

Hydrographic Products/Services as a Fundamental Component of the e-Navigation Concept of Operation



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Role for Hydrographers related to e-Navigation: Present and Future

For IHO, national HOs, and other members of the hydrographic community, it will be important to continually reassess what is their role and responsibility under the e-Navigation concept of operation.

e-Navigation

Definition:

“the harmonized collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance birth-to-birth navigation and related services, for safety and security at sea and protection of the marine environment.”

e-Navigation

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e-Navigation

Significant outcomes/benefits related to:

1. Shipboard navigation systems
2. Management of VTS and related services
3. Communications infrastructure

e-Navigation (IMO vision)

1. Shipboard navigation systems

- Integration of ownship sensors
- Supporting information
- Standard user interface
- Comprehensive systems for managing guard zones and alerts

Core elements include:

- High-integrity electronic positioning (e.g., dGPS)
- Use of ENC's and ECDIS
- An analysis capability to reduce human error

... all while actively engaging the mariner in the process of navigation while preventing human error.

e-Navigation (IMO vision)

2. Management of vessel traffic and related services from ashore

- *to be “enhanced” through better provision, coordination, and exchange of comprehensive data in [digital] formats that will be more easily understood and utilized.*

e-Navigation (IMO vision)

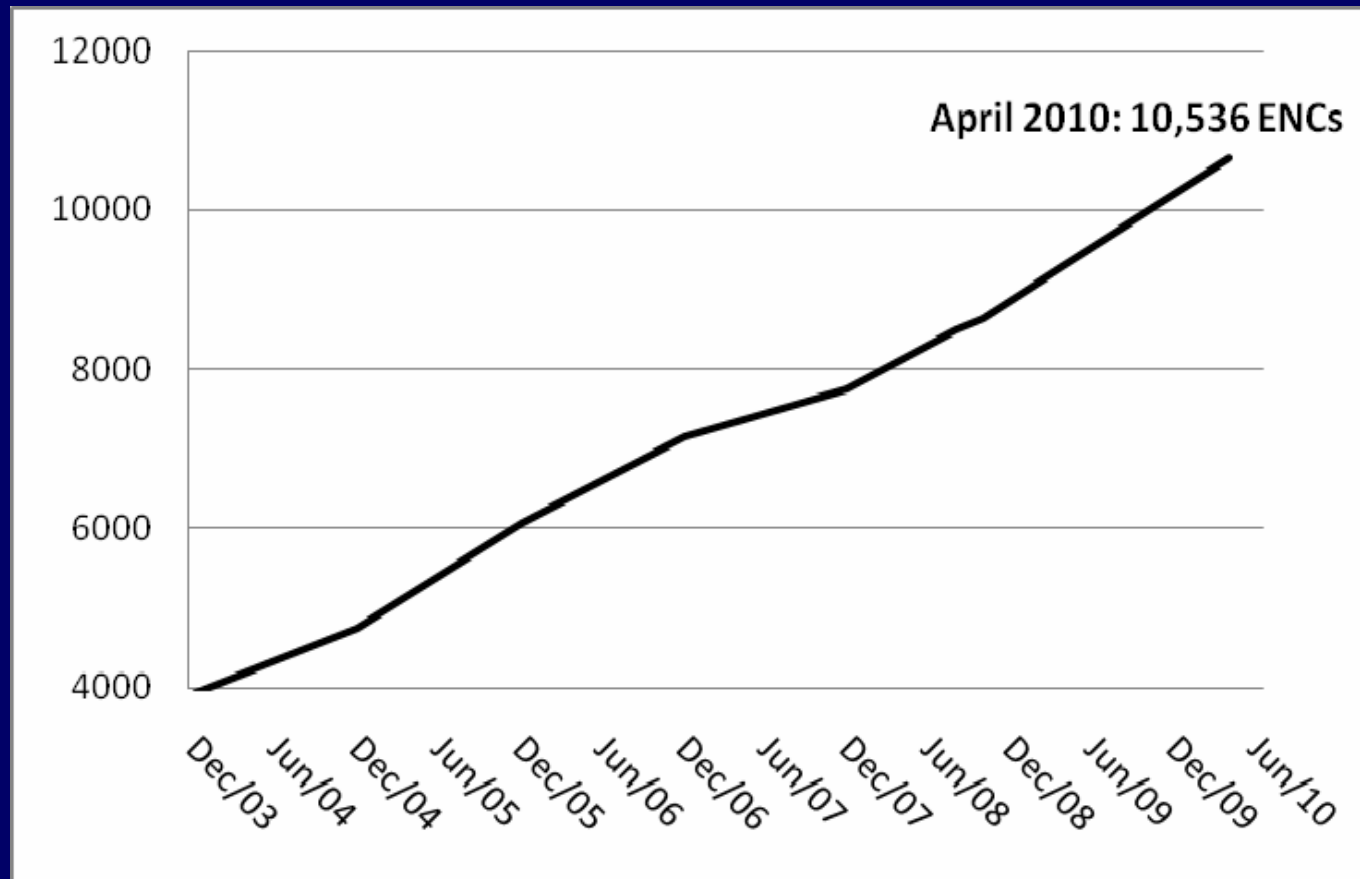
3. A communications infrastructure

*designed to enable **authorized seamless information transfer***

*onboard ship, between ships, **between ship and shore**, and between shore authorities.*

Primary focus of IHO

Ensure ENC coverage for major shipping routes/ports *



Source: IHO Report to NAV 56 (IMO paper NAV 56/8/7)

Coverage Comparison - April 2010

For international voyages:

Paper Charts ↔ ENCs

Chart Scale	% ENC Coverage
Small Scale (planning)	100%
Medium Scale (coastal approach)	84 %
Large Scale (ports)	91 %

e-Navigation-related Equipment, Systems and Services

Two Key questions:

- 1. What are they? (...or will be)*
- 2. What will not be included?*

At IMO NAV54, existing components and potential “building blocks” were identified:

Radar

ECDIS/IBS

Electronic Navigational Charts (ENCs)

Communications

Positioning, Navigation and Timing

Situational Awareness

Maritime Information Systems

Human Factors

Shore-based

Equipment

Systems

Services

Shipborne

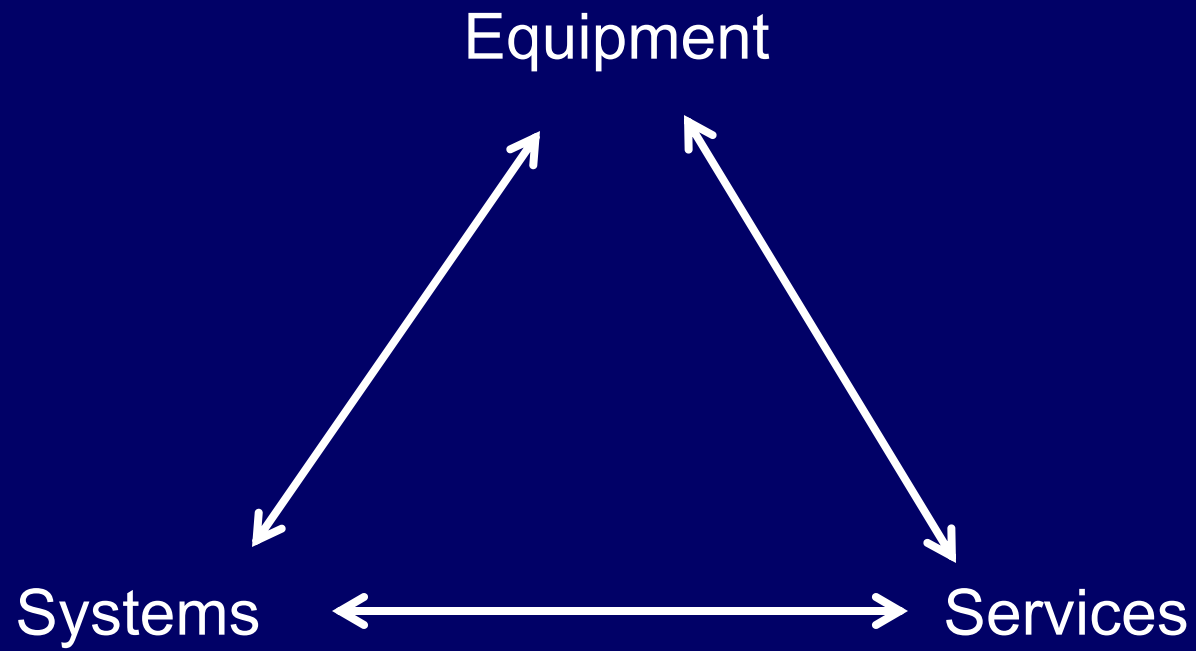
Equipment

Systems

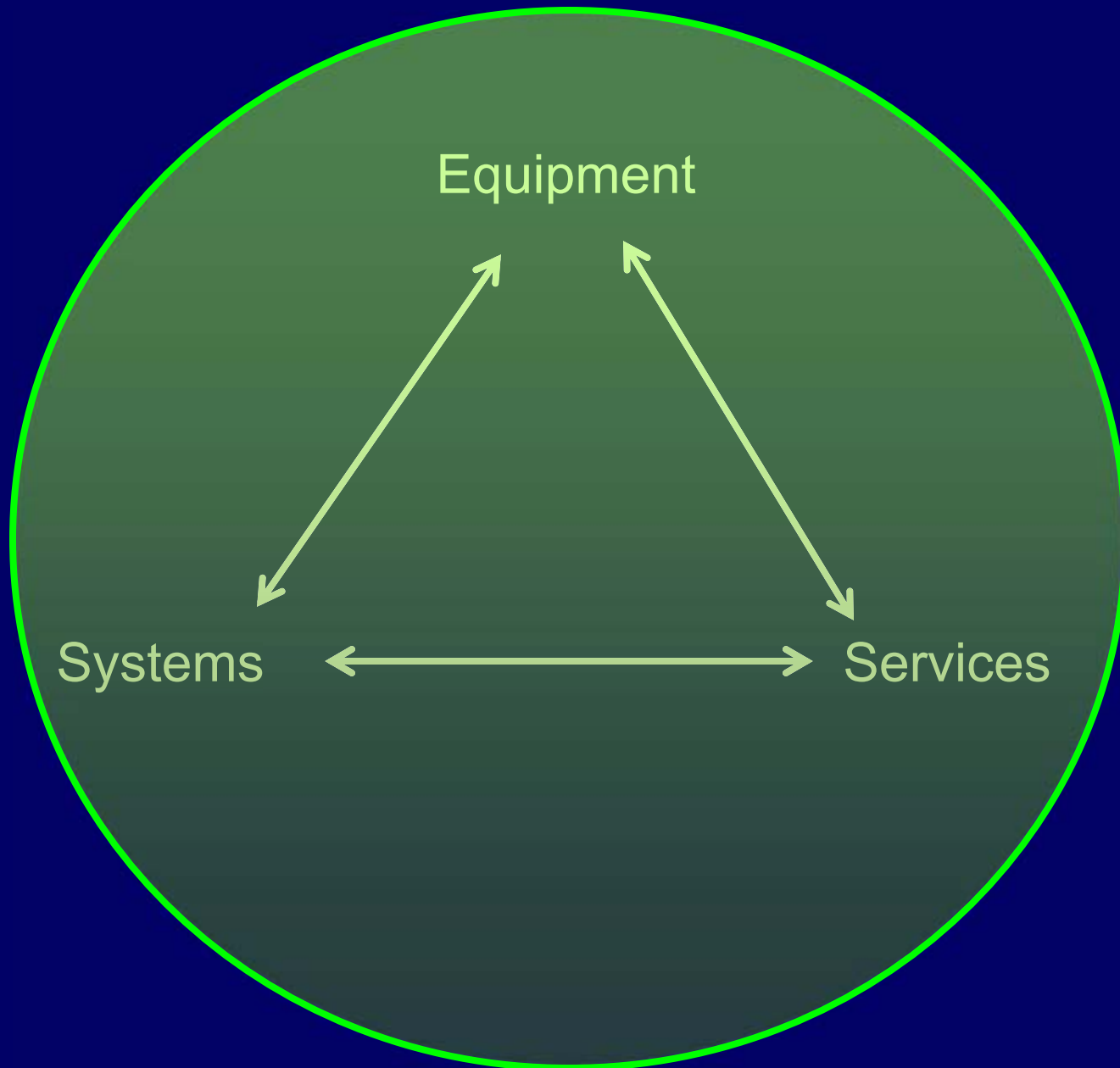
Services

Mix of Equipment/Systems/Services

Equipment	Shore-based	Shipborne
GMDSS - Global Maritime Distress Safety System	X	X
Radar/ARPA	X	X
GPS – Global Positioning System		X
ECDIS	X	X
AIS	X	X
CCTV	X	X
VHF voice radio [?]	X	X
Systems	X	X
LRIT – Long-range Identification and Tracking	X	X
SSN - SafeSeaNet	X	X
GNSS – Global Navigation Satellite System	X	X
Nav Warnings	X	
e-Loran [?]		
Services	X	
VTs	X	X
VTM	X	X
MRCC – Maritime Rescue Coordination Center	X	X
Maritime Coastal Radio	X	X
Weather Service		X



e-Navigation Concept of Operation



e-Navigation Challenges and Opportunities

Some examples associated with information
“portrayal”:

1. “Harmonizing” shipborne and shore-based displays
2. Guiding Principles for Presentation/Display of AIS
Application-Specific Messages
3. Virtual AtoN

Data and Information Content

Parameter	No. bits	Description
Message ID	6	Identifier for Message 8; always 8
Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated.
Source ID	30	MMSI number of source station
Spare	2	Not used. Should be set to zero.
IAI	16	DAC=001; FF=11
Latitude	24	Measuring position, 0 to +/-90 degrees, 1/1000th minute
Longitude	25	Measuring position, 0 to +/-180 degrees, 1/1000th minute
Date and time	16	Time of transmission, Day, hour, minute, (ddhhmm in UTC)
Average wind speed	7	Average of wind speed values for the last 10 minutes
Wind gust	7	Maximum wind speed value reading during the last 10 minutes, 0-120 kts, 1kt
Wind direction	9	0-359, 1 degree
Wind gust direction	9	0-359, 1 degree
Air temperature	11	Dry bulb temperature -60.0 to +60.0 degrees Celsius, 0.1 of a degree
Relative humidity	7	0-100, 1%
Dew point	10	-20.0 - +50.0 degrees, 0.1 degree
Air pressure	9	800-1200 hPa, 1hPa
Air pressure tendency	2	0 = steady, 1 = decreasing, 2 = increasing
Horizontal visibility	8	0-25.0, 0.1 NM
Water level (incl. tide)	9	Deviation from local chart datum, -10.0 to 30.0 m
Water level trend	2	0 = steady, 1 = decreasing, 2 = increasing
Surface current direction	9	0-359 degrees, 1 degree
Current speed, #2	8	Current measured at a chosen level below the sea surface, 0.0 - 25.0 kts, 0.1 kt
Current direction, #2	9	0-359, 1 degree
Current measuring level #2	5	Measuring level in m below sea surface, 0-30m, 1 m
Current speed, #3	8	0.0 - 25.0 knots, 0.1 knot
Current direction, #3	9	0-359 degrees, 1 degree
Current measuring level, #3	5	Measuring level in m below sea surface, 0-30 m, 1 m
Significant wave height	8	0.0 - 25.0 m, 0.1 m
Wave period	6	Period in seconds, 0-60 s, 1 s
Wave direction	9	0-359 degrees, 1 degree
Swell height	8	0.0 - 25.0 m, 0.1 m
Swell period	6	Period in seconds, 0 - 60 s, 1 s
Swell direction	9	0-359 degrees, 1 degree
Sea state	4	According to Beaufort scale (manual input?), 0 to 12, 1
Water temperature	10	-10.0 - +50.0 degrees, 0.1 degree
Precipitation (type)	3	According to WMO
Salinity	9	0.0 - 50.0 000, 0.1 000
Ice	2	Yes/No
Spare	6	
Total	352	Occupies 2 slots

IMO Meteorology and Hydrology Message as specified in IMO SN/Circ.236, Annex 2, Application 1. Also described in AIS, Vol. 1, Part 1, Operational Issues, Ed. 1.3. IALA Guideline No 1028, p. 131.

SN/Circ.236			Revised/New Messages	
Appl No.	Message Name	FI	Message Name	FI
1	Met/Hydrological	11	Met/Hydrographic	11
2	Dangerous cargo indication	12	Dangerous cargo indication	25
3	Fairway closed	13	---	--
4	Tidal window	14	Tidal window	14
5	Extended ship static and voyage related data	15	Extended ship static and voyage related data	24
6	No. of persons onboard	16	No. of persons onboard	16
7	Pseudo-AIS targets	17	VTS-generated targets	17
			Clearance time to enter port	18
			Marine traffic signal	19
			Berthing data	20
			Weather report from ships	21
			Area Notice - broadcast	22
			Area Notice - addressed	23
			Environmental	26
			Route Information – broadcast	27
			Route Information – addressed	28
			Text Description – broadcast	29
			Text Description – addressed	30

Comparison of existing AIS Binary Message Applications contained in IMO SN/Circ.236 and the revised/new messages proposed by the IMO Intercessional Working Group on AIS Binary Messages to IMO NAV55 (July 2009).

AIS Binary Message Content in XML format

```
<?xml version="1.0" encoding="utf-8"?>

<ais-binary-message version="1.0"
  xmlns:xi="http://www.w3.org/2001/XInclude">

  <!-- XInclude is not used in this file. Here for demonstration only -->
  <xi:include href="structs-inc.xml"/>

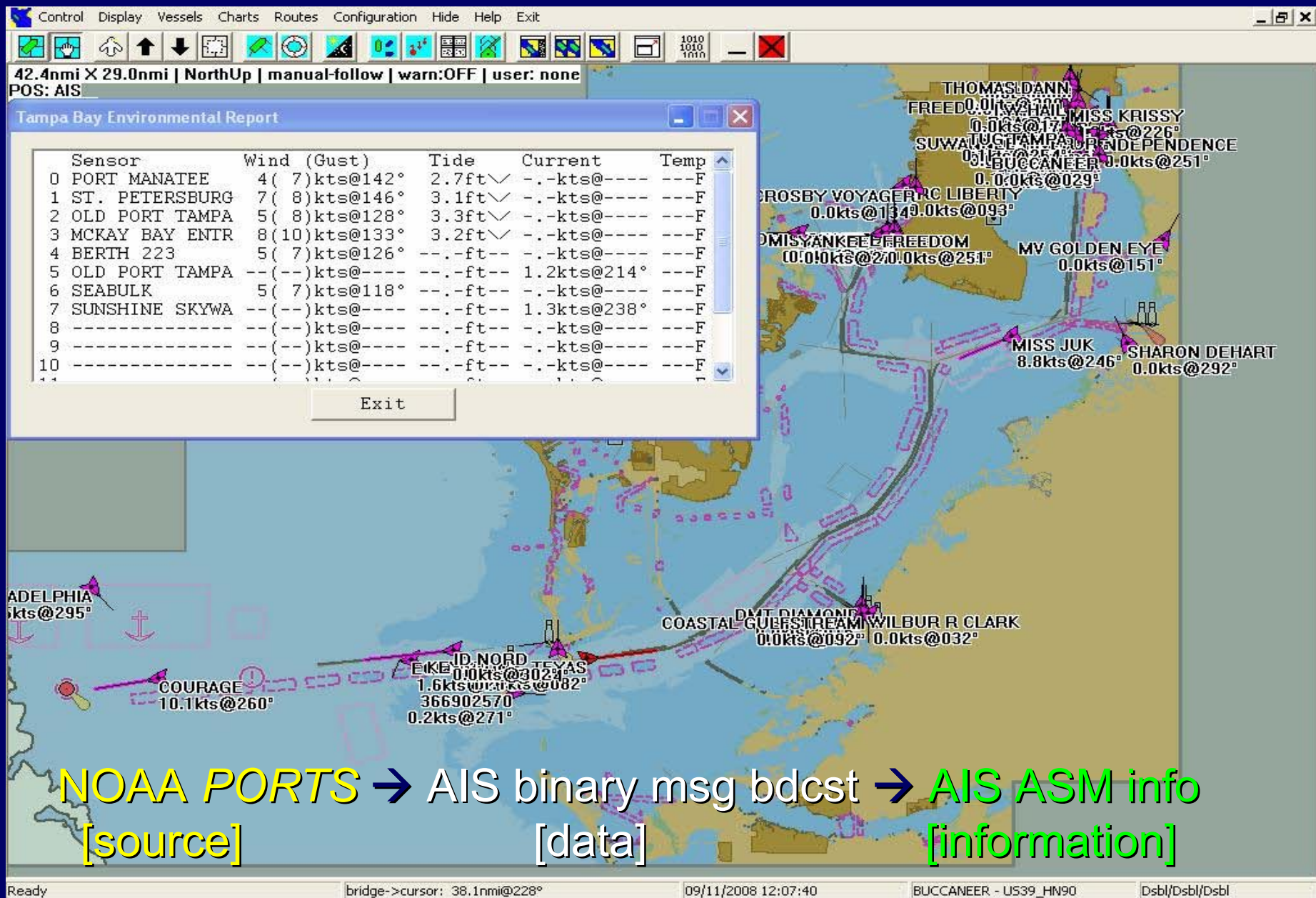
  <struct name="pos_small" postgis_type="POINT">
    <description>Generic representation of position on the WGS84
    sphereoid. Smaller number of bits than standard position.
    Lat/Lon reversed.
    </description>

    <field name="latitude" numberofbits="24" type="decimal">
      <description>North South location</description>
      <range min="-90" max="90"/>
      <unavailable>91</unavailable>
      <units>degrees</units>
      <scale>60000</scale>
      <decimalplaces>4</decimalplaces>
      <testvalue>37.42446</testvalue>
    </field>

    <field name="longitude" numberofbits="25" type="decimal">
      <description>East West location</description>
      <range min="-180" max="180"/>
      <unavailable>181</unavailable>
      <units>degrees</units>
      <scale>60000</scale>
      <decimalplaces>4</decimalplaces>
      <testvalue>-122.16328</testvalue>
    </field>

  </struct>
```


AIS Binary Message Broadcast Testbed – Tampa Bay



Displaying AIS Application- Specific Messages

At present, SOLAS vessels not required to have specific equipment to display AIS Application-Specific messages (ASM).

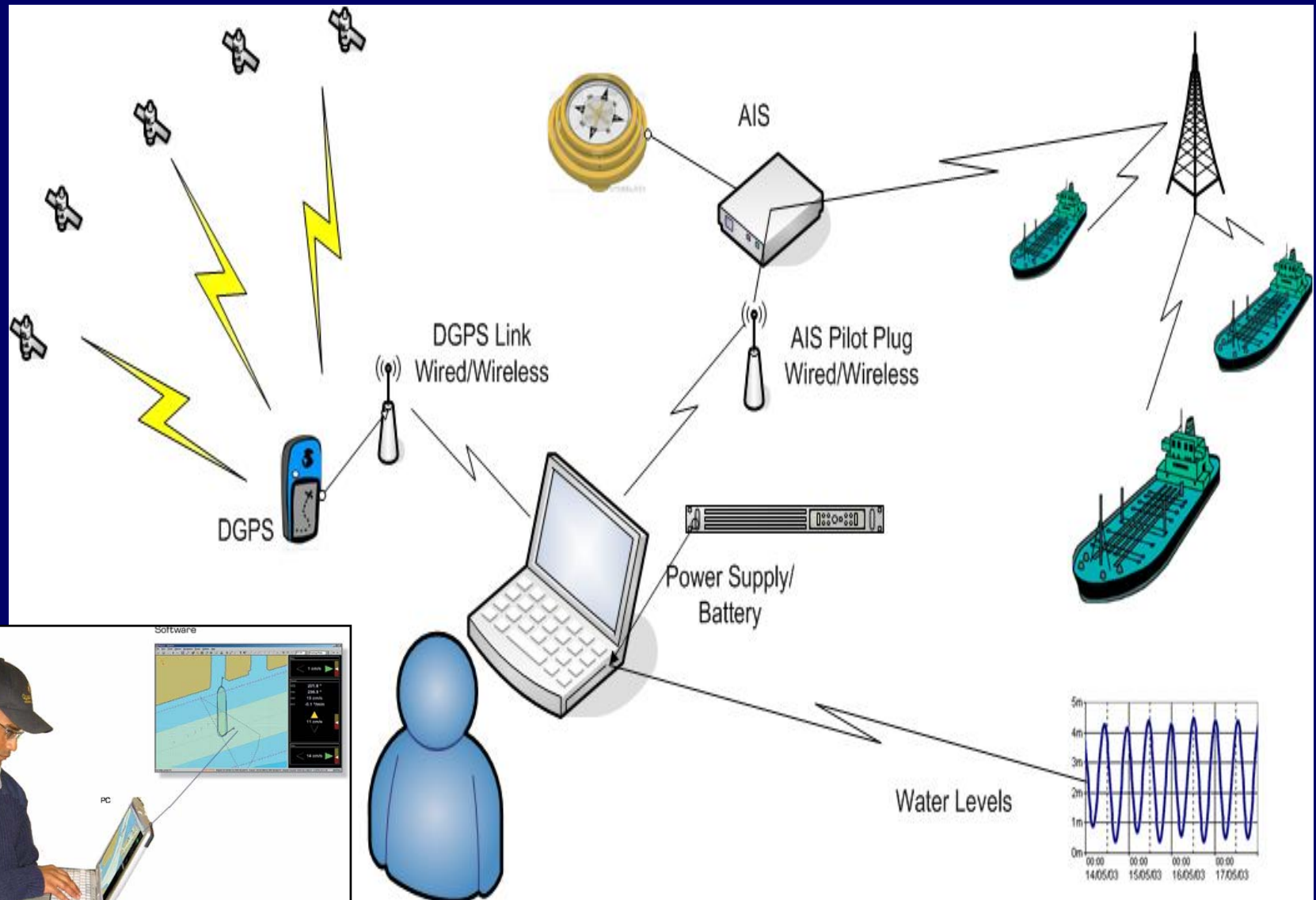
- AIS Minimum Keyboard Display (MKD) can only display text information.
- Some AIS binary messages already being displayed on:

ECDIS & ECS

Integrated Navigation Systems (INS)

Portable Piloting Units (PPUs)

Portable Piloting Unit (PPU)



Basic Display Options for AIS Application-Specific Messages

#	Application *	Alpha-numeric	Graphical	Symbol	Geo-spatial (Point, line, or polygon)
1	Meteorological and hydrological data	X	X	X	X
2	Dangerous cargo Indication	X			
3	Fairway closed	X			X
4	Tidal window	X	X	X	X
5	Extended ship static and voyage-related data	X	X		
6	Number of persons onboard	X			
7	VTs-generated AIS targets			X	X

* AIS Application-Specific Messages contained in **IMO SN/Circ. 236**

Halifax Harbour

Main Concern: air draft underneath two suspension bridges

DGPS mounted on bridge provides precise height (centimeter level, 24/7/365).

Real-time tidal information forecasts predicted water levels (i.e., “nowcast”).

AIS binary broadcast transmits information to **Portable Piloting Unit (PPU)**.



Halifax Harbour



HALIFAX-DARTMOUTH
BRIDGE COMMISSION

Main

Air Draught

Tide Sensor

GPS Sensor

Temp. Sensor

Health Status

Prediction PDF

Air Draught:

49.6

Submit

Clear

Tide Direction



Falling

12:39

Angus L. Macdonald

Air Gap 12:43 **50.41** ● Calculated

Air Draught **49.60**

Clearance **0.81** ● Warning

ALM 51.41 ● Calculated

Altitude

12:43

Tide 1.00 ● Calculated

One

12:40

A. Murray MacKay

Air Gap 12:43 **50.99** ● Calculated

Air Draught **49.60**

Clearance **1.39** ● Acceptable

AMM 51.99 ● Calculated

Altitude

12:43

Tide 1.00 ● Calculated

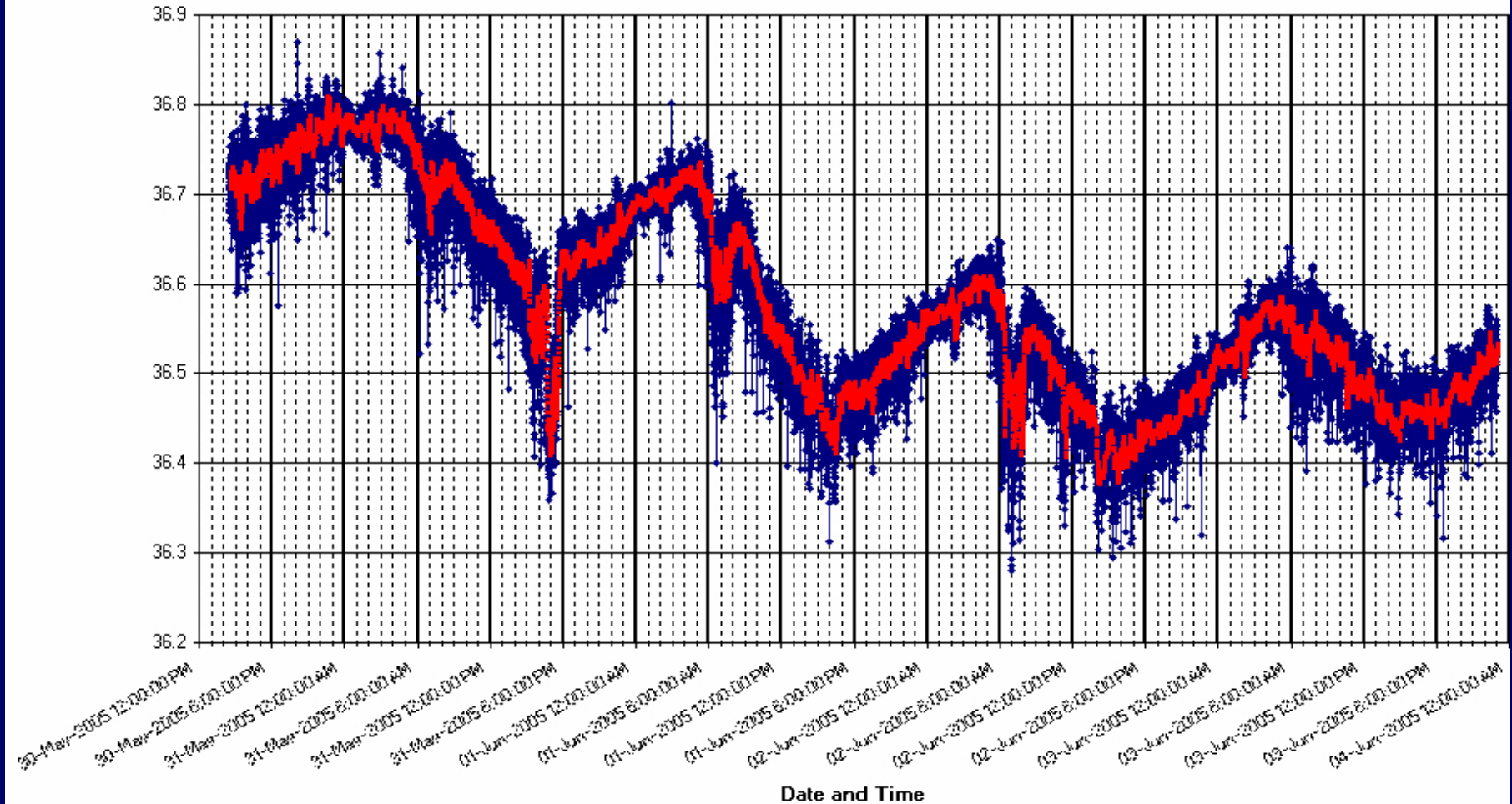
One

12:40

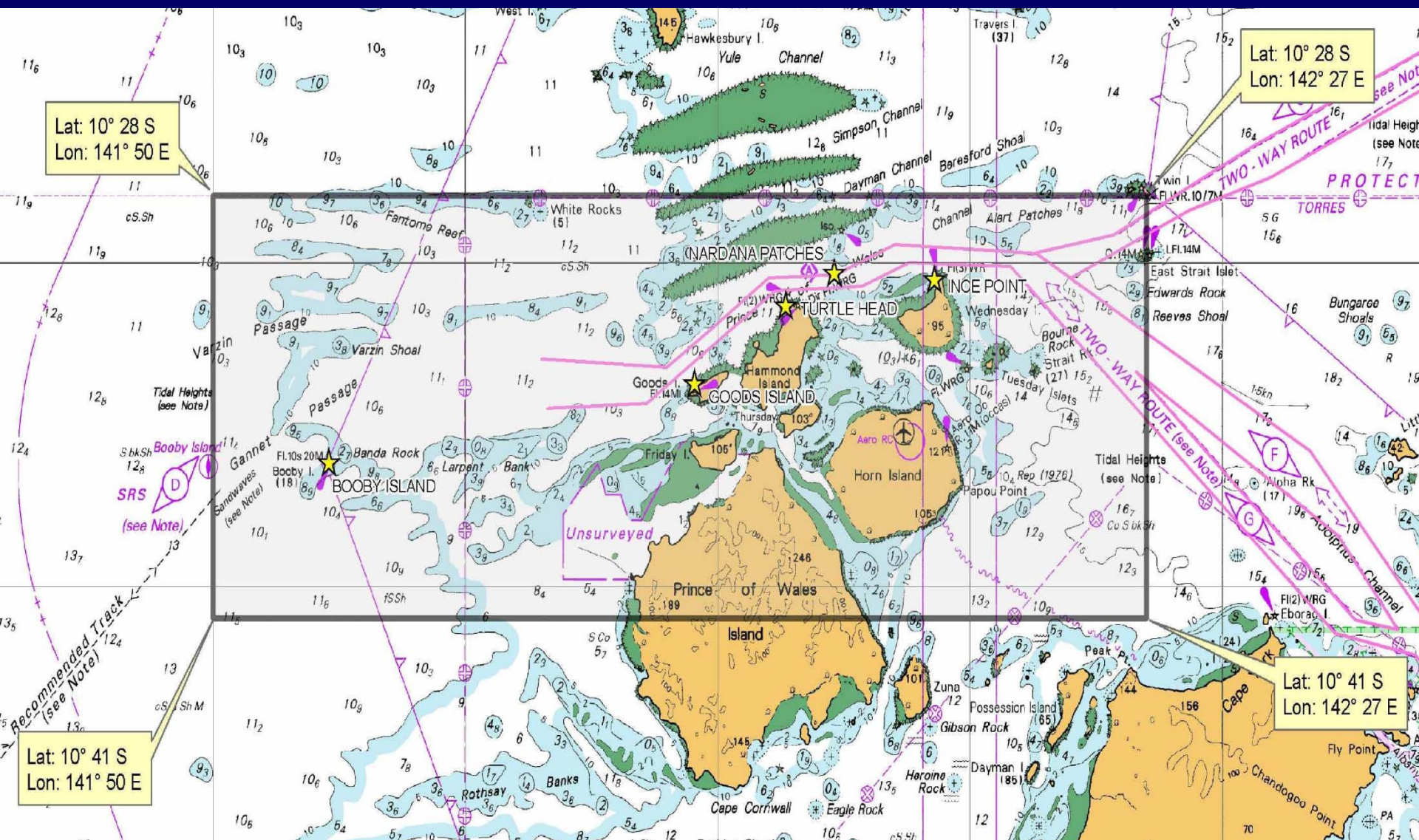
AGMS Version: 0.8

Halifax Harbour

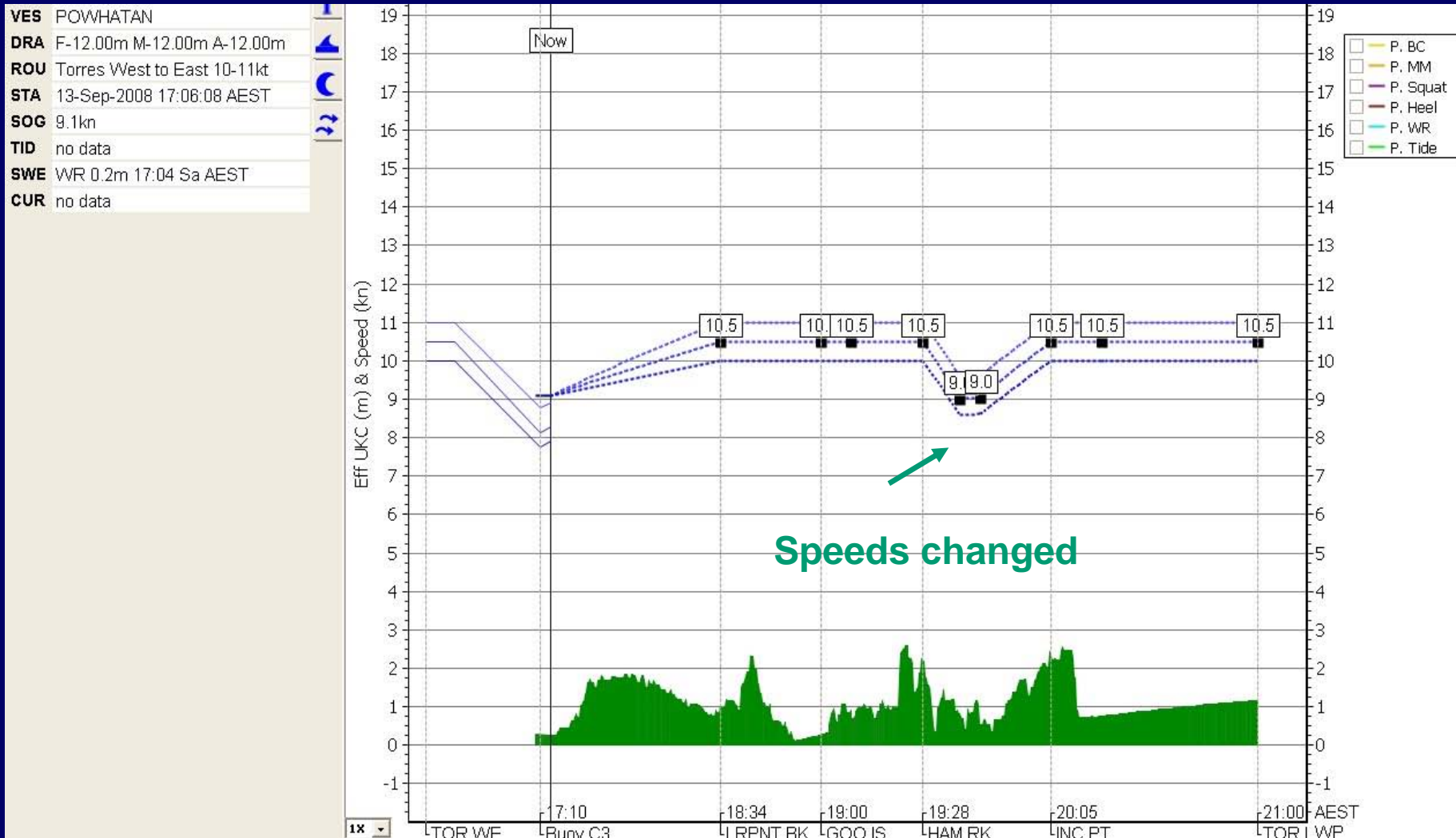
MacDonald Bridge Height Variations (May 30th - June 4th, 2005)



Torres Strait: Under-keel Clearance (UKC)

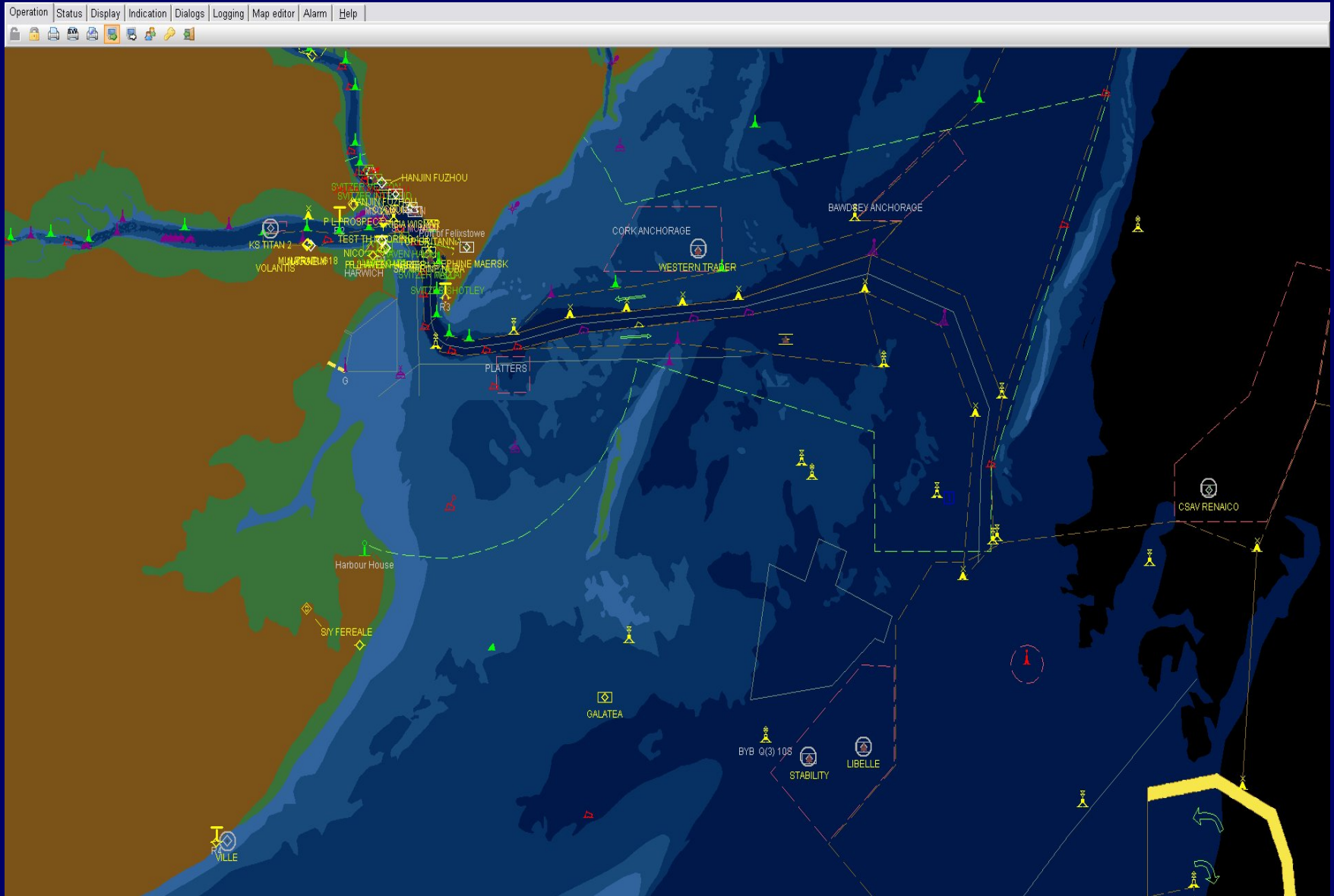


Speed Profiles changed



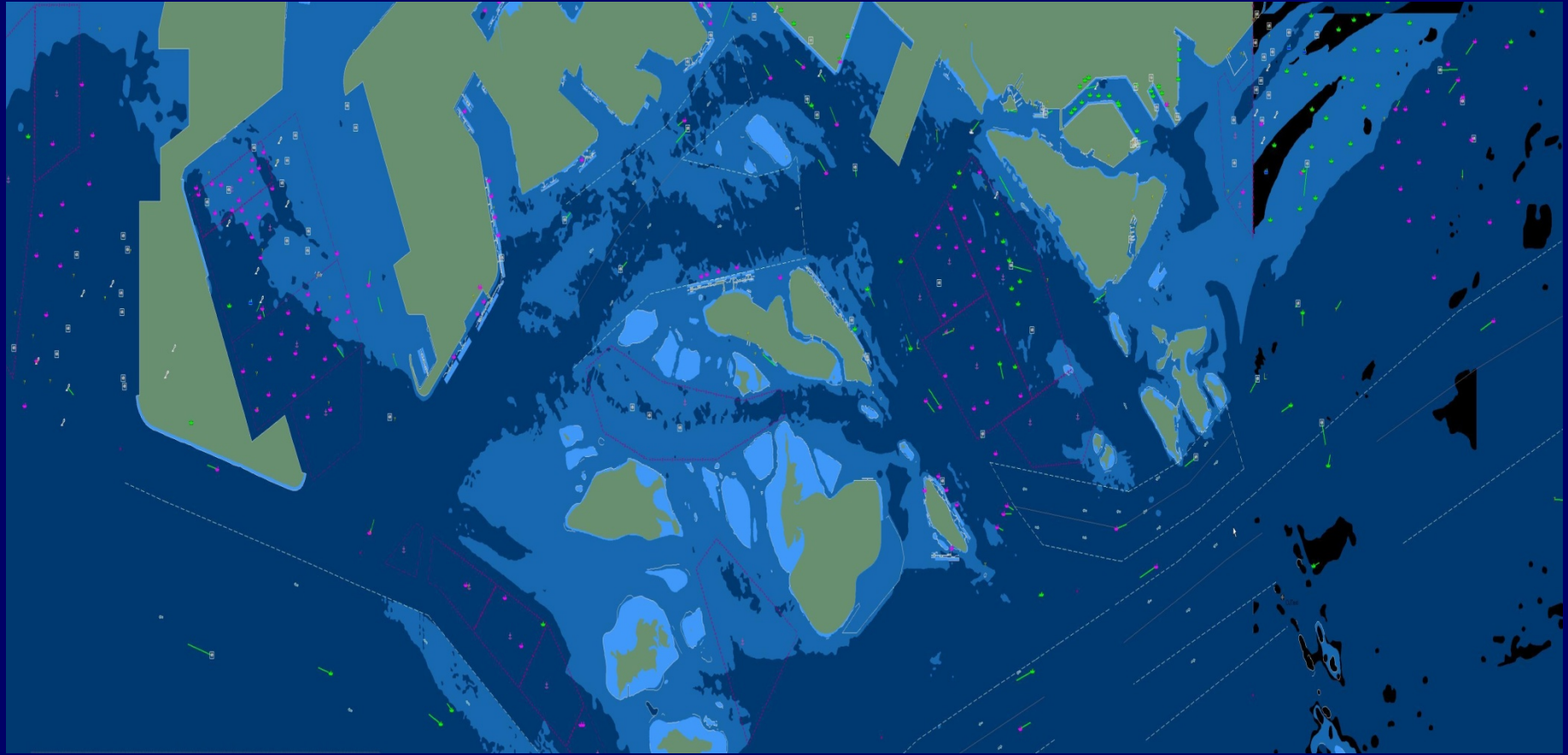
Speed Profile changed to remove breaches

Chart Display at VTS Centre – Example #1



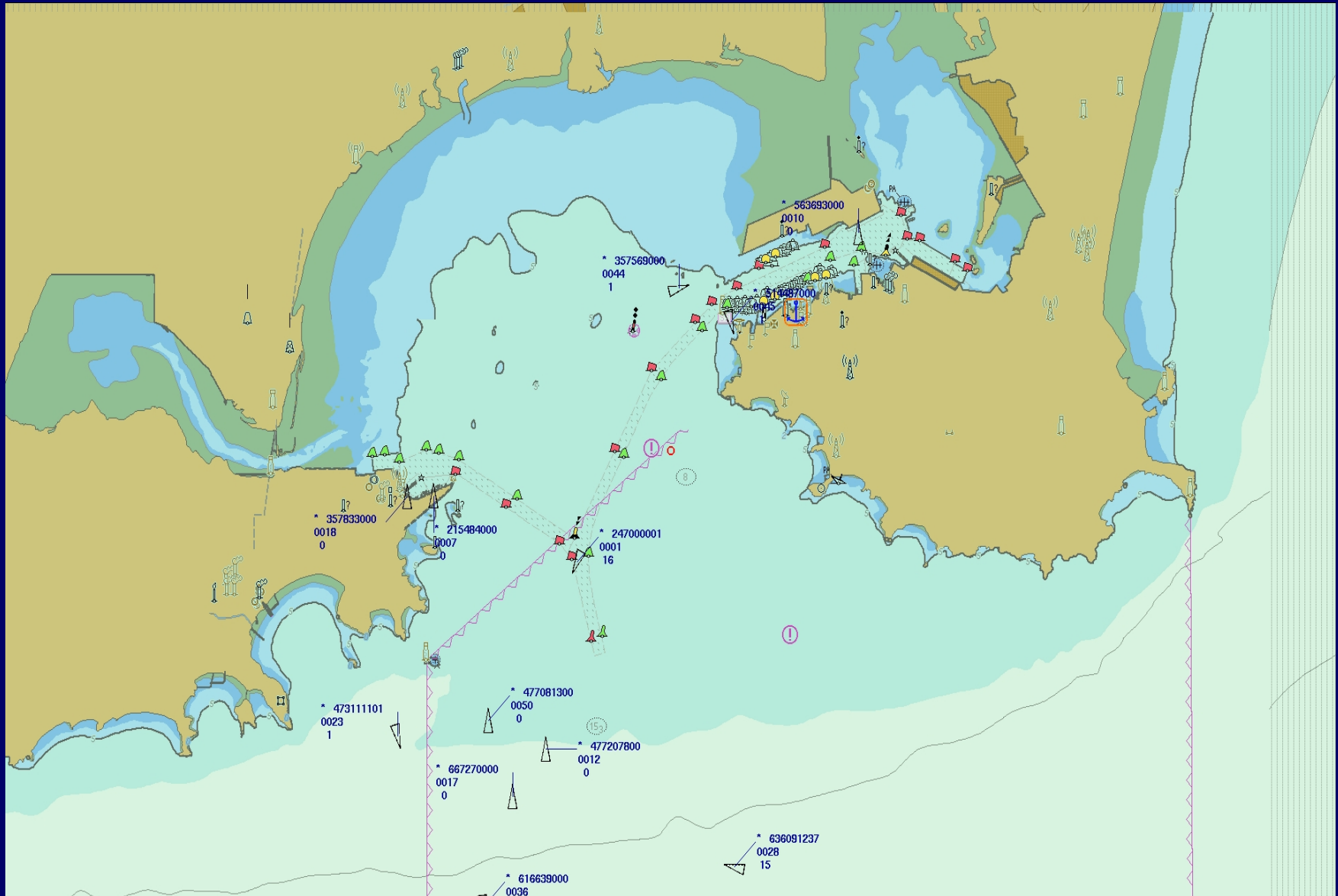
Source: Olaf Christians, Atlas Maritime Security GmbH

Chart Display at VTS Centre – Example #2



Source: Mervyn Winter, Marine Data Solutions

Chart Display at VTS Centre – Example #3



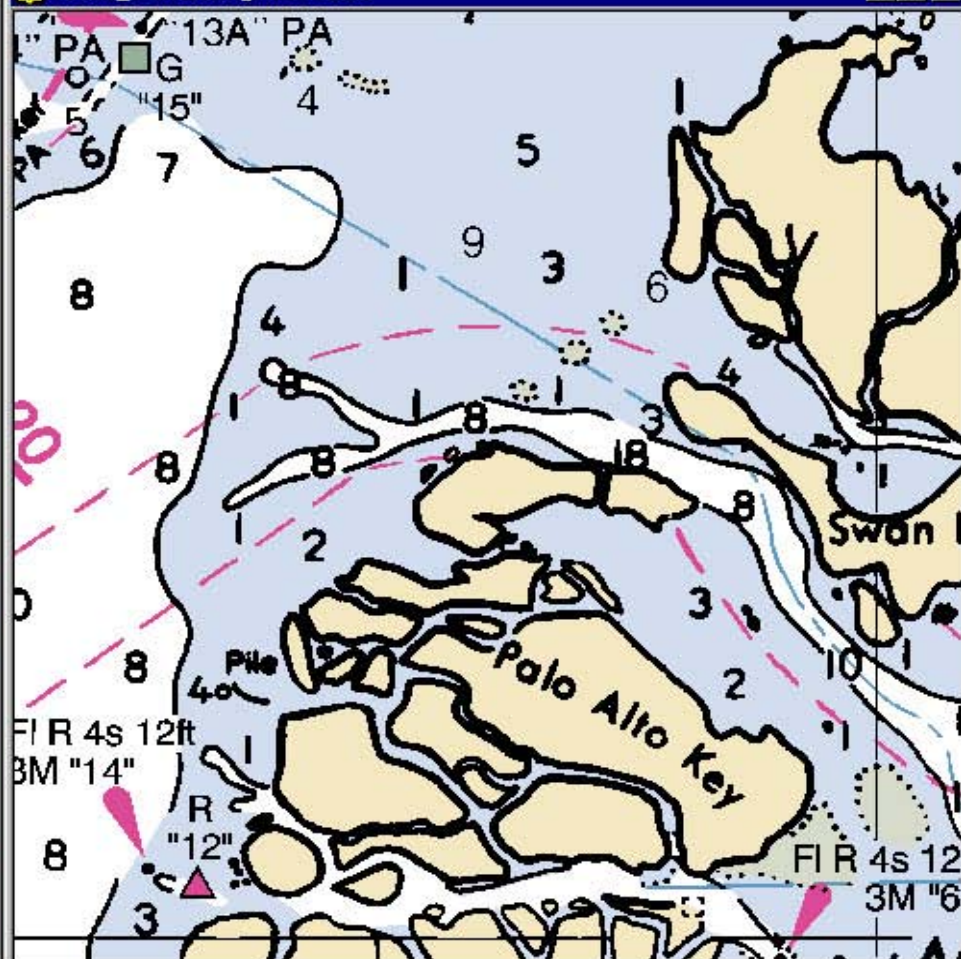


NOT FOR NAVIGATION NavPhoto



Sync to Vessel Relative ☒ Link Charts North Up ☐ No NTMs Found 3.94 KM

11451_2 Soundings in : FEET



Sync to Vessel Relative ☒ Link Charts North Up ☐ No NTMs Found 3.95 KM

OB: Course: 000 Mag Range: 0000.0 Mi Lat: xxxxxxxxxxxx Lon: xxxxxxxxxxxx Elapsed Time: 00:00:00 Time To: 00:00:00

Ready

1:80000 1.00X

Lat: 25° 20' 05" N
Lon: 080° 16' 16" W
Rng: 7783.4 KM
Brg: 115° True

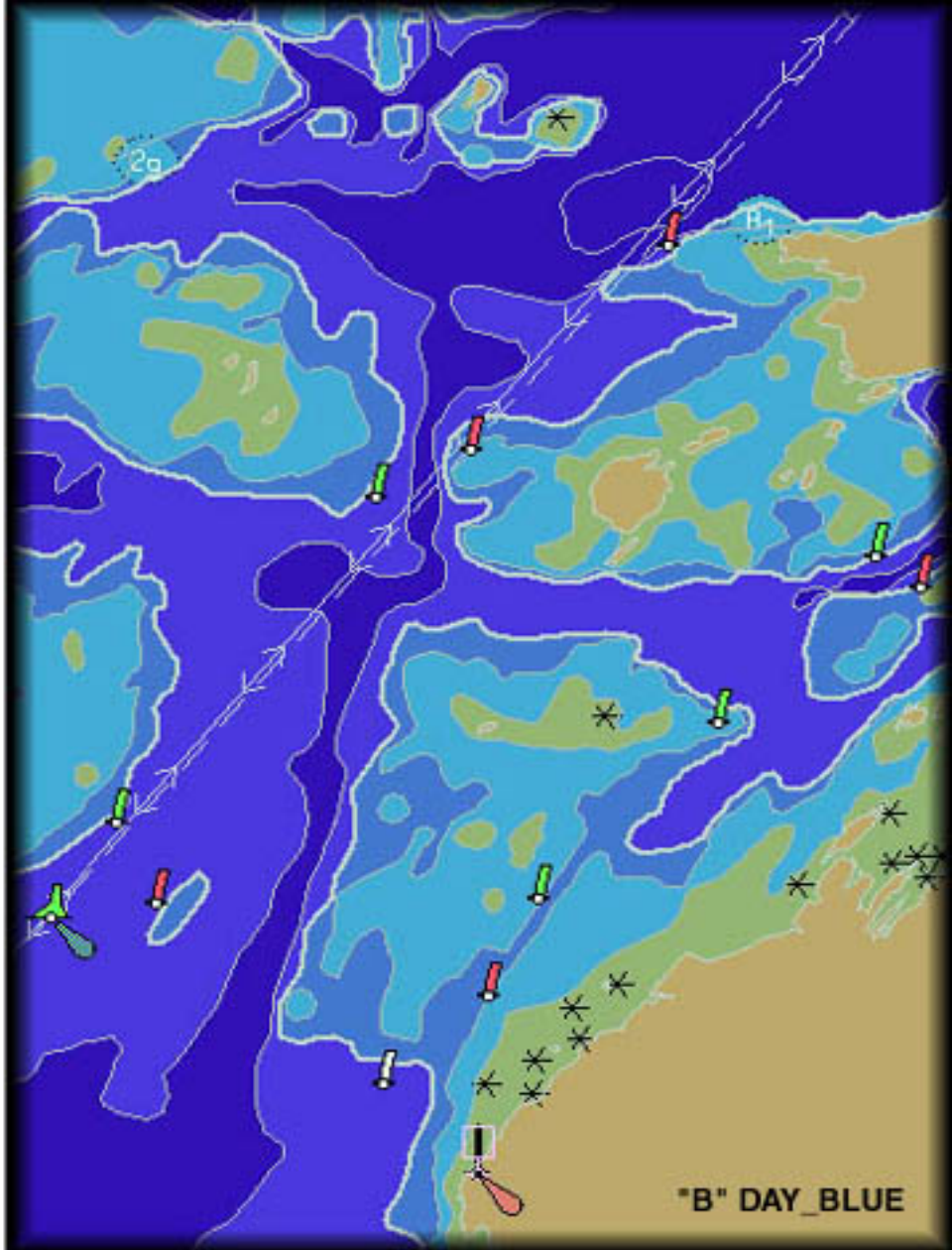
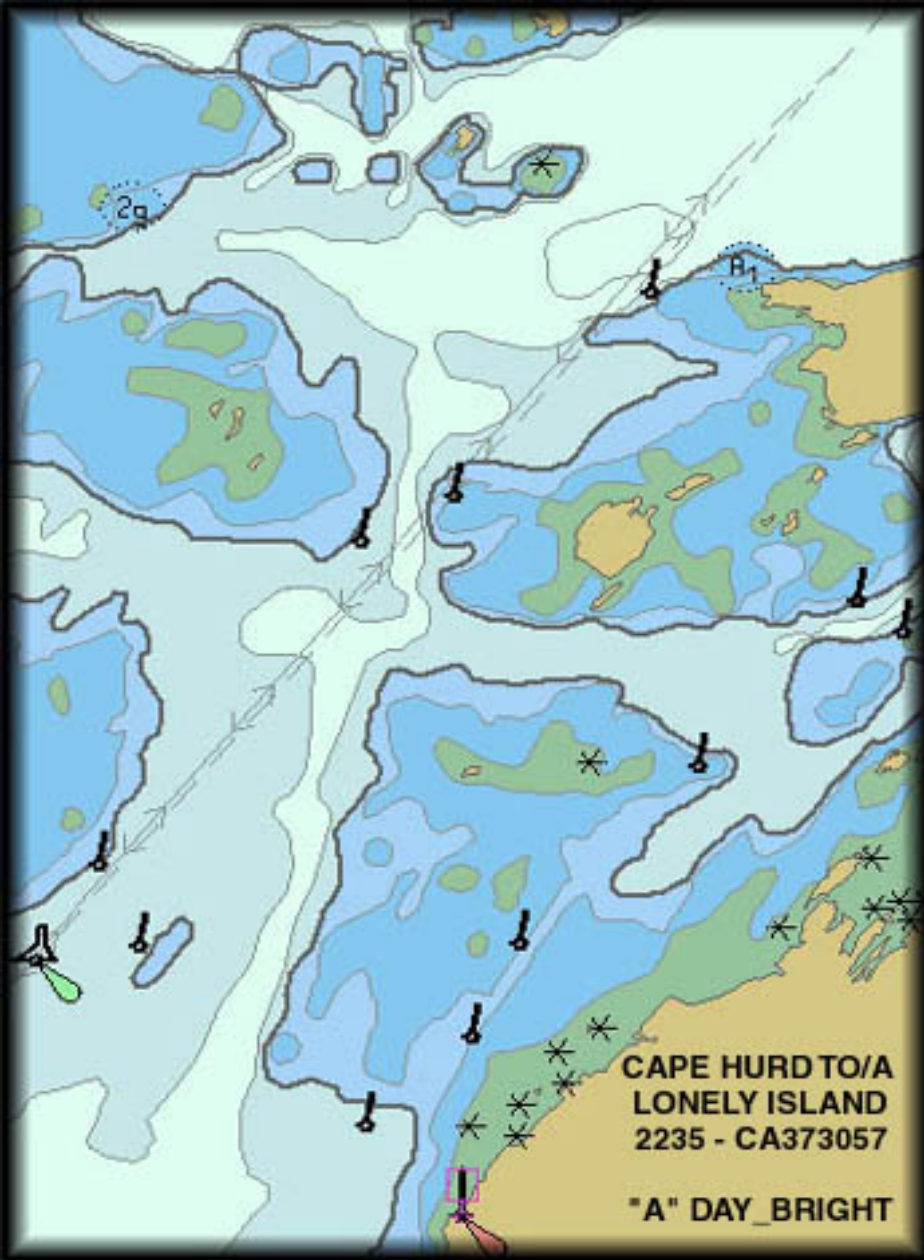
LOCAL
+ 1X -

Var 5.4° W
Rot 0°

Datum OK NONE

Offshore Navigator 4.0

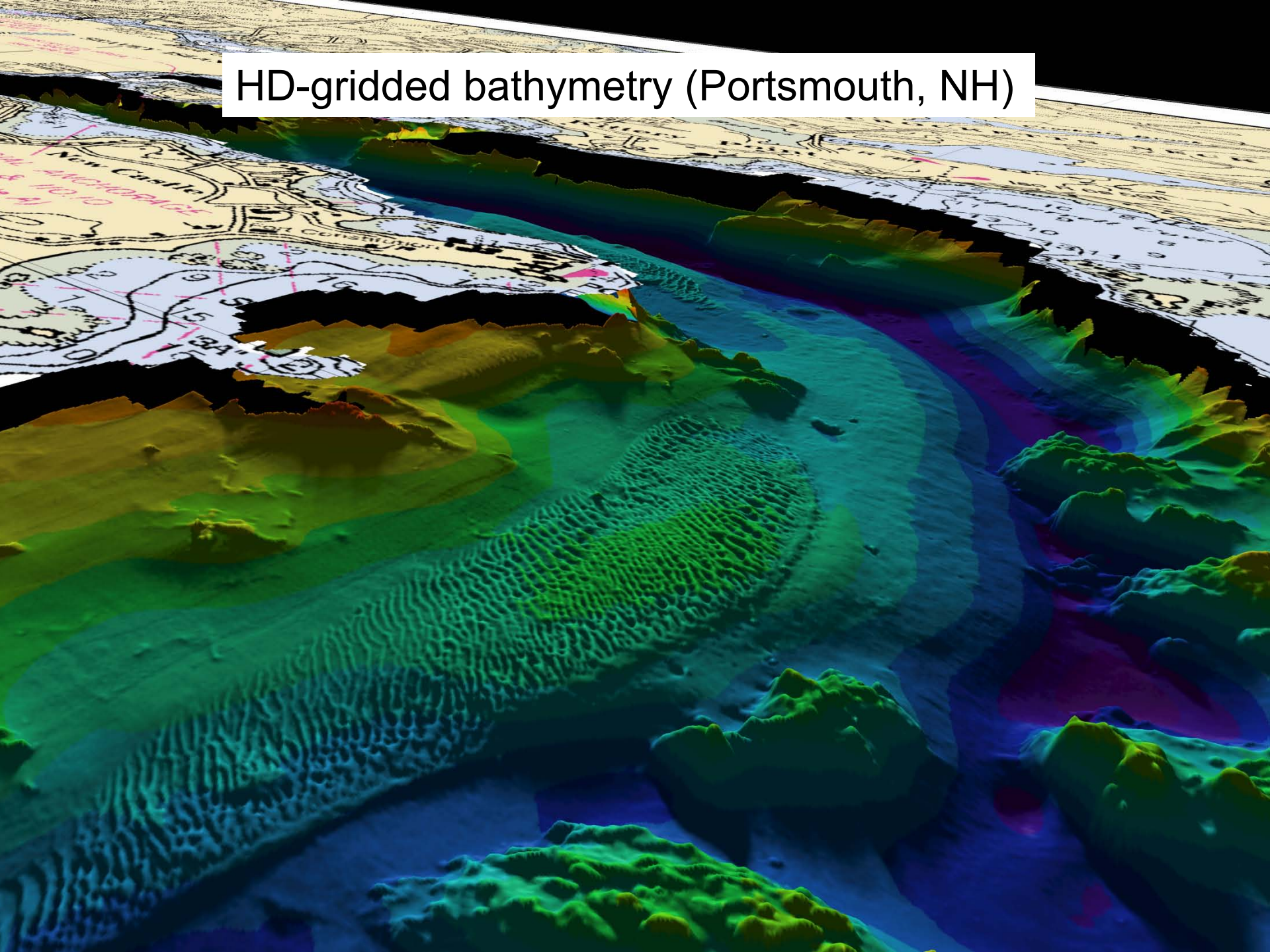
11451_2 MAIMI TO MARATHON & FLORIDA BAY EXT 1



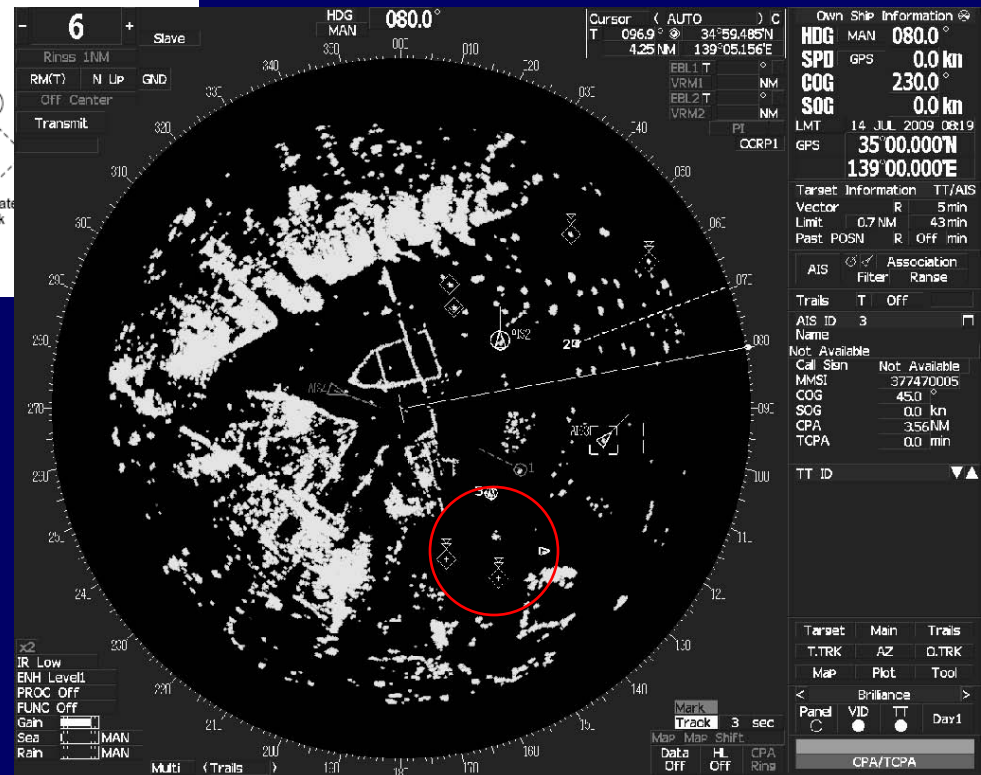
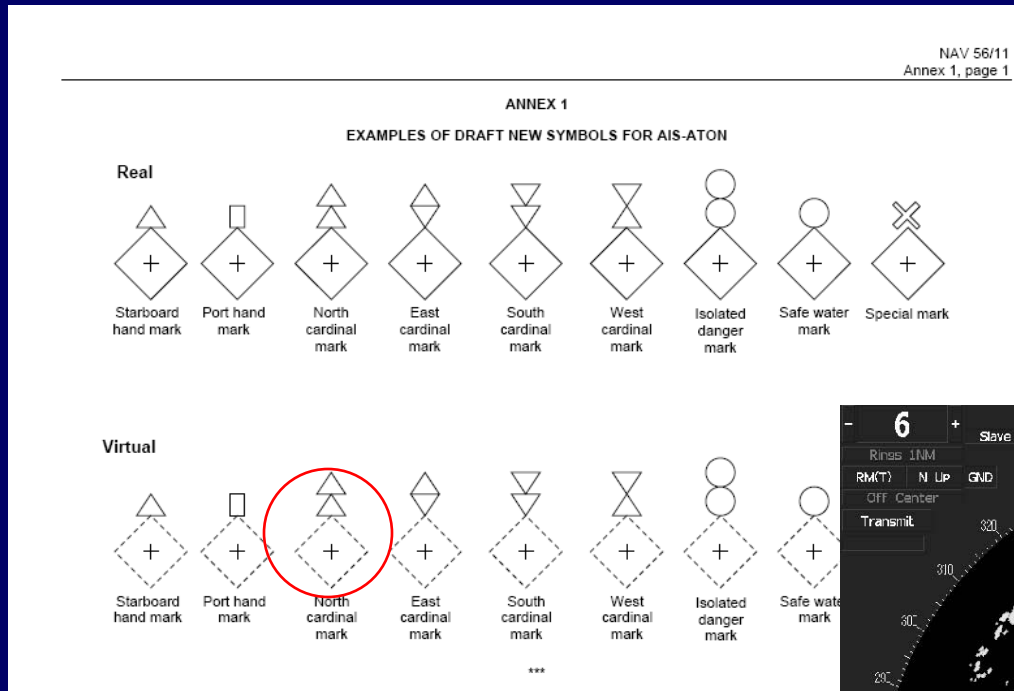
IHO S-52 Colours and Symbols

"24-Hour Day Blue"

HD-gridded bathymetry (Portsmouth, NH)



Virtual AtoN Symbols



ANNEX



IALA Recommendation O - 143

On

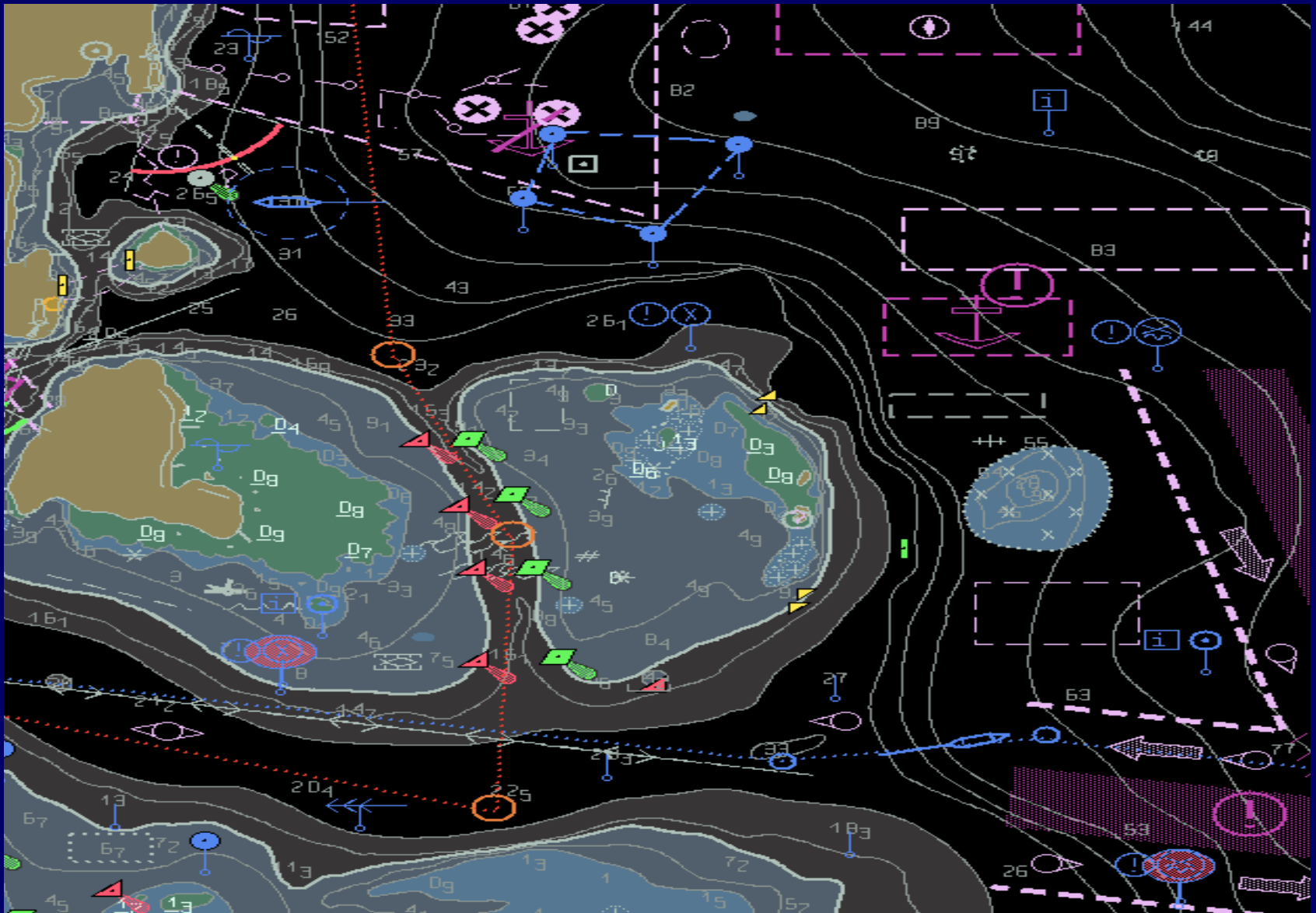
Virtual Aids to Navigation

Edition 1

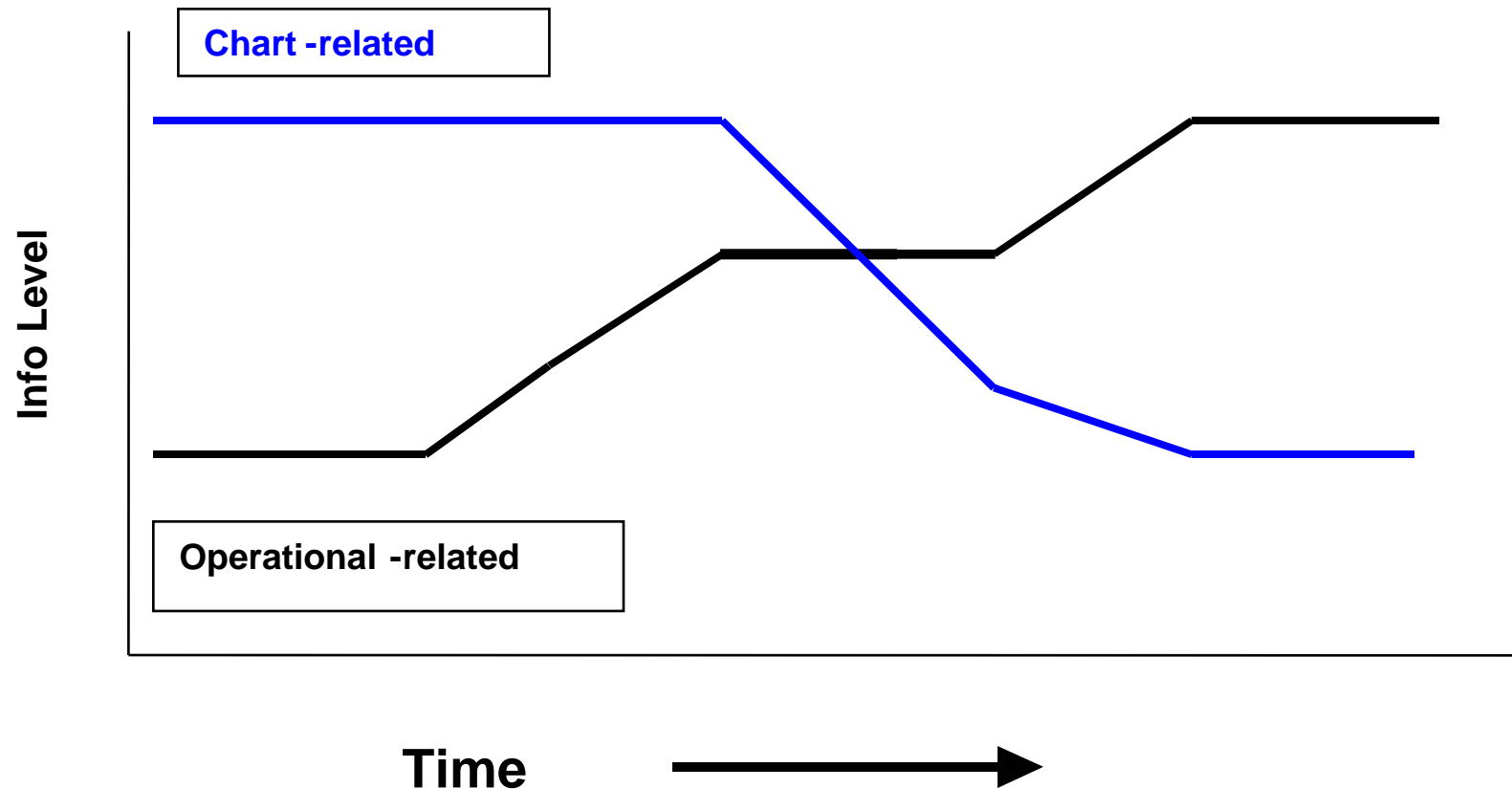
March 2010

This document is available on the IALA website, www.iala-aism.org, on page Publications/Recommendations.

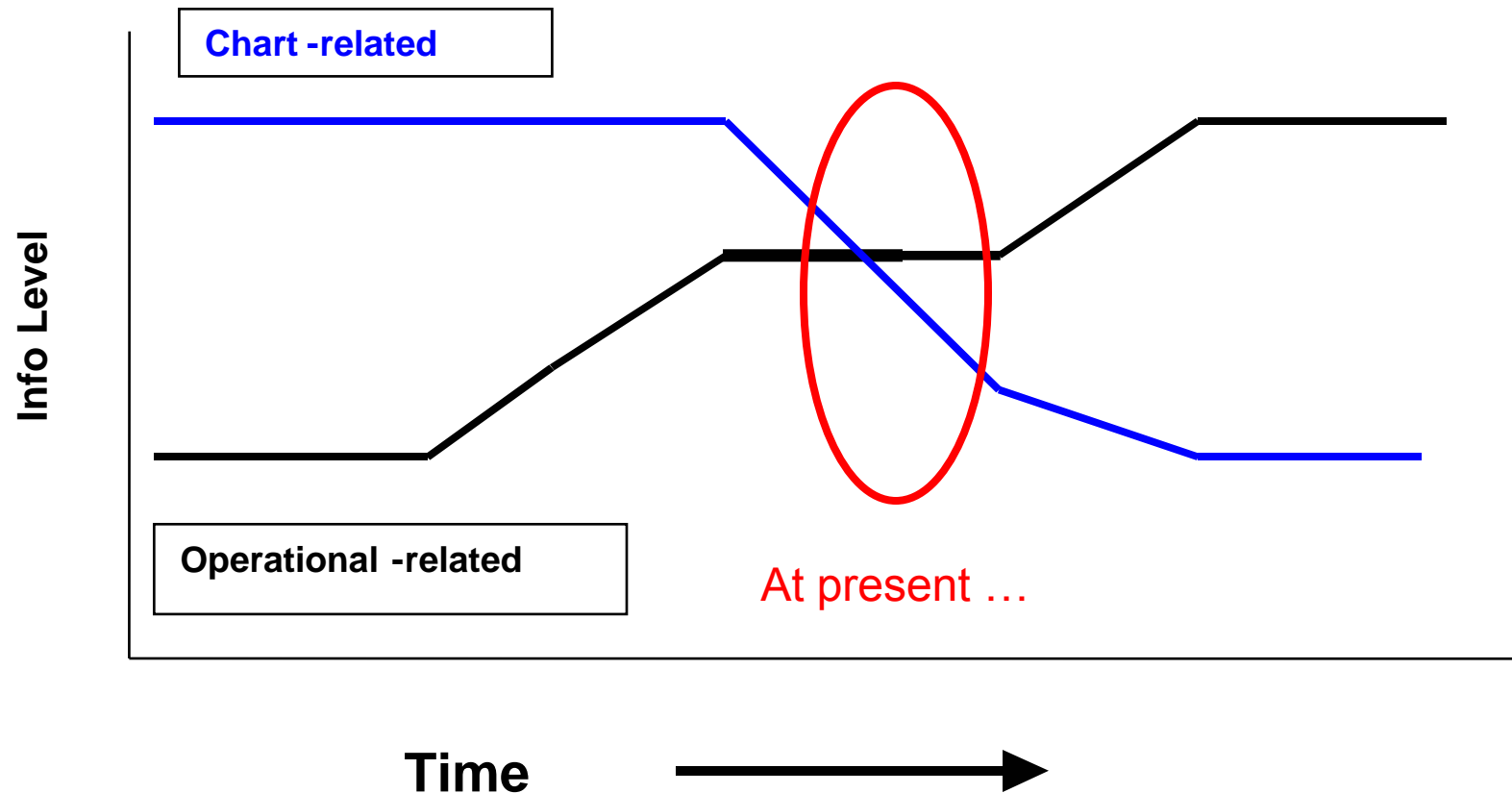
IHO Colours and Symbols for ECDIS (IHO S-22)



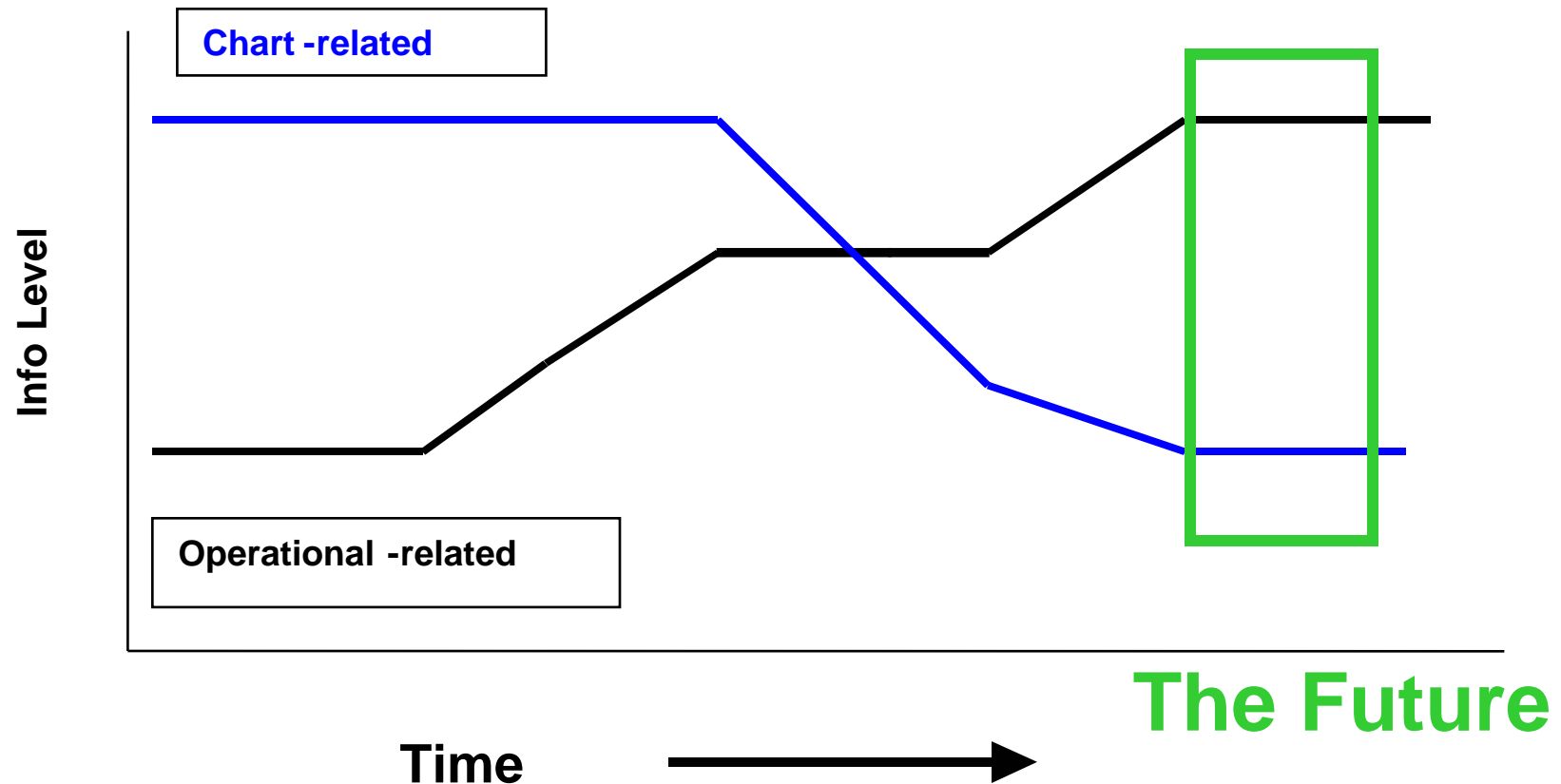
Trend in Display of Navigation-related Information



Trend in Display of Navigation-related Information



Trend in Display of Navigation-related Information



IHO Involvement in e-Navigation: Present and Future

Short answer: Ensure that the necessary hydro standards, products and services are in place to support the implementation of the e-Navigation concept of operation.

For hydrographic and chart-related data

ENCs (required for ECDIS) provide standardized means of:

- Codifying & encapsulating
- Transferring and distributing
- S-57 → S-101 ENC Product Specifications

For time-critical navigation safety-related information

AIS Application-Specific Messages will be used to broadcast:

- dynamic data to be used with chart-related data (e.g., dynamic ENC)
- how best portrayed on ECDIS

IHO Involvement with other Organizations

ISO 19100 series of geographic standards

- Basis for IHO S-100 family standards
- Includes ENCs, digital nautical pubs, symbology, etc.,
- Ideally, relevant ISO and IHO standards can be jointly published

Expert Contributors

- Industry, academia, and “stakeholder” involvement in IHO WGs

Non-governmental International Organizations (NGIOs)

- International Chamber of Shipping
- International Maritime Pilots Association

Direct IHO Involvement in e-Navigation

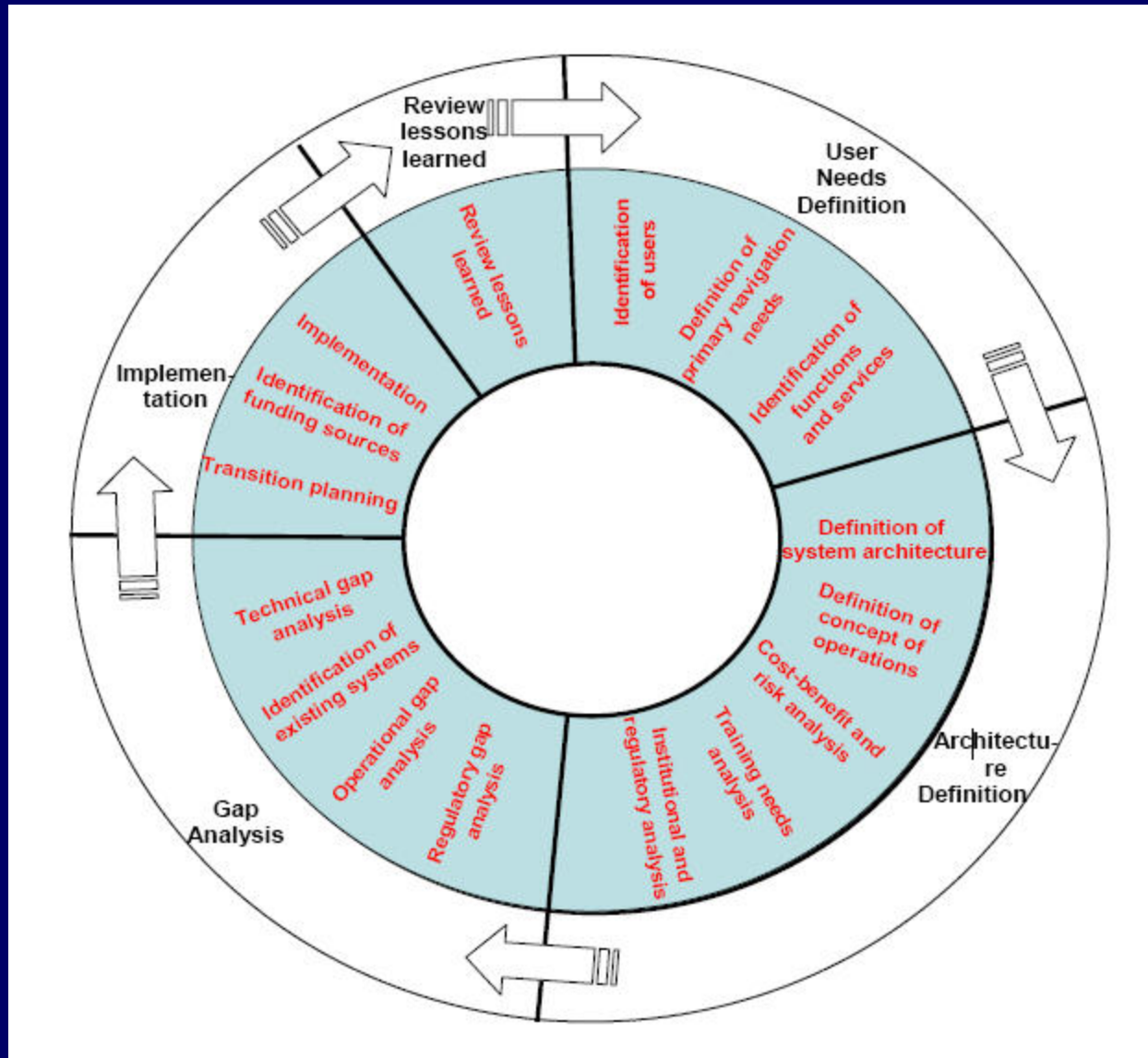
- IMO** - Attend Maritime Safety Committee (MSC) and Sub-committee on Safety of Navigation (NAV)
- Submit reports on status of chart-related developments

IALA - Actively participate in IALA e-Navigation Committee

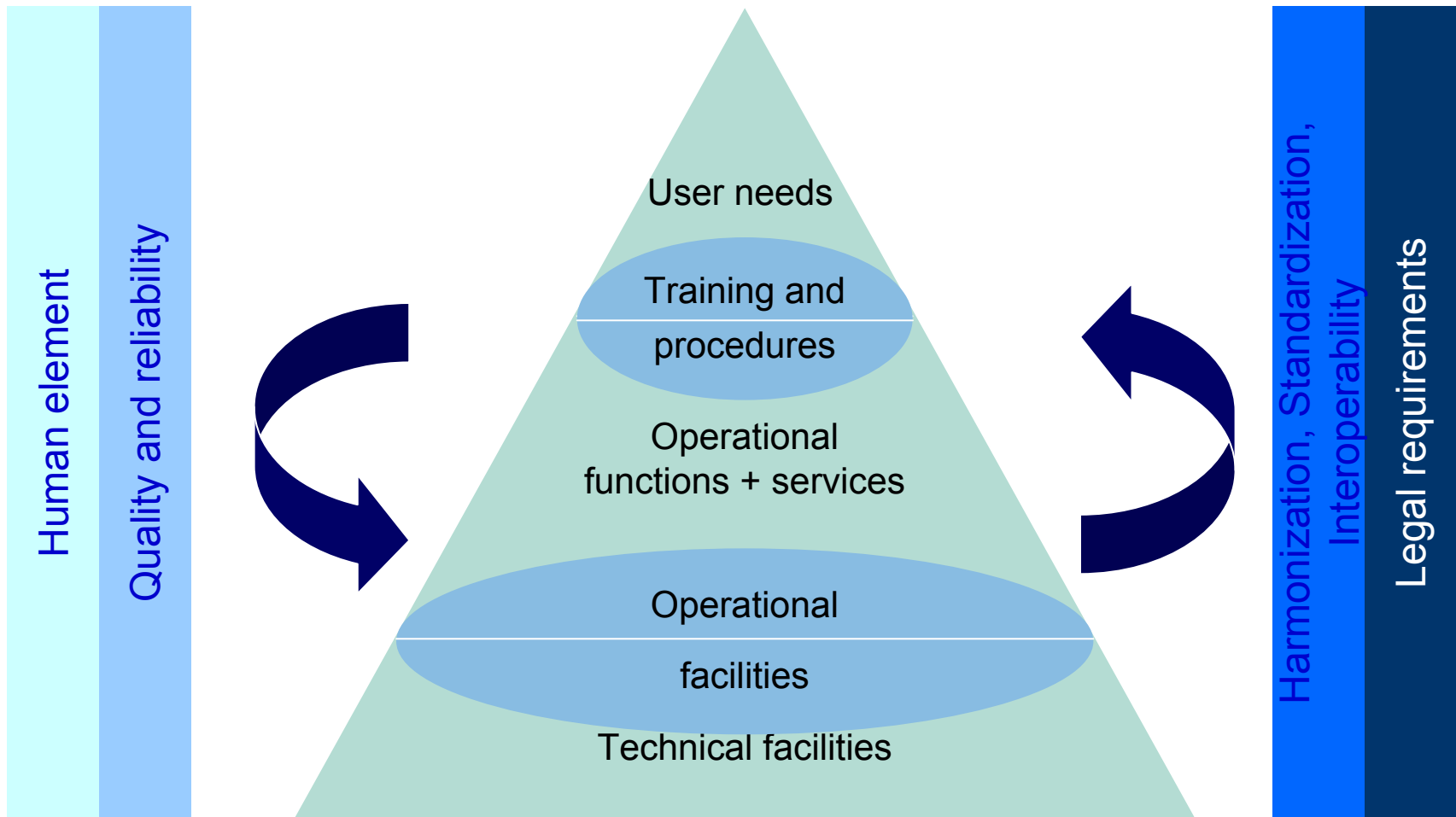
Specific initiatives:

- Potential use of IHO Registry for “other” types of maritime information
- AtoN metadata requirements from IALA
- Extended continental shelf boundary claims from the UN
- Inland ENC requirements by Inland ENC Harmonization Group
- Sea Ice Coverage MIOs from WMO

Components of e-Navigation Implementation Process



Conceptual Process for e-Navigation



Role for Hydrographers related to e-Navigation: Present and Future

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