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OGC Hydrologic Features

Part 1: Conceptual Model (HY\_Features)

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Abstract

The OGC HY\_Features implementation standard defines a standard information model for the identification of hydrologic features independent from geometric representation and scale. The conceptual model describes hydrologic features by defining the fundamental relationships among major components of the hydrosphere. This includes relationships such as the hierarchy of basins, the segmentation of watercourses, and the topological connectivity of hydrologic features.

The standard is based on the concept that a given hydrologic feature may have multiple representations. This supports referencing the same feature(s) in different information systems and assists the organization and cataloging of observations, model results, or other studies of a feature. The ability to represent the same watershed, river, or other hydrologic feature in several ways is critical to aggregation of cross-referenced features into integrated datasets and data products on global, regional, or basin scales.

The Hydrologic feature types are defined using the OGC General Feature Model (ISO19109:2006) with reference to definitions within the International Glossary for Hydrology. The conceptual model is expressed in the Geographic Information Conceptual Schema Language (ISO19103:2005) using the Unified Modeling Language (UML).

Keywords

The following are keywords to be used by search engines and document catalogues.

ogcdoc, OGC document, hydrology, feature, identification, conceptual model, ontology, implementation standard

Preface

This standard defines the HY\_Features common hydrologic feature model for the identification of hydrologic features. It is intended to be used to document and share information about the objects of study and reporting in Hydrology in many applications. This standard was specifically commissioned to link hydrologic information across the scientific and technical programs of the World Meteorological Organization (WMO), and to assist the WMO Members to discover, access and use hydrologic data from different sources.

This standard has been designed to support the need for governance and guidance by national and international authorities. Aspects of the standard that support this end are; 1) its canonical form, 2) its implementation neutrality, 3) conformity to internationally recognized standards of geographic information, and its use of semantics inferred from terminology endorsed by the WMO and the UN Educational, Scientific and Cultural Organization (UNESCO).

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Submitting organizations

The following organizations submitted this Document to the Open Geospatial Consortium (OGC):

1. Federal Institute of Hydrology (BfG), Global Runoff Data Centre of WMO
2. CSIRO, Land and Water
3. USGS

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| Bruce Simons | CSIRO |

# Scope

This OGC Implementation Standard defines a common hydrologic feature model for the identification and description of hydrologic features using established models and patterns in use in the Hydrology domain and endorsed by WMO and UNESCO such as those documented in the “International Glossary of Hydrology”.

Part 1 (this document) introduces the conceptual model itself. The normative model is a machine-readable UML artefact published by the OGC in conjunction with this document at: [insert URL here].

Part 2 (a future document) is expected to define an OWL and RDF representation of the conceptual model suitable for defining links between features that reference the HY\_Features model, to support documentation and discovery of data as well as data transformation. This work may provide a basis for further work in the wider OGC on a methodology (tooling) to publish ontologies to support their practical use.

The initial scope is defined by the WMO Commission for Hydrology (WMH-CHy): to facilitate data sharing within the hydrologic community of the WMO Member countries and to improve the quality of data products based on these data by defining hydrologic features to convey the identity of water-objects through the data processing chain “from measurement to hydrological information” [8].

Though standardized transfer routines such as those developed in WaterML2 Part 1 Time Series and Part 2 Ratings and Gagings support the syntactic interoperability of systems and services, the current standard Web services do not sufficiently support a semantic-based retrieval of the data they offer. To enable semantic interoperability of hydrologic data and services, it is necessary to agree on common concepts and methods for machine interpretation of the concepts. To this goal, the HY\_Features model was developed in order to formalize the concepts and relationships of hydrologic features using the WMO/UNESCO “International Glossary of Hydrology” [3] as a starting point.

This standard is meant to support the linkage of data products distributed across differing applications and jurisdictions. To enable this, a holistic and highly general concept of a catchment is defined such that a particular catchment may be represented differently in a wide range of data products while retaining its identity. In addition to unique identification of features in multiple systems, a second objective is to provide a standard terminology and ontology to describe relationships between hydrologic features. This may be useful to building a data transfer formats for specific subsets, particularly catchment hierarchy and river network topology but such data transfer format development is not in scope for this standard.

The HY\_Features model provides a basis for common and stable references to hydrologic features in a wide variety of applications:

* to link hydrologic observations to their feature-of-interest, e.g. link a streamflow observation to the river or watershed being observed,
* to allow aggregation of cross-referenced features into integrated datasets and data products on global, regional, or basin scales,
* to enable information systems to unambiguously link data across distributed systems and domains,
* to enable cross-domain or multi-discipline services to communicate through reference to standard concepts.

This standard defines a set of Application Schemas (normative) containing feature type definitions that conform to the OGC General Feature Model (ISO19109:2006), expressed in the Geographic Information Conceptual Schema Language (ISO19103:2005) using the Unified Modeling Language (UML).

## HY\_Features in the overall context of ISO and OGC standards

The HY\_Features conceptual model is intended to realize the General Feature Model by providing a domain-specific instance of the general GF\_FeatureType (aka FeatureType) «metaclass» capturing the Hydrology phenomenon. Since its concern is primarily the issue of feature identification, a basic class HY\_HydroFeature is defined to reflect the entirety of atmospheric, surface and sub-surface hydrologic features. *Figure* 1 shows how the HY\_Features model might fit into the existing OGC feature landscape, particularly the observation context.

The HY\_Features model allows the feature-of-interest concept of the O&M model (ISO19156:2011) to be realized for hydrologic observations. Depending on the application, the observation target may be theDomain Feature like a water body or water containing unit, or a Sampling Feature used as a proxy for this. Specifically observation-centric applications such as the WaterML2.0 implementation profiles of O&M may use the concepts provided in this standard to identify the domain-specific relationship between a sampling feature and the ultimate sampled feature.

With respect to observation results arranged in a spatial or temporal coverages, the HY\_Features model allows to realize the representation of the target feature-of-interest by the coverage. Applications describing datasets may use the concepts provided to identify the represented hydrologic feature.

Describing how hydrologic features are related together, the HY\_Features model may be used to describe the relationships between geospatial data products representing these features as well as to discover, access and interpret hydrologic data provided using Web Services.

## HY\_Features in the overall context of the WMO Information System

WIS, the WMO Information System, provides mechanisms for the international exchange of information related to weather, climate and water. In this framework, the *WMO Core Metadata Profile* version 1.3 [[4](#_ENREF_4)] was developed. This specification defines the content, structure and encoding of discovery metadata published within the WIS Discovery-Access-Retrieval (DAR) Catalogue. The metadata standard is defined as an informal category-1 profile of the ISO19115:2003 ‘Geographic information – Metadata’

Image2

Figure 1: HY\_Features in the context of the OGC Abstract Specifications

WIGOS, the WMO Integrated Global Observing System, is a coordinated system comprised of the present WMO global observing systems. Complementary to the WMO Core Metadata Profile, a WIGOS Core Metadata Standard is under development that will allow the essential observational information to be exchanged regardless of the format used for the data transfer.

In this context, the HY\_Features model will provide a required component of a metadata model describing hydrologic data sets and products generated from observation. The HY\_Features feature types may be used to relate the spatial or temporal coverages to the WMO basin they represent. Controlled vocabularies will be required, and a binding mechanism to specify how these independently governed and published components can be combined. *Figure 2* shows how the HY\_Features model might fit into WIS / WIGOS.

Image2

Figure 2: Placement of HY\_Features in the context of WIS / WIGOS

# Conformance

This standard defines the conceptual model for the identification of hydrologic features by their fundamental relationships using the General Feature Model (ISO19109:2006). The UML model in this International Standard defines conceptual classes; various software systems define implementation classes or data structures. All of these reference the same information content.

The UML model in this International Standard may be used in two ways: a) to derive implementation classes for data exchange or b) via reference, herein termed mapping, from terms used in an implementation to the equivalent terms in the HY\_Features model. The form of such a mapping is not specified in this standard, but in general there is correspondence expected between classes implementing HY\_Features concepts, either an exact correspondence, or a correspondence to a specialization of an HY\_Features class with narrower scope.

Requirements for OGC HY\_Features standardization target types are considered:

* Encodings (such as GML or OWL) of the HY\_Features conceptual UML model described in this standard and
* Application schemas formally mapped to HY\_Features concepts including Feature Type classes and associative relationships.

For brevity, the terminology **implement** is used to indicate either a direct encoding or existence of a formalized mapping that would enable a client, at run-time, to determine that a particular implementation class implements a specific HY\_Features concept.

Parts 2 and 3 are intended to provide GML and OWL encodings of the HY\_Features application schema, whereby the mapping from the implementation to this specification will be formalized through use of encoding rules that allow direct correspondence of schema elements with the UML elements defined.

Conformance with this standard shall be checked using all the relevant tests specified in Annex A (normative) of this document. The framework, concepts, and methodology for testing, and the criteria to be achieved to claim conformance are specified in the OGC Compliance Testing Policies and Procedures and the OGC Compliance Testing web site[[1]](#footnote-1).

In order to conform to this OGC™interface standard, a software implementation shall choose to implement:

1. Any one of the conformance levels specified in Annex A (normative).
2. Any one of the Distributed Computing Platform profiles specified in Annexes TBD through TBD (normative).

All requirements-classes and conformance-classes described in this document are owned by the standard(s) identified.

# References

The following normative documents contain provisions that, through reference in this text, constitute provisions of this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

ISO 19101:2002, Geographic Information—Reference Model

ISO/TS 19103:2005, Geographic Information — Conceptual schema language

ISO 19107:2003, Geographic Information — Spatial schema

ISO 19108:2006, Geographic Information — Temporal schema

ISO 19109:2006, Geographic Information — Rules for application schemas

ISO 19115:2012, Geographic Information — Metadata – Fundamentals (Draft)

ISO 19156:2011, Geographic Information — Observations and Measurements

# Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

For the purposes of this document, the following additional terms and definitions apply.

application schema

Conceptual schema for data required by one or more applications  
[ISO 19101].

basin

Physiographic unit wherein all waters, surface and subsurface waters, are flowing to a common outlet, caused either by gravity or by pumping.



catchment

Physiographic unit wherein hydrologic processes take place.

NOTE: This class denotes the physiographic unit, for which is concluded that a hydrological determination exists, but is not explicitly identified. This approach refers to the common recognition of a catchment as the basic unit of study in hydrology, of water resources management and environmental reporting.

domain feature

Feature of a type defined within a particular application domain.  
[ISO19156].

feature

Abstraction of real-world phenomena.  
[ISO19101]

hydrographic network

Aggregate of rivers and other permanent or temporary watercourses, and also lakes and reservoirs. [3]

NOTE: Not to be confused with the network of hydrological stations and observing posts.

hydrography

Science dealing with the description and measurement of open bodies of water. [3]

NOTE: In this context, hydrography refers to the description of water bodies. Its measurement in terms of surveying, e.g. for navigational purposes, is not in the concern of the HY-Features model.

hydrologic feature

Abstract notion of the Hydrology phenomenon.

hydrology

Science that deals with the waters above and below the land surfaces of the Earth, their occurrence, circulation and distribution, both in time and space, their biological, chemical and physical properties, their reaction with their environment, including their relation to living beings. [3]

hydrometric feature

Real-world phenomenon which forms part of a hydrometric network.

NOTE: The hydrometric feature refers to a physical structure intended to observe properties of a hydrologic feature. Used to sample a hydrologic feature, a hydrometric feature may be considered a sampling feature of observation. A sampling feature is described in general in ISO 19156, the special monitoring point of hydrologic observation is described in the *WaterML 2.0* Specification [5].

hydrometry

Science of the measurement and analysis of water including methods, techniques and instrumentation used in hydrology. [3]

mapping

A machine-readable formalism of the correspondence of elements of disparate class representations of hydrologic features.

NOTE: In the context of common semantics, it refers to concept mapping particularly to an agreed reference concept. No specific semantic mapping standard is supported by the OGC standards baseline at this time, so only the expressivity requirements of mappings are specified in relevant conformance clauses.

multilingual keyword

Keyword used in a multilingual context.

NOTE: A keyword is generally described in ISO 19115.

named feature

Feature identified by a name.

NOTE: Hydrologic features and their real-world representations have names within common experience, but may have different names in their cultural, political and historical contexts.

representation

Real-world phenomenon representing an abstract feature.

river positioning system

Linear system used to reference indirect positions along a watercourse.

sampling feature

Artifacts of an observational strategy … intended to sample some feature of interest in an application domain.  
[ISO 19156]

storage

Impounding of water in surface or underground reservoirs, for future use. [3]

NOTE: Storage refers to a water body in terms of a usable water resource. The management of the reservoir as human action with the objective to efficient and sustainable use the resource, is not in the scope of the conceptual model. Yet, often an indication is required whether a water body is used for storage.

water body

Mass of water distinct from other masses of water. [3]

NOTE: This refers to water bodies accumulating water on and below the land surface.

# Conventions

This sections provides details and examples for any conventions used in the document. Examples of conventions are symbols, abbreviations, use of XML schema, or special notes regarding how to read the document.

## Identifiers

The normative provisions in this specification are denoted by the URI

http://www.opengis.net/spec/{standard}/{m.n}

All requirements and conformance tests that appear in this document are denoted by partial URIs which are relative to this base.

## Symbols (and abbreviated terms)

CHy WMO Commission for Hydrology

GML Geography Markup Language

GRDC Global Runoff Data Centre

HDWG OGC Hydrology Domain Working Group

ISO International Organization for Standardization

OGC Open Geospatial Consortium

OWL [Web Ontology Language](http://de.wikipedia.org/wiki/Web_Ontology_Language)

UML Unified Modeling Language

WaterML 2 WaterML 2.0 – an observation model for hydrology

WIS WMO Information System

WIGOS WMO Integrated Global Observing System

WMO World Meteorological Organization

XML eXtensible Markup Language

## UML notation

Most diagrams that appear in this specification are presented using the Unified Modeling Language (UML) static structure diagram, as described in Subclause 5.2 of the OGC Web Services Common Implementation Specification (OGC 04-016r2).

## WMO Terminology

The HY\_Featuresmodel uses as far as possible the terminology recommended for use in the WMO Member countries. The key reference is the “International Glossary of Hydrology” [[3](#_ENREF_1)], a joint publication of the WMO and the UNESCO. Wherever appropriate, terms from this glossary are applied to the feature concepts to capture meaning and contextual relationships. Differences in terminology were explored through reconciling the definitions documented in the IGH with the aspects reflected in various data sets and products in use, augmenting the accepted definitions having explicit semantics with the relationships inferred from other terminology.

Some requirements classes defined in this standard refer to the Scoped Name concept of ISO19103. Intended to form a basis for information and data sharing in the community of the WMO member countries, the *Scoped Name* should reflect a name endorsed by the WMO.

## Naming convention

The *HY*-prefix used in the UML model follows the ISO naming conventions for UML elements. There is no explicit requirement to use this name in an implementation for the same semantic elements, but it is required to provide an explicit mapping between terminology used and HY\_Features to unambiguously indicate hydrologic feature concepts to support unambiguous interpretation in cross-domain applications. There is not yet specified how mappings between abstract element names and implementations should be recorded; it is expected that system interoperability will be facilitated by making such mappings available as a component of the dataset documentation.

The *EXT*-prefix refers to “external”, common patterns that are required, but not hydrology-specific, and should be imported when available from an external source.

# Clauses not Containing Normative Material

## The abstract notion of the Hydrology phenomenon

The processes governing the continuous depletion and replenishment of water resources result at various stages in a wide range of hydrologic objects which are subject to monitoring, modelling and reporting in hydrology and related sciences. This standard applies to data and data products representing the Hydrology phenomenon in its complexity of waters above and below the land surfaces of the Earth, their occurrence, circulation and distribution, both in time and space, their biological, chemical and physical properties, their reaction with their environment, including their relation to living beings. [[3](#_ENREF_1)]

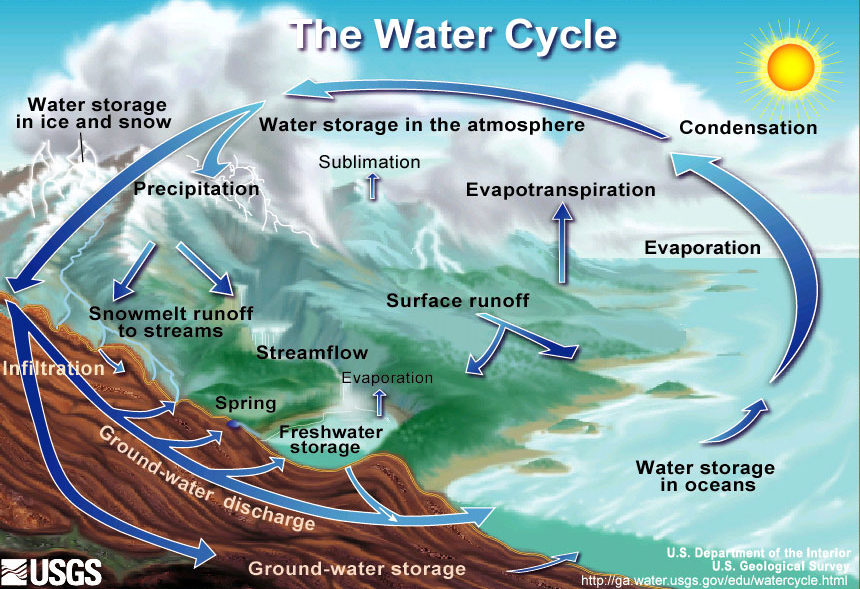


Figure 3: Processes of the Hydrologic Cycle

Water is moving from the atmosphere to the Earth and back to the atmosphere due to the processes forming the Water Cycle (*Figure 3*). Water from precipitation reaching the land surface is accumulated in water bodies occupying empty space on the land surface or in water bearing formations of soil and rock. Due to continuous interaction with soil water and groundwater, a water body permanently gains or loses water.

The most general abstraction of the complex Hydrology phenomenon is that of the Catchment, commonly recognized as the unit of study where hydrologic processes take place whose results are represented in various data products. Depending on application and scale, the same catchment may be displayed in different ways. Scaling up or down leads to multiple representations of the same catchment. Some scales seems to be more or less general because of their wide range of use, but always chosen for a specific purpose they are still distinct. Some applications require cartographic representations while others are focused on topological relationships (*Figure 4*). A catchment may be described geometrically by streamlines, drainage area or the bounding polygon, or topologically as a graph of nodes and links. Analysis and reporting of landscape interactions refers typically to areas of study or its boundaries, while observations usually relate to monitoring points located in a network.

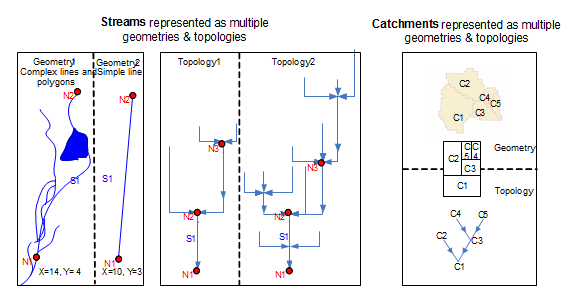


Figure 4: Cartographic vs. topological representation

In inter-disciplinary programs, inter-program collaboration and cross-domain research projects, the catchment is addressed as the monitoring and reporting unit whereby monitoring stations are usually placed on a flowline in relation to identified reference points. Across administrative jurisdictions, the catchment is the agreed unit of water resources assessment and management. For example at a national scale the “Hydrologic Unit Code” (HUC) is defined by the US Geological Survey for the National Water Information System (NWIS). [7] Another example are the so-called “River Basin Districts” of the European Water Framework Directive [6] designated not to administrative or political boundaries, but rather to the natural hydrologic unit.

## Catchment and catchment representation

The core concept of HY\_Features model is that a study of the Hydrology phenomenon will reflect common concepts of the real world by specific modeled features (as per ISO 19109 General Feature Model). Depending on the scientific concern, the relevant hydrologic feature may represent different aspects of the Hydrology phenomenon.

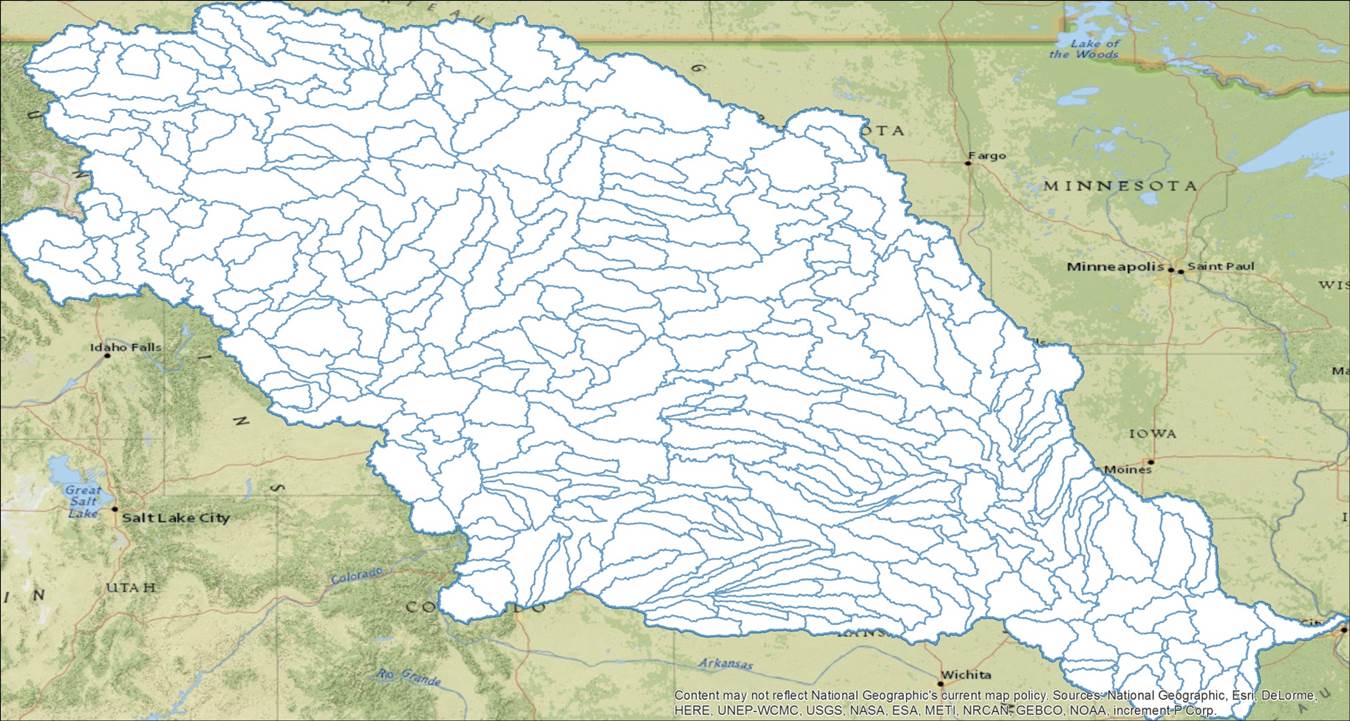
Recognized as the unit of study across hydrologic disciplines, a catchment may be represented in various sub-domain models, including by a simple tree network of blue lines, or the network of catchments. Catchment boundary (watershed), catchment area, a linear flowpath, the hydrographic or channel network and also the hydrometric network of stations are alternative views representing the same catchment, whereby each data product represents exactly one catchment. *Figure 5* shows different types of geospatial data overlaying the represented Missouri region.



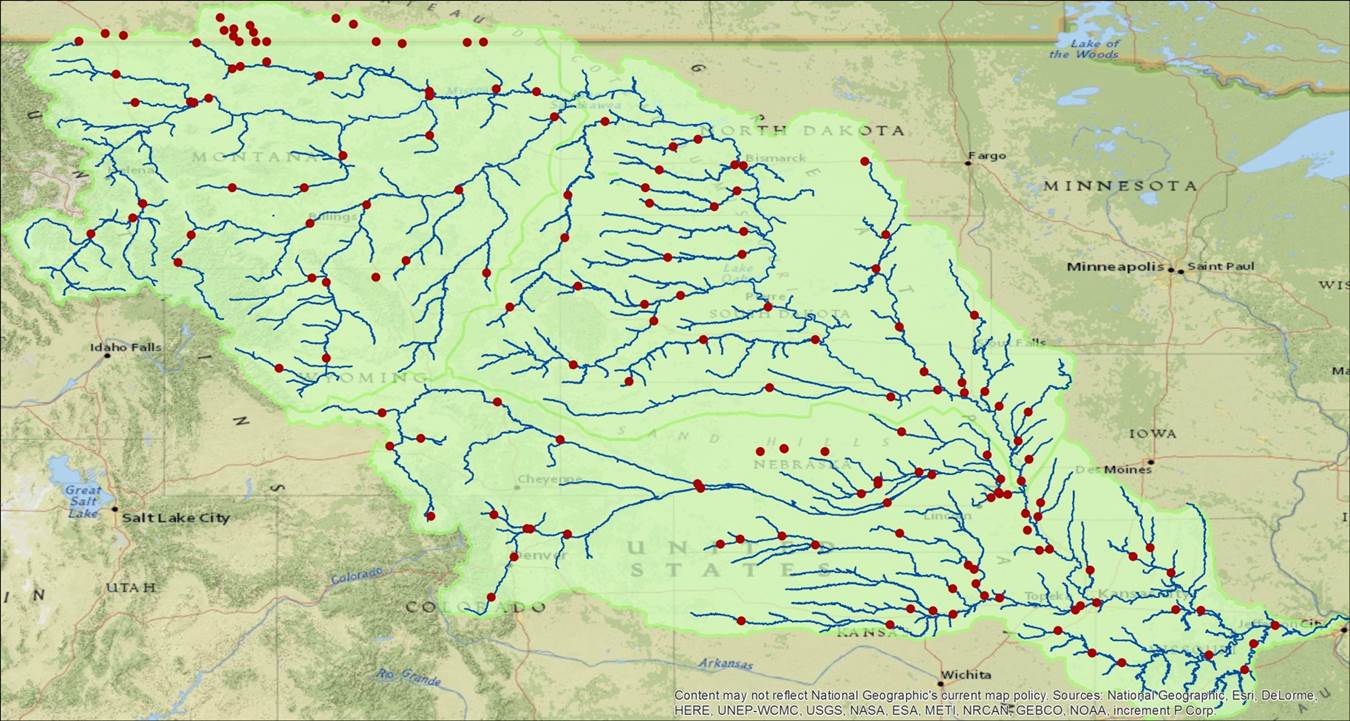
a)



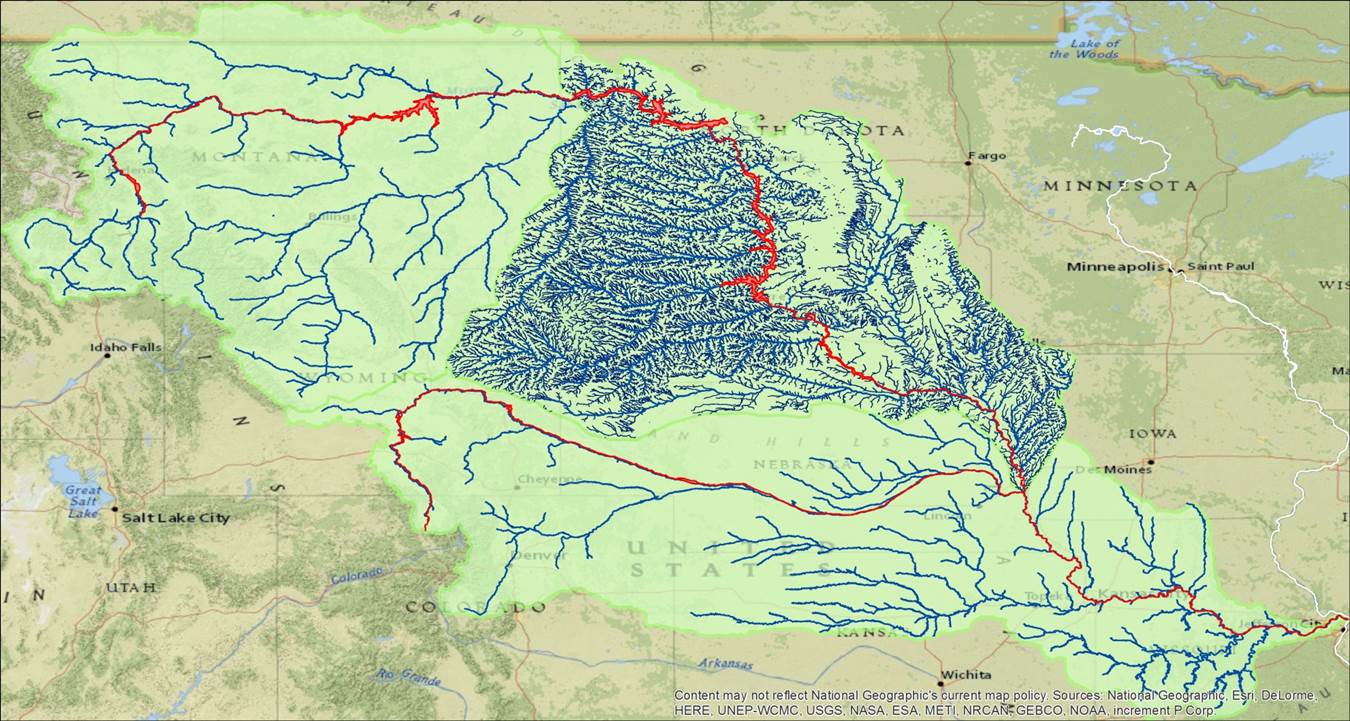
b)



c)



f)



e)



d)

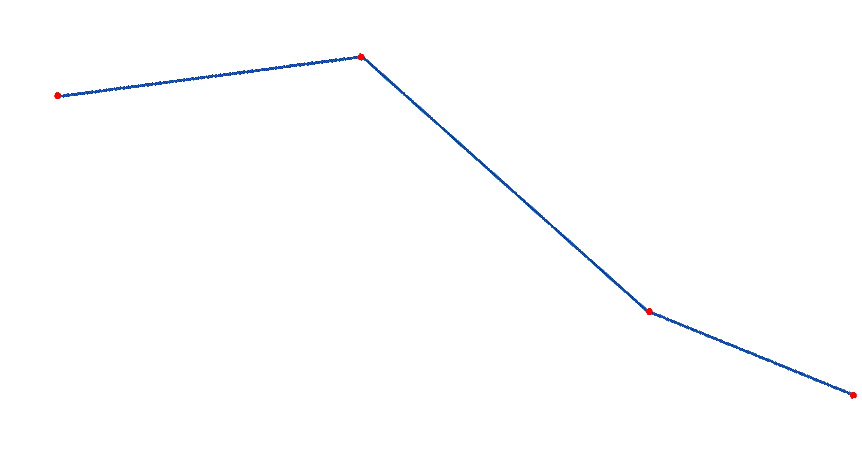


Figure 5: Multiple representation of the Missouri catchment (Source: USGS and GRDC)

a).Catchment boundary (watershed), b) Catchment area, c) Hydrologic unit containing sub-units, d) Abstract flowline and common outlet, e) Network of flow lines at different level of detail, f) Network of monitoring stations

## Catchment hierarchy and network topology

Following the holistic approach of today’s environmental reporting it may be concluded that a hydrologic determination exists for the catchment to which the reporting refers. However, in the reporting practice this hydrologic determination often is not clearly expressed. Rather an approach is applied that understands a catchment as the jurisdictional framework to bring together hydrologic information represented in geospatial data products related to regions nested or aggregated in the containing catchment. The HY\_Features conceptual model follows this approach by defining the Catchment as the unit where hydrologic processes take place such as flow accumulation governed by physical laws, but whose hydrologic determination is not explicitly identified (*Figure 6*). The specific, hydrologically determined catchment where runoff is accumulated and directed to a common outlet, is denoted as a Basin identified by its common outlet (*Figure 7*). This definition refers to the definitions of *basin*, *drainage basin* and *groundwater basin* given in the WMO-UNESCO International Glossary of Hydrology, describing the drained physiographic units whose waters are flowing to a common outlet.

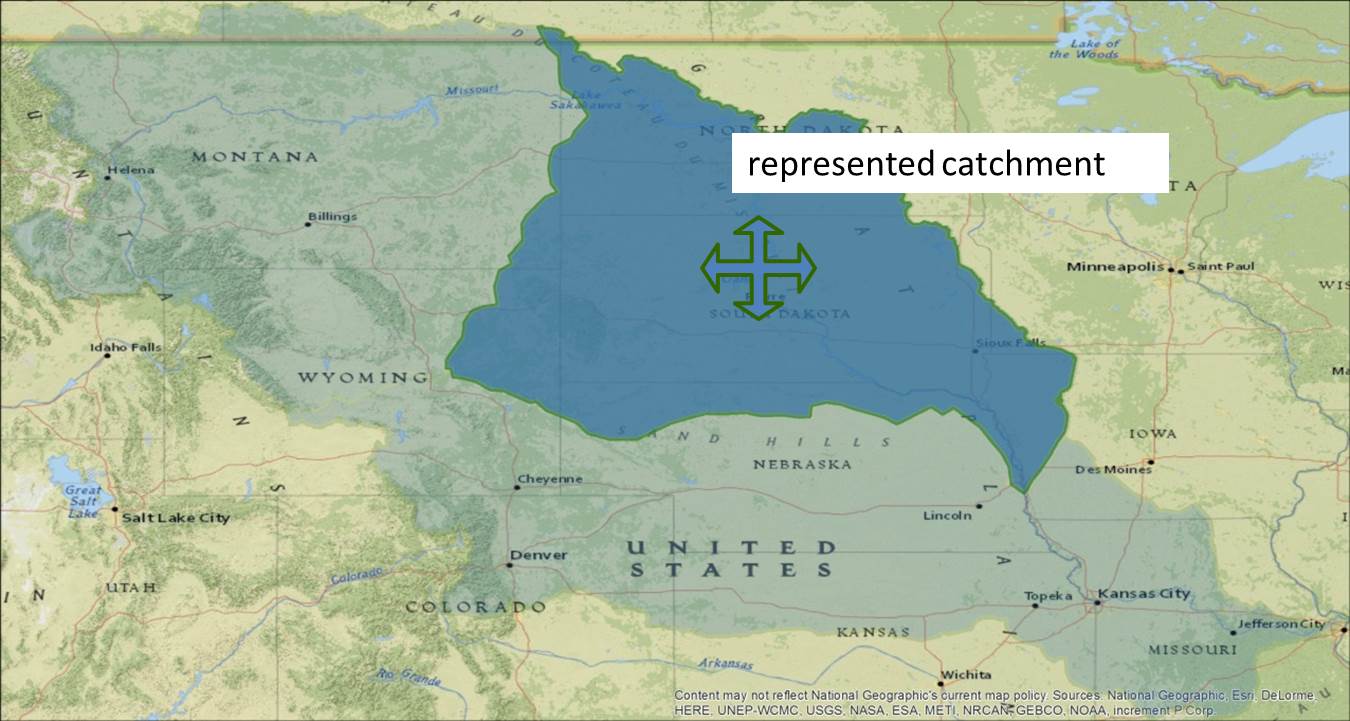


Figure 6: Catchment area representing the unit where hydrologic processes take place

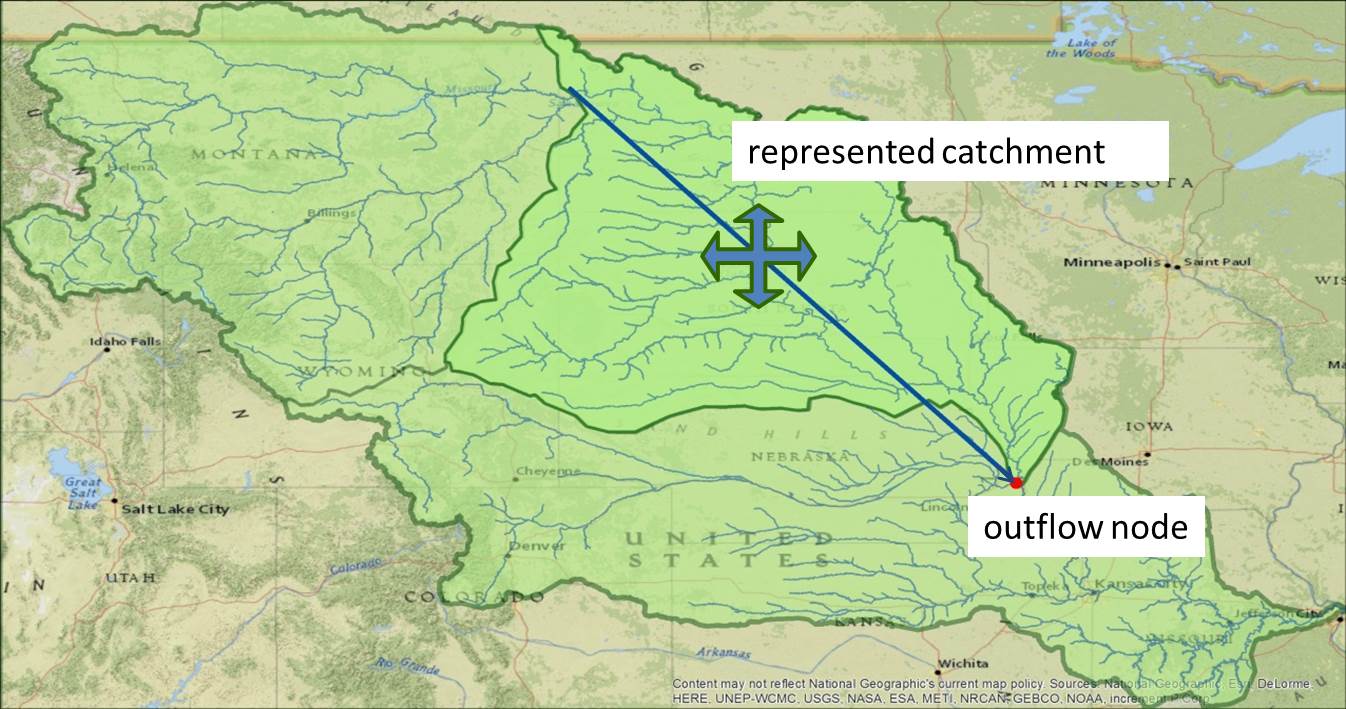


Figure 7: Flowpath representing the hydrologically determined basin

A Catchment may be nested or aggregated in a containing high-order catchment to support a simple downstream hierarchy of catchments (*Figure 8*, *Figure 9*). To reflect the commonly applied organization of basins in upstream hierarchies, the Basin is defined as an aggregate of sub-basins of which each may be associated with an immediate upstream basin. The basin aggregate refers to the co-existence of sub-basins identified by the common outlet having the inflow identified, or not. This allows for basin division into tributary basins and interbasins (with identified inflow). Defined as a special type of catchment, the basin inherits the nesting defined for the catchment. (*Figure 10*).



Figure 8: Catchment hierarchy – catchment nesting

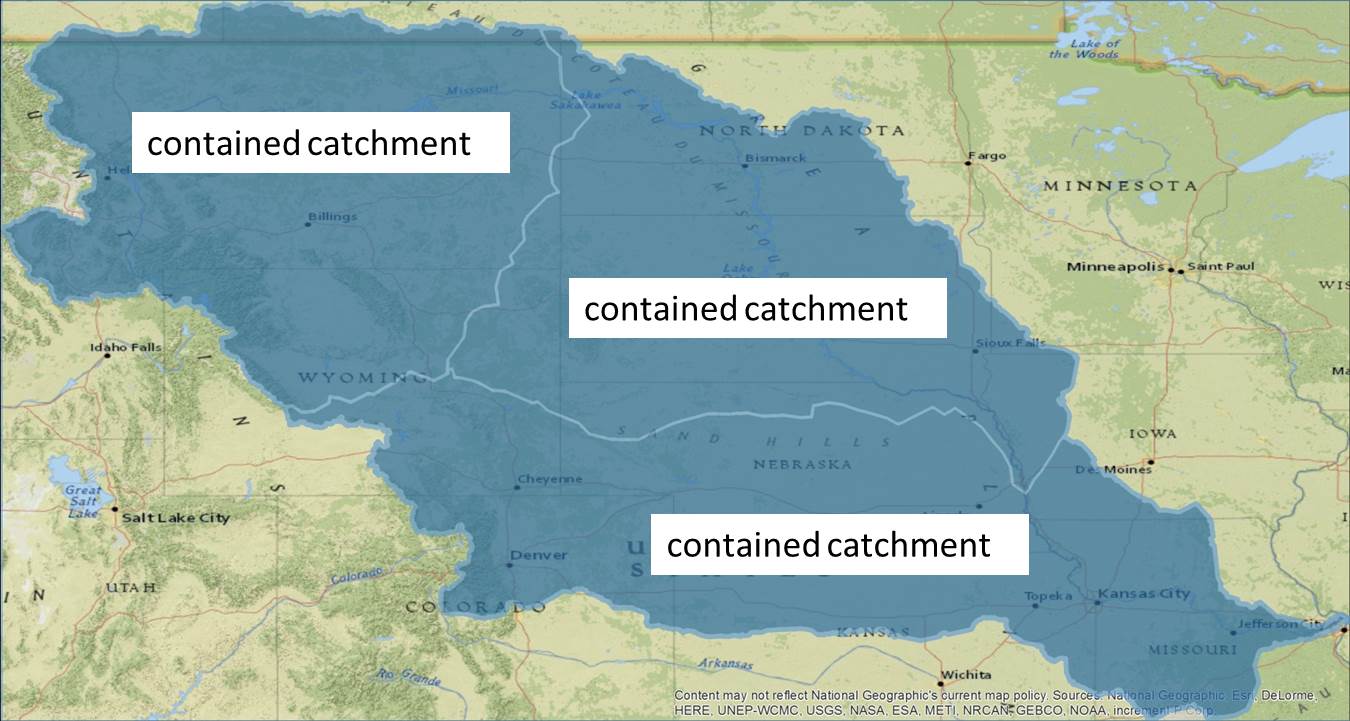


Figure 9: Catchment hierarchy – catchment aggregation

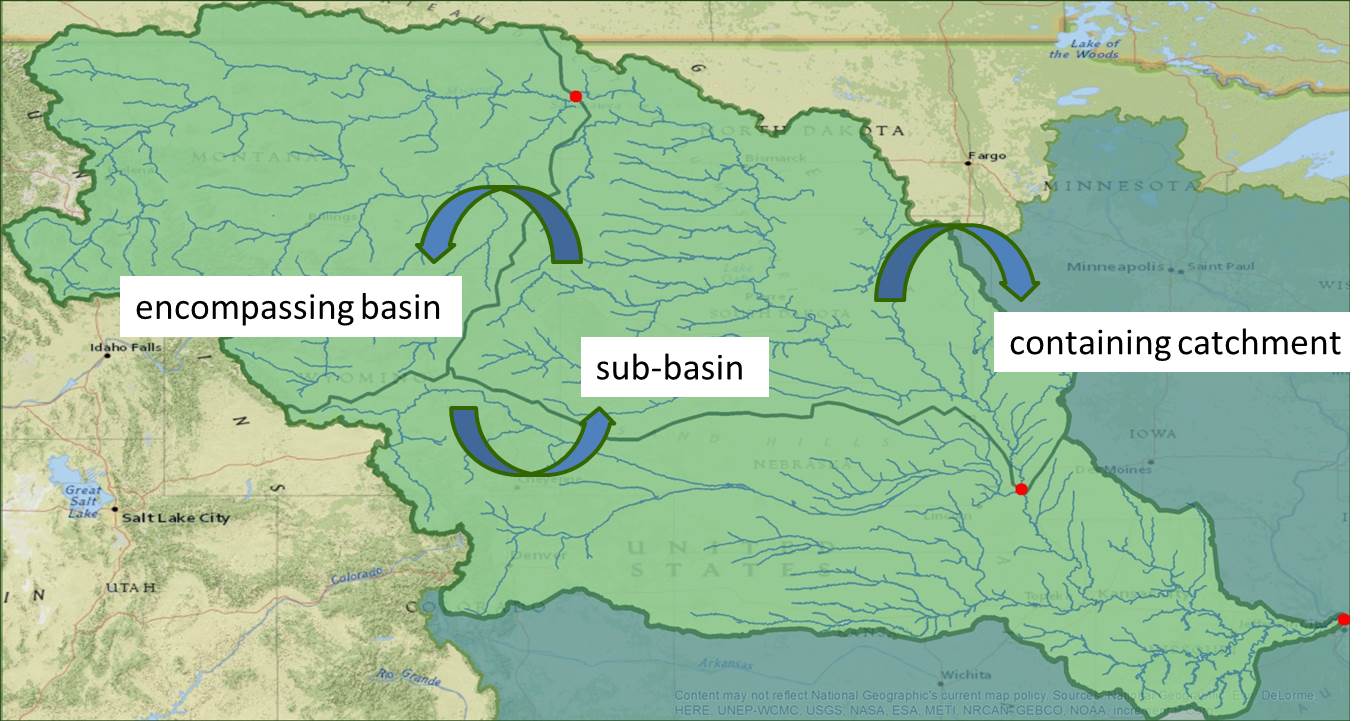


Figure 10: Basin hierarchy – basin, basin aggregate and nesting catchment

Understanding the Basin topologically as the link between inflow and outflow nodes, and presuming that basins are delineated using a simple tree structure, an upstream-downstream relation between outflow nodes can be built to describe a network of basins without knowing the complex hydrology between inflow and outflow nodes, whereby the outflow node of a basin coincides with the inflow node of a receiving downstream basin; the upstream basin may be described as the basin contributing to the inflow node of the relevant basin. (*Figure 11*)

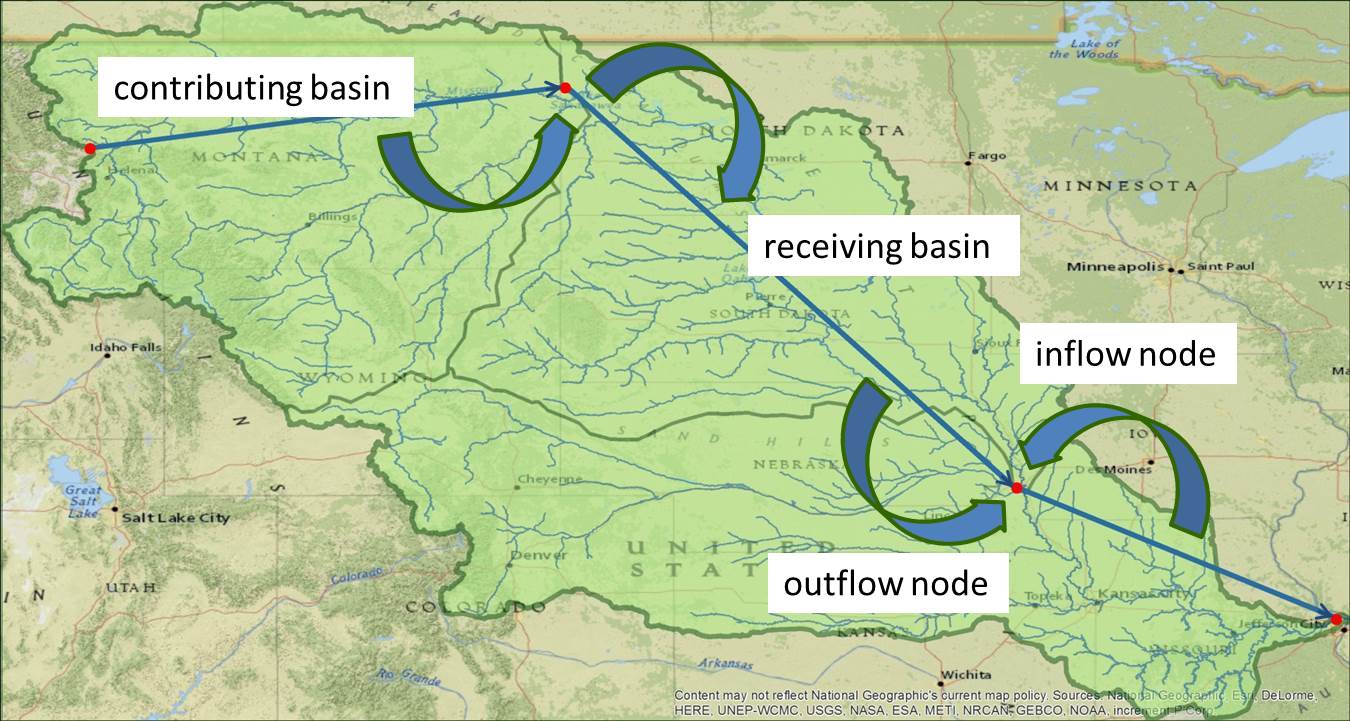


Figure 11: Upstream-downstream relation between basin

Inflow and outflow nodes topologically located in the network of basins may get assigned a position using a reference point located in the basin network. Considering each identified location on, or projected onto the land surface, as the common outlet of a corresponding basin, objects can be placed “on the river” using the relationship between outflow nodes *(Figure 12*).

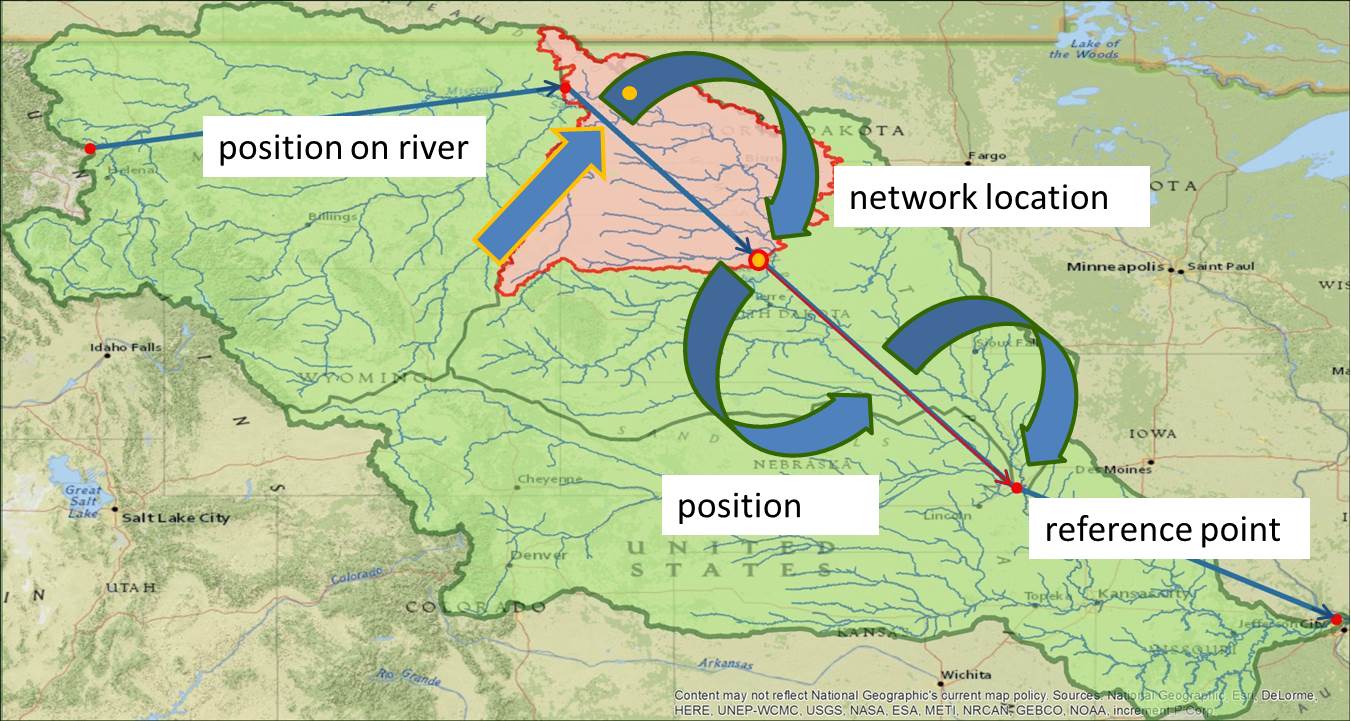


Figure 12: Position of objects “on river” using the relationship between outflow nodes

## Aggregation and segmentation of watercourses

Water bodies are aggregated into the hydrographic network of rivers and other permanent or temporary watercourses, and also lakes and reservoirs. Each water body may be segmented into reaches confined by vertical sections. Due to differences in thermal or salinity characteristics, by oxygen or nutrient content, a water body may be stratified into distinct horizontal layers.

Water bodies may be aggregated into a hydrographic network using a connecting system of channels expressed in flow or drainage patterns. This system of channels exists independently of whether water flows therein or not. It does not define whether a water body interacts with water bodies upstream and downstream. For example, normally stagnant waters may or may not be connected to streams during flood events, or streams may be interrupted to pools of stagnant water in periods of drought or not. Likewise, an aquifer system determines the potential connection between bodies of groundwater, but not causes the interaction.

Water may be stored and managed in surface or underground reservoirs in terms of a resource for future use, regulation or control. Conceptually, each water body accumulating water, or the layers therein, may be managed as a reservoir. Referring to a zone-based reservoir management storage reservoirs are also understood as stratified water bodies.

Water bodies are observed using monitoring stations and observing posts. Almost all stations are physical artifacts, or collections of these. Yet, some stations may be fictive ones. Monitoring stations may be connected logically in hydrometric networks which represent a distinct basin that is the subject of monitoring or reporting at local or regional scale. It is common practice to locate a monitoring station in relation to local landmarks and permanent reference points, or in relation to the extent of the monitored water body.

## The Atmospheric Hydro Feature application schema (informative)

The Atmospheric Hydro Feature application schema provides a model to take into account water from atmospheric origin, particularly from precipitation, without the complexity the complexity and detail of a rainfall-runoff model This enables contextually related information models to build relationships to hydrologic features, finally to a represented catchment.

This informative package provides concepts of water falling through the atmosphere (precipitation) to be accumulated in a water body on or below the land surface. This allows atmospheric water to be related to the hydrographic network of water bodies representing an overall catchment, as well as to a corresponding basin identified by an inflow or outflow node using a reference point associated with the accumulating water body. Special concepts of water suspended in the atmosphere may by defined with an application. Special concepts should not contradict the definitions endorsed by the WMO as published in the "International Meteorological Vocabulary".published and maintained by the WMO [9].

The Atmospheric Hydro Feature schema introduces the concepts of HydroMeteor Precipitation, Rain and Snow.

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Figure 12: Atmospheric Hydro Feature schema

The HY\_Hydrometeor class conceptualize a meteor “consisting of an ensemble of liquid or solid water particles falling through or suspended in the atmosphere, blown by the wind from the Earth's surface or deposited on objects on the ground or in the free air” [9].

The HY\_Precipitation class specializes HY\_HydroMeteor. It refers to falling water and does not mean the amount of precipitation measured by means of rain-gauge, which is understood as a property of a rain feature. HY\_Precipitation is not explicitly defined as a special subtype of the general HydroFeature type to allow other contextual generalizations. HY\_Precipitation carries two associations: *rain* and *snow*.

The HY\_Rain and HY\_Snow classes define special types of liquid or solid water intended to separately reflect ice or water particles falling from a cloud.

## The Subsurface Hydro Feature application schema (informative)

The informative Subsurface Hydro Feature application package introduces concepts reflecting water accumulated below the land surface as well as the formation of rock or soil containing the body of water. This concept refers to the holistic approach of the basin as the unit wherein all water, surface and subsurface water, is directed to an identified common outlet. It allows subsurface water to be related to the hydrographic network of water bodies, as well as to a corresponding basin identified by an inflow or outflow node using a reference point associated with the confining unit. Special concepts of subsurface water, its confines and special relationships may be defined with an application. Special concepts should not contradict the definitions endorsed by the WMO as published in the "International Glossary of Hydrology". A conceptual model capturing the specifics of features associated with the groundwater domain will be provided with the GroundwaterML 2.0 under development.

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Figure 13: Subsurface Hydro Feature schema

### The Subsurface Water model

The Subsurface Water model introduces a simple model of water accumulated in rock or soil below the land surface, either specialized by pressure head or the property to move due to gravity and capillary action. This allows to handle concepts of subsurface waters separately from those of the confining aquifer. An application focused on a special type of subsurface water may use the concepts when describing the relationship of groundwater or water in soil to a basin in terms of the ultimate target of observation. Depending on the particular application, special types may be defined and described by suitable properties.

The HY\_Groundwater class specializes HY\_Water\_LiquidPhase with respect to the existence of water occupying the saturated zone. It inherits the *accumulatingWaterBody* association, which allows to relate subsurface water to the hydrographic network of water bodies.

The HY\_VadoseWater class specializes HY\_Water\_LiquidPhase with respect to the existence of water occupying the unsaturated zone. It inherits the *accumulatingWaterBody* association, which allows to relate subsurface water to the hydrographic network of water bodies. HY\_SoilWater, HY\_SoilMoisture and HY\_GravitationalWater specialize vadose water.

### The Subsurface Water Confines model

The Subsurface Water confines model introduces concepts of the hydrogeologic units, particularly an aquifer, containing subsurface water, incl. the well used to extract, inject or infiltrate water from/into these. Depending on the particular application, special types of containing units may be defined and described by suitable properties.

The HY\_HydroGeologicUnit class provides a simple means for taking into account the hydrologically significant characteristics of formations of rock or soil, allowing further contextual specializations of hydro-geologic features. HY\_HydroGeologicUnit carries one association: *containingUnit*.

The HY\_Aquifer class defines the existence of the containing unit wherein groundwater may be accumulated, understood as groundwater reservoir. The segmentation of aquifer is not in the scope of the HY\_Features conceptual model. HY\_Aquifer carries one association: *well*.

The HY\_Well class provides the concept of a well that may be used for discharge as well as recharge of water. The geometric representation of the well may vary with an application and needs to be defined with implementation. HY\_Well carries one association: *wellLocation,* which allowsto locate the well in the network of basins.

# The HY\_Features common hydrologic feature model (normative)

## The HY\_Features hydrology model

This standard defines the HY\_Features common hydrologic feature model as standard for the identification and description of hydrologic features reflecting both hydrologic significance as well as topological connectivity of hydrologic features. It describes the hydrologic features by defining the fundamental relationships between the major components of the hydrosphere. Core concepts are those of catchment and catchment representation, of catchment and basin hierarchy, and of aggregation and segmentation of watercourses including a simple model for an indirect positioning of features in a network of catchments. A utilities package provide common concepts required by the domain model that are not hydrology-specific.

Module identification aims to simplify the scope of each part of the model in order to improve its accessibility and provide scope for testing. It is intended that implementations need to consider only those parts of the common model implicated by its scope. Table 1 lists the applications schema, the leaf packages included and the concepts reflected therein.

Table 1 – HY\_Features modules, packages and concepts reflected

| **Application schema** | **concepts reflected** | **leaf packages included** |
| --- | --- | --- |
| HY\_HydroFeature | fundamental properties and relationships between features governed by the physical laws of hydrology | HY\_Catchment  HY\_HydrographicNetwork  HY\_NamedFeature  HY\_RiverPositioningSystem  HY\_Storage |
| HY\_AtmosphericFeature (informative) | Hydrology phenomenon above the Earth’s land surface without complexity and detail of a rainfall-runoff model |  |
| HY\_SubsurfaceHydroFeature (informative) | Hydrology phenomenon below the Earth’s land surface without complexity and detail of a groundwater or soil moisture model |  |
| HY\_SurfaceHydroFeature | Hydrology phenomenon on the Earth’s land surface without complexity and detail of hydrologic and hydraulic models | HY\_SurfaceWater  HY\_SurfaceWaterConfines |
| HY\_HydrometricNetwork | hydrometric network as an aggregate of logically connected hydrometric features |  |
| HY\_Utilities | common concepts required by the domain model that are not hydrology-specific |  |

The conceptual model is expressed in the Geographic Information Conceptual Schema Language (ISO 19103:2005) based on the Unified Modeling Language (UML). The organization into packages and package dependencies are shown in ***Fehler! Verweisquelle konnte nicht gefunden werden.****.*

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Figure 14: HY\_Features modules and packages

## The HY\_Features conceptual conformance (mapping)

Conceptual conformance to the HY\_Features model is a matter of being able to unambiguously identify what elements of an implementation schema map to the HY\_Features model, and the ability to populate all mandatory elements of the Feature Types present in such mappings.

The HY\_Features conceptual model provides the basis for determining whether two references to hydrologic features are references to the same feature, i.e. to determine with what object types the identifiers and names may be assigned, and how to distinguish between the reference concept (e.g. a catchment) and its representation (e.g. flowpath, catchment area or boundary).

Disparate systems describing hydrologic features may be mapped to the equivalent HY\_Features definitions to disambiguate the local usage of terminology and specific implementation choices made. Equivalence here aims to the compatibility of concepts, i.e. the logical similarity which is usually an assessment based on text analyses whereby the referenced concept is considered to be the "lowest common ancestor" of the implementation concept in such a way that the essential properties are met but may be specialized in the relevant context.

An implementation schema conforming to HY\_Features shall provide a formal mapping from one or more Feature Types present in the implementation schema to Feature Types defined in the HY\_Features specification, including all mandatory properties defined by the realized HY\_Features concept. Default values to be assumed must be specified in this mapping. Note that use of a formal encoding of HY\_Features, in conjunction with conformance to ***/req/ hy\_features\_conceptual\_model/encoding*** constitutes such a formal mapping.

## The HY\_Features data conformance (encoding)

Conformance to the HY\_Features model with respect to the data refers to the encoding of the HY\_Features concepts. Designed conform to the General Feature Model (ISO19109:2006), the conceptual model defines hydrologic features representing the general “FeatureType”. Consequently, each feature addressed in the requirements shall be understood as an instance of the GF\_FeatureType (aka FeatureType) «metaclass».

An implementation schema using Feature Types defined using the namespace of a formal **encoding** of HY\_Features shall conform to the requirements specified by that encoding, as defined by the relevant part of HY\_Features specification (e.g. HY\_Features Part 2: GML encoding)

Feature **identifiers** present in data encoded using a HY\_Features conformant implementation schema shall be identical wherever the same Feature instance is being encoded or referenced. This specifically applies to data available in multiple related datasets or exposed by multiple service interfaces.

Regarding **completeness**, all mandatory properties defined by a Feature Type defined in HY\_Features shall be present for each Feature instance encoded by a conformant implementation schema.

|  |  |
| --- | --- |
| **Requirements Class** | |
| **/req/hy\_features\_conceptual\_model** | |
| Target type | Implementation Schema |
| Name | HY\_Features Conceptual Conformance |
| Dependency | /iso/19109/ |
| Requirement | /req/ hy\_features\_conceptual\_model/mapping |
| Requirement | /req/ hy\_features\_conceptual\_model/encoding |

|  |  |
| --- | --- |
| **Requirements Class** | |
| **/req/hy\_features\_content** | |
| Target type | Dataset |
| Name | HY\_Features Data Conformance |
| Dependency | /req/hy\_features\_conceptual\_model |
| Dependency | /iso/19109/ |
| Dependency | /iso/19150/ |
| Dependency | /iso/19136/ |
| Requirement | /req/ hy\_features\_conceptual\_model/identifiers |
| Requirement | /req/ hy\_features\_conceptual\_model/completeness |

## The Hydro Feature application schema

The Hydro Feature application schema defines fundamental properties and relationships between features governed by the physical laws of hydrology. The core concept is that of a catchment and its multiple representation in the real world. Geometric representations such as catchment area, catchment boundary, flowpath as well as topologic representation by hydrographic network, channel network, or the hydrometric network of stations are alternative views representing a catchment.

The Hydro Feature schema provides a model to identify hydrologic features, and thus the opportunity to connect disparate representations of a catchment. By making relationships between identified features expressible in a standard form, this allows the hydrosphere to be divided into a hierarchy of hydrologically connected catchments and related phenomena contained therein, irrespective of the various representations available for these phenomena. The Hydro Feature schema contains five leaf packages: HY\_NamedFeature, HY\_Catchment, HY\_HydrographicNetwork, HY\_RiverPositioning, HY\_Storage.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_abstract/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)\* | |
| Target type | Implementation schema |
| Name | HY\_HydroFeature (abstract) |
| Dependency | /req/hy\_utilities/ |
| Requirement | [/req/hy\_abstract/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)hy\_namedfeature/\* |
| Requirement | [/req/hy\_abstract/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)hy\_catchment/\* |
| Requirement | [/req/hy\_abstract/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)hy\_network/\* |
| Requirement | [/req/hy\_abstract/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)hy\_positioning/\* |
| Requirement | [/req/hy\_abstract/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)hy\_storage/\* |

### The Named Feature model

The Named Feature model defines the hydrologic feature as a feature to which names are given through common usage. It provides a flexible approach to record multiple names and identifiers that may be assigned to an identified feature without necessarily have a formal naming model by providing a means to localize names in a cultural, political or historical context.

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Figure 15: Special types of a named hydrologic feature

#### Hydro feature

The HY\_HydroFeature class denotes the abstraction of the complex Hydrology phenomenon by definition of feature types describing separate aspects of the hydrology phenomenon. This includes related phenomena that participate in hydrologic systems but have specific characteristics. Given the complexity of the domain, and the nature of real-world physical phenomena, for any given feature a wide range of possible characteristics, states and representations may be relevant.

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Figure 16: The named HydroFeature

The **identifier** attribute provides a means to assign to the hydrologic feature an unique and unambiguous identifier in a given context. An instance of HY\_HydroFeature shall contain an identifier that may be used as a persistent reference to this feature.

The **name** association provides an abstract pattern shared by all hydrologic features where names are given to a feature through common usage, handle issues of cultural, political and historical variability that may occur with trans-boundary features without necessarily have a formal model. This association shall be used where a name or label is assigned to an instance of HY\_HydroFeature.

The **context** association is a generalized mechanism to handle various forms of contextualization of features that may be required. Using this mechanism it is not necessary to further specialize HY\_Features to assign metadata, at the expense of providing complex data types that are self-describing in terms of the content they contain.

Generally applicable characteristics assigned to an instance of HY\_HydroFeature in a spatial, temporal or classification context maybe specified using one or more instances of the associated context property. This may be through an inline value of a specialized data type, or by reference.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_namedFeature/**hydrofeature** | |
| Target type | Implementation Schema |
| Name | HY\_HydroFeature |
| Dependency | [/req//hy\_namedFeature/hydrofeature](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature)name |
| Dependency | /req//hy\_namedFeature/hydrofeaturecontext |
| **Requirement** | /req/hy\_namedFeature/hydrofeature.identiy |
| Requirement | /req/hy\_namedFeature/hydrofeature.name |
| Requirement | /req/hy\_namedFeature/hydrofeature.context |

### The Catchment model

The catchment model defines a logical network of catchments each intentionally represented by geometry or topology. The catchment model defines relationships between catchments, between catchment and basin, and basin and its common outlet.

The catchment model allows for the existence of catchments to be recognised, and identifiers assigned based on outflow nodes even if stream networks, areas and watersheds are not reliably determined. This is sufficient to define simplified hierarchies. It is intended that hydrological reporting applications may use this model without the full complexity and detail of scientific catchment models.

The catchment model provides the topological concept to consider an arbitrary point on, or projected onto, the land surface as the outfall of a corresponding basin. Positioned in the hydrographic network, this point provides the identifiable reference point to which alternative representations may refer. The logical network of catchments allows to establish topological relationships between hydrometric stations without the detail of stream flow, flow conditions or cartographic interpretation.

#### Catchment representation

The HY\_CatchmentRepresentation class provides the most common concepts of geometric representation in use in hydrology such as flowpath, catchment area, and catchment boundary, as well as a network topology.

HY\_CatchmentRepresentation is an abstract class. With respect to the most common concepts in use in hydrology, catchment representation is specialised to:

* the HY\_Flowpath class with respect to the linear representation,
* the HY\_CatchmentArea class with respect to the areal representation,
* the HY\_CatchmentBoundary class with respect to the boundary (polygon) representing a catchment, further specialized to HY\_Watershed with respect to the summit or boundary line separating adjacent drainage basins.

The HY\_Network class is defined with respect to a high-order network to which hydrologic features participate such as to the hydrographic network of water bodies allowing features that may or may are not connected at the representation level to be logically connected using this system. The network of channels wherein water may flow or not is also considered to be a network representation of a catchment like the network of logically connected hydrometric stations. Hydrographic network, channel network and hydrometric network are defined separately to reflect the different study areas they have.

In related contexts other types of catchment representation may exist. Concepts that not conforms to the definition in this standard, e.g. a time series representing the catchment at its inflow/outflow node, or representations in more-dimensional perspectives, may use the general catchment representation class whereby each geometric representation may be realised with an appropriate geometry type.

If present, all sub-types of CatchmentRepresentation shall support the inherent *representedCatchment* property whereby each representation may be realised with an appropriate geometry. The HY\_Watershed class carries one association: *outfall* which refers to the lowest point on the summit line.

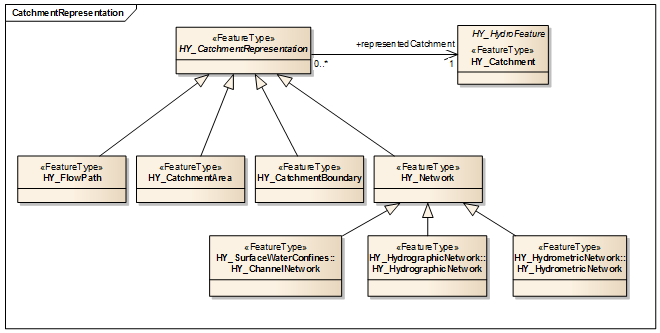


Figure 17: Catchment Representation and Catchment Hierarchy

The **representedCatchment** association shall be used to identify the catchment represented by geometry or a network structure. Each catchment representation shall be implemented with an appropriate geometry representation.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_catchment/**catchment**](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**representation** | |
| Target type | Encoding the conceptual model |
| Name | HY\_CatchmentRepresentation |
| Dependency | [/req/hy\_catchment/catchment](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature) |
| Requirement | [/req/hy](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature)\_catchment/catchmentrepresentation.representedcatchment |

The **outfall** association describes the lowest point on the summit or boundary line. If present, this association should be used to identify the common outlet of the basin bounded by the watershed.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**watershed** | |
| Target type | Encoding the conceptual model |
| Name | HY\_Watershed |
| Dependency | [/req/hy\_catchment/outfall](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature) |
| Requirement | [/req/hy](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature)\_catchment/watershed.outfall |

#### Catchment

The HY\_Catchment class defines the catchment as the unit wherein all hydrologic processes take place, without an identification of the hydrologic determination. HY\_Catchment is a specialization of the general HY\_HydroFeature class. It inherits *identifier*, *name* and *context* properties from the generalization. The HY\_Catchment class carries one association: *containing Catchment.*

The **containingCatchment** association provides a means to describe the nesting of catchments, or more special of basins, in a simple “is-in” containment hierarchy as typically used for high order organization of management and reporting units. If required, this association shall be used to identify the catchment therein the relevant catchment is nested.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_catchment/**catchment**](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment) | |
| Target type | Implementation schema |
| Name | HY\_Catchment |
| Dependency | /req/hy\_namedFeature/hydrofeature |
| Requirement | [/req/hy\_catchment/catchment](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment).containingcatchment |

#### Basin aggregate

The HY\_BasinAggregate is a specialization of HY\_Catchment, defined to identify a set of one or more discrete upper-level systems that are hydrologically discrete. Typically, this will be a river system “flowing” to a main-stem river, into a sea or an internal sink. The HY\_BasinAggregate class inherits the *containingCatchment* property and carries one association: *subBasin.*

The association provides a means to describe the tributary basin or inter-basin that is aggregated part of the relevant basin. Thisassociation shall be used to identify the basin (hydrologically discrete) that is aggregated part of the relevant basin (aggregate).

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**basinaggregate** | |
| Target type | Implementation schema |
| Name | HY\_BasinAggregate |
| Dependency | [/req/hy\_catchment/catchment](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment) |
| Dependency | [/req/hy\_catchment/basin](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment) |
| Requirement | /req/hy\_catchment/basinaggregate.subbasin |

#### Basin

The HY\_Basin class is a specialization of HY\_Catchment, special due to its hydrologic determination by the common outlet to which all contained waters flow. The basic concept is that of a “link” between a single inflow location and a single outflow location without knowing the complex hydrology between them. Each basin may be nested in a containing basin in a simple “is-in” hierarchy; each basin may be sub-basin of an all-encompassing basin aggregate, either as tributary basin without an identified inflow, or as inter-basin determined by inflow and outflow nodes. The HY\_Basin class inherits the *containingCatchment* property and carries five properties: *code*, *encompassingBasin, upstreamBasin, outflowNode, inflowNode.*

The **code** attribute assigns to the basin a unique identifier in given context If required, the code shall be implemented using a controlled classification or coding system. Example: WMO Basin Codes

The **encompassingBasin** association provides a means to describe the network of basins the relevant sub-basin is part of. This association shall be used to identify the basin (hydrologically discrete) encompassing the relevant (sub-)basin.

The **upstreamBasin** association provides a means to describe the basin immediately upstream of the relevant basin without knowing a particular inflow location. Note that this defines the topological hierarchy between basins; the nesting is inherited from the catchment class. This association shall be used to identify a basin immediately upstream of the relevant basin.

The **outflowNode** association provides a pattern to identify the location of outflow of the contributing basin. This allows to identify the downstream basin whereby the inflowlocationcoincides with the outflowNode. This association shall be used to identify the location where water flows out of the relevant basin. To sufficiently describe an upstream-downstream-relation, the outflowNode shall coincide with the inflowNode of a downstream basin

The **inflowNode** association provides a pattern to identify the location of inflow to the receiving basin. This allows to identify the upstream basin whereby the outflowlocationcoincides with the inflowNode. This association shall be used to identify the location where water flows into the relevant basin. To sufficiently describe a upstream-downstream-relation, the inflowNode shall coincide with the outflowNode of a upstream basin.

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| **Requirements Class** | |
| [/req/hy\_catchment](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)/**basin** | |
| Target type | Implementation schema |
| Name | HY\_Basin |
| Dependency | [/req/hy\_catchment/catchment](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment) |
| Dependency | /req/hy\_catchment/basin |
| Dependency | /req/hy\_catchment/basinaggregate |
| Requirement | /req/hy\_catchment/basin.encompassingbasin |
| Requirement | /req/hy\_catchment/basin.upstreambasin |
| Requirement | /req/hy\_catchment/basin.outflownode |
| Requirement | /req/hy\_catchment/basin.inflownode |

#### Outfall

The HY\_Outfall class defines the topological concept to identify and locate the common outlet of the basin. Conceptually, any location on, or projected onto, the Earth’s surface is considered to be the common outlet of a corresponding basin. This may be a particular location such as a fixed landmark, a monitoring station, or a spring where groundwater enters the surface, but also a body of water. It may be a real place or a fictive one projected onto the surface or built from joining several locations. For example, vertically arranged points may be aggregated and projected onto surface, an estuary may be logically merged to a point located at the river mouth, diffuse groundwater discharge may be accumulated to springs, rivers or lakes. The location of the common outlet may, or may not, referenced by coordinates.

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Figure 18: Catchment, Basin and Outfall

Since the geometry will vary with application, the outfall has no pre-defined shape attribute. Shape and geometry type need to assigned with the implementation. HY\_Outfall carries three associations: *contributingBasin, receivingBasin, position*.

The **contributingBasin** association provides a means to describe the basin which contributes water to the outflow node. This association shall be used to identify the basin determined by its outflow location.

The **receivingBasin** association provides a means to describe the basin which receives water via the inflow node. If required, thisassociation shall be used to identify the basin determined by its inflow location.

The **position** association provides a means to assign a position to the outfall relative to a reference point. If present, this association shall be used to locate the outfall using the concept of Indirect Position as described in clause …

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| **Requirements Class** | |
| [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**outfall** | |
| Target type | Implementation schema |
| Name | HY\_Outfall |
| Dependency | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)basin |
| Dependency | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)indirectposition |
| Requirement | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)outfall.contributingbasin |
| Requirement | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)outfall.receivingbasin |
| Requirement | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)outfall.position |

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Figure 19: Basin and Outfall

#### Reference Point

The HY\_ReferencePoint class is introduced to stably reference to an identified permanent reference location such as a fixed landmark referenced by coordinates. The HY\_ReferencePoint class carries the attributes *refPoint* and *refPointType*, and one association: *networkLocation*.

The **refPoint** attribute assigns to the reference point the GM\_Point type. If required, the reference point shall be implemented as GM\_Point type as defined in ISO 19107. Note that GM\_Point supports a direct position property.

The **refPointType** attribute refers to the HY\_RefPointType code list containing terms documented in the WMO Glossary of Hydrology [3] or the WMO Guide to Hydrological Practices [8] to describe special types of reference point. If required, an implementation may use a term from the HY\_RefPointType code list to describe the reference point.

The **networkLocation** association provides a means to locate the reference point in the network of basins. If required, this association shall be used wherever the reference point is considered to be outfall of basin.

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| **Requirements Class** | |
| [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**referencepoint** | |
| Target type | Implementation schema |
| Name | HY\_ReferencePoint |
| Dependency | urn:iso:dis:iso:19103:Point |
| Dependency | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)refpointype |
| Dependency | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)outfall |
| Requirement | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)referencepoint.refpoint |
| Requirement | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)referencepoint.refpointType |
| Requirement | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)referencepoint.networklocation |

### The Hydrographic Network model

The Hydrographic Network model defines a high-order network of water bodies which may or may not be topologically connected at the representation level. It defines topological relationships between the major elements of the hydrosphere including the segmentation of a watercourse without imposing a particular network scale. The core concept is that of water accumulated in a water body which is aggregated part of the hydrographic network. A water body may be divided into segments, vertical sections and horizontal strata.

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Figure 20: Aggregation and segmentation of the water body

Recognizing that water is accumulated on and below the land surface, a general concept of water body is provided that may be applicable to bodies of surface water as well as of soil water and groundwater. Special concepts of water bodies are defined within the Surface Water model (informative, clause …) and in the Subsurface Water model (informative, clause …).

Recognizing that the system of channels or aquifers wherein water bodies may be aggregated exists independently of whether water flows therein or not, the containing physiographic structures are considered forming a separate network such as a channel network. Special concepts of water body confines are defined within the Surface Water model (clause …) and in the Subsurface Water model (informative, clause …).

The Hydrographic Network model allows water bodies to be located in the basin network via an identified special reference point. A position may be assigned using the concept of Indirect Position (clause …) (*Figure 21*)

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Figure 21: Location of a water body in the basin network

The Hydrographic Network model introduces the concepts *HydrographicNetwork,* *WaterBody, WaterBodySegment, WaterBodyStratum, Water\_LiquidPhase, Water\_SolidPhase, CrossSection* and *LongitudinalSection.*

#### Hydrographic network

The HY\_HydrographicNetwork class specializes the Network representation (clause 7.2.2) with respect to the aggregate of “rivers and other permanent or temporary watercourses, and also lakes and reservoirs” [3]. HY\_HydrographicNetwork inherits the *representedCatchment* property and carries the association to the aggregated water body.

The **networkWaterBody** association provides a means to describe the hydrographic network by at least one aggregated water body. If present, this association shall be used to identify the aggregated water body.

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**hydrographicnetwork** | |
| Target type | Implementation schema |
| Name | HY\_HydrographicNetwork |
| Dependency | /req/hy\_network/network |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbody |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)hydrographicnetwork.networkwaterbody |

#### Water body

The HY\_WaterBody class specializes the Hydro Feature with respect to the “mass of water (liquid) distinct from other masses of water” [3]. HY\_WaterBody inherits *identifier*, *name* and *context* properties from the generalization HY\_HydroFeature class and carries two association: *hydrographicNetwork*, *waterBodySegment*.

The **hydrographicNetwork** association provides a means to describe the water body as part of a hydrographic network (aggregate). If present, this association shall be used to identify the hydrographic network the relevant water body is part of.

The **networkSegment** association provides a means to describe the water body by at least one aggregated segment. If present, this association shall be used to identify the aggregated segment.

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**waterbody** | |
| Target type | Implementation schema |
| Name | HY\_WaterBody |
| Dependency | /req/hy\_namedFeature/hydrofeature |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)hydrographicnetwork |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbody.hydrographicnetwork |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbody.networksegment |

#### Water body segment

The HY\_WaterBodySegment class specializes the Hydro Feature with respect to a segment of a water body. HY\_WaterBodySegment inherits *identifier*, *name* and *context* properties from the generalization and carries seven associations: *waterBody, water body stratum,* *streamCrossSection, streamLongitudinalSection*, *fixedLandmark*, *upstreamSegment,* *downstreamSegment* and *stratum.*

The **waterBody** association provides a means to describe the segment as part of a water body (aggregate). If present, this association shall be used to identify the water body the relevant segment is part of.

The **stratum** association provides a means to describe the water body (segment) by at least one aggregated stratum, whereby the stratum provides the relation to the storage of in a reservoir. If present, this association shall be used to identify the aggregated water body stratum.

The **streamCrossSection** and **streamLongitudinalSection** associations provide a means to describe a vertical section (of a stream) at right angles to the main direction of flow, or along a channel at its centre line. This associations allow to locate the relevant water body in the basin network via a reference point that coincides with the outfall of a corresponding basin. If present, these associations shall be used to locate the relevant water body segment in the network of basins via an identified cross section or longitudinal Section .

The **fixedLandmark** association provides a means to describe a permanent landmark, fixed and referenced by coordinates. This association allows to locate the relevant water body in the basin network via a reference point that coincides with the outfall of a corresponding basin. If present, the this association shall be used to locate the relevant water body segment in the network of basins an identified reference point.

The **upstreamSegment** and **downstreamSegment** associations provide a means to describe water body segments upstream or downstream of the relevant segment. If present, these associations shall be used to identify the segment upstream or downstream of the relevant segment.

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**waterbodysegment** | |
| Target type | Implementation schema |
| Name | HY\_WaterBodySegment |
| Dependency | /req/hy\_namedFeature/hydrofeature |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbody |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodystratum |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment.waterbody |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment. stratum |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment. streamCrossSection |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment. streamLongitudinalSection |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment. fixedLandmark |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment. upstreamSegment |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment. downstreamSegment |

#### Water body stratum

The HY\_WaterBodyStratum class specializes the Hydro Feature with respect to a distinct horizontal layer of consistent characteristics in a within a water body segment. A stratum may be caused by differences in thermal or salinity characteristics or by oxygen or nutrient content, but also determined by virtual storage zones of a reservoir. The water body stratum is defined part of the hydrographic network, and with respect to the concept of a zone-based reservoir management associated with the reservoir.

HY\_WaterBodyStratum inherits identifier, name and context properties from the generalization and carries two association: *waterBodySegment, storage.*

The **segment** association provides a means to identify the stratum as part of a water body (segment). If present, this association shall be used to identify the water body the relevant segment is part of.

The **storage** association provides a means to describe the storage characteristics of the water body (stratum) used for storage, regulation and control of water resources. If present, this association shall be used to identify the reservoir the relevant stratum is part of.

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**waterbodystratum** | |
| Target type | Implementation schema |
| Name | HY\_WaterBodyStratum |
| Dependency | /req/hy\_namedFeature/hydrofeature |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment |
| Dependency | [/req/hy\_storage/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)reservoir |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodystratum.segment |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodystratum.storage |

#### Water – Liquid phase

The HY\_Water\_LiquidPhase class provides a concept of water reaching the land surface to be accumulated in a water body. Special concepts of HY\_Water\_SolidPhase to describe ice filling empty space in formations of soil and rock are defined in the Subsurface Water model (clause …). If required, an application dealing with water quality data or monitoring a sample independent from shape may make use of the concepts when describing the relationship to the water body or finally to a basin. HY\_Water\_LiquidPhase carries one association: *accumulatingWaterBody.*

The **accumulatingWaterBody** association provides a means to describe liquid water (material) accumulated in a water body. If present, this association shall be used to identify the water body (stratum) therein water, e.g. from precipitation or snowmelt, is accumulated.

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**waterliquidphase** | |
| Target type | Implementation schema |
| Name | HY\_Water\_LiquidPhase |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodystratum |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterliquidphase.accumulatingwaterbody |

#### Water – Solid phase

The HY\_Water\_SolidPhase class provides a concept of accumulation of snow and ice in a glacier, or on top of , or in a water body. Special concepts of HY\_Water\_SolidPhase to describe ice filling empty space in formations of soil and rock may defined with application. If required, an application dealing with snow and ice data may make use of the concepts when describing the relationship to a water body or finally to a basin.

HY\_Water\_SolidPhase carries three association: *accumulatingGlacie, coveredWaterBody, snowmelt.*

The **accumulatingGlacier** association provides a means to describe snow and ice (material) accumulated in a glacier. If present, this association shall be used to identify the glacier therein snow and ice are accumulated.

The **coveredWaterBody** association provides a means to describe a layer of snow and ice on top of an open water body. If present, this association shall be used to identify the water body (segment) that is covered by snow and ice.

The **snowmelt** association provides a means to describe snow and ice that has become liquid by melting. If present, this association shall be used to identify the liquid water originating from snowmelt.

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**watersolidphase** | |
| Target type | Implementation schema |
| Name | HY\_Water\_SolidPhase |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)glacier |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbodysegment |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterliquidphase |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)watersolidphase.accumulatingglacier |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)watersolidphase.coveredwaterbody |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)watersolidphase.snowmelt |

#### Cross section / Longitudinal section

The HY\_CrossSection and HY\_LongitudinalSection classes provide concepts of a vertical section at right angles to the main (average) direction of flow, or along a centre line. These concepts reflect either a property of a water body (clause 7.2.3.3) or a property of the containing channel (clause …). The geometric representation may vary with an application and needs to be defined implementation. HY\_CrossSection carries two association: *crossSectionPoint, upstreamCrossSection;* HY\_LongitudinalSection carries one association: *longitudinalSectionPoint.*

The **crossSectionPoint** and **longitudinalSectionPoint** associations provide a means to assign a reference point to a vertical section. This allows to locate the section in the basin network via a reference point that coincides with the outfall of a corresponding basin. If present, this associations shall be used to locate the relevant section in the network of basins using an identified point.

The **upstreamCrossSection** association provides a means to describe a cross section upstream of the cross section. This allows for a simple upstream/downstream relation of two cross sections. If present, this association shall be used to identify the cross section located upstream of the relevant cross section.

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**crosssection** | |
| Target type | Implementation schema |
| Name | HY\_CrossSection |
| Dependency | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)referencepoint |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)crosssection |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)crosssection.crosssectionpoint |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)crosssection.upstreamcrosssection |

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**longitudinalsection** | |
| Target type | Implementation schema |
| Name | HY\_LongitudinalSection |
| Dependency | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)referencepoint |
| Requirement | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)longitudinalsection.longitudinalsectionpoint |

#### Glacier

The HY\_Glacier class is introduced here to provide a means to take the relationships between glacier (accumulating snow and ice) and water body (accumulating liquid water from melting snow and ice) into account at the application level. As glaciology is a science on its own, the relationships between glacier and water body are not in the scope of the HY\_Features conceptual model.

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| **Requirements Class** | |
| [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**glacier** | |
| Target type | Implementation schema |
| Name | HY\_Glacier |
| Dependency | /req/hy\_namedFeature/hydrofeature |
| Requirement |  |

### The River Positioning model

The River Positioning model provides concepts to assign a position to a (hydrologic) feature of interest via its topology and geometry. River Positioning introduces the concept of Indirect Position where any location on the land surface may be described relative to or as a distance to a reference point as described in clause 7.2.2.6 of this standard. Relative position may be expressed as verbally, or percentage of the distance to the reference point

The concept of Indirect Position requires a river mileage system whose origin is the position of the relevant feature of interest, e.g. water monitoring point or a river section. The coordinates are provided as a distance (Length) from this origin to the reference point fixed by coordinates.

#### Indirect Position

The concept of Indirect Position is suitable to assign a position to the Outfall (clause 7.2.2.5) of a corresponding basin, and using this to any feature to which a reference point can be assigned and located in the network of basins. HY\_IndirectPosition carries four properties: *relativePosition*, *distanceToRefPoint, referencePoint, mileageCS*.

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Figure 22: Location of a water body in the basin network

The **relativePosition** attribute provides a means to locate the feature of interest relative to an identified reference point. If present, this property should be implemented using the HY\_RelativePosition as described in clause 7.2.4.1 of this standard.

The **distanceToRefPoint** attribute provides a means to locate the feature of interest by distance to a reference point to a feature of interest. If present, this property shall be implemented using the HY\_DistanceToRefPoint as described in clause 7.2.4.2 of this standard.

The **referencePoint** association provides a means to assign a reference point as defined in clause 7.2.2.6 of this standard. If required, this association shall be used to identify the reference point used to locate the feature of interest relative or as distance to this.

The **mileageCS** association provides a means to assign a CS to a river mileage system. River mileage usually refers to a line assuming a horizontal curve (e.g. thalweg or stream centre line). Thus, an implementation may use the one-dimensional CS\_LinearCS of ISO 19111:Spatial Referencing by Coordinates, supporting at least one horizontal axis. The axis description shall provide information about the direction (upstream, downstream) and about the smallest unit of division (precision).

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Figure 23: River Positioning

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| **Requirements Class** | |
| [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**indirectposition** | |
| Target type | Implementation schema |
| Name | HY\_IndirectPosition |
| Dependency | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)referencepoint |
| Dependency | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)rivermileagecs |
| Dependency | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)relativeposition |
| Dependency | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)distancetorefpoint |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)indirectposition.relativeposition |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)indirectposition.distancetorefpoint |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)indirectposition.referencepoint |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)indirectposition.mileagecs |

#### Relative position

The HY\_RelativePosition class provides a means to express the position of a feature of interest as percentage of the total distance to the reference point, or as a verbal description of the spatial relationship to a reference point. HY\_RelativePosition carries two attributes: *description, percentage*.

The **description** attribute refers to the HY\_RelativePositionDescription code list containing general terms commonly used in hydrology to describe a spatial relation between two points. If required, an implementation may use a term from the HY\_RelativePositionDescription code list to describe the relation to the reference point.

The **percentage** attribute refers to a positive value, expressing the distance to a reference point as percentage of the total distance between the feature of interest and the reference point. If required, an implementation may use a Real to express by number the relation to the reference point.

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| **Requirements Class** | |
| [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**relativeposition** | |
| Target type | Implementation schema |
| Name | HY\_RelativePosition |
| Dependency | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)relativepositiondescription |
| Dependency | /iso/19103/Real |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)relativeposition.description |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)relativeposition.percentage |

#### Distance to reference point

The HY\_DistanceToRefPoint class provides a means to express the position of a feature of interest as distance to a reference point including a statement of accuracy (i.e. closeness to the true value) and precision (i.e. smallest unit of length applied). HY\_RelativePosition carries three attributes: *accuracyStatement, distanceValue, precisionStatement*. If required, these attributes should be implemented using data types defined in ISO19103:Application schema.

The **accuracyStatement** attribute provide a means to express the quality of the distance measurement in by a simple statement in sense of “exact”, “greater than” or “less than” the expected value. It is expected that the Data Quality standard (ISO19157) under development will provide an appropriate means to express such an accuracy statement.

The **distanceValue** attribute provide a means to express the distance value, the **precisionStatement** attribute a means to describe the precision of the reported distance value.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**distancetorefpoint** | |
| Target type | Implementation schema |
| Name | HY\_DistanceToRefPoint |
| Dependency | /iso/19103/Length, Distance, CharacterString |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)distancetorefpoint.accuracystatement |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)distancetorefpoint.distancevalue |
| Requirement | [/req/hy\_positioning/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)distancetorefpoint.precisionstatement |

#### River mileage CS, Mileage system axis

The HY\_RiverMileageCS class defines a linear coordinate system used to represent arbitrary water observation points along a stream. Origin of the CS is the location of the relevant feature of interest (e.g. water monitoring point). Coordinates are provided as distance (Length) upstream or downstream from this origin to a reference point. HY\_RiverMileageCS carries one association to HY\_MileageSystemAxis. If required, these attributes may be implemented using feature types defined in ISO19111.

### The Storage model

The Storage model provides an abstract pattern to describe a hydrologic feature in terms of a resource stored in surface or underground reservoirs for future use, independent of its network connectivity. Connectivity with the hydrographic network may be designed with application. The storage model allows networks to be described without details of storage capacities, and vice versa storage reservoirs to be referenced independently of their representation within a network. Storage refers to surface and subsurface water; special concepts of surface or underground reservoirs may be defined with application.

#### Reservoir

The HY\_Reservoir class defines the reservoir as a natural or man-made body of water used for storage, regulation and control of water resources. This concept refers to surface and subsurface water. Special concepts of surface or underground reservoirs may be defined with a particular application. Note that the commonly recognized groundwater reservoir refers to the containing aquifer, and shall not be confused with the Reservoir (understood as a body of water).

Being a specialization of the HY\_HydroFeature, the reservoir may be identified at least by name and the given context.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_storage/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**reservoir** | |
| Target type | Implementation schema |
| Name | HY\_Reservoir |
| Dependency | /req/hy\_namedFeature/hydrofeature |
| Dependency | /req/hy\_network/waterbodysegment |
| Requirement |  |

## The Surface Hydro Feature application schema

The Surface Hydro Feature application schema provides concepts of hydrologic features on the land surface. Taking into account the separation of a water body and the confining physiographic structures, concepts of surface water bodies are provided separately from those of the surface water confines. The Surface Hydro Feature schema contains the packages: Surface Water and Surface Water Confines.

C:\Documents and Settings\Administrator\Desktop\Image2.EMF

Figure 24: Surface Hydro Feature

### The Surface Water model (informative)

The Surface Water model summarises the most common concepts of surface water bodies each special by origin, size, or by the phase of the accumulated water or the property to move. Being defined specializations of HY\_WaterBody (see clause 7.4.3.2), all surface water bodies inherit the name and context properties.

This is an informative package whose concepts may be realised with an identified entity. If required, an application focused on a special type of surface water body may use the concepts provided in this standard to describe the relationship of an implemented concept to the represented basin. Depending on the particular application, each special type may be described by suitable attributes.

### The Surface Water Confines model

The Surface Water Confines model provides concepts on the most common structures confining a water body including the aggregation and segmentation of the channel without imposing a particular drainage pattern. Depending on the application, any component of the channel network may be described by suitable attributes. If required, an application describing structures confining surface water bodies make use of the concepts when describing the relationship to a water body or a basin.

C:\Documents and Settings\Administrator\Desktop\Image2.EMF

Figure 25: Surface Water Confines

#### Channel Network

The HY\_ChannelNetwork class specializes the Network representation (clause 7.2.2) with respect to arrangement of natural or man-made drainage channels within an area. HY\_ChannelNetwork inherits the *representedCatchment* property, and carries the association to the aggregated channel and a *drainagePattern* attribute.

The **drainagePattern** attribute provides a general pattern describing the arrangement of the drainage channels within an area. If required, this attribute may be implemented using the HY\_DrainagePattern code list (see ….)

The **networkChannel** association provides a means to describe the channel network by at least one aggregated channel. If present, this association shall be used to identify the aggregated channel.

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| --- | --- |
| **Requirements Class** | |
| [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**channelnetwork** | |
| Target type | Implementation schema |
| Name | HY\_ChannelNetwork |
| Dependency | /req/hy\_network/network |
| Dependency | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channel |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelnetwork.channel |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelnetwork.drainagepattern |

#### Channel

The HY\_Channel class provides a concept to describe the deepest portion of river bed as a natural or man-made channel through or along which water may flow. This concepts refers to a watercourse which periodically or continuously contains moving water [3], or which forms a connecting link between two bodies of water. The water body flowing in a channel includes through-flow lakes, underground/subterranean streams, or streams in or beneath a glacier. HY\_Channel carries two association: *channelNetwork*, *channelSegment*.

The **channelNetwork** association provides a means to describe the channel as part of a channel network (aggregate). If present, this association shall be used to identify the channel network the relevant channel is part of.

The **networkSegment** association provides a means to describe the channel by at least one aggregated segment. If present, this association shall be used to identify the aggregated segment.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**channel** | |
| Target type | Implementation schema |
| Name | HY\_Channel |
| Dependency | [/req/waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelnetwork |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterliquidphase |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channel.network |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channel.segment |

#### Channel segment

The HY\_ChannelSegment class provides a concept to describe the portion of the channel between two or more cross-sections. HY\_ChannelSegment may be specialized to Reach which refers to the open channel. HY\_ChannelSegment carries five associations: *channel, movingWater, containedWaterBody*, *bedProfileTransversal, bedProfileLongitudinal*.

The **channel** association provides a means to describe the segment as part of a channel (aggregate). If present, this association shall be used to identify the channel the relevant segment is part of.

The **movingWater** association provides a means to describe water (material) periodically or continuously moving in the channel (watercourse) . If required, this association shall be used to identify the water moving in the channel (segment).

The **containedWaterBody** association provides a means to describe the channel (segment) as container for a water body (segment). If required, this association shall be used to identify the contained water body.

The **bedProfileTransversal** and  **bedProfileLongitudinal** associations provide a means to describe the transversal shape of a stream bed as well as the longitudinal shape of a stream bed in a vertical plane. This associations allow to locate the channel segment in the basin network via a reference point that coincides with the outfall of a corresponding basin. If required, these associations shall be used to locate the relevant channel segment in the network of basins via an identified cross section or longitudinal profile.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**channelsegment** | |
| Target type | Implementation schema |
| Name | HY\_ChannelSegment |
| Dependency | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channel |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterliquidphase |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)waterbody |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)crosssection |
| Dependency | [/req/hy\_network/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)longitudinalsection |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelsegment.channel |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelsegment.movingwater |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelsegment.containedwaterbody |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelsegment.bedprofiletransversal |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelsegment. bedprofilelongitudinal |

#### Reach

The HY\_Reach class specializes the Channel Segment with respect to an open channel between two identified cross sections. HY\_Reach inherits the *channel, movingWater, containedWaterBody*, *bedProfileTransversal, bedProfileLongitudinal properties from generalization.*

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**reach** | |
| Target type | Implementation schema |
| Name | HY\_Reach |
| Dependency | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)channelsegment |
| Requirement |  |

#### RiverBed

The HY\_RiverBed class provides a concept to describe the lowest part of reach shaped by the flow of water and along which most of the sediment and runoff moves in inter-flood periods. HY\_RiverBed carries one association: *channel .*

The **channel** association provides a means to describe the channel of which the river bed the lowest part. If present, this association shall be used to identify the reach (special channel segment) whose lowest part is the river bed, and to locate the river bed in the network of basins using a reference point.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**riverbed** | |
| Target type | Implementation schema |
| Name | HY\_RiverBed |
| Dependency | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)reach |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)riverbed.channel |

#### Bank

The HY\_Bank class provides a concept to describe the rising land bordering a river margin of a channel at the left-hand (right-hand) side when facing downstream. HY\_Bank carries one association: *borderedChannel .*

The **borderedChannel** association provides a means to describe the channel bordered by bank/s. If present, this association shall be used to identify the reach (special channel segment), and to locate the bank in the network of basins using a reference point.

|  |  |
| --- | --- |
| **Requirements Class** | |
| [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)**bank** | |
| Target type | Implementation schema |
| Name | HY\_Bank |
| Dependency | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)reach |
| Requirement | [/req/hy\_waterbodyconfines/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)bank.borderedchannel |

#### Coast

The HY\_Coast class specializes HY\_Bank with respect to the rising land that is affected by waves in a water body (segment) between uppermost landward and lowermost seaward impacts of surf action. HY\_Coast carries one association: *coastalWaterBody .*

The **coastalWaterBody** association provides a means to describe the network of basins the relevant sub-basin is part of. If present, this association shall be used to identify the basin (hydrologically discrete) encompassing the relevant (sub-)basin.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_waterbodyconfines/**coast** | |
| Target type | Implementation schema |
| Name | HY\_Coast |
| Dependency | /req/hy\_waterbodyconfines/bank |
| Requirement | /req/hy\_network/waterbodysegment |

## The Hydrometric Network application schema

The Hydrometric Network application schema provide concepts allowing hydrometric stations, or segments of these, to be related to the basin they represent, without the detail of the observation strategy. This is usually required in the context of environmental reporting or when interpreting, comprising and processing results of preceding observations into a new set of data.

The core concept is that of catchment representation by a network of logically connected monitoring stations (see Catchment Representation see clause 7.4.2.1). This schema introduces the concept of *position on river* which allows an arbitrary hydrometric feature, even free from any position, to be located in the basin network.. This allows to establish upstream-downstream relationships as well as hydrometric features to be positioned in the network using the concept of Indirect Position (see clause 7.2.4).

If required, an application capturing the monitoring of hydrologic features, the observation and measurement of their properties may use the concepts to locate sampling or sampled feature of interest. Depending on the particular application, special types may be defined and described by suitable properties.

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Figure 26: Hydrometric Network

### The Hydrometric Network model

HY\_HydrometricNetwork provides for a network of hydrometric stations which are logically connected, e.g. stations along a watercourse. A hydrometric network is an aggregate of one or more hydrometric features.

A "positionOnRiver" locates a hydrometric feature on a hydrographic feature relative to a reference point in the hydrographic network.

A hydrometric feature may have localised names, typical properties and individual characteristics. A hydrometric feature may be disjoined to segments.

The Hydrometric Network model defines a network of monitoring stations which may be logically connected via the inflow nodes or outflow nodes of corresponding basins. Defining a relationship between the hydrometric feature and the outfall of the contributing basin, this model allows to establish upstream-downstream relationships as well as to assign a position to a hydrometric feature.

The Hydrometric Network model defines a network of monitoring stations that are logically connected, e.g. along a watercourse. Defining a relationship (position on river) between the hydrometric feature and the outfall of the contributing basin, this model allows to establish upstream-downstream using the inflow nodes or outflow nodes of the corresponding basins as well as to assign a position to a hydrometric feature.

The Hydrographic Network model introduces the concepts *HydrometricNetwork,* *HydrometricFeature*, and *HydrometricFeatureSegment.*

#### HydrometricNetwork

The HY\_HydrometricNetwork class specializes HY\_CatchmentRepresentation with respect to the network (aggregate) of stations and observing posts situated within any given area in such a way as to provide the means of studying the hydrological regime. This should not to be confused with the network of hydrographic features (hydrographic network) or with network sampling as distinct method of sampling. HY\_HydrometricNetwork inherits the *representedCatchment* association from the generalization and carries one association: *hydrometricFeature*.

The **hydrometricFeature** association provides a means to describe the hydrometric network by at least one aggregated station. If present, this association shall be used to identify the aggregated station.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_metric/**hydrometricnetwork** | |
| Target type | Implementation schema |
| Name | HY\_HydrometricNetwork |
| Dependency | [/req/hy\_catchment/](http://schemas.opengis.net/spec/hydrology/catchment/1.0/req/hy_catchment)catchmentrepresentation |
| Dependency | /req/hy\_metric/hydrometricfeature |
| Requirement | /req/hy\_metric/hydrometricnetwork.networkfeature |

#### Hydrometric Feature

The HY\_HydrometricFeature class provides a concept of a hydrometric station which is identified part of a network (of at least one station), and may be disjoined into segments. Even if HY\_HydrometricFeature may be understood in sense of a sampling feature used for observation, there is no other significance outside the hydrometric network. If required, an application may use this concept to identify the role of a sampling feature in a given network. HY\_HydrometricFeature carries three associations: *hydrometricNetwork,*  *hydrometricFeatureSegment* and *positionOnRiver*

The **hydrometricNetwork** association provides a means to describe the hydrometric station as part of a hydrometric network (aggregate). If present, this association shall be used to identify the hydrometric network the relevant feature is part of.

The **hydrometricFeatureSegment** association provides a means to describe the hydrometric feature by at least one aggregated segment. If present, this association shall be used to identify the aggregated segment.

The **positionOnRiver** association provides a means to topologically locate the hydrometric feature in the network of basins using a reference point that coincides with the outfall of a corresponding basin. If present, this association shall be used to assign a location in the basin network to a hydrometric feature.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_metric/**hydrometricfeature** | |
| Target type | Implementation schema |
| Name | HY\_HydrometricFeature |
| Dependency | /req/hy\_catchment/referencepoint |
| Dependency | /req/hy\_metric/hydrometricnetwork |
| Dependency | /req/hy\_metric/hydrometricfeaturesegment |
| Requirement | /req/hy\_metric/hydrometricfeature.positiononriver |
| Requirement | /req/hy\_metric/hydrometricfeature.hydrometricnetwork |
| Requirement | /req/hy\_metric/hydrometricfeature.hydrometricfeaturesegment |

#### Hydrometric Feature Segment

The HY\_HydrometricFeatureSegment class defines the segment of a hydrometric feature. This refers to composite stations configured by arranging at least one of several monitoring components. HY\_HydrometricFeatureSegment carries three associations: *HydrometricFeature.*

The **hydrometricFeature** association provides a means to describe the particular component as part of a hydrometric station (aggregate). If present, this association shall be used to identify the hydrometric station the relevant component is part of.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_metric/**hydrometricfeaturesegment** | |
| Target type | Implementation schema |
| Name | HY\_HydrometricFeatureSegment |
| Dependency | /req/hy\_metric/hydrometricfeature |
| Requirement | /req/hy\_metric/hydrometricfeaturesegment.hydrometricfeature |

## The Utilities application schema (within HY\_Features)

The Utilities application schema provides generally applicable concepts usually required in multi-lingual and cross-domain application contexts. The utility components are not hydrology-specific and may be provided for cross-domain usage. It is expected that future evolution of OGC and ISO standards, particularly ISO19115/ISO19139 and ISO19103, will provide a suitable replacement for these.

### Localized Name

The naming of hydrologic features within different cultures and languages is a fundamental issue in information systems with global focus. For example, the same feature may be named differently according to locale and usage, or the name may apply to a part of the feature only.

The Localized Name concept provides a pattern to handle the cultural, political and historical variability of names as well as the relationships between alternative names, without the complexity of a toponymy model. The EXT\_LocalisedName class provides a concept of a name whose usage is bound to location. EXT\_LocalisedName carries three attributes: *name*, *transliteration* and *usage*.

The **name** attribute provides a means to assign to a feature an individual name used in a country or region under the conditions of nation and language. If present, the name attribute shall be implemented using the ScopedName as defined in ISO 19103.

The **transliteration** attribute provides a means to identify the ISO standard used for romanisation, transcription or transliteration of characters of another alphabet into Latin characters. If present, the transliteration attribute may be implemented using the EXT\_TransliterationCode code list, defined in Annex C.4 of this standard.

The **usage** attribute provides a means to describe the a general usage type of the relevant name. If present, the usage attribute may be implemented using the EXT\_UsageType code list, defined in Annex C.5 of this standard.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_utilities/**localisedname** | |
| Target type | Implementation schema |
| Name | EXT\_LocalisedName |
| Dependency | /iso/19103/ScopedName |
| Dependency | /req/hy\_utilities/transliterationcode |
| Dependency | /req/hy\_utilities/usagetype |
| Requirement | /req/hy\_utilities/localisedname.name |
| Requirement | /req/hy\_utilities/localisedname.ttransliteration |
| Requirement | /req/hy\_utilities/localisedname.usage |

### Multi-lingual Keyword

This EXT\_MultilingualKeyword class provides a simple means to handle the cultural and linguistic variability of hydrology-specific keywords intended to be applied for a Keyword in terms of the ISO19115, without importing the full cultural, political and linguistic applicability package for feature description using keywords in multi-lingual contexts. EXT\_LocalisedName carries two attributes: *keyword* and *type*.

The **keyword** attribute provides a means to assign to a feature a significant word, phrase or name commonly or conventionally used to describe an agreed meaning. If present, the keyword attribute may be implemented using the EXT\_LocalisedCharacterString type as defined in this standard.

The **type** attribute provides a means to identify the role of the keyword is the domain specific context. If present, the type attribute may be implemented using the EXT\_KeywordRole code list which is here provided as an empty container that may be appropriately populated with relevant terms in an extension model.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_utilities/**multilingualkeyword** | |
| Target type | Implementation schema |
| Name | EXT\_MutlilingualKeyword |
| Dependency | /req/hy\_utilities/localisedcharacterstring |
| Dependency | /req/hy\_utilities/keywordrole |
| Requirement | /req/hy\_utilities/multilingualkeyword.keyword |
| Requirement | /req/hy\_utilities/multilingualkeyword.type |

### Spatial, Temporal and Classification Context

The EXT\_SpatialContext class provides a means describing the interaction of the (hydrologic) feature with a target spatial feature. This characterisation may be specialised to simplify the nature of this information, such as a single numeric value. Examples: number of countries (or admin unit) in catchment, appearance of soil types in catchment, WMO-Basin in catchment. EXT\_SpatialContext carries four attributes: *domain, overlapsCount, relatedFeatureType,* and *spatialContextDescriptor.*

The **domain** attribute identifies the domain within which a spatial context is described, the **relatedFeatureType** attribute denotes an identifier from related domain specifying the hydrologic feature, and the **spatialContextDescriptor** attribute provides a means to assign a controlled vocabulary term from a related domain characterizing the spatial context of the hydrologic feature, e.g. country. If present, these attributes shall be implemented using the ScopedName type as defined in ISO 19103.

The **overlapsCount** attribute describes the overlap of particular features in the target domain that the hydrologic feature overlaps. If present, these attributes shall be implemented using the Real data type as defined in ISO 19103.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_utilities/**spatialcontext** | |
| Target type | Implementation schema |
| Name | EXT\_SpatialContext |
| Dependency | /iso/19103/ScopedName |
| Dependency | /iso/19103/Real |
| Requirement | /req/hy\_utilities/spatialcontext.domain |
| Requirement | /req/hy\_utilities/spatialcontext.relatedfeaturetype |
| Requirement | /req/hy\_utilities/spatialcontext.spatialcontextdescriptor |
| Requirement | /req/hy\_utilities/spatialcontext.overlapscount |

The EXT\_TemporalContext class provides a means to describe the existence or behaviour of the (hydrologic) feature in time. This characterisation may be specialised to simplify the nature of this information, such as a single numeric value. Examples: lifespan, permanence. EXT\_TemporalContext carries three attributes: *extent, statusIdentifier* and *temporalContextDescriptor.*

The **extent** attribute describes the temporal extent of the feature. If present, these attributes shall be implemented using the TM\_Period type as defined in ISO 19108.

The **statusIdentifier** attribute denotes whether a feature characteristic applies, or not. If present, these attributes shall be implemented using the Boolean data type as defined in ISO 19103.

The **temporalContextDescriptor** attribute provides a means to assign a controlled vocabulary term from a related domain characterizing the temporal context of the hydrologic feature, e.g. lifespan. If present, these attributes shall be implemented using the ScopedName type as defined in ISO 19103.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_utilities/**temporalcontext** | |
| Target type | Implementation schema |
| Name | EXT\_TemporalContext |
| Dependency | /iso/19108/TM\_Period |
| Dependency | /iso/19103/ScopedName |
| Dependency | /iso/19103/Boolean |
| Requirement | /req/hy\_utilities/temporalcontext.domain |
| Requirement | /req/hy\_utilities/temporalcontext.statusidentifier |
| Requirement | /req/hy\_utilities/temporalcontext.temporalcontextdescriptor |

The EXT\_ClassificationContext class provides a means to describe the classification used to arrange a feature or feature property according to established criteria. . EXT\_ClassificationContext carries three attributes: *class, classification* and *topic..*

The **class** attribute denotes a position or rank in a classification system, the **classification** attribute identifies the classification system used, and the topic attribute denotes the upper-level topic name of the related classification system. If present, these attributes shall be implemented using the ScopedName type as defined in ISO 19103.

|  |  |
| --- | --- |
| **Requirements Class** | |
| /req/hy\_utilities/**classificationcontext** | |
| Target type | Implementation schema |
| Name | EXT\_ClassificationContext |
| Dependency | /iso/19103/ScopedName |
| Requirement | /req/hy\_utilities/classificationcontext.class |
| Requirement | /req/hy\_utilities/classificationcontext.classification |
| Requirement | /req/hy\_utilities/classificationcontext.topic |

# 

# Annex A: Conformance Class Abstract Test Suite (Normative)

Introduction

These test suites ascertain the compliance of the conformance targets for the HY\_Features specification with the specification itself.

Each instance of hydrologic feature data is encoded according to a specific interchange schema, so the role of conformance with the abstract specification is that such an implementation schema can be related to the common definitions of HY\_Features.

Conformance class: Encoding of data using HY\_HydroFeature application schema

|  |  |  |
| --- | --- | --- |
| **Conformance Class: HY\_Features schema equivalence** | | |
| /req/hy\_abstract/\* | | |
| Requirements | /req/hy\_namedFeature/hydrofeature | |
| Dependency |  | |
| Test | /conf/uml-hy\_abstract/hy\_namedfeature/\*  /conf/uml-hy\_abstract/hy\_catchment/\*  /conf/uml-hy\_abstract/hy\_network/\*  /conf/uml-hy\_abstract/hy\_positioning/\*  /conf/uml-hy\_abstract/hy\_storage/\* | |
| Requirement | All relevant elements of a data exchange schema including hydrologic features are mapped to equivalent HY\_Features elements. |
| Test purpose | Ascertain that a hydrologic data exchange schema can be interpreted using related HY\_Features definitions. |
| Test method | Inspect the mapping between the data exchange schema and the HY\_Features model to determine that all relevant schema elements are mapped to HY\_Features equivalents |
| Test type | Capability |

Conformance class: Encoding of data using HY\_AtmosphericFeature application schema

|  |  |  |
| --- | --- | --- |
| **Conformance Class: HY\_Features schema equivalence** | | |
| /req/hy\_atmosphere**/\*** | | |
| Requirements | [/req/hy\_atmosphere](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature)/atmosphericfeature\* | |
| Dependency | **/**conf/uml-namedfeature/hydrofeature | |
| Test | /conf/uml-hy\_atmospheric-feature/\* | |
| Requirement | All relevant elements of a data exchange schema including hydrologic features are mapped to equivalent HY\_Features elements. |
| Test purpose | Ascertain that a hydrologic data exchange schema can be interpreted using related HY\_Features definitions. |
| Test method | Inspect the mapping between the data exchange schema and the HY\_Features model to determine that all relevant schema elements are mapped to HY\_Features equivalents |
| Test type | Capability |

Conformance class: Encoding of data using HY\_SurfaceHydroFeature application schema

|  |  |  |
| --- | --- | --- |
| **Conformance Class: HY\_Features schema equivalence** | | |
| **/**conf/hy\_surface**/\*** | | |
| Requirements | [/req/hy\_surfacehydrofeature](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature)/\* | |
| Dependency | [**/conf/uml-namedfeature/hydrofeature**](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature) | |
| Test | /conf/uml-hy\_surface/hy\_waterbody/\*  /conf/uml-hy\_surface/hy\_waterconfines/\* | |
| Requirement | All relevant elements of a data exchange schema including hydrologic features are mapped to equivalent HY\_Features elements. |
| Test purpose | Ascertain that a hydrologic data exchange schema can be interpreted using related HY\_Features definitions. |
| Test method | Inspect the mapping between the data exchange schema and the HY\_Features model to determine that all relevant schema elements are mapped to HY\_Features equivalents |
| Test type | Capability |

Conformance class: Encoding of data using HY\_SurfaceHydroFeature application schema

|  |  |  |
| --- | --- | --- |
| **Conformance Class: HY\_Features schema equivalence** | | |
| /conf/hy\_subsurface**/\*** | | |
| Requirements | /[req/hy\_subsurfacehydrofeature](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature)/\* | |
| Dependency | **/**[**conf/uml-namedfeature/hydrofeature**](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature) | |
| Test | /conf/uml-hy\_subsurface/hy\_subsurface\_water/\*  /conf/ uml-hy\_subsurface /hy\_subsurface\_confines/\* | |
| Requirement | All relevant elements of a data exchange schema including hydrologic features are mapped to equivalent HY\_Features elements. |
| Test purpose | Ascertain that a hydrologic data exchange schema can be interpreted using related HY\_Features definitions. |
| Test method | Inspect the mapping between the data exchange schema and the HY\_Features model to determine that all relevant schema elements are mapped to HY\_Features equivalents |
| Test type | Capability |

Conformance class: Encoding of data using HY\_SurfaceHydroFeature application schema

|  |  |  |
| --- | --- | --- |
| **Conformance Class: HY\_Features schema equivalence** | | |
| **/req/hy\_metric/\*** | | |
| Requirements | [/req/hy\_metric/\*](http://schemas.opengis.net/spec/hydrology/named-feature/1.0/req/hy_hydro-feature) | |
| Dependency | **/**conf/uml-namedfeature/hydrofeature | |
| Test | /conf/uml-hy\_metric/hy\_hydrometric/\* | |
| Requirement | All relevant elements of a data exchange schema including hydrologic features are mapped to equivalent HY\_Features elements. |
| Test purpose | Ascertain that a hydrologic data exchange schema can be interpreted using related HY\_Features definitions. |
| Test method | Inspect the mapping between the data exchange schema and the HY\_Features model to determine that all relevant schema elements are mapped to HY\_Features equivalents |
| Test type | Capability |

# Annex B: Code lists required for the HY\_Features model

## B.1 Reference Point Type (code list)

|  |  |
| --- | --- |
| **Table C.1:** Terms identifying a fixed landmark determined as reference point | |
| barrage | barrier across a stream provided with a series of gates or other control mechanisms to control the water-surface level upstream, to regulate the flow or to divert water supplies into a canal.  *(Source: barrage. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0110EN.HTM)* |
| bifurcation | division of a stream into two branches.  *(Source: bifurcation. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0131EN.HTM)* |
| confluence | joining, or the place of junction, of two or more streams.  *(Source: confluence. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0235EN.HTM)* |
| dam | barrier constructed across a valley for impounding water or creating a reservoir.  *(Source: dam. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0285EN.HTM)* |
| diversion of water | transfer of water from one watercourse to another, such watercourses being either natural or man-made.  *(Source: diversion of water (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0349EN.HTM)* |
| fork | (1) place where two or more streams flow together to form a larger stream. (2) place where a stream divides into two or more streams.  *(Source: fork. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0499EN.HTM)* |
| hydrometric station | station at which data on water in rivers, lakes or reservoirs are obtained on one or more of the following elements: stage, streamflow, sediment transport and deposition, water temperature and other physical properties of water, characteristics of ice cover and chemical properties of water.  *(Source: hydrometric station. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from*  *http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0627EN.HTM)* |
| inlet | structure admitting water supplies from the source or through an intake structure built upstream.  *(Source: inlet. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0679EN.HTM)* |
| intake | structure or site, the purpose of which is to control, regulate, divert, and admit water directly from the source, through an inlet built upstream.  *(Source: intake. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0684EN.HTM)* |
| outlet | opening through which water flows out or is extracted from a reservoir or stream.  *(Source: outlet. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0868EN.HTM)* |
| ponor | hole or opening in the bottom or side of a depression where a surface stream or lake flows either partially or completely underground into a karst groundwater system.  *(Source: ponor. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0925N.HTM)* |
| rapids | reach of a stream where the flow is very swift and shooting, and where the surface is usually broken by obstructions, but has no actual waterfall or cascade.  *(Source: rapids. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0980EN.HTM)* |
| reference climatological station | climatological station the data of which are intended for the purpose of determining climatic trends. This requires long periods (not less than thirty years) of homogeneous records, where man-made environmental changes have been and/or are expected to remain at a minimum. Ideally the records should be of sufficient length to enable the identification of secular changes of climate. (TR)  *(Source: reference climatological station. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF0998EN.HTM)* |
| river mouth | place of discharge of a river into a sea or a lake.  *(Source: river mouth. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF1043EN.HTM)* |
| sinkhole | place where water disappears underground in a limestone region. It generally implies water loss in a closed depression or blind valley.  *(Source: sink hole. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF1116EN.HTM)* |
| source | origin of river.  *(Source: source. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF1166EN.HTM)* |
| spring | place where water flows naturally from a rock or soil onto land or into a body of surface water.  *(Source: spring. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF1185EN.HTM)* |
| waterfall | vertical fall or the very steep descent of a stream of water.  *(Source: waterfall. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF1365EN.HTM)* |
| weir | overflow structure which may be used for controlling upstream water level or for measuring discharge or for both.  *(Source: weir. (2010). In International Glossary of Hydrology Online.Retrieved May 5, 2010, from http://webworld.unesco.org/water/ihp/db/glossary/glu/EN/GF1396EN.HTM)* |

## B.2 Relative Position Description (code list)

|  |  |
| --- | --- |
| **Table C.2:** Terms commonly used in hydrology to describe a spatial relation between two points | |
| at | located at the (reference) point |
| between | located between two (reference) points |
| downstream | located downstream of the (reference) point, e.g. in the direction of the current in a river or stream. |
| left | located left-hand of the (reference) point when facing downstream. |
| nearby | located in a short distance to the (reference) point. |
| right | located right-hand of the (reference) point when facing downstream. |
| upstream | located upstream of the (reference) point, e.g. in the direction towards the source of a stream. |

## B.3 Drainage Pattern (code list)

|  |  |
| --- | --- |
| **Table C.3:** Terms commonly used in hydrology to describe a drainage pattern  (Source: drainage patterns (1985). In Morisawa, M. (1985): Rivers. London, New York.-pp159-164) | |
| annular | main rivers have circular pattern with subsidiary channels at right angels |
| centripetal | streams flow inward to center |
| dendritic | spreading treelike arrangement; no evident orientation of channels (random orientation). |
| distributary | one main channel divides into many channel-ways ending with many outlets. |
| parallel | main channels regularly spaced and parallel or sub-parallel to each other; tributaries join at very acute angels. |
| pinnate | featherlike, closely grouped , short tributaries (fine texture). |
| radial | streams flow outward from center. |
| rectangular | drainage forms a perpendicular net with the two directions equally developed. |
| trellis | a dominant drainage direction with a secondary direction perpendicular to this; primary tributaries join main stream at right angles, secondary tributaries parallel main stem. |

## B.4 Transliteration Standard Code (code list)

|  |  |
| --- | --- |
| **Table C.4:** ISO standards relevant to the romanisation, transcription or transliteration of characters of another alphabet into Latin characters. | |
| ISO 11940(1998) | Transliteration of Thai |
| ISO 11941(1996) | Transliteration of Korean script into Latin characters |
| ISO 15919(2001) | Transliteration of Devanagari and related Indic scripts into Latin characters |
| ISO233(1984,1993,1999) | Transliteration of Arabic characters into Latin characters |
| ISO 259(1984) | Transliteration of Hebrew characters into Latin characters |
| ISO 3602(1989) | Romanization of Japanese (kana script) |
| ISO 7098(1991) | Romanization of Chinese |
| ISO 843(1997) | Conversion of Greek characters into Latin characters |
| ISO 9(1995) | Transliteration of Cyrillic characters into Latin characters: Slavic and non-Slavic languages |
| ISO 9984(1996) | Transliteration of Georgian characters into Latin characters |
| ISO 9985(1996) | Transliteration of Armenian characters into Latin characters |

## B.5 Usage type (code list)

|  |  |
| --- | --- |
| **Table C.5:** Terms commonly used to indicate the type of name usage. | |
| conventional | accepted, used, or practiced by most people (“agreed by convention”) |
| historical | restricted to or based on fact in history |
| official | ordered or allowed by those in authority |
| vernacular | used in or suitable for speech, usually not used in formal writing |

# Annex C: Use cases (Informative)

1. Use Case: Using standard data model to discover, access and interpret relationships between complex hydrological data sets exposed as Web Services.
2. Use Case: Publish ontologies to describe spatial data products and the relationships between them.
3. Use case: Software development needs international data structures for hydrologic information. 🡪 profile to handle the exchange river network information (“stream, waterbody, catchment data products”).

# Annex D: Mapping of information models to HY\_Features concepts (Informative)

The SWG needs to show that the conceptual model has been adequately tested. We plan to do that through visual (map) examples, corresponding UML examples, and annotations that describe how various specific datasets map to the examples. Annex will be formal UML mappings for reference from the documents.

In terms of testing the model, we then went through and looked at some data products, and also the core requirements of the NFIE, and how these "mapped" to the model - we will now complete this with a set of diagrams, where we create "cartoon" examples of real world hydrology, then annotate this with both the existing data products and the HY\_Features terms. This is a human friendly mapping, which addresses the work items to develop informative resources and mappings. We will also provide an informative annex of these mapping expressed in UML - using the idiom which we know can be compiled to an OWL form - but given that the UML for the data products is non-normative, and the mapping idiom is also ad-hoc, these are simply informative things.

(email rob2scott)

## D.1 Requirements for mapping concepts

## D.2 UML mapping idiom

## D.3 Mapping examples (cartoons)

## D.3.1 Mapping example USGS NHD+ model

## D.3.2 Mapping example AU HydroGeofabric model

## D.3.3 Mapping example INSPIRE Hydrography theme( (UK, CEH example)

# Annex E: Revision history

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date | Release | Author | Paragraph modified | Description |
| 02.10.2015 | 0.1 | Irina Dornblut | Initial version | Initial draft (OGC format) |
|  |  |  |  |  |
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# Annex F: Bibliography

1. OGC, *Hydrology Domain Working Group Charter.* Open Geospatial Consortium, 2008. OGC 08-095r5.
2. OGC, *OGC HY\_HY\_Features: a Common Hydrologic Feature Model*. OGC Discussion Paper. Open Geospatial Consortium, 2013. OGC 11-039r3
3. WMO, *International Glossary of Hydrology/Glossaire International d'Hydrologie.* WMO (Series); no. 385, ed. World Meteorological Organization. Paris ; Geneve,: United Nations Educational, Scientific and Cultural Organization ; World Meteorological Organization, 1992.
4. WMO, *WMO Core Metadata Profile.* version 1.3 Specification. Geneva: World Meterological Organisation, 2012.
5. OGC, *WaterML 2.0: Part 1- Timeseries*. Open Geospatial Consortium, 2012. OGC 10-126r4.
6. EC. D2.8.I.8 *INSPIRE Data Specification on Hydrography*. Version 3.0.1. European Commission, 2010.
7. USGS, *Hydrologic units, hydrologic unit codes, and hydrologic unit names* (Modified from Slack and Landwehr, 1992 and Seaber, Kapinos, & Knapp, 1987). 1992
8. WMO, *Guide to Hydrological Practices. Volume I: Hydrology – From Measurement to Hydrological Information*. - 6th ed. - WMO (Series); no. 168., ed. World Meteorological Organization. 2008, Geneva
9. WMO, *International Meteorological Vocabulary*. - WMO (Series) ; no. 182. ed. World Meteorological Organization. – Geneva : World Meteorological Organization, 1992, Geneva
10. OGC, *Observations and Measurements*. *Part1 - Observation schema*. Open Geospatial Consortium, 2007. OGC 07-022r1.
11. NASA, *QUDT - Quantities, Units, Dimensions and Data Types Ontologies.* NASA. *-* Online. Retrieved October 2014, from http://qudt.org/.
12. OGC, *WaterML - WQ, an O&M and waterML 2.0 profile for water quality data.* Open Geospatial Consortium, 2014. OGC 14-003.
13. GRDC, *Hydrologic Information - Metadata: semantic structure for the desrption of hydrologic data.* - 2nd, fully rev. ed. Global Runoff Data Centre. - GRDC Report Series ; 39r2. - Koblenz, 2013. - Online: http://doi.bafg.de/BfG/2013/GRDC\_Report\_39,2.pdf

1. www.cite.opengeospatial.org [↑](#footnote-ref-1)