



## **Road Map for Implementation of a Harmonized Reference System, S-104 Water Level and S-111 Surface Currents in the Baltic Sea**

**2024-03-19**

### **A. OVERVIEW**

This is a Draft Road Map describing the implementation of a Harmonized Reference System, S-104 Water Level and S-111 Surface Currents in the Baltic Sea. The purpose of the roadmap is to provide guidelines for BSHC member countries to develop national transition plans and to enable the CDWCWG to monitor and harmonize implementation within the Baltic Sea region.

#### **A.1 Final outcome**

Harmonized Reference System in use in the Baltic Sea by the year 202X.

Production of S-104 Water Level and S-111 Surface Currents in Baltic Sea by the year 202X.

#### **A.2 Vision**

Transition to S-100 environment and usage of new S-100 based products will happen in the future, S-101 based ENC's expected to be available and in use by 2025 ([S-100 Implementation Strategy](#)). Change from separate national vertical references to harmonized one makes it possible to take all the advantages of the new environment in to use in the Baltic Sea region.

#### **A.3 Benefits**

- Future navigation more reliable and safe
  - Only one vertical reference in use within the Baltic Sea
  - Depth and water level information consistent within the Baltic Sea
- Future navigation more effective by possibility to utilize all the new features and possibilities of S-100 based systems
- Water level information more efficiently in use
  - Better utilization of ship's cargo carrying capacity

#### **A.4 Commitments**

- BSHC commitments
- IHO resolutions (3/1919) - technical specifications
- HELCOM ministerial declarations - political support
- INSIPRE - requirements

#### **A.5 Role of CDWCWG**

- Foster and support the transition process

- Propose harmonize actions and follow up (monitor) progress
- Propose a framework for future management and revision of the reference system
- Communicate with and support other stakeholders (e.g. BOOS, IHO/TWCWG)
- Giving general information e.g. by articles, presentations and posters
- Report to BSHC and relevant international bodies

## **B. MAIN PHASES OF IMPLEMENTATION**

Here is presented some main steps as general guidelines leading to harmonized vertical reference bearing in mind that there will be national differences in the implementation.

### **B.1 Evaluate national actions and time schedules**

- National decisions needed
  - political commitment
  - time schedule
  - resources
- National feasibility studies
  - scope of the transition (all the data or not, precision of the transformation etc.)
  - legislation regulations
  - technical standards
- Establish a national contact network
  - identify relevant national stakeholders (national administrations, pilots, ports, ship-owners etc.)

### **B.2 Prepare national plans to organize the transition**

- Nomination of the leading organization (national HO?)
- Organizing the transition, e.g.:
  - as a separate project or
  - included in normal work routines
- Planning the main milestones for the transition period

### **B.3 Analyse of present national situation**

- Source data (depth data, other chart objects with depth or height information)
- Data systems
- Products
- Connection to national height reference frame
- Water level data
- Current data

### **B.4 National implementation plan**

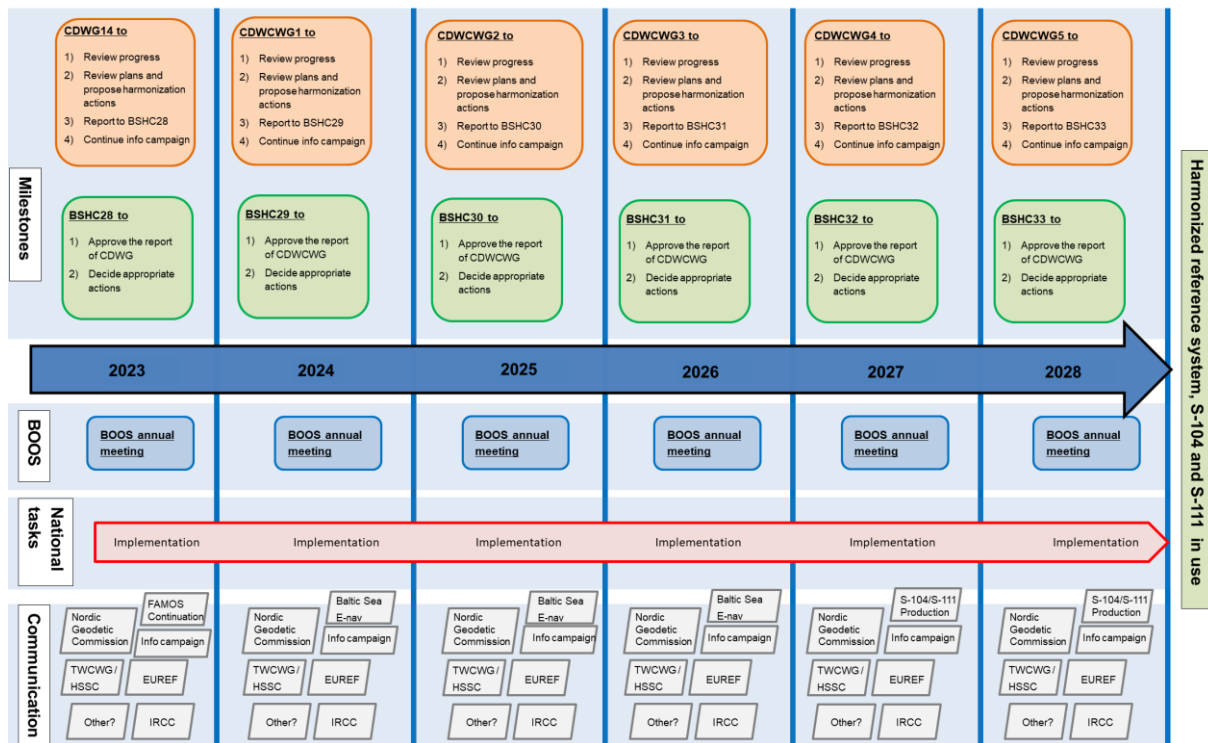
- Detailed national milestones
- Overview how following issues has been taken into account in the national implementation plan
  - water level and surface currents information
  - data systems
  - transformation of the water level information to new datum
  - publishing the products

## Appendix 1: CDWCWG Road map

Sketch showing the road map for the BSHC Chart Datum, Water level and Currents Working Group (CDWCWG) Implementation of a Harmonized Reference System, S-104 Water Level and S-111 Surface Currents in the Baltic Sea.

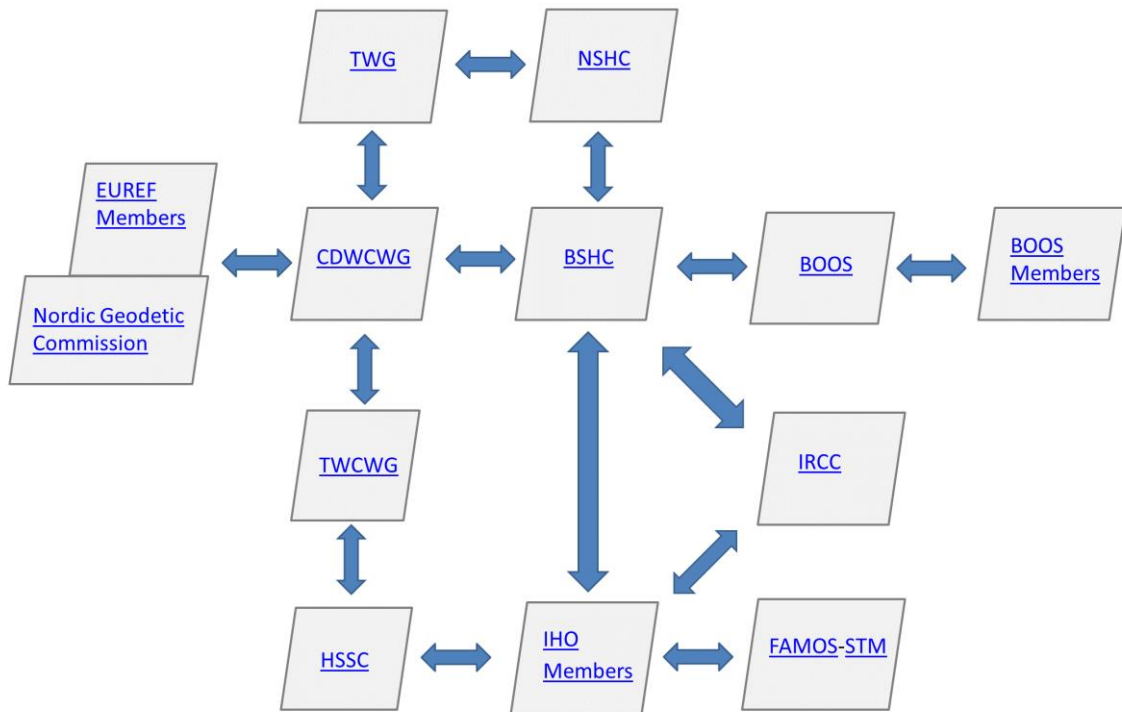
### RoadMap

BSHC CDWCWG / Harmonized Reference System / S-104 and S-111 Implementation / Time Line  
2023-12-18



Appendix 2: CDWCWG Implementation process

CDWCWG Implementation process



### Appendix 3: Sweden reply to the CDWCWG Questionnaire 2024

#### Questionnaire to BSHC Member States on the implementation status of Baltic Sea Chart Datum 2000 (BSCD2000), S-104 Water Level and S-111 Surface Currents

Please return to Thomas Hammarklint by email ([thomas.hammarklint@sjofartsverket.se](mailto:thomas.hammarklint@sjofartsverket.se))  
at the latest by **15 March 2024**.

Member state	Sweden
Date of reply	2023-12-18
Point of Contact	Thomas Hammarklint, SMA, <a href="mailto:thomas.hammarklint@sjofartsverket.se">thomas.hammarklint@sjofartsverket.se</a>

#### 1. Are all the decisions done to implement the Baltic Sea Chart Datum 2000?

The change of chart datum in Swedish official nautical chart portfolio; the Chart Improvement project (Sjökortslyftet) is included in the Swedish HO "Vision 2020" (*Målbild 2020*), approved and decided 2014 of SMA HO management.

Chart Improvement project: The vertical reference and coastline will be updated and referred to Baltic Sea Chart Datum 2000<sup>(RH2000)</sup> (BSCD2000) in all Swedish charts, except those covering inland waters, at the latest in the year of 2030. Lakes covered of official charts will be taken care of in similar before 2030.

Swedish Maritime Administration (SMA) and Swedish Meteorological and Hydrological Institute (SMHI) have a cooperation agreement covering this area of responsibility. Transition to the new vertical reference for the water level was implemented June 3, 2019. The user of water level information has the possibility to choose between mean sea level and BSCD2000 as the reference.

In the EU-financed project FAMOS, SMA and SMHI have harmonized and upgraded the [Swedish Water Level network](#) (2017-2019), including new sensors for 60 stations. All stations in the network are connected to the land based height system RH2000, and by that, BSCD2000.

1.1. When the decisions has been done or planned to be done?

Year 2014.

1.2. What are the national decisive organizations?

Swedish Maritime Administration (SMA) includes Hydrographic Office (HO) and is representing Sweden in IHO and is also responsible for the official Swedish nautical charts.

SMA cooperates with the Swedish Meteorological and Hydrological Institute (SMHI) to observe and present water level information. During 2017-2019, SMA and SMHI have established a new Swedish Sea Level network (as a part of FAMOS Odin), using the Baltic Sea Chart Datum 2000 (BSCD2000) as the reference datum for all water level information. Since 2019-06-03, all data is presented related to BSCD2000, however the user can choose to present data relative mean sea level as well. Data will also be distributed to BOOS and other European networks referring to this datum. SMHI have a coordination role for the Baltic Sea and within BOOS to distribute this kind of data. SMA has been a member

of BOOS since May 2017 and nowadays almost all oceanographic data are distributed to the BOOS Data Exchange system via SMHI.

## 2. What is the national status of implementation of chart datum?

2.1. What actions have already been done?

- All new hydrographic surveys started July 1, 2013 or later refer to BSCD2000.
- The Swedish depths database (DIS) was transformed to the Swedish realisation RH 2000 of the BSCD2000 2013-05-23.
- All new charts in inland waters produced 2008 or later refer to BSCD2000 with added offset adapted for each lake.
- In areas where no modern surveying has been performed and only old analogue depth data is available these fair sheets has been scanned, transformed and uploaded into DIS (referring to BSCD2000). Digitalization has been finalized 2016.
- Vertical/Height information in the database Poseidon, storing nautical object including lighthouses, refer to BSCD2000.
- Since 2019-06-03, all Swedish Sea Level stations are connected to BSCD2000 and data is presented in BSCD2000, however the user can choose to present data relative mean sea level as well.

2.2. What actions have been planned to be executed and what is the schedule?

See answer 1.

2.3 Which ENC Approach have been updated with the new reference datum? If possible, attach a chart datum overview covering Your countries nautical charts, designed graphically or as a table, updated around January, 2020. Also, if possible, include an attribute to each named chart describing the CD difference to BSCD2000 in cm (CD minus BSCD2000). Example attached at the end of the Questionnaire (Annex).

See the attached example under Annex.

## 3. Has Your country established the national realization of EVRS and are the water level stations connected to this new height system (BSCD2000)?

3.1 Which organization/-s is responsible for the water level stations/data in Your country?

Swedish Maritime Administration (SMA) and Swedish Meteorological and Hydrological Institute (SMHI).

3.2 Which reference are used today to present water level information? Does Your country planning to present water level information referring to BSCD2000? Doing it already today? Date decided for change the reference to BSCD2000?

All involved water level stations are connected to BSCD2000. Since 2019-06-03, all water level information is presented in BSCD2000, however the user can choose to present data relative mean sea level, as well.

3.3 Are there any plans for digital service/-s intended for the users to have the option to choose MSL or BSCD2000 as the reference level for water level information?

Yes, the users have the possibility to choose reference datum for water level information.

3.4 GNSS supported UKC control/confirmation is probably the reality in a few years. But we also need reliable water level predictions for carrying out optimal loading and real time water level data to check the GNSS data. Do we need a shared service in the Baltic Sea for water level information (predictions/real-time), that fulfils nautical needs and demands?

Sweden see that a service for water level information is needed and that a reliable and robust shared service for nautical use is important.

3.5 Do we need to work together with the development of the IHO S-104 standard?

Yes, as a first step we need to work together and in the next step to develop and validate the new S-104 standard for water level information.

#### 4. Are the relevant national contacts and interest groups defined for the change of chart datum and water level reference?

4.1. What are the essential national interest groups in Your country?

- Swedish Maritime Administration ("Sjöfartsverket" SMA) (including correspondence with local harbours through head of Pilot areas)
- The Swedish Meteorological and Hydrological Institute (SMHI)
- The Swedish National Land Survey ("Lantmäteriet" LM)
- The Swedish Transport Agency ("Transportstyrelsen" TS)
- The Swedish Transport Administration ("Trafikverket" TV)
- The Geological Survey of Sweden ("Sveriges Geologiska Undersökning" SGU)
- The County Administrative Boards ("Länsstyrelserna" Lst)

4.2. Are the relevant point of contacts known and contacts been made to them?

- SMA: Thomas Hammarklint (HO point of contact)
- SMHI: Fredrik Waldh (co-operation in progress)
- LM: Jonas Ågren and Per-Anders Olsson (co-operation in progress)
- TS: Johan Skogwik (HO point of contact)
- TV: Not yet (TBD)
- SGU: Björn Bergman (co-operation in progress)
- Lst: Not yet (TBD)

Also, HELCOM SAFE NAV has been informed by SMA HO.

4.3 Are You planning any information campaign about the change of chart datum and water level reference? If, yes have you published information about this somewhere?

Yes, an information campaign has been conducted during 2019. More information can be found here:

<https://www.sjofartsverket.se/en/services/hydrographic-information/nautical-charts/sjokort/reference-levels/new-reference-level-in-charts-and-products>

## **5. Have You identified any obstacles or major issues concerning transition to the harmonized vertical reference?**

### **5.1. What are the major obstacles or issues?**

The HO has replaced the former chart production system in 2016. Information to the users about the transition to the chart datum Baltic Sea Chart Datum 2000 (BSCD2000) is a major challenge. To change into a new reference datum for water level to early might cause a misleading understanding about the true depths.

Communication with users of data and products under the transition period at the optimal time is a challenge. Chart products belonging to different parts of the coast line will be updated to the new reference level at different times. Parallel to this the change of the reference for water levels was carried out at a given time.

### **5.2. What measures has been planned to avoid them?**

Extra time allocated in the plan but the time schedule is tight. The work started in the northern parts of Bay of Bothnia and the plan for 2021 is to reach the area south of South of Stockholm.

We probably need to evaluate our timing of our information to those concerned so far.

## **6. Connections to neighbouring countries**

### **6.1. Which are the relevant countries to cooperate?**

Sweden has boundaries to all other counties surrounding the Baltic Sea. To some extent cooperation is needed with all of them, but in practice handled through BSHC.

Sweden (and Denmark) has maritime borders adjacent to Norway in areas with limited tide. Norway applies different rules (compared to Sweden and Denmark) regarding the choice of reference level. As a result the reference level used in the charts shifts up to about a half meter along the border. There is need of an agreement between Sweden, Norway and Denmark regarding the delimitation and shift of Chart Datum towards the North Sea. Sweden has an action within the Nordic Hydrographic Commission to invite Denmark and Norway for this.

### **6.2. Are the needed points of contacts already known?**

Necessary point of contacts is known.

Important to continue the dialogue between CDWCWG/BSHC and BOOS to get the water level operating institutions in the transition to the new reference.



6.3. What actions have been agreed with the relevant countries (e.g. synchronising plans and schedules)?

There is no synchronising done in regards to time schedule. It is up to each and every member state to implement the agreed vertical reference system (EVRS) and reference level. All steps towards EVRS will improve the existing situation.

Sweden has a fruitful exchange of information and experiences with Finland concerning harmonization within the FAMOS project and the Chart Improvement project. Within the FAMOS Continuation project Activity 2 there is an ongoing activity to finalize the FAMOS Geoid model.

## **7. Are there any needs for support from BSHC?**

Support the dialogue with Norway and NSHC in order to handle the reference level difference at the border between Sweden and Norway (...and preferably also between Denmark and Norway). That kind of dialogue will probably support any future agreement concerning the reference level for high-resolution bathymetric data in European coastal waters.

## **8. Do you have any other proposals or guidance to the CDWG to help and foster the transition process?**

The Chart Improvement project was included in the FAMOS project and has received EU co-financing from the Connecting Europe Facility (CEF Transport) for the years 2015-2019. For more information, see: <http://www.famosproject.eu/activities/future-navigation>

## **9. Are you using GNSS and GNSS augmentation services for referring to your (bathymetric) surveys to the chart datum?**

In areas with acceptable coverage we are using GNSS with RTK, either from own base stations or the SWEPOS Network RTK service provided by Swedish Land Survey "Lantmäteriet". In areas in open sea with poor coverage or where the height component is inadequate we only use the horizontal component from RTK or Network DGPS from SWEPOS or IALA DGPS. Depths are then corrected by tide models to the chart datum.

9.1 What GNSS augmentation service is used for hydrographic surveys? (If there are several augmentation services, list all of them.)

SWEPOS Network services provided by Swedish Land Survey, "Lantmäteriet" and IALA DGPS.

9.2 To which coordinate system, and vertical reference level/frame the GNSS augmentation service is referred to? (If there are several systems in use, list all of them.)

Coordinate system SWEREF 99 (Swedish realization of ETRS89), SWEREF 99 TM (national map projection, extended UTM zone 33). We are using the geoid model SWEN17\_RH2000 to convert from ellipsoid height to Swedish national reference level RH2000 (BSCD2000), which is calculated from the NKG gravimetric model.

9.3 Does your HO require, in-house or procured, that Hydrographic survey system shall be prepared to be able to measuring the GNSS-height and refer the depth to the geoid?

Yes.

9.4 Do you discuss within your HO the need of an altimetric measured Mean Sea Surface (MSS)? (For example, in order to support hydrodynamic models, shipping and / or adjust existing depth data)?

Yes.

9.5 Has your HO assessed the need for dynamic geodetic reference systems (time-dependent transformation relationship) between primarily national and global reference frames?

Yes.

## 10. What is the national status of the implementation of IHO S-104 Water Level and S-111 Surface Currents?

10.1 What actions have already been done?

HO have started discussions with the Swedish Meteorological and Hydrological Institute (SMHI) about the new standards and who will be responsible to produce the new products.

10.2 What actions have been planned to be executed and what is the schedule?

Already in 2024 we will be a part of BS E-nav (three years Interreg-project) and look into the organization and how we will produce S-104 and S-111. HO will start more formalized activities in 2025 and plan to start to produce S-104 in 2027 and S-111 in 2028 (at the earliest).

10.3 Are all the decisions done to implement S-104 and S-111?

No, we will investigate this in 2024-2025.

10.4 When the decisions have been done or planned to be done?

First, we will investigate this in 2024-2025 and then take the decisions.

10.5 Which organization/-s is responsible for observed and modelled/forecasted water level (Refer to 3.1) and currents in Your country?

SMA and SMHI for water level and current observations (see 3.1)

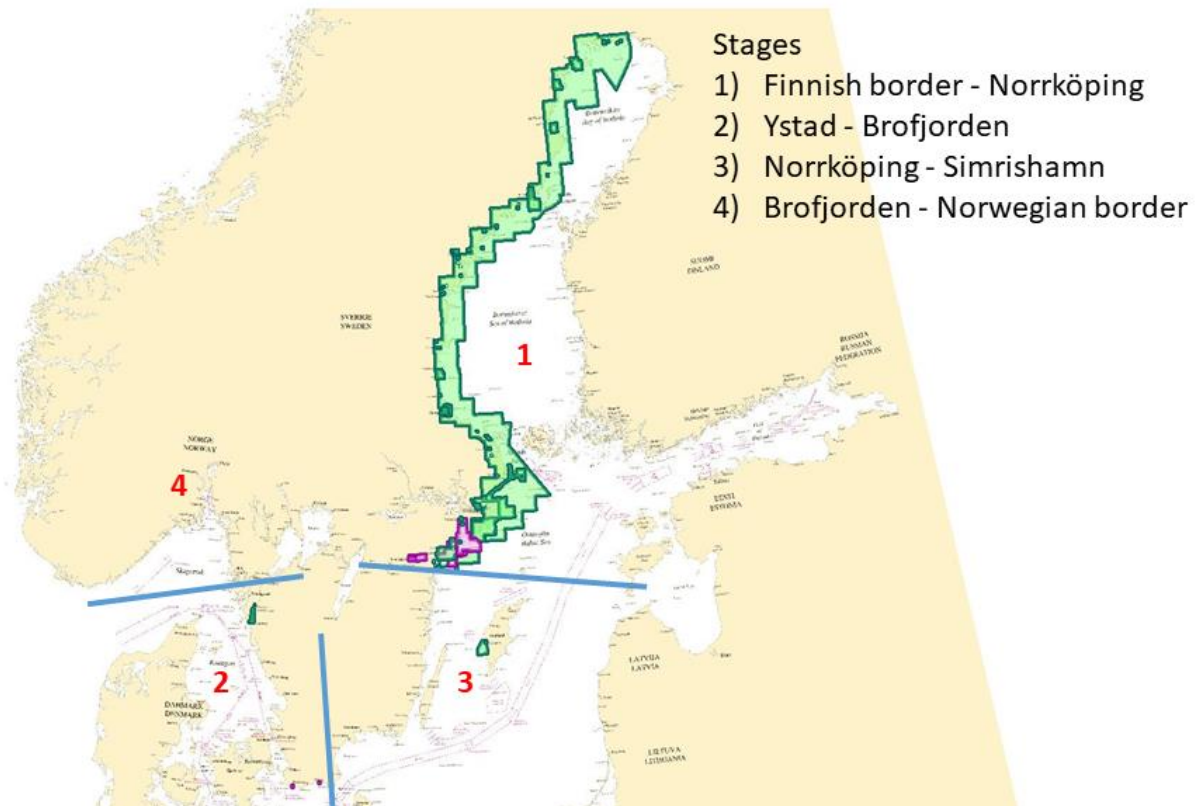
SMHI for modelled/forecasted water level and currents.

10.6 How is Your country represented in the IHO Tides, Water Level and Currents Working Group (TWCWG)?

SE are represented by Thomas Hammarklint (SMA/Hydrographic Office).

## Annex

### Chart Improvement Project (status 2024-03-19)



Example of ENC Approach from Sweden (updated 2024-03-19): **Green** cells are referring to the new chart datum BSCD2000, **purple** cells are ongoing adjustments to BSCD2000 and the rest of the cells refer to various Mean Sea Level.