Road Map for Implementation of Harmonized Vertical Reference System
5 February 2019

A. OVERVIEW

This is a Draft Road Map describing the transition to the Harmonized Vertical reference System within the Baltic Sea. The purpose of the Road Map is to give guidelines for BSHC member countries to make the national transition plans and to make possible for the CDWG to monitor and harmonize the transition within the Baltic Sea region.

A.1 Final outcome

Harmonized vertical reference in use within the whole Baltic Sea by the year 2020.

A.2 Vision

Transition to S-100 environment and usage of new S-100 based products will happen in the future, S-101 based ENCs expected to be available and in use by 20XX. 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 CDWG

- Foster and support the transition process
- Propose harmonize actions
- Follow up (monitor) progress
- Communicate with and support other stakeholders (e.g. BOOS, IHO/TWLWG)
- 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

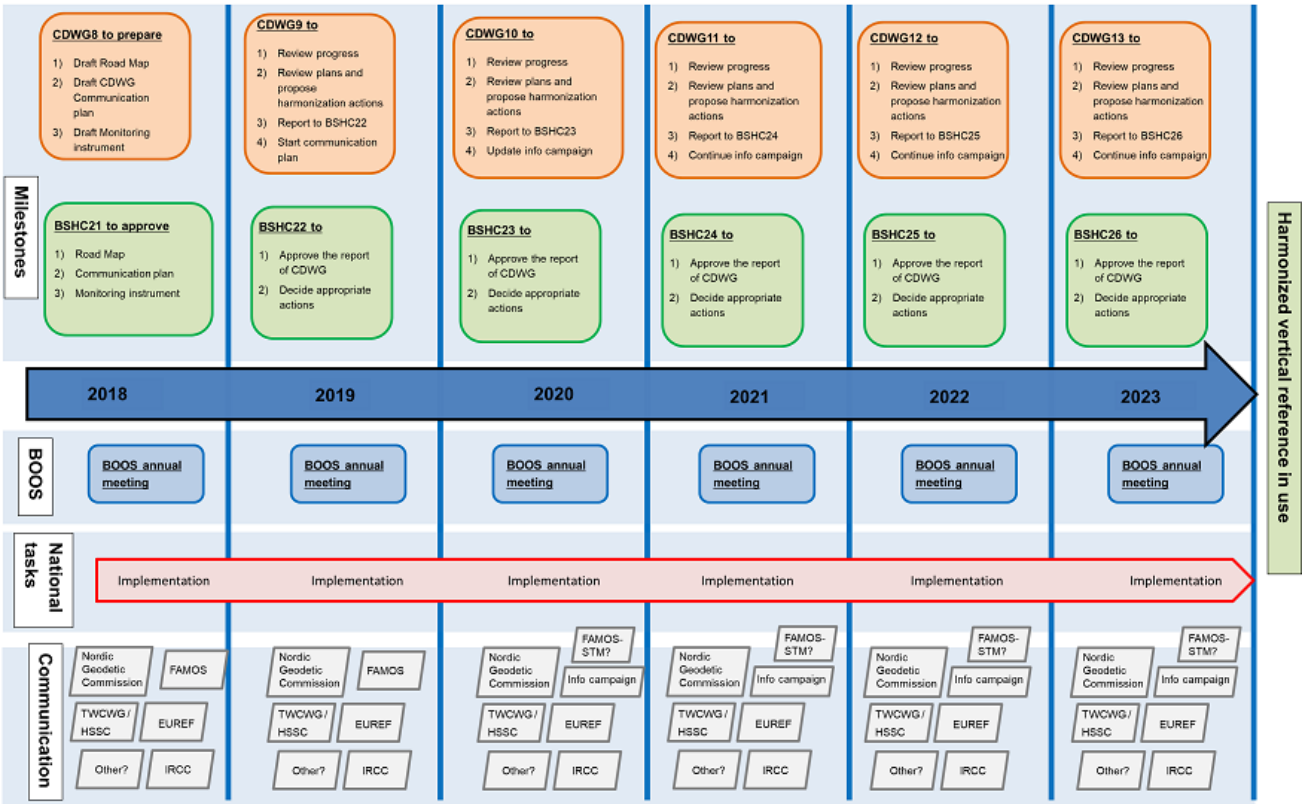
B.4 National implementation plan

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

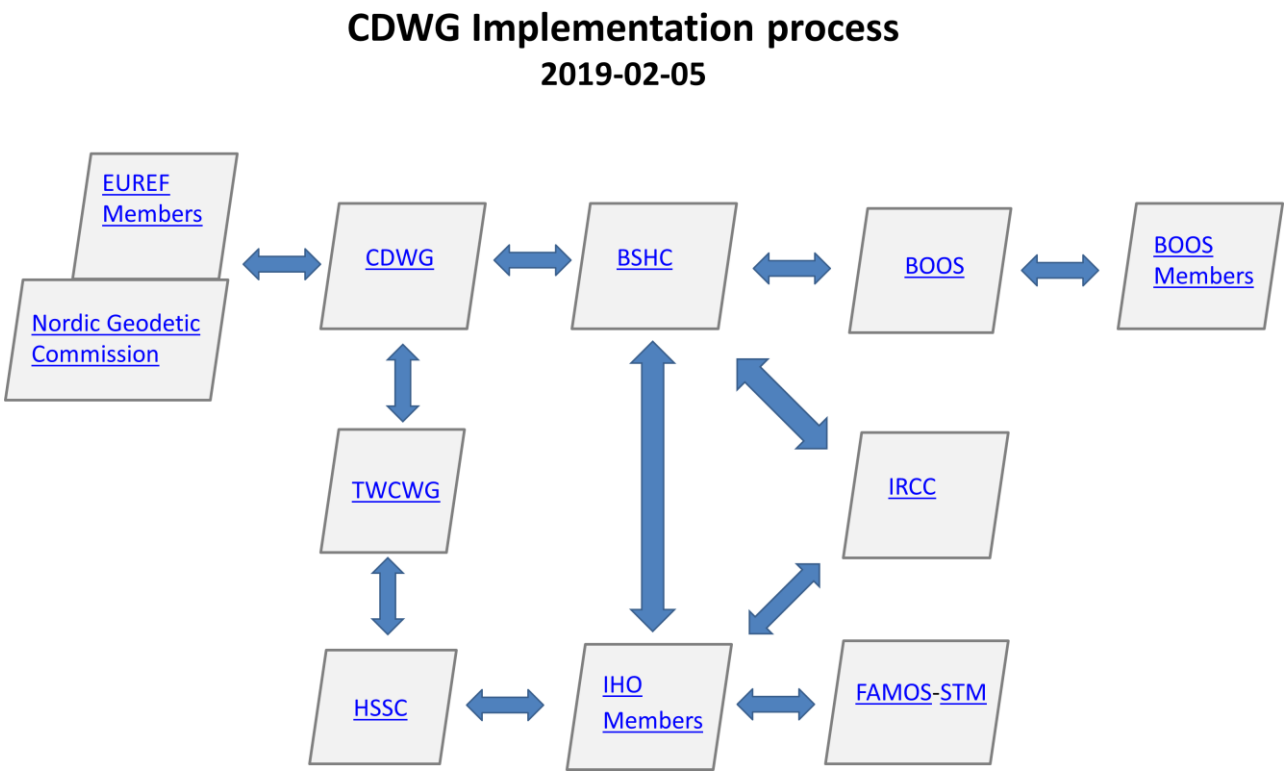
Appendix 1: CDWG Road map

Sketch showing the road map for the BSHC Chart Datum Working Group Implementation of a harmonized reference datum in the Baltic Sea.

RoadMap
BSHC CDWG / Harmonized Vertical Reference / Time Line
2019-02-05



Appendix 2: CDWG Implementation process



Appendix 3: Sweden reply to the CDWG Questionnaire 2019

Reply of Sweden to the Questionnaire to BSHC Members on their Commitment and Plans for the Transition to a Harmonised Vertical Reference (2018-12-14). Reply gives an example of the issues to take into account while analysing the present situation and drafting an implementation plan.

Questionnaire to BSHC Member States on their implementation status of the transition to a Harmonised Vertical Reference, Baltic Sea Chart Datum 2000.

*Please return to Thomas Hammarklint by email (thomas.hammarklint@sjofartsverket.se) at the latest by **25 January 2019**.*

Member state	Sweden
Date of reply	2018-12-14
Point of Contact	Thomas Hammarklint, Hydrographic Office (HO), Swedish Maritime Administration (SMA), thomas.tammarklint@sjofartsverket.se

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$^{(RH2000)}$ (BSCD2000) in all Swedish charts, except those covering inland waters, before the end of 2021. Lakes covered of official charts will be taken care of in similar way before the end of 2022.

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 will take place during the same period. Discussions with SMHI on a specific date for the transition into BSCD2000 are on-going. It is possible to together with other countries concerned agree on this. The possibility for the user to choose between mean sea level and BSCD2000 will be implemented.

In the EU-financed project FAMOS, SMA and SMHI will harmonize and upgrade the Swedish Water Level network (2017-2018), including new sensors for 53 stations. All water level data will be presented in 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 official Swedish nautical charts.

SMA cooperates with the Swedish Meteorological and Hydrological Institute (SMHI) to present water level information. During 2017-2018, 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. The beginning of 2019 will be a transition period and 2019-06-03 all data will be presented related to BSCD2000. 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.

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 of the harmonized vertical reference (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 September 2015 the Chart Improvement project started. Up to this date 10 paper charts and equivalent ENCs have been updated to BSCD2000.
- 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 data base Poseidon, storing nautical object including light houses, refer to BSCD2000.

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, 2019. 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, but the water level information is still presented in relation to Mean Sea Level.
Yes, starting 2019-06-03 all water level information will be presented in BSCD2000.

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, during a short period, before the change 2019-06-03, the users will have the possibility to choose the 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)
- 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 is planned during the spring of 2019. More information can be found here:
http://www.sjofartsverket.se/rh2000

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. There was a temporary disruption during September 2016 to December 2017 in the Chart Improvement project.

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.

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 2019 is to reach the area south of South of Stockholm.

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 CDWG/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 Chart Datum. 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.

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 is included in the FAMOS project and has received EU co-financing from the Connecting Europe Facility (CEF Transport) for the years 2015-2018. 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.

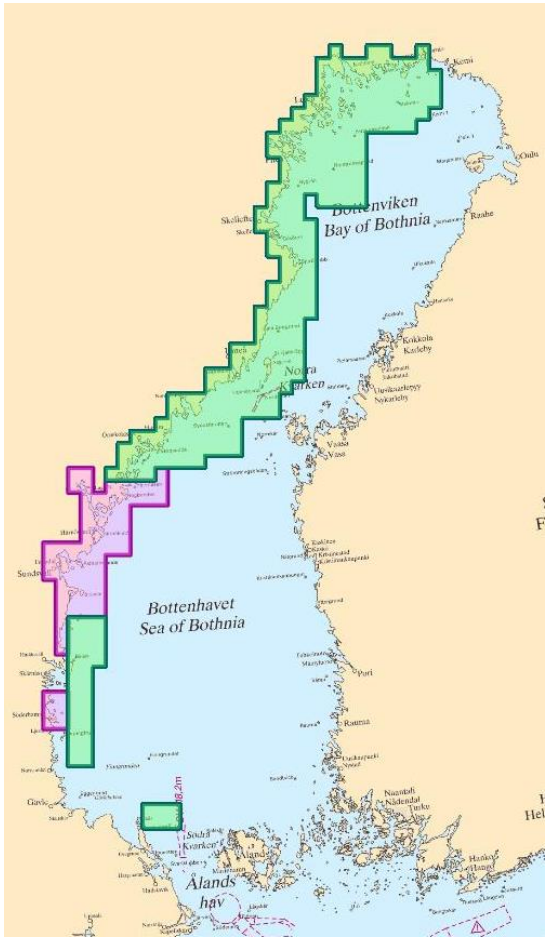
9.1 What GNSS augmentation service is used for hydrographic surveys? (If there are several augmentation services, list all of them.)

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 TM (extended UTM zone 33). We are using the geoid model SWEN08_RH2000 to convert from ellipsoid height to Swedish national reference level RH2000 (BSCD2000). Since 2018, we use the new geoid model SWEN17_RH2000, which is calculated from the NKG gravimetric model.

Annex



Example of ENC Approach from Sweden: 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.