SWEDISH STANDARDS INSTITUTE

SWEDISH STANDARD
SS 63 70 08:2006

Approved 2006-09-04

Edition 1

Geographic information – Surface water systems – Concept and application schema

Geografisk information – Ytvattensystem – Begrepps- och applikationsschema

ICS 35.020; 35.240.01; 35.240.30; 35.240.50; 35.240.60; 35.240.99

Language: English

Published: November 2006

Upplysningar om **sakinnehållet** i standarden lämnas av SIS, Swedish Standards Institute,
telefon 08 - 555 520 00.

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Contents

Foreword

The Swedish standard SS 63 70 08, Geographic information – Surface water systems – Concept and application schema has been composed by the technical committee SIS/TK 452 Water systems. TK 452 is part of the project area Stanli within SIS, Swedish Standards Institute.

This work has been done by a working group within the technical committee for Water systems, SIS/TK 452, of Stanli. The work was started in January 2003. The working group has been compiled by representatives from:

— Lantmäteriet
— Elforsk AB
— Swedish Environmental Protection agency
— Swedish Maritime Administration
— Swedish Association of Local Authorities and Regions
— Swedish Geological Survey, SGU
— Swedish Meteorological and Hydrological Institute, SMHI
— Working group leader from the National Land Survey
— Modelling leader, consultants.

0 Introduction

0.1 General

The purpose of this standard is, on one hand, to make it possible to exchange geographic information about lakes, watercourses and surface water systems and, on the other, to be part of national and international initiative concerning harmonisation of geographic information, for instance the EC framework directives for water and INSPIRE.

The use of geographic information systems (GIS) in society is increasing and thus the need to be able to exchange geographic information in a simple manner. There is a large demand to be able to identify surface water localities with the help of unique identities in order to simplify the exchange of information about them. The collection of information involves great costs. If the information, instead of being collected, could be obtained from a party that already collected it, great savings could be made.

There is also a large demand to be able to describe the Swedish surface water system as a continuous network with a correct flow in which the movements of the water may be traced. This applies for instance to the environmental area, where it is desirable to be able to trace the spread of pollutants in the surface water system, compile source distributions for different substances and make scenario computations for different action plans. The implementation of the EU framework directives for water implies an increased focus on this type of issues.

Use cases are found in annex E in this standard. The use cases will be tested in connection with the implementation phase of this standard.

As foundation for the development of this standard, reference material has been used, for instance SS 63 70 04:1999 Road and railway networks, the ISO 19100 series, The Stanli handbook *Samverkande GIS med ISO 19100*, the EC water directive, Nordic Glossary of Hydrology, TNC water glossary and existing data models within the hydrography area.

Below are described some aspects that may make the understanding of the function of this standard easier.

0.2 Concept and application schemas

The concept schema in this standard is a model of reality. The application schema (in earlier Stanli terms called information model and application model) tries to describe the information that has been collected about real world phenomena within the water area, such as lakes, water courses and coastal waters. This standard supports uniform construction of geographic datasets, making it possible for different organisations to exchange data for different applications within the surface water area. The application schema is often more generalised or simplified than the real world.

EXAMPLE A *local contributing area* in the real world may, as described in the concept schema, contain small bodies of surface water. It has however in the application schema been defined as containing no surface water bodies.

0.3 The meaning of a schema

The application schema specifies rules for the description of surface water systems as constructed of its sub systems. A surface water system may thereby, with the application schema as toolbox, be constructed and divided in several ways, but the schema can only deal with one description at a time.

EXAMPLE If it is stated that a *lake* could be divided into three *basins,* the same lake can not, in the same description, be divided into only two *basins*. In this case there must be a new, separate description. The schema gives no help with the associations between the three *basins* in association with the two.

0.4 The standard in relation to real datasets

This standard describes how national unique identities shall look and be created. Identities linked to features are today mainly missing. This standard does not obtain full impact until a national dataset with identified features on an appropriate level of detail is constructed.

EXAMPLE This standard does not specify how the *outflow area* of the river Dalälven shall be divided. It is up to the involved parties to, guided by the principles of this standard, agree on how the river shall be divided for data exchange.

0.5 Demands and complexity

The demands on an application schema for surface water are heavy. On one hand, the *water surface system* has an inherent hierarchical structure; on the other hand, the *surface water bodies* are divisible. *Lakes* may for instance be divided into *basins*. It shall furthermore be possible to observe and analyse the *surface water system* as a network. Taken together, this gives a relatively complex schema in order to meet the demands.

The schema must also be able to deal with changes and different geometries.

0.6 Geometry and topology

The geometry of an object is of 0, 1, 2 or 3 dimensions, i.e. a point, line, surface or body. The topology indicates the associations between objects, the relations they have to each other. The same object may have by several different geometries, sometimes called multiple geometries.

0.7 Phenomena and features

Different terms for objects and such are used in different schema types and modelling languages. In the table below are shown the use of terms (and synonyms) in this standard.

Table 1 – The relationship between concept and application schema in this standard

	Real world representation in the concept schema	**Application schema in UML**
Groups of the same kind, for instance *lake*	phenomenon (note: the concept represents the phenomenon in the schema)	class (feature type)
One special individual, for instance "Little Lake"	body (individual occurrence)	feature (instance)

1 Scope

This standard deals with the geographic representation of surface water systems. The standard defines concepts related to surface water systems. From the concepts, this standard creates a data structure with rules and content for information about surface water systems. The application schema deals with the following aspects of surface water:

— the surface water systems inherent hierarchical structure in various sub systems and levels

— how the surface water system may be represented on different levels of detail

— the surface water system as a correct flow network with described topology

— unique identities, phenomena identities, hydrological codes and some central attributes

— how updating of information is handled

— version handling

— how time validity may be given

— metadata, specifically quality

— geometries in several dimensions, reference systems

This standard supports reporting in conformance with the EC water directives, flow calculations and calculations of transport of dissolved substances in water.

This standard does not deal with classification of water according to their biological or limnological characteristics or to administrative division. Nor does this standard deal with division of water according to linguistic, dialectal or geographic variants, for instance mere, pool, brook, rivulet, stream, creek, river, stretch of water between rapids, or forms like bay, gulf, delta or similar.

This standard does not encompass technical utility systems, fairways, land or groundwater or water quality.

2 Normative references

The following reference documents are necessary for the application of this document. For dated references, only the declared edition is valid. For undated references, the latest edition of the document is valid (including eventual additions).

SS-EN ISO 19107	*Geographic information – Spatial schema*
SS-EN ISO 19108	*Geographic information – Temporal schema*
SS-EN ISO 19115	*Geographic information – Metadata*
SS-ISO 19118	*Geographic information – Encoding*
SS 63 70 07	*Geographic information – Representation of changes in datasets*

3 Terms and definitions

For the purposes of this standard, the following terms apply. For definitions of surface water terms, see the concept schema in clause 5 or the class descriptions in clause 6. See also table D.1, which is a translation table between Swedish and English terms with corresponding class names in the application schema.

3.1
abstract class
sv. abstrakt klass
class that does not represent a real phenomenon [UML]

3.3
application schema
sv. applikationsschema
formal graphical documentation of data structure, rules and content for information for a specific application

3.4
attribute
sv. attribut
characteristics of a class described by the values it can have [UML]

3.5
attribute type
sv. attributtyp
type of information (often corresponding to a characteristic) that is relevant for a specific feature type

3.6
concept schema
sv. begreppsschema
documentation in graphical form describing mutual relations between concepts and also containing their definitions and names

NOTE Concept schemas are used to describe phenomena and characteristics within a delimited application area.

3.7
data type
sv. datatyp
specification of value domain and permitted operations on values within this domain [SIS-ISO/TS 19103]

3.8
level of detail
sv. detaljeringsnivå
wealth of detail in a representation of reality with respect to number and feature set

NOTE The level of detail has reference to a level in a hierarchical structure where a feature may consist of several features from a level of higher wealth of detail.

3.10
phenomenon
sv. företeelse
something existing in the real world or a hypothetical world and can be delimited as a unit by itself

EXAMPLE A fish, measurement, measuring buoy, judgement, project.

3.11
class
sv. klass
description of a group of features which share the same characteristics [UML]

NOTE Classes are used in application schemas to represent for instance feature types, data types and types for spatial features. Is sometimes called feature class

3.12
metadata
sv. metadata
information about a dataset

NOTE Information about lineage and measuring accuracy are considered to belong to metadata as well as information about which application schema and which code lists the dataset is built upon.

3.13
feature
sv. objekt
information about an individual phenomenon [Stanli notation]

3.14
object
sv. objekt
abstraction of an individual phenomenon [UML]

3.15
feature type
sv. objekttyp
specification of information about a group of phenomena with similar characteristics [Stanli notation]

3.16
package
sv. paket
group of related classes [UML]

NOTE An application schema is composed of one or more packages. Each package also contains references to other packages that it is directly dependant on.

3.17
association
sv. samband
relation between features

NOTE 1 Associations are established between two features which may be of the same or different feature types.

NOTE 2 An association is always of a specific association type.

3.18
association type
sv. sambandstyp
connection from one feature type to another feature type or the feature type itself

3.19
expansion rule
sv. utökningsregel
specification of how an expansion may be made to an application schema and how it shall be documented

NOTE Expansion rules may for instance contain additions to code lists and specialisations through inheritance.

3.20
value domain
sv. värdedomän
set of valid values for one or more attribute types

4 Abbreviated terms

For the purposes of this standard, the following abbreviations are applicable.

GIS	Geographic information system
JRC	Joint Research Centre, the EU commission's joint research centre
OCL	Object Constraint Language
SMHI	Swedish Meteorological and Hydrological Institute
SVAR	Swedish Water Archives
UML	Unified Modelling Language. Object oriented analyses and design language developed by the Object Management Group (OMG)
WFD	The EC framework directives for water, 2000/60/EC
XML	Extensible Markup Language
XML schema	Schema describing the possible data content in an XML file regarding structure, content and semantics

5 Concept schema

5.1 Introduction

A concept schema explains the meaning and characteristics of and relations between concepts that are used in this standard. The concept schema does not state the structure of the information but shows the picture of reality that concerns this standard. The terms, concepts and mutual relations of the concept schema form the basis for a common language and view.

The following subclause about surface water bodies contains a number of terms which are not used in the concept schema, but needs to be defined as they are terms generally used in hydrological connections. Most remarkable is that such a central and commonly used term as *river* is excluded from the concept schema. The reason for this is that *river* may have several different meanings and therefore been impossible to agree on an unambiguous definition, see 5.2.8.

In the following clauses, the concepts have been arranged in four groups: surface water bodies, water locations, surface water systems and hydrological areas. The concept schema is also shown in a number of schemas in Stanli notation. In the schemas, definitions are also shown.

5.2 Surface water bodies

5.2.1 surface water body

delimited accumulation of stagnant or running surface water which is defined by a *shoreline* and/or water locations

NOTE Surface water means water on the ground. In this standard is included water in *coastal water areas*, water in *transitional areas* and all inland water except ground water and *soil water*. Marshes, bogs, glaciers and springs are not handled in this standard. *A surface water body* may be a *lake*, *a coastal water area*, *a river reach* or *transitional area* but also a *basin* or a *river reach segment*. The last group are parts of a larger *surface water body*.

Figure 1 – Examples of different types of *surface water bodies*

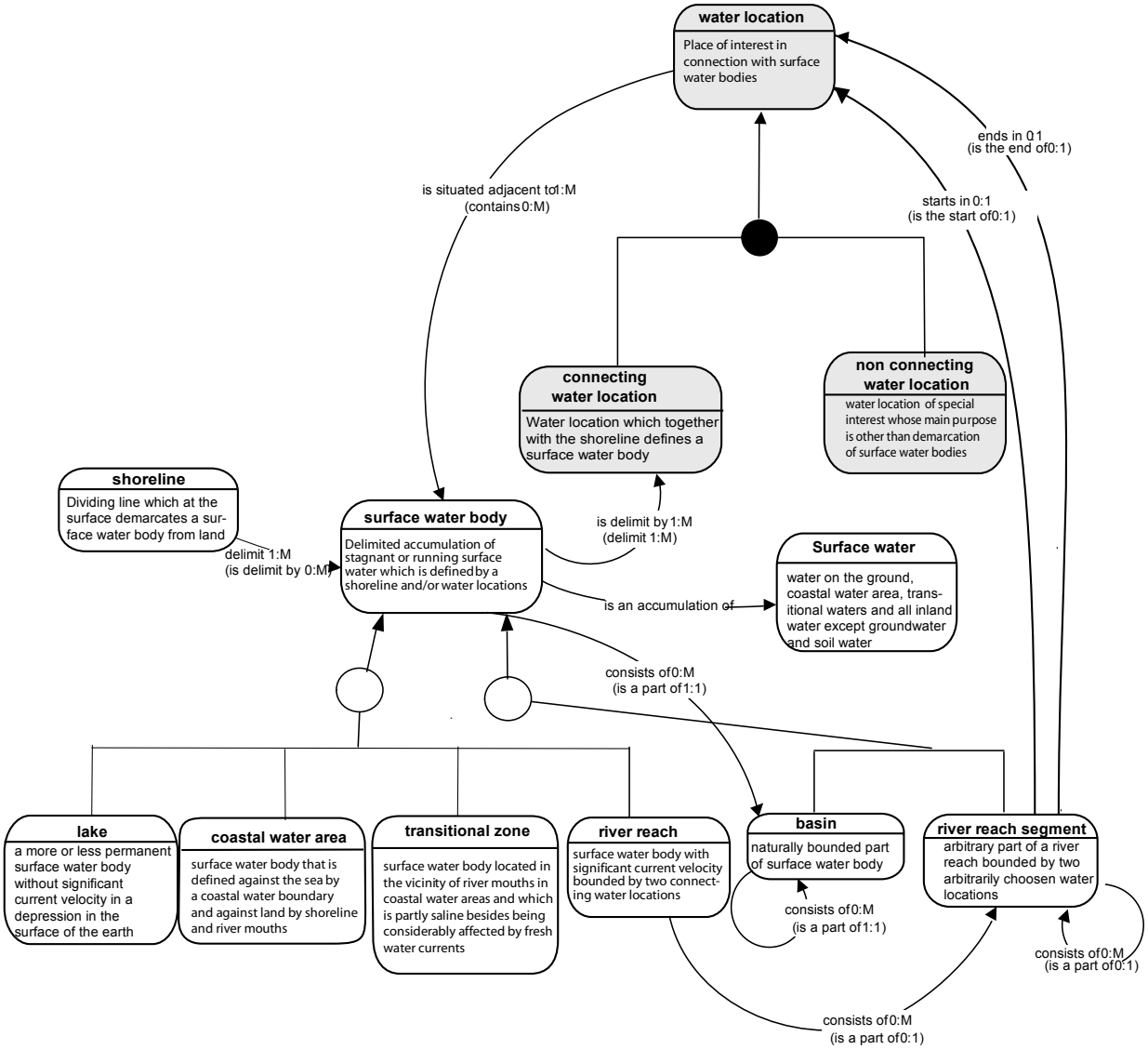

Figure 2 – Schema for concepts concerning surface water bodies. Grey shaded concepts may also be found in figure 9

5.2.2 basin

naturally bounded part of surface water body

NOTE All *surface water bodies* may be divided into *basins*. A *basin* (within a *river reach*) has, contrary to a *river reach segment*, a more clearly marked and naturally created demarcation, for instance a bulge. A *basin* may be divided into more *basins* which in turn may be divided into more *basins* etc.

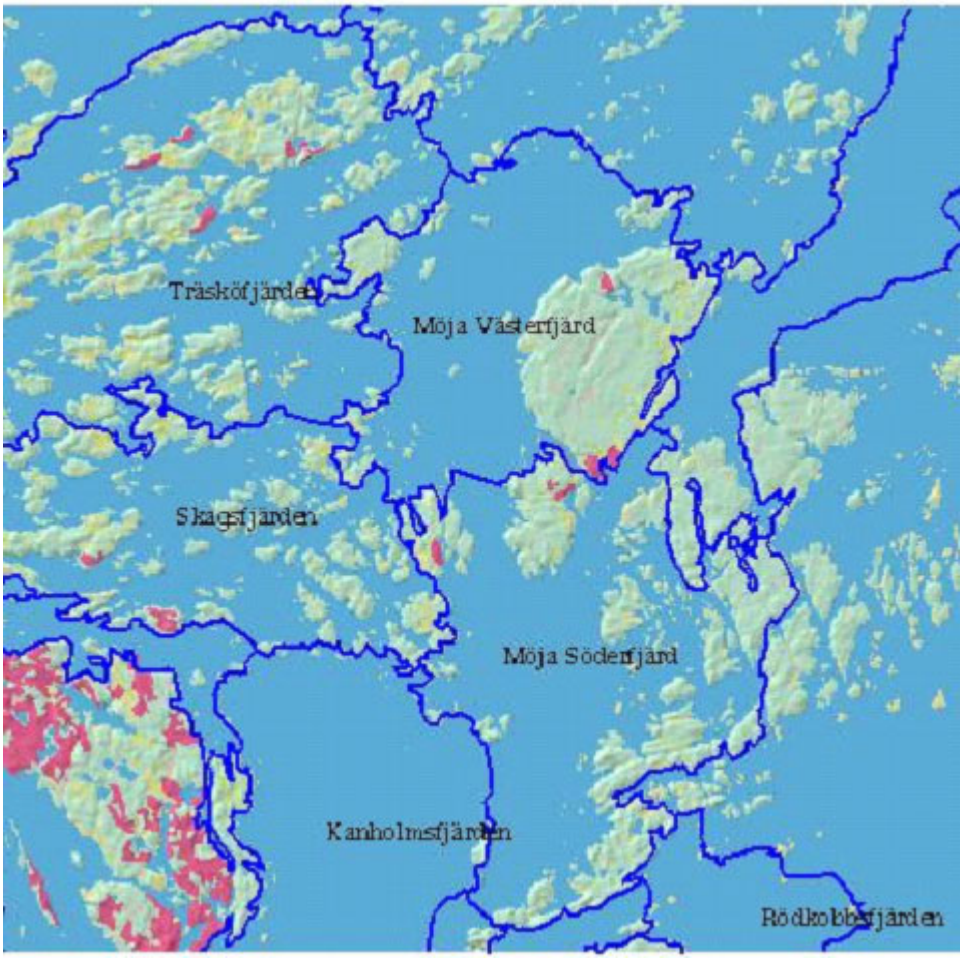

Figure 3 – Example of basin, here within a coastal water area, only the water surface is referred to

5.2.3 coastal water area

surface water body that is defined against the sea by a *coastal water boundary* and against land by *shoreline* and *river mouths*

NOTE 1 Sweden has by this definition three *coastal water areas*: along the Swedish mainland coast, around Gotland and around Gotska Sandön. A finer division of the coastal water results therefore in (coastal water) basins.

NOTE 2 The Swedish Board of fisheries defines the coastal water boundary as the *territorial sea baseline* plus four nautical miles, compare with figure 5.

Figure 4 – *Coastal water areas*

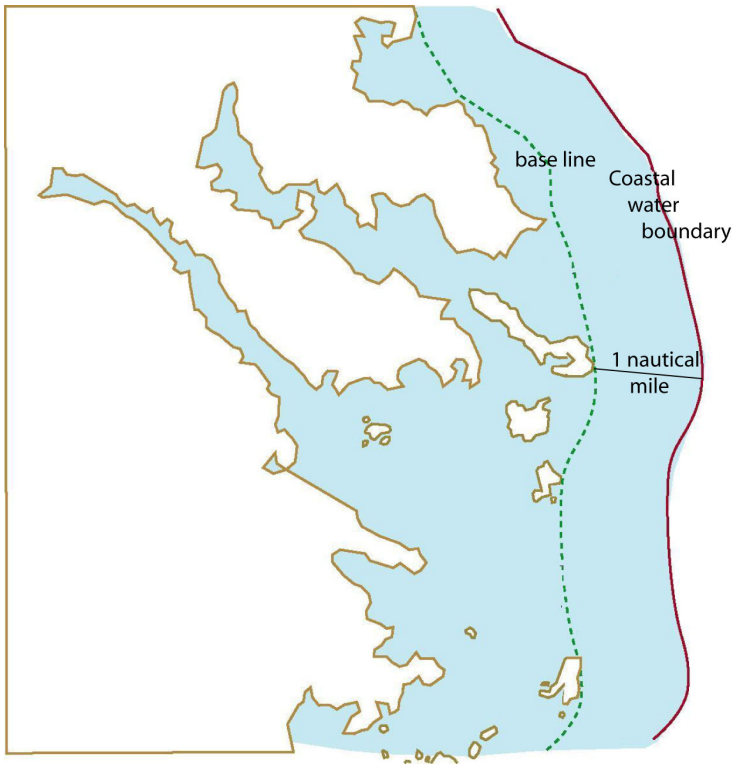

Figure 5 – The outer border of the coastal water is the *coastal water boundary* which is defined from the *territorial sea baseline*

5.2.4 lake

a more or less permanent *surface water body* without significant current velocity in a depression in the surface of the earth

NOTE *Lakes* also have a three-dimensional distribution and demarcation against the bottom. Also artificial *lakes*, for instance controlled *lakes* and dams are part of the concept. A *lake* may consist of one or more *basins*.

5.2.5 river reach

surface water body with significant current velocity bounded by two *connecting water locations*

NOTE *River reaches* also have a three-dimensional distribution and demarcation against the bottom. The commonly used term *river* has been avoided due to its use with different interpretations, see 5.2.8. The term watercourse is also used with similar meaning. Both natural *river reaches* and artificial *river reaches* like canals, tunnels and water transfers are part of the concept.

5.2.6 river reach segment

arbitrary part of a *river reach* bounded by two arbitrarily chosen *water locations*

NOTE *River reach segments* may for instance be sections with different characteristics like rapids, waterfall, tunnel, sampling areas, culvert or part of *river reach* which is strongly modified or of differing interest. A *river reach segment* may not pass a connecting water location. A *river reach segment* may be divided into several *river reach segments* which in turn may be divided into more *river reach segments* etc. The difference between river reach segment and river reach is that the river reach is located between two connecting water locations.

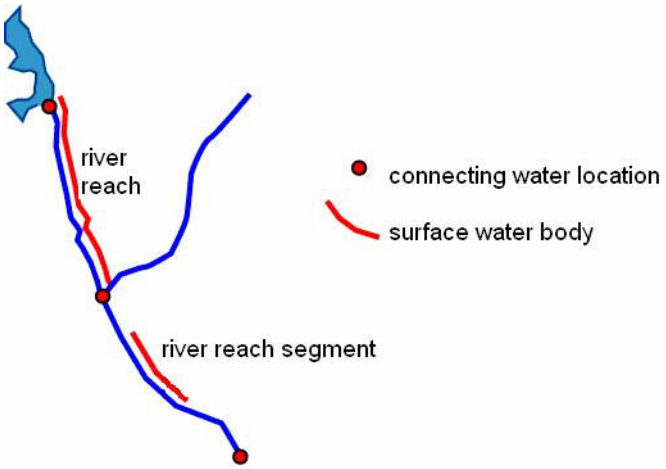

Figure 6 – Example of *river reach* and *river reach segment*

5.2.7 transitional zone

surface water body located in the vicinity of river mouths in *coastal water areas* and which is partly saline besides being considerably affected by fresh water currents

NOTE Transitional zone is not part of the coastal water area. Coastal water areas may only be divided into basins. These basins may not be transitional zones. Transitional zones may be divided into basins.

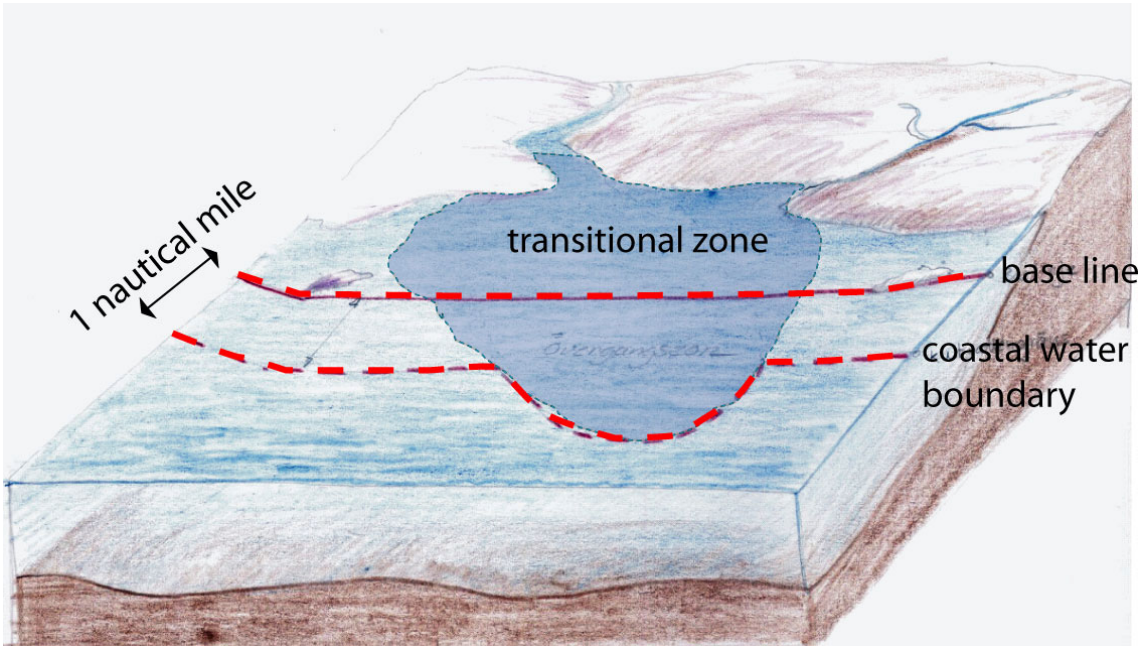

Figure 7 – Example of *transitional zones*

5.2.8 River

5.2.8.1 General

It has not been possible to find an acceptable, unambiguous definition of the term *river.* Because of this it has not been included in the concept schema or the application schema.

In the application schema, the phenomenon *river* is covered by different classes, for instance *river reach*, *water course* or *main river* depending on the meaning of *river* in each context. Below four different conceivable definitions can be found, illustrating the difficulties of using the term in this standard.

5.2.8.2 Natural depressions in which water flows

This is the definition in TNC 45 water glossary 2.

5.2.8.3 A water body with a spring and a mouth

The SMHI water course register contains specific water bodies which have a spring and a *mouth*, either in the sea, a *lake* or in another watercourse. In conformance with this definition, a *river* is the same as the *main river* for a water system.

EXAMPLE Dalälven-Österdalälven-Sörälven as *main river* for the water system Dalälven and Kalixälven-Kaitumälven as *main river* the water system Kalixälven.

As these water bodies are regarded as an unbroken stretch from spring to mouth, it may be said that the lakes through which the watercourses flow are parts of the watercourses. Each watercourse shall have a name.

5.2.8.4 A water body with a specific name

In everyday speech, a *river* is a *watercourse* with a specific name.

EXAMPLE 1 Motala ström is the *river* beginning at the *outlet* of Vättern and runs through the *lakes* Boren, Roxen and Glan and having its mouth in Bråviken. Also in this connection, the *lakes* could be seen as parts of the *river*.