more easily.

The language used for the metadata is English.

Time reference for all **data will be UTC.**

All water level values to be given in metres (up to three decimal places for real values).

Figure 12.2 - S-104 ExchangeSet Catalogue.

Figure 12.3 – S-104 ExchangeSet.

Figure 1242 - S-104 Exchange Set: Class details.

12.2.1 S104_ExchangeCatalogue

Each exchange set has a single S100_ExchangeCatalogue which contains meta information for the data and support files in the exchange set.

Name	Description	Mult	Value	Type	Remarks
S100_ExchangeCatalogue	An exchange catalogue contains the discovery metadata about the exchange datasets and support files	-		-	-
Identifier	Uniquely identifies this exchange catalogue	1		S100_CatalogueIdentifier	
Contact	Details about the issuer of this exchange catalogue	1		S100_CataloguePointOfContact	
productSpecification	Details about the product specifications used for the datasets contained in the exchange catalogue	0..1		S100_ProductSpecification	Conditional on all the datasets using the same product specification
exchangeCatalogueName	Catalogue filename	1		CharacterString	In S-101 it would be CATLOG.101
exchangeCatalogueDescription	Description of what the exchange catalogue contains	1		CharacterString	
exchangeCatalogueComment	Any additional Information	0..1		CharacterString	
compressionFlag	Is the data compressed	0..1		Boolean	Yes or No
algorithmMethod	Type of compression algorithm	0..1		CharacterString	Eg. RAR or ZIP
sourceMedia	Distribution media	0..1		CharacterString	
replacedData	If a data file is cancelled	0..1		Boolean	

Name	Description	Mult	Value	Type	Remarks
	is it replaced by another data file				
dataReplacement	Cell name	0..1		CharacterString	

12.1.2 S100_CatalogueIdentifier

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_CatalogueIdentifier	An exchange catalogue contains the discovery metadata about the exchange datasets and support files	-	-	-
Attribute	identifier	Uniquely identifies this exchange catalogue	1	CharacterString	
Attribute	editionNumber	The edition number of this exchange catalogue	1	CharacterString	
Attribute	date	Creation date of the exchange catalogue	1	Date	

12.1.3 S100_CataloguePointofContact

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_CataloguePointOfContact	Contact details of the issuer of this exchange catalogue	-	-	-
Attribute	organization	The organization distributing this exchange catalogue	1	CharacterString	This could be an individual producer, value added reseller, etc.
Attribute	phone	The phone number of the organization	0..1	CI_Telephone	
Attribute	address	The address of the organization	0..1	CI_Address	

12.2.2 S100_DatasetDiscoveryMetaData

Data in the Discovery Metadata are used to identify the relevance of the dataset to the particular application.

Name	Description	Mult	Value	Type	Remarks
S100_DatasetDiscoveryMetadata	Metadata about the individual datasets in the exchange catalogue	-		-	-
fileName	Dataset file name	1		CharacterString	
filePath	Full path from the exchange set root directory	1		CharacterString	Path relative to the root directory of the exchange set. The location of the file after the exchange set is unpacked into directory <EXCH_ROOT> will be <EXCH_ROOT>/<filePath>/<filename>
description	Short description giving the area or location covered by the dataset	1		CharacterString	E.g. a harbour or port name, between two named locations etc.
dataProtection	Indicates if the data is encrypted	0..1		Boolean	0 indicates an unencrypted dataset 1 indicates an encrypted dataset
protectionScheme	specification or method used for data protection	0..1		CharacterString	Eg S-63
digitalSignature	Indicates if the data has a digital signature	0..1		Boolean	0: unsigned 1: datafile is digitally signed [to be reconciled when S-100 finalizes digital signature elements]
digitalSignatureValue	Digital signature	0..1		CharacterString	This contains a base64 encoding of the hexadecimal numbers comprising the digital signature itself. The content of these fields are defined, along with the algorithms for their calculation, in S-63 ed2.0 Part (C). [to be reconciled when S-100 finalizes digital signature elements]
classification	Indicates the security classification of the dataset	0..1		Enumeration	One of the following from ISO 19115 MD_SecurityConstraints> MD_ClassificationCode (codelist) 1. unclassified 2. restricted 3. confidential 4. secret 5. top secret
purpose	The purpose for which the dataset has been issued	1		MD_Identification>purpose CharacterString	E.g. new, re-issue, new edition, update etc.
specificUsage	The use for which the dataset is	1		CharacterString	E.g. in the case of ENCs this would be

Name	Description	Mult	Value	Type	Remarks
	intended				a navigation purpose classification.
editionNumber	The edition number of the dataset	1		CharacterString	When a data set is initially created, the edition number 1 is assigned to it. The edition number is increased by 1 at each new edition. Edition number remains the same for a re-issue.
issueDate	date on which the data was made available by the data producer	1		Date	
productSpecification	The product specification used to create this dataset	1		S104_ProductSpecification	
producingAgency	Agency responsible for producing the data	1		CI_ResponsibleParty	
horizontalDatumReference	Reference to the register from which the horizontal datum value is taken	1		characterString	EPSG
horizontalDatumValue	Horizontal Datum of the entire dataset	1		Integer	4326
verticalDatum	Vertical Datum of the entire dataset	1		S100_VerticalAndSoundingDatum	
soundingDatum	Sounding Datum of the entire dataset	1		Enumeration S100_VerticalAndSoundingDatum	Not relevant to S-104. Fixed value corresponding to literal localDatum from S100_VerticalAndSoundingDatum.
dataType	The encoding format of the dataset	1		S100_DataFormat	
otherDataTypeDescription	Encoding format other than those listed.	0..1		CharacterString	
dataTypeVersion	The version number of the dataType.	1		CharacterString	
dataCoverage	Area covered by the dataset	1		S100_DataCoverage	
comment	Any additional information	0..1		CharacterString	

12.2.3 S104_DataCoverage

Name	Description	Mult	Value	Type	Remarks
S100_DataCoverage		-		-	-
ID	Uniquely identifies the coverage	1		Integer	-
boundingBox	The extent of the dataset	1		EX_GeographicBoundingBox	-

	limits				
boundingPolygon	A polygon which defines the actual data limit	1..*		EX_BoundingPolygon	-
optimumDisplayScale	The scale with which the data is optimally displayed	0..1		Integer	
maximumDisplayScale	The maximum scale with which the data is displayed	0..1		Integer	
minimumDisplayScale	The minimum scale with which the data is displayed	0..1		Integer	

12.2.4 EX_GeographicBoundingBox

From ISO 19115:2003 Corr. 1 (2006).

Name	Description	Mult	Type	Remarks
EX_GeographicBoundingBox	geographic position of the dataset	-	-	Defined in ISO 19115
westBoundLongitude	western-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)	1	Real	Arc degrees
eastBoundLongitude	eastern-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)	1	Real	Arc degrees
southBoundLatitude	southern-most coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees (positive north)	1	Real	Arc degrees
northBoundLatitude	northern-most, coordinate of the limit of the dataset extent expressed in latitude in decimal degrees (positive north)	1	Real	Arc degrees

12.2.5 EX_BoundingPolygon

From ISO 19115:2003 Corr. 1 (2006).

Name	Description	Mult	Type	Remarks

Name	Description	Mult	Type	Remarks
EX_BoundingPolygon	boundary enclosing the dataset, expressed as the closed set of (x,y) coordinates of the polygon (last point replicates first point)	-	-	Defined in ISO 19115
polygon	sets of points defining the bounding polygon	1	GM_Object	Must be a GM_Polygon (See S-100 Part 7, ISO 19107, ISO 19136)

12.2.6 S100_VerticalAndSoundingDatum

Role Name	Name	Description	Mult	Type	Remarks
Class	S104_VerticalAndSoundingDatum	Allowable vertical and sounding datums	-	-	-
Value	meanLowWaterSprings		-	-	1
Value	meanSeaLevel		-	-	2
Value	meanLowerLowWaterSprings		-	-	3
Value	lowestLowWater		-	-	4
Value	meanLowWater		-	-	5
Value	lowestLowWaterSprings		-	-	6
Value	approximateMeanLowWaterSprings		-	-	7
Value	indianSpringLowWater		-	-	8
Value	lowWaterSprings		-	-	9
Value	approximateLowestAstronomicalTide		-	-	10
Value	nearlyLowestLowWater		-	-	11
Value	meanLowerLowWater		-	-	12
Value	lowWater		-	-	13
Value	approximateMeanLowWater		-	-	14
Value	approximateMeanLowerLowWater		-	-	15
Value	meanHighWater		-	-	16
Value	meanHighWaterSprings		-	-	17
Value	highWater		-	-	18
Value	approximateMeanSeaLevel		-	-	19
Value	highWaterSprings		-	-	20
Value	meanHigherHighWater		-	-	21
Value	equinoctialSpringLowWater		-	-	22

Value	lowestAstronomicalTide		-	-	23
Value	localDatum		-	-	24
Value	internationalGreatLakesDatum1985		-	-	25
Value	meanWaterLevel		-	-	26
Value	lowerLowWaterLargeTide		-	-	27
Value	higherHighWaterLargeTide		-	-	28
Value	nearlyHighestHighWater		-		29
Value	highestAstronomicalTide		-		30(HAT)
Value	Ellipsoidal Height	Not in S100!!!			31

12.2.7 S104_DataFormat

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_DataFormat	Encoding format	-	-	
Value	HDF5	Format	1	Character	
Value	BAG	Format			S102 Bathymetric Attributed Grid

12.2.8 S100_ProductSpecification

Name	Description	Mult	Type	Remarks
S100_ProductSpecification	The Product Specification contains the information needed to build the specified product	-	-	-
name	The name of the product specification used to create the datasets	1	CharacterString	S-104 Surface Current Product Specification
version	The version number of the product specification	1	CharacterString	1.0.0
date	The version date of the product specification	1	Date	

12.1.9 S100_CatalogueMetadata

Name	Description	Mult	Value	Type	Remarks
S100_CatalogueMetadata		-		-	-
filename	The name for the catalogue	1..*		CharacterString	

fileLocation	Full location from the exchange set root directory	1..*		CharacterString	Path relative to the root directory of the exchange set. The location of the file after the exchange set is unpacked into directory <EXCH_ROOT> will be <EXCH_ROOT>/<filePath>/<file name>
scope	Subject domain of the catalogue	1..*		S111_CatalogueScope	
versionNumber	The version number of the product specification	1..*		CharacterString	
issueDate	The version date of the product specification	1..*		Date	
productSpecification	The product specification used to create this file	1..*		S100_ProductSpecification	
digitalSignatureReference	Digital Signature of the file	1		CharacterString	Reference to the appropriate digital signature algorithm
digitalSignatureValue	Value derived from the digital signature	1		CharacterString	

Identifies components of the Catalogue.

12.1.10 S100_CatalogueScope

Role Name	Name	Description	Mult	Type	Remarks
Class	S100_CatalogueScope		-	-	-
Value	featureCatalogue				
Value	portrayalCatalogue				

12.3 Carrier Metadata

The carrier metadata consists of the data and parameters needed to read and interpret the information in the Water Level product even if the other S-104 MetaData files are unavailable.

Table 12.1 – S-104 Carrier metadata. Latitude and longitude values precise to 10^{-7} deg.

N	Name	Camel Case	Data Type	Remarks and/or Units
1	Product Spec and version	productSpecification	Character	This must be encoded as 'S-104.X.X.X', with Xs representing the version number
2	Date-Time of data product issue	dateTimeOfIssue	Character	DateTime. Must be consistent with issueDate in discovery metadata.
3	Name of geographic region	nameRegion	Character	
4	Name of geographic sub-region	nameSubregion	Character	
5	Horizontal datum	horizontalDatumReference	Character	EPSG
6	Horizontal datum number	horizontalDatumValue	Integer	4326 (for WGS84)
7	Indicates if the data is encrypted	dataProtection	Enumeration	0: unencrypted dataset 1: encrypted dataset
8	Specification or method used for data protection	protectionScheme	Character	Eg. S-63
9	Valid Time of Earliest Value	dateTimeOfFirstRecord	Character	DateTime
10	Valid Time of Latest Value	dateTimeOfLastRecord	Character	DateTime
11	Time interval	timeRecordInterval	Integer	Seconds
12	Number of time records	numberOfTimes	Integer	
13	Type of Waterlevel data	typeOfWaterlvelData	Enumeration	1. Historical observation 2. Real-time observation 3. Astronomical prediction 4. Analysis or hybrid method 5. Hydrodynamic model hindcast 6. Hydrodynamic model forecast
14	Data organization index, used to read the data	dataCodingFormat	Enumeration	1: Time series at fixed stations 2: Regularly-gridded arrays 3: Irregularly-gridded arrays
15	Number of fixed stations	numberOfStations	Integer	Used only if dataCodingFormat = 1
18	Vertical datum reference	verticalDatum	Enumeration	Chart datum as per Clause 12.2.6
19	Longitude of grid origin	gridOriginLongitude	Real	Arc Degrees (if dataCodingFormat=2)
20	Latitude of grid origin	gridOriginLatitude	Real	Arc Degrees (if dataCodingFormat=2)
21	Grid spacing, long.	gridSpacingLongitudinal	Real	Arc Degrees (if dataCodingFormat=2)
22	Grid spacing, lat.	gridSpacingLatitudinal	Real	Arc Degrees (if dataCodingFormat=2)
23	Number of points, long.	numPointsLongitudinal	Integer	iMax (if dataCodingFormat=2)
24	Number of points, lat.	numPointsLatitudinal	Integer	jMax (if dataCodingFormat=2)
25	First grid point num., long.	minGridPointLongitudinal	Integer	0 (if dataCodingFormat=2)
26	First grid point num., lat.	minGridPointLatitudinal	Integer	0 (if dataCodingFormat=2)
27	Nodes in irregular grid	numberOfNodes	Integer	Used if dataCodingFormat=3

28	Land mask value	gridLandMaskValue	Real	Negative value (e.g. -1.0 or -99.999). Also denotes a missing value.
31	Horizontal position uncertainty	uncertaintyOfHorizontalPosition	Real	-1.0 (unknown) or positive value (m)
32	Vertical position uncertainty	uncertaintyOfVerticalPosition	Real	-1.0 (unknown) or positive value (m)
33	Time uncertainty	uncertaintyOfTime	Real	-1.0 (unknown) or positive value (s)
34	Methodology	methodCurrentsProduct	Character	Brief description of current meter type, forecast method or model, etc.

12.4 Generic metadata

Valid Time of First Value		1	Date-Time	YYYY-MM-DDTHH:MM:SSZ	Valid Time of First Value
Valid Time of Last Value		1	Date-Time	YYYY-MM-DDTHH:MM:SSZ	Valid Time of Last Value

Single point metadata

Name/Role	Source	Multiplicity	Value	Type	Remarks
Time_interval (delivery)		1		Real	
Unique Identifier		1		Character/numerical	
Unique Name		1		Character string	
Value for missing data		1		Real	

Feature Type: WaterLevel

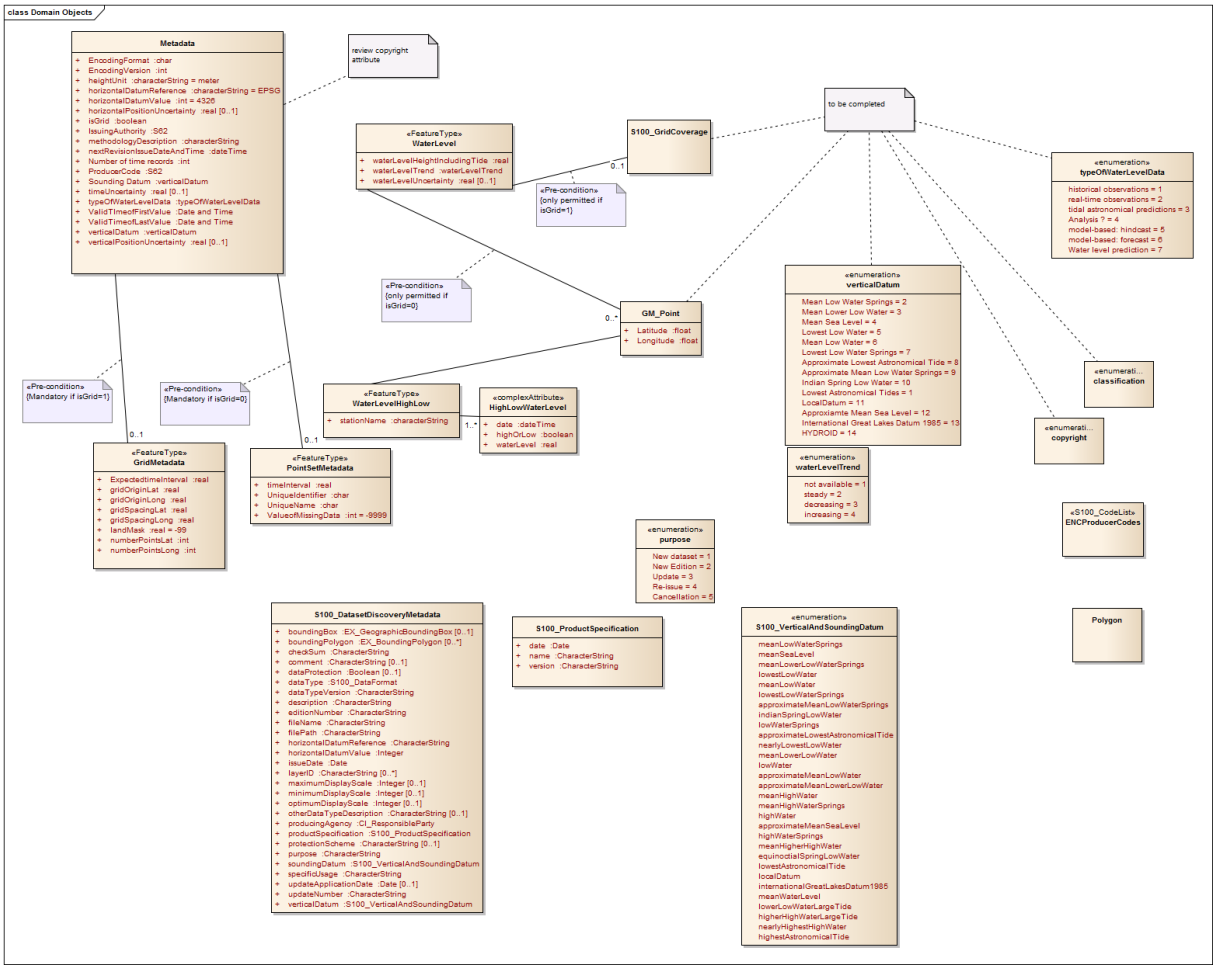
Name/Role	Source	Multiplicity	Value	Type	Remarks
Position (x,y)	S100	1			Latitude and Longitude of the entity
Water level Height including		1			metres

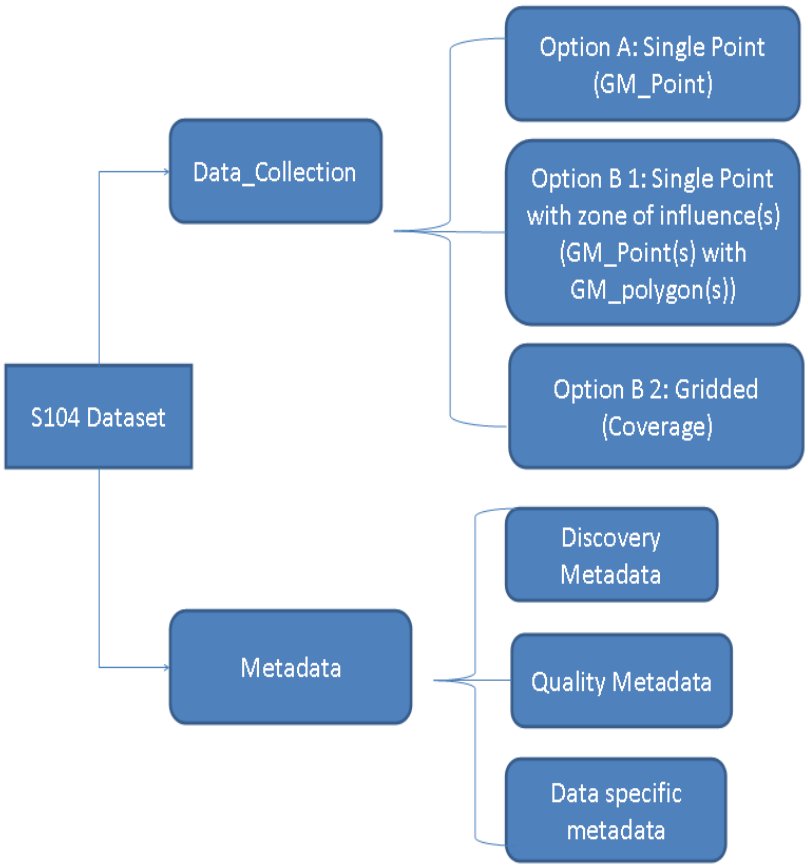
tide					Maximum 2 decimal places Observed/ predicted
Water level uncertainty		1		Real	metres – maximum 2 decimetres -99 if uncertainty is unknown
Water level trend	ASM	1	* to be confirmed in enumeration list starts at 1 or 0 0 1 2 3	Enumerate	0 = steady 1 = decreasing 2 = increasing 3 = not available

Annex A - Data Classification and Encoding Guide

Annex B –Data Product format (encoding)

Annex C – Application Schema





Annex D – Feature Catalogue

Annex F – Portrayal Catalogue