**PILOTAGE: Generic Test Case of Pilotage Information mapped to SNPWG Object Model**

1.   Overview

This document provides a generic test case showing how pilotage information in Sailing Directions might be successfully converted to data, following the SNPWG Object Model (with some improvements), such that the data would effective, consistent results in future ECDIS.

The "Sailing Directions" content used in this case is hypothetical; it is abstracted from a study of real world sailing directions for a variety of major ports around the world, and is basically traceable to the real world content. The intent here is to provide one, concise example of a range of the most crucial variables involved when communicating the topic of pilotage to mariners via ECDIS.

The subject of pilotage involves many considerations, many of which are out of scope for the current study. This case is limited to sailing directions information needed by fleet managers and mariners in order to comply with pilotage requirements. This user group, when planning or navigating a passage using ECDIS, need to accomplish 3 things related to pilotage:

Determine pilotage requirement for the vessel class and cargo	→	Arrange for pilotage	→	Execute pilotage
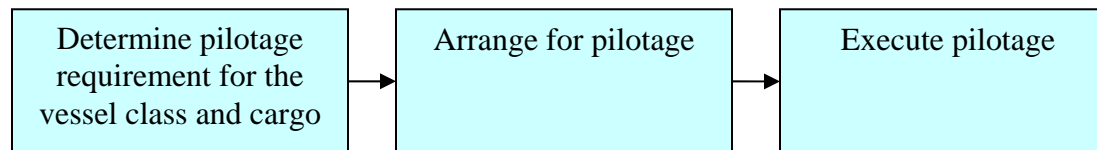
This case creates S-100 conformant data from sailing directions and ENC that could effectively communicate in ECDIS what must be known for these 3 pilotage activities. Implementation of both ENC and sailing directions will have to change to achieve any S-100 data solution. This case involves small changes to the way ENC and SD are implemented, and some modification of the SNPWG10 object model.

1.1. Method
- **Describe conceptual ECDIS functionality for test case, and describe the hypothetical harbor situation**
- **Create raw Sailing Directions pilotage content, and map content to SNPWG/S-100 data model**
- **Create 3 use cases: a) Determine pilotage requirements, b) Arrange for pilotage, c) execute pilotage**
- **Analysis and recommendations**

2. Conceptual ECDIS User Interface, Showing Test Bay and an Info Report at Test Bay Narrows
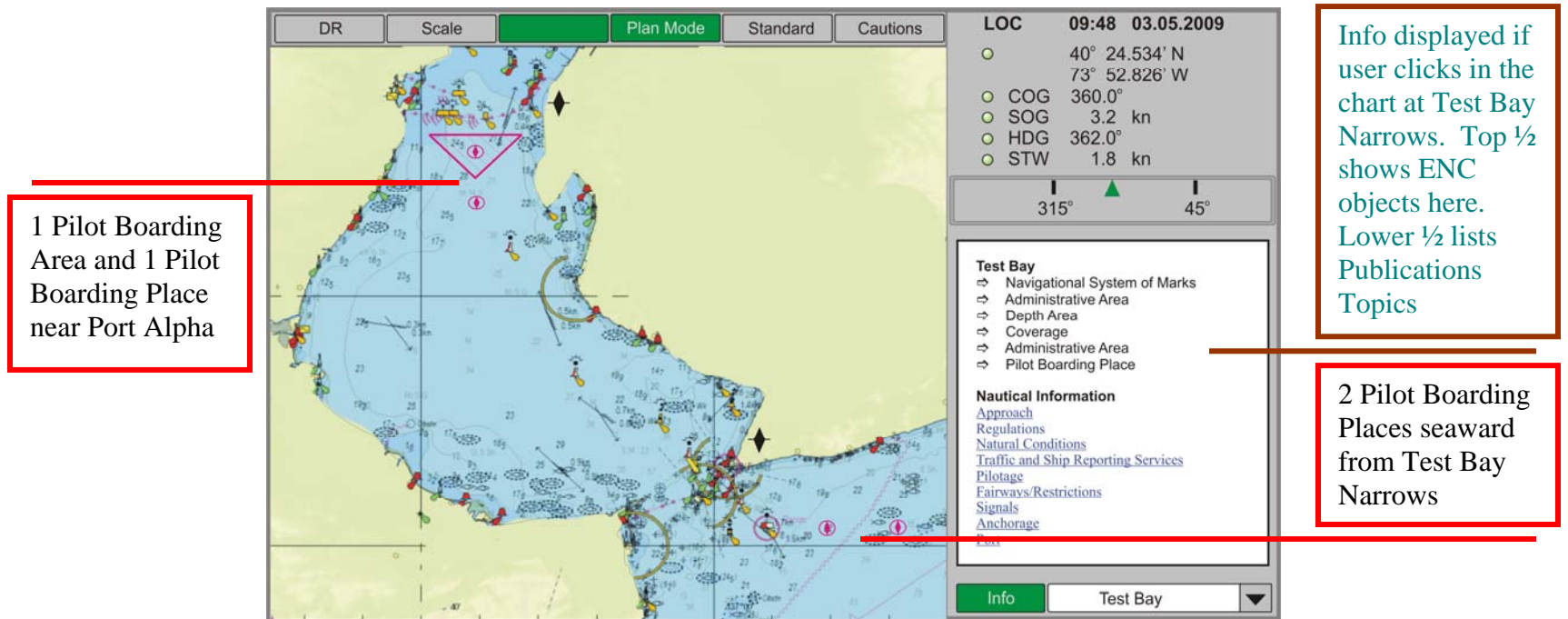

Info displayed if user clicks in the chart at Test Bay Narrows. Top ½ shows ENC objects here. Lower ½ lists Publications Topics

1 Pilot Boarding Area and 1 Pilot Boarding Place near Port Alpha

2 Pilot Boarding Places seaward from Test Bay Narrows

Figure 1: Hypothetical S-100 ECDIS view of Test Bay**.**

The conceptual ECDIS design presents buttons across the top allowing user to change views. For the test case, it is set to Planning Mode, which presents 3 panels: Chart View (left), Position View (top right), and Info View (lower right.) in this mode, clicking any place in Chart View generates an Info View that lists chart objects at that location and nautical information topics. In Fig. 1, the user has clicked a pilot boarding place seaward of Test Bay Narrows. Clicking an item listed in Info View generates a new Info View detailing that item. Detailed Info Views may link to additional detail. User can page back and forth through info displays. Test Bay faces the ocean to the SE. There are 2 commercial ports in Test Bay, Port Alpha and Port Beta. A trans-ocean voyage to Port Alpha is examined in the test case. Access from seaward is through Test Bay Narrows. Test Bay Pilot Service serves the Narrows. Port Alpha Pilots Association serves ports in the bay.

3.   Significant Assumptions About Nautical Information Objects and Associated Geographic/Spatial Objects

Regulations objects are tied to an ADMARE object where the regs apply

1 pilot boarding area and 1 Pilot Boarding Point tied to Alpha Pilot Dist.

2 pilot boarding places tied to Test Bay Pilot District.

2 Pilot Service Area objects (Test Bay Pilots and Alpha Pilots)
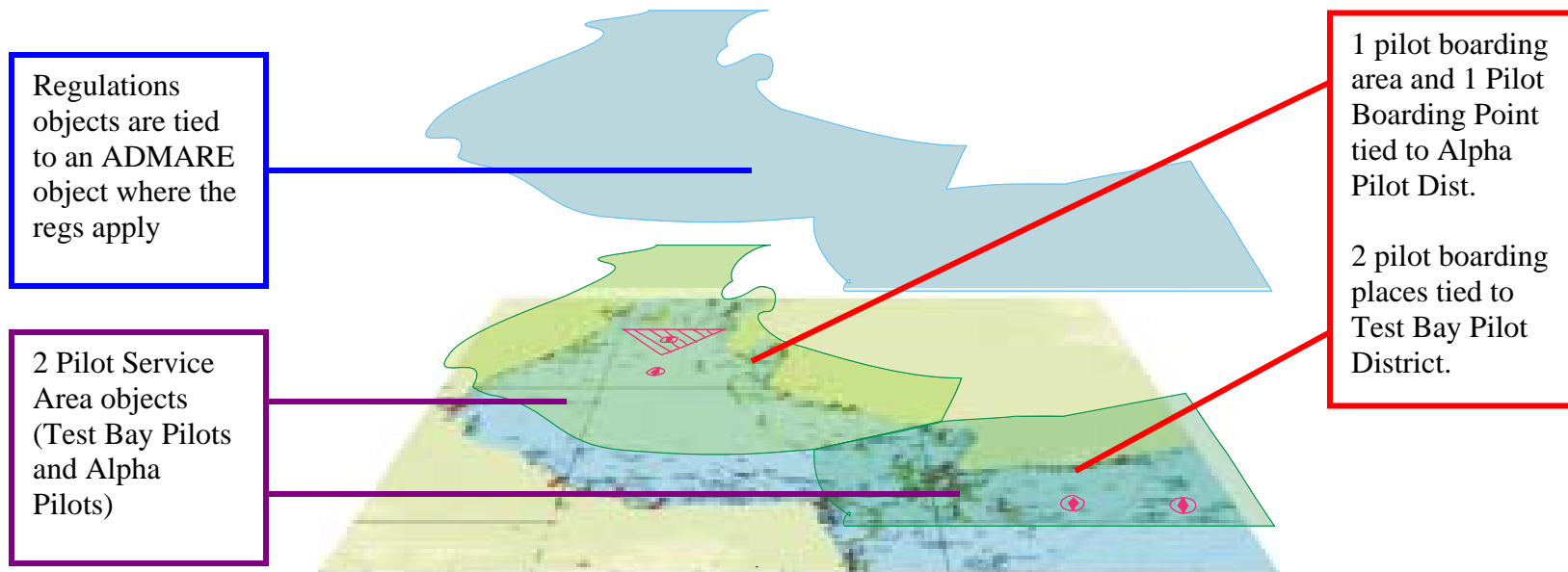
Figure 2: ENC spatial objects of interest.

In this case, the 2 pilot services are represented in ENC with polygons which cover all geographic objects such as pilot boarding places that they serve. Similarly, pilotage regulations are tied to an ADMARE object that covers the 2 pilot services. The ordering (layering) shown above is only for illustration purposes; Actual ENC objects classes could have any display order and display scale characteristics. The goal of this case is to explore what objects/attributes are needed (information objects, geographic objects, and spatial objects) and what associations between them are needed in order for ECDIS to communicate what the mariner needs to know. The 3 ECDIS use cases in this document work better, and the object model is more elegant, if pilotage regulations and pilot services are associated with area spatial objects, and if ECDIS for S-100 ENC is capable of basic spatial analysis tasks such as determining containment of objects by other objects, spatially.

4.   Test Bay Sailing Directions Content, Mapped to Amended SNPWG10 Object Model

The following table shows Test Bay Sailing Directions content on the left, and the content mapped to the SNPWG10 model on the right. The goal was to convert as much as possible of the Sailing Directions into ECDIS software-readable coded values, minimizing the amount of reading and interpretation of SD text left to the mariner.   Entries in the ID column uniquely identify each object. The "associates" rows, in gray, indicate which objects are associated with the current object. New/changed model items are in **blue.** These additions and changes are explained in the accompanying "FCD changes" document.

Testland Sailing Directions, Vol 1	*ID*	*Object*	*Attribute*	*Value or Content*
Chapter 8: Test Bay	reglts01	reglts	cataut	15 (maritime)
		reglts	catrxn	1 (pilotage)
8.5 Pilotage		reglts	rxncod	1 (pilotage compulsory)
	associates	admare01, chalim01		
8.5.1 Regulations: Pilotage is required for all vessels over	chalim01	chalim	maxdrf	12.00
12 meters draught, for all vessels over 100 meters overall		chalim	maxloa	100
length, and for all vessels carrying hazardous cargo.		chalim	catcgo	7
Foreign vessels entering Test Bay must file a voyage plan		chalim	limtyp	10 (information object targeted by the chalim object applies to vessels satisfying the conditions)
96 hours prior to arrival, including pilotage arrangements. Vessels entering the bay through Test Bay Narrows must	associates	reglts01		
have a Federally certified pilot onboard after passing Test	shprep01	shprep	catrep	8 (other)
Bay Light. Transits between ports in Test Bay requiring		shprep	ntctim/ntchrs	96
pilotage may use a certified harbour pilot. Specific		shprep	ntctim/ntctxt	prior to arrival in Test Bay
regulations for pilotage on movement within Test Bay are		shprep	INFORM	File voyage plan including pilotage arrangements
found in the National Shipping Regulations.	associates	admare01, chalim02		
	chalim02	chalim	catrgy	2 (Foreign)
		chalim	limtyp	10
	associates	shprep01		
	reglts03	reglts	cataut	15
		reglts	catrxn	1 (pilotage)
		reglts	rxncod	2 (qualifications of pilot on board)
		reglts	INFORM	Vessels entering the bay through Test Bay Narrows must have a Federally certified pilot onboard after passing Test Bay Light.
		reglts	pltqfc	4

associates	admare01			
reglts04	reglts	cataut		15
	reglts	catrxn		1 (pilotage)
	reglts	rxncod		2
	reglts	INFORM		Transits between ports in Test Bay requiring pilotage may use a certified harbour pilot.
	reglts	pltqfc		3
associates	admare01			
reglts05	reglts	cataut		15
	reglts	catrxn		1
	reglts	INFORM		Specific regulations for pilotage on movement within Test Bay are found in the National Shipping Regulations.
	reglts	TXTDSC		TL000001.TXT[1]
associates	admare01			
admare01	ADMARE	JRSDTN		3
	ADMARE	NATION		TL
	ADMARE	OBJNAM		Test Bay
associates	reglts01, shprep01, reglts03-05			
pltsrv01	pltsrv	OBJNAM		Test Bay Pilot Service
	pltsrv	catplt		1,2,3
	pltsrv	ntctim/ntchrs		24
	pltsrv	PILDST		Test Bay Pilot District
	pltsrv	pltqfc		4,3
	pltsrv	pltrqs		Vessels transiting Test Bay Narrows must contact the pilot service and arrange pilotage in advance, by telephone or fax.
associates	condet01			
condet01	condet	calnam		Test Bay Pilot Service
	condet	CALSGN		KMA 903
	condet	numtel		+00 9090 12345
	condet	nmtlow		+00 9090 12340
	condet	numfax		+00 9090 12346
	condet	delpnt		123 Test St

8.5.2 Pilot Service: Two pilot services manage Test Bay. Pilot service for vessels transiting Test Bay Narrows is managed by: Test Bay Pilot Service, 123 State Street, Testtown, Testland 1101001, Telephone: +00 9090 12345, Fax: +00 9090 12346, Call Sign: KMA 903. Email: test@TBPilots.com. Hours of operation: 09:00 to 17:00 weekdays, 08:00 to 15:00 Saturdays. Closed Sundays and Holidays. After hours emergent issues may be addressed via the after hours number: +00 9090 12340.

Vessels transiting Test Bay Narrows must contact the pilot service and arrange pilotage at least 24 hours in advance, by telephone or fax, with an update to the pilot vessel on VHF 16 6 hours in advance.

Traffic within Test Bay for the Alpha Pilotage District is managed by Port Alpha Pilots Association, 456 Alpha St, Alphatown, Testland 1101002, Telephone: +00 8080 12345, Fax: +00 8080 12346, Call Sign: KMA 904. Hours of operation: 09:00 to 17:00 weekdays and Saturdays. Closed Sundays and Holidays. After hours emergent issues may be addressed via the after hours number: +00 8080 12340.

Vessels planning arrival or departure from Port Alpha or Port Beta must contact Port Alpha Pilots and arrange pilotage at least 12 hours in advance, by telephone, radiotelephone, or fax. A 6 hour update to the pilot station at Alpha Light is required. The pilot vessel monitors VHF 16 and works on channel 22.

	condet	citynm	Testtown
	condet	contry	Testland
	condet	poscod	1101001
	condet	emails	test@TBPilots.com
	condet	COMCHA	16
associates	pltsrv01		
srvhrs01	srvhrs	wkdywk	1/5,6
	srvhrs	wkhrdy/timref	2 (LT)
	srvhrs	wkhrdy/timstw	0900, 0900
	srvhrs	wkhrdy/timenw	1700, 1500
associates	pltsrv01		
pltsrv02	pltsrv	OBJNAM	Port Alpha Pilots Association
	pltsrv	catplt	3
	pltsrv	ntctim/ntchrs	12
	pltsrv	PILDST	Port Alpha Pilot District
	pltsrv	pltqfc	4
	pltsrv	pltrqs	Vessels planning arrival or departure from Port Alpha or Port Beta must contact Port Alpha Pilots and arrange pilotage in advance, by telephone, radiotelephone, or fax.
associates	condet02		
condet02	condet	calnam	Port Alpha Pilots Association
	condet	CALSGN	KMA 904
	condet	numtel	+00 8080 12345
	condet	nmtlow	+00 8080 12340
	condet	numfax	+00 8080 12346
	condet	delpnt	456 Alpha Street
	condet	citynm	Alphatown
	condet	contry	Testland
	condet	poscod	1101002
associates	pltsrv02		
srvhrs02	srvhrs	OBJNAM	Port Alpha Pilot Service
	srvhrs	wkdywk	1/6
	srvhrs	wkhrdy/timref	2 (LT)

<table>
<tr><td rowspan="27">Pilot Embarkation and Disembarkation – the Narrows

Vessels over 14 meters draught or 100 meters overall length and all vessels carrying hazardous goods normally meet the pilot vessel 6.5 miles E of Test Bay Light (34°24.6'N., 136°55.8'E.). Vessels are requested to create a leeward shelter for the pilot boarding ladder.   Pilots board from an orange pilot boat with a white superstructure marked Test Bay Pilots.

Vessels with a draft 14m or less will meet the pilot vessel 3.4 miles E of Test Bay Light (34°25'N, 137°00'E.) Be advised that there is a high concentration of traffic in this area and visibility can be limited by fog.</td><td></td><td>srvhrs</td><td>wkhrdy/timstw</td><td>0900</td></tr>
<tr><td></td><td>srvhrs</td><td>wkhrdy/timenw</td><td>1700</td></tr>
<tr><td>associates</td><td>pltsrv02</td><td></td><td></td></tr>
<tr><td>pilbop01</td><td>PILBOP</td><td>CALSGN</td><td>KMA 903</td></tr>
<tr><td></td><td>PILBOP</td><td>CATPIL</td><td>1</td></tr>
<tr><td></td><td>PILBOP</td><td>catpbp</td><td>1</td></tr>
<tr><td></td><td>PILBOP</td><td>COMCHA</td><td>16</td></tr>
<tr><td></td><td>PILBOP</td><td>gmllcn</td><td>6.5 miles E of Test Bay Light</td></tr>
<tr><td></td><td>PILBOP</td><td>OBJNAM</td><td>Test Bay Pilot Boarding Place 1</td></tr>
<tr><td></td><td>PILBOP</td><td>PILDST</td><td>Test Bay Pilotage District</td></tr>
<tr><td></td><td>PILBOP</td><td>pltmov</td><td>1,2,3</td></tr>
<tr><td></td><td>PILBOP</td><td>pltvsl</td><td>Orange pilot boat, white superstructure marked Test Bay Pilots.</td></tr>
<tr><td></td><td>PILBOP</td><td>dstntn</td><td>Test Bay, inbound from and outbound to sea</td></tr>
<tr><td></td><td>PILBOP</td><td>pltrqs</td><td>Update pilot vessel in advance</td></tr>
<tr><td></td><td>PILBOP</td><td>ntctim/ntchrs</td><td>6</td></tr>
<tr><td></td><td>PILBOP</td><td>svaprc</td><td>Vessels are requested to create a leeward shelter for the pilot boarding ladder.</td></tr>
<tr><td>associates</td><td>chalim03</td><td></td><td></td></tr>
<tr><td>chalim03</td><td>chalim</td><td>maxdrf</td><td>14.00</td></tr>
<tr><td></td><td>chalim</td><td>maxloa</td><td>100</td></tr>
<tr><td></td><td>chalim</td><td>catcgo</td><td>7</td></tr>
<tr><td></td><td>chalim</td><td>limtyp</td><td>2 (use by vessels meeting limitations is required)</td></tr>
<tr><td>associates</td><td>pilbop01</td><td></td><td></td></tr>
<tr><td>pilbop02</td><td>PILBOP</td><td>CALSGN</td><td>KMA 903</td></tr>
<tr><td></td><td>PILBOP</td><td>CATPIL</td><td>1</td></tr>
<tr><td></td><td>PILBOP</td><td>catpbp</td><td>1</td></tr>
<tr><td></td><td>PILBOP</td><td>COMCHA</td><td>16</td></tr>
<tr><td></td><td>PILBOP</td><td>gmllcn</td><td>3.4 miles E of Test Bay Light</td></tr>
<tr><td></td><td>PILBOP</td><td>OBJNAM</td><td>Test Bay Pilot Boarding Place 2</td></tr>
<tr><td></td><td>PILBOP</td><td>PILDST</td><td>Test Bay Pilotage District</td></tr>
<tr><td></td><td>PILBOP</td><td>pltmov</td><td>1,2,3</td></tr>
</table>

In heavy weather, vessels should contact the pilot vessel again 3 hours prior to arrival at the pilot boarding place. Ships outbound from Test Bay may be diverted to Test Bay Anchorage A, 3 miles west of Test Bay Light, and vessels inbound from sea may be diverted to Anchorage B, 6 miles SE of Test Bay Light.

Pilot Embarkation and Disembarkation – Port Alpha

Vessels under 14 meters draught inbound from the

ID	Type	Attribute	Value
	PILBOP	pltvsl	Orange pilot boat, white superstructure marked Test Bay Pilots.
	PILBOP	dstntn	Test Bay, inbound from and outbound to sea
	PILBOP	pltrqs	Update pilot vessel in advance
	PILBOP	ntctim/ntchrs	6
	PILBOP	INFORM	Be advised that there is a high concentration of traffic in this area and visibility can be limited by fog.
associates	chalim04		
chalim04	chalim	maxdrf	14.00
	chalim	limtyp	1 (use by vessels meeting limitations is prohibited)
associates	pilbop02		
pilbop03	PILBOP	CALSGN	KMA 903
	PILBOP	CATPIL	1
	PILBOP	catpbp	2
	PILBOP	gmllcn	Test Bay anchorage, 3 miles W of Test Bay Light
	PILBOP	COMCHA	16
	PILBOP	OBJNAM	Test Bay Alternate Pilot Boarding
	PILBOP	PILDST	Test Bay Pilotage District
	PILBOP	pltmov	2
	PILBOP	pltvsl	Orange pilot boat, white superstructure marked Test Bay Pilots.
	PILBOP	dstntn	Test Bay, outbound to sea
	PILBOP	pltrqs	Update pilot vessel in advance
	PILBOP	ntctim/ntchrs	3
associates			
pilbop03A	PILBOP	CALSGN	KMA 903
	PILBOP	CATPIL	1
	PILBOP	catpbp	2
	PILBOP	gmllcn	Anchorage B, 6 miles SE of Test Bay light
	PILBOP	COMCHA	16
	PILBOP	OBJNAM	Test Bay Alternate Pilot Boarding
	PILBOP	PILDST	Test Bay Pilotage District
	PILBOP	pltmov	1

Narrows, except tankers and vessels carrying hazardous cargo, will handover pilotage to the Port Alpha Pilot at the Pilot Boarding Area A, 1 mile South of Port Alpha Lighted Whistle Buoy 7. Vessel and pilot boat should agree on a meeting point within the boarding area 1 hour prior to embarkation/disembarkation, using VHF 16 or 22. Vessels inbound from the Narrows that are over 14 meters draught, tankers and all vessels carrying hazardous goods meet the pilot vessel 2 miles South of Port Alpha Lighted Whistle Buoy 7. Port Alpha Pilots association is served by two 35' orange pilot boats marked PILOT. A pilot vessel is on station in Pilot Boarding Area A 24 hours by 7 days/week.	PILBOP	pltvsl	Orange pilot boat, white superstructure marked Test Bay Pilots.
	PILBOP	dstntn	Test Bay, inbound from sea
	PILBOP	pltrqs	Update pilot vessel in advance
	PILBOP	ntctim/ntchrs	3
associates			
pilbop04	PILBOP	CALSGN	KMA 904
	PILBOP	CATPIL	1
	PILBOP	catpbp	1
	PILBOP	COMCHA	16, 22
	PILBOP	gmllcn	1 mile South of Port Alpha Lighted Whistle Buoy 7
	PILBOP	OBJNAM	Pilot Boarding Area A
	PILBOP	PILDST	Alpha Pilotage District
	PILBOP	pltmov	1,2,3
	PILBOP	pltvsl	Two 35' orange pilot boats marked PILOT.
	PILBOP	dstntn	Port Alpha or Beta, inbound from and outbound to Test Bay Pilot Boarding Place
	PILBOP	pltrqs	Update pilot vessel in advance
	PILBOP	ntctim/ntchrs	6
	PILBOP	ntctim/ntctxt	update 1 hr prior to embarkation/disembarkation
	PILBOP	svaprc	Vessel and pilot boat should agree on a meeting point within the boarding triangle prior to embarkation/disembarkation
associates	chalim05		
chalim05	chalim	maxdrf	14.00
	chalim	catvsl	3 (tanker)
	chalim	catcgo	7
	chalim	limtyp	1 (use is prohibited)
associates	pilbop04		
pilbop05	PILBOP	CALSGN	KMA 904
	PILBOP	CATPIL	1
	PILBOP	catpbp	1
	PILBOP	COMCHA	16, 22
	PILBOP	gmllcn	2 miles South of Port Alpha Lighted Whistle Buoy 7

[1] This file contains the text of the "National Shipping Regulations" for Testland.

		PILBOP	OBJNAM	Pilot Boarding Place B
		PILBOP	PILDST	Alpha Pilotage District
		PILBOP	pltmov	1,2,3
		PILBOP	pltvsl	Two 35' orange pilot boats marked PILOT.
		PILBOP	dstntn	Port Alpha or Beta, inbound from and outbound to Test Bay Pilot Boarding Place
		PILBOP	pltrqs	Update pilot vessel in advance
		PILBOP	ntctim/ntchrs	6
	associates	chalim06		
	chalim06	chalim	maxdrf	14
			limtyp	2 (use is required)
			catvsl	3 (tanker)
			catcgo	7
	associates	pilbop05		
	srvhrs03	srvhrs	wkdywk	1/7
		srvhrs	wkhrdy/timref	2 (LT)
		srvhrs	wkhrdy/timstw	0000
		srvhrs	wkhrdy/timenw	2400
	associates	pilbop04		

5. USE CASES: 2nd Mate of Panama registered cargo ship plans international voyage to Port Alpha

Use Case 1: 2nd mate uses ECDIS to **determine pilotage requirements**
2nd Mate of a cargo ship, L=294m, B=32m, Draft 12m, plans international voyage to Port Alpha
Actor: 2nd Mate
Actor: ECDIS software (S-100 ENC loaded in ECDIS)
1) 2nd Mate sets ECDIS to Planning Mode, observes Pilot Boarding Place Symbols in/around Test Bay
2) 2nd Mate clicks on a pilot boarding place symbol in Chart View, close to Port Alpha
3) ECDIS checks for a pilotage regulations ADMARE containing the PILBOP, checks for pilot services and pilot boarding places contained in the area covered by the pilotage regulations, and presents Info View report for the selected location. (see figure 3)
4) 2nd Mate clicks Pilotage link in Info View (fig 3.)
5) ECDIS compares OWNSHIP characteristics to Pilotage requirements in ENC for all Pilot District objects related to clicked point in chart
6) ECDIS determines that Pilotage is required for this vessel at Port Alpha, Port Beta, and Test Bay Narrows
7) ECDIS displays the Pilotage Info Display (figure 4.)
8) 2nd Mate reads content of Pilotage Info Display

Test Bay
- ⇨ Navigational System of Marks
- ⇨ Administrative Area
- ⇨ Depth Area
- ⇨ Coverage
- ⇨ Administrative Area
- ⇨ Pilot Boarding Place

Nautical Information
Approach
Regulations
Natural Conditions
Traffic and Ship Reporting Services
Pilotage
Fairways/Restrictions
Signals
Anchorage
Port

Figure 3

Pilotage: TEST BAY
Pilotage required for this ship at
 Test Bay Narrows **CONTACT SERVICE**
 Port Alpha   **CONTACT SERVICE**
Pilot Service must be arranged in advance
Voyage plan must be filed 96hr in advance

Port Alpha Pilot Boarding A,B   DETAIL

Nautical Information
Approach
Regulations
Natural Conditions
Traffic and Ship Reporting Services
Pilotage
Fairways/Restrictions
Signals
Anchorage
Port

Figure 4

Use Case 2: 2nd Mate uses ECDIS to **arrange pilotage**

1) 2nd Mate completes Use Case 1

2) 2nd Mate selects the CONTACT SERVICE choice for Test Bay in the Figure 4 Information Display window.

3) ECDIS locates pilot service and contact detail for Test Bay Pilot Service

4) ECDIS displays Pilot Service Information View for Test Bay (Figure 5)

5) 2nd Mate reads Test Bay Pilot Service detail, including linking to National Shipping Regulations. Shipping Regs for pilotage in this area state that a voyage plan including pilotage plans must be submitted 96 hours prior to departure.

6) 2nd Mate contacts the Test Bay Pilot Service and arranges pilotage.

7) 2nd Mate repeats steps 2-6 for Port Alpha pilot service.

8) 2nd mate includes pilotage plans in voyage plan

Pilot Service: TEST BAY PILOT SERVICE
⇨Foreign flag: File voyage plan specifying pilotage 96hr prior to arrival in Test Bay
⇨Vessels transiting Test Bay Narrows must contact the pilot service and arrange pilotage 24 hours in advance, by telephone or fax.
⇨Vessels entering the bay through Test Bay Narrows must have a Federally certified pilot onboard after passing Test Bay Light.
⇨Transits between ports in Test Bay requiring pilotage may use a certified harbour pilot.
⇨Specific regulations for pilotage in Test Bay
National Shipping Regulations

Call Name	Test Bay Pilot Service
Call Sign	KMA 903
Telephone	+00 9090 12345
Alt Phone	+00 9090 12340
Fax	+00 9090 12346
Address	123 Test St
City	Testtown
AdminDiv	Testland
Post Code	1101001
VHF	16

Hours: 09:00-17:00 M-F,08:00-15:00 S

.

Figure 5

Use Case 3: 2nd Mate uses ECDIS to **execute pilotage**

1) 2nd Mate completes Use Case 2

2) 2nd Mate sets an alarm in ECDIS to advise the Watch Officer to update the Test Bay pilot vessel, and also to notify the Alpha Pilot Association pilot vessel, at the appropriate time.

3) ECDIS displays notice time alarm with contact detail for the Test Bay Pilot Vessel to the Watch Officer

4) Pilot boards the ship as planned. Master and Pilot review Pilot Checklist. Master hands over the con to the Pilot

5) Pilot and Bridge Crew begin navigating ship from Test Bay PBP toward Alpha PBP.

6) ECDIS displays notice time alarm with contact detail for Alpha Pilot Vessel to the Pilot

7) Pilot instructs Communications Officer to contact Alpha Pilot Vessel.

8) Comms Officer confirms pilot boarding location for handover of pilotage to Alpha Pilot Vessel

9) Test Bay Pilot disembarks and Alpha Pilot embarks at the Alpha PBP.

10) Master reviews Pilot Checklist with Pilot and hands over con to the new Pilot

11) Pilot and Bridge Crew navigate ship to berth.

6.   ANALYSIS: Observations and Questions:

Observations:

The Design of Publications, ENC, AND ECDIS Must All Change Together to Achieve S-100

Today, ENC and sailing directions are separate tools and systems. ENC is presents geographic features relevant to marine navigation in a navigation application. If there is a pilot boarding place object in a chart, it may carry bits of SD content, but one knows one must also read the sailing directions. S-100 intends to combine the *geographic* functions of ENC today with the *procedural instructions* functions of sailing directions, fusing the two types of information into an integrated, geographic data product. Some interesting consequences appear in the test case:

> No association between PILBOP and pltsrv is defined, nor any association between pltsrv and regulations objects. They are unnecessary because in all cases, the ADMARE geographic to which all the regulations are tied completely contains the two pilot service objects, spatially – and similarly, the pltsrv objects completely contain all PILBOP objects which are served by the pilot services.

This produces an elegant solution for pilotage, respecting   the S-100 definition that S-100 products are primarily hydrographic databases.

A related assumption about S-100 capable ECDIS must also be true in order for the example use cases to work:

ECDIS must change from being primarily an electronic chart *display system* to being an electronic *information system.* ECDIS must essentially become a GIS. S-100 ECDIS would have to be able to analyze topological relationships between spatial objects, if it is intended to serve as a reference system for the highly conditional information in nautical publications represented as geographic objects/attributes and information objects tied to geographic objects.

Finally, for all of this to work, management and maintenance of nautical publications information would have to switch from the desktop publishing or content management systems used by Hydrographic Offices today to a new type of GIS solution that can manage conditional, textual information, sequences of instructions, etc. using geographic objects.

The Topic of Pilotage is Favorably Biased Toward Implementation As Geographic Information

Pilotage has several strongly geographic aspects: 1) pilotage services are typically bound to ports; 2) certain important aspects of pilotage are bound to locations in space (e.g., boarding places, pilot stations, buildings, street addresses, etc.); 3) the geographic aspects of pilotage were already defined and implemented in S-57 ENC.

Pilotage information is inherently rich in object-attribute information, compared to other kinds of information in publications, such as cargo restrictions, communications procedures, passage interdiction rules, etc.

Consider Use Case 2 and figure 5. At the top of the Figure 5 Info View is a scrollable list of pilotage information items. The information in the list certainly is crucial. Several things have to happen in order to generate the displayed list. In step 3 of use case 2, the ECDIS would have to read all pilotage related objects that might contain relevant information. In this case, that includes all 4 regulations objects, all chalim objects, the 2 pilot service objects, and the shprep object. Now focus on the first statement in figure 5: "Foreign flag: File voyage plan specifying pilotage 96hr prior to arrival in Test Bay", and compare it with the shprep01 object and chalim02 on page 4 above. To construct the first statement in Figure 5, the S-100 dataset would have to be structured such that ECDIS software could construct the "Foreign flag:" phrase from chalim02,catrgy=2, follow it with the shprep01, INFORM content, followed by its ntctim/ntchrs value, followed by the content stored in its ntctim/ntctext attribute. Do the current S-100 Product Specifications and the SNPWG10 FCD provide a means to encode this "extra" information so the syntax of the sentence in the Info View can be created from the values in the data? Is there another conformant way of encoding the information show at the top of figure 5 that overcomes this issue?

The hierarchical, conditional nature of sailing directions presents a pervasive issue, even in the favorably biased example of Pilotage. Other examples worth reviewing within this case:

- Notice time: Look through the uses of notice time, notice hours, notice text, pilot request, and service area procedure in the table in Section 3. Please have a look at PILBOP04, for a specific example. Instructions for this pilot boarding place require the ship to contact the pilot 6 hours in advance, and again 1 hour in advance. For the example case, pltrqs and ntctim were used to handle the 6 hour update instruction, and ntctxt and svaprc were used to cover the 1 hour update. This would probably not work in practice; how would ECDIS software know to split up ntctim and ntctxt (those 2 are a new complex attribute we created) , and how would it know that the pltrqs element goes with ntctim, while the ntctxt element goes with the svaprc element?
- Regulations: Breaking up the prose sailing directions regulations into separate objects was useful. It enabled ECDIS to compare characteristics of the 2nd mate's own ship to restriction elements such as length, and automatically decide whether the ship required pilotage. It was necessary to add some attributes, e.g., category of restriction (catrxn) and restriction code (rxncod) to make this work in the example.   It seems likely that trying to use these variables to handle all real word types of regulatory restrictions would result in an extremely long enumerated list.
- Please look through the items in the Section 3 table that are encoded as strings , e.g. the dstntn attributes, etc. Are there clear ways to further break these down and convert to coded values?
- Conversely, think about the coded-value items in the table. What percentage are actually used in the use cases?   Is it worthwhile to reduce sailing instructions items to coded values in cases where the coded values are only useful in ECDIS if used to reconstitute human readable sentences?

Additional Questions:
- Was any important information in the Sailing Directions lost when converted to the SNPWG object model?
- If the intent of S-100 is to enable Hydrographic Offices to maintain nautical publications content and chart data in a single database, how will HOs, especially those that use content management systems to manage text publications today, transition from CMS to "GIS." W GIS solutions for ENC today are ready to also produce sailing directions, lists of radio signals, etc.?
- Would you map the Sailing Directions content to the SNPWG model differently?
- Were any crucially important objects or attributes in SNPWG/S57 missed that should be added to the generic case? Some possibilities:
  - Restrictions, Recommendations (often hard to distinguish from regulations in real-world sailing directions prose)
  - CTNARE, PRCARE, RESARE, HRBFAC, HRBARE, SEAARE, consha, prtare
  - Autori, mrnsrv, M_NPUB, resdes, rcmdts, BUISGL, LNDMRK
- Does it seem easier for the 2nd Mate to use the ECDIS application to handle pilotage planning than reading the prose?

Pilotage Example - Objects and Attributes Used
June 24, 2009

NOTE: Press CTRL+Click to follow links in this document.

Objects and Attributes used to classify the Sailing Directions content in the Generic Test Case are shown in Table 1, below. Some object-attribute bindings defined in the SNPWG10 Feature Concept Dictionary (FCD) on the SNPWG Wiki were changed, and some entirely new attributes were defined for the Generic Test Case. FCD definitions for changed objects and changed/new attributes are found in this document, as linked below. Unchanged objects and attributes can be found at the SNPWG Wiki.

Type	Abbreviation	Name	Notes
Geographic Object	ADMARE	Administration Area	See S57 definition
Geographic Object	PILBOP	Pilot Boarding Place	Changed from S57 definition
Geographic Object	pltsrv	Pilot Service	
Information Object	chalim	Characteristics of Vessels which cause Limitations	
Information Object	condet	Contact Details	
Information Object	reglts	Regulations	
Information Object	shprep	IMO Ship Report	
Information Object	srvhrs	Service Hours	
Attribute	calnam	Call Name	
Attribute	CALSGN	Call Sign	See S57 definition
Attribute	cataut	Category of Authority	
Attribute	catcgo	Category of Cargo	
Attribute	catpbp	Category of Pilot Boarding Place	SNPWG will likely change the name and acronym for this variable to overcome the duplication with next item
Attribute	CATPIL	Category of Pilot Boarding Place	See S57 definition
Attribute	catplt	Category of Pilot	
Attribute	catrep	Category of IMO Ship Report	
Attribute	catrgy	Category of Vessel Registry	
Attribute	catrxn	Category of Regulation / Restriction /Recommendation	
Attribute	catvsl	Category of Vessel	
Attribute	citynm	City Name	
Attribute	COMCHA	Communications Channel	See S57 definition
Attribute	contry	Country	
Attribute	delpnt	Delivery Point	
Attribute	dstntn	Destination	
Attribute	emails	Email Address	
Attribute	gmllcn	Location Name	
Attribute	INFORM	Information	See S57 definition
Attribute	JRSDTN	Jurisdiction	See S57 definition
Attribute	limtyp	Limitation Type	
Attribute	maxdrf	Maximum Draft	
Attribute	maxloa	Maximum Overall Length	
Attribute	NATION	Nationality	See S57 definition

Attribute	nmtlow	Telephone Number Outside Working Hours	
Attribute	ntchrs	Notice Time in Hours	
Attribute	ntctim	Notice Time	
Attribute	ntctxt	Notice Time Text	
Attribute	numfax	Fax Number	
Attribute	numtel	Telephone Number	
Attribute	OBJNAM	Object Name	See S57 definition
Attribute	PILDST	Pilot District	See S57 definition
Attribute	pltmov	Pilot Movement	
Attribute	pltqfc	Pilot Qualification	
Attribute	pltrqs	Pilot Request	
Attribute	pltvsl	Pilot Vessel	
Attribute	poscod	Postal Code	
Attribute	rxncod	Regulation / Restriction / Recommendation Code	
Attribute	svaprc	Service Access Procedure	
Attribute	timenw	Time of End of Work	
Attribute	timref	Time Reference	
Attribute	timstw	Time of Start of Work	
Attribute	TXTDSC	Textual Description	See S57 definition (need change?)
Attribute	wkdywk	Working Days of Week	
Attribute	wkhrdy	Working Hours of Day	

Geographic Object Classes

PILBOP

Geographic Object Class: Pilot boarding place   Acronym: PILBOP

Camel case: PilotBoardingPlace

Set Attribute_A: CALSGN; CATPIL; catpbp; catvsl; COMCHA; DATEND; DATSTA; dstntn; NOBJNM; NPLDST; ntctim; OBJNAM; PEREND; PERSTA; PILDST; pltmov; pltrqs; pltvsl; STATUS; svaprc;

Set Attribute_B: INFORM; NINFOM; NTXTDS; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Associated information object classes: srvhrs; chalim;

Definition:
The meeting place to which the pilot comes out. (IHO Chart Specs, M-4)

References:
INT 1: IT 1.1-4; M-3: ? M-4: 491.1 2;

Remarks:
No remarks.

Distinction:
No distinctions.

pltsrv

Geographic Object Class: Pilot service   Acronym: pltsrv

Camel case: PilotService

Set Attribute_A: catplt; DATEND; DATSTA; NOBJNM; NPLDST; ntctim; OBJNAM; PEREND; PERSTA; PILDST; pltqfc; pltrqs; rmtplt;

Set Attribute_B: INFORM; NINFOM; NTXTDS; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Associated information object classes: condet; rcmdts; reglts; resdes; shprep; srvhrs;

Definition:
The area where pilotage services are available. Pilotage is a service provided by a person who directs the movements of a vessel through pilot waters, usually a person who has demonstrated extensive knowledge of channels, aids to navigation, dangers to navigation, etc., in a particular area and is licensed for that area. (adapted from IHO Dictionary, S-32, 5th Edition, 3843)

References:
INT 1:
M-3: Chapter C Section C 2.8
M-4:

Remarks:
The name of this object may be the same as the Pilot District of the associated PILBOPs.

Distinction:
No distinctions.

Information object classes

chalim

Information Object Class: Characteristics of vessels which cause limitations   Acronym: chalim

Camel Case: CharacteristicsOfVesselsCausingLimitations

Set Attribute_A: balast; catcgo; catdhc; catrgy; catvsl; DATEND; DATSTA; icecap; limtyp; maxair; maxbrd; maxdpl; maxdrf; maxdwt; maxgtn; maxloa; maxntn; mindpl; mindwt; mingtn; minloa; minntn; N0BJNM; OBJNAM; PEREND; PERSTA; prfmnc;

Set Attribute_B: INFORM; NINFOM;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Associated information object classes: natinf; rcmdts; reglts; resdes;

Definition:
Characteristics of vessels (by construction, cargo or performance), which limit the passage of vessels, or the use by vessels, of an area or facility.

References:
INT 1: M-3: Chapter C, Section C 3.3 M-4:

Remarks:
This object is used to describe the characteristics of vessels, which limit the passage of a vessel, or the use of a facility by a vessel, because the vessel is:
• carrying ballast water.
• matches one of the values in the ship type, cargo type or dangerous or hazardous cargo type attributes;
• or does not match the performance requirements;
• or exceeds one of the "max" attributes or;
• or is less than one of the "min" attributes.
As an example of how this information object could be used, ship dimensions or type of cargo could be used in combination with a related geographic object, in which regulations (e.g. length limit or type of cargo restrictions) apply.

Distinction:
No distinctions.
.

reglts

Information Object Class: Regulations   Acronym: reglts

Camel Case: Regulations

Set Attribute_A: cataut; catrxn; DATEND; DATSTA; NOBJNM; OBJNAM; PEREND; PERSTA; pltqfc; rxncod;

Set Attribute_B: INFORM; NINFOM; NTXTDS; SCAMAX; SCAMIN; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Definition:
Regulations for a related area or facility.

References:
INT 1: M-3: Chapter C 2.2.1, C 2.7, C 2.8, C 3.19, C 3.21 M-4:

Remarks:
No remarks.

Distinctions:
natinf; rcmdts; resdes;

shprep

Information Object Class: IMO Ship report   Acronym: shprep

Camel Case: ImoShipReport

Set Attribute_A: catrep; ntctim; imorep

Set Attribute_B: INFORM; NINFOM; NTXTDS; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Associated information object: chalim

Definition:
This describes how a ship should report to a maritime authority, including when to report, what to report and whether the format conforms to the IMO standard.

References:
IMO Resolution A 851(20) adopted 27 November 1997

Remarks:
TXTDSC and NTXTDS are used to describe non-standard ship reports. The Associated Information Object chalim indicates characteristics of vessels which use this report.

srvhrs

Information Object Class: Service hours   Acronym: srvhrs

Camel Case: ServiceHours

Set Attribute_A: DATEND; DATSTA; NOBJNM; OBJNAM; PEREND; PERSTA; wkdywk; wkhrdy;

Set Attribute_B: INFORM; NINFOM; NTXTDS; TXTDSC;

Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

Associated information object classes: nwkday;

Definition:
The time when a service is available and known exceptions.

References:
M-3:

Remarks:
No remarks.

Attributes

catpbp

Attribute: Category of pilot boarding place   Acronym: catpbp

Camel case: categoryOfPilotBoardingPlace   Attribute type: E

Expected input:

ID	Meaning
1	Primary
2	Alternate

Definitions:

primary: The preferred and published pilot boarding place which is used in normal weather conditions.

alternate: The pilot boarding place which is used if the primary boarding place is unsuitable, for example because of weather or sea state.

Remarks:

No remarks.

D.A. discovered that this object needs to be renamed because of a name clash with camel-case names. The probable new name is as follows:

Attribute: Preference of pilot boarding place   Acronym: prfpil

Camel case: preferenceOfPilotBoardingPlace

9

catplt

Attribute: Category of pilot   Acronym: catplt

Camel case: categoryOfPilot   Attribute type: L

Expected input:
ID	Meaning
1	pilot
2	deep sea
3	harbour
4	bar
5	river
6	channel
7	lake

Definitions:
pilot:
pilot licenced to conduct vessels during approach from sea to a specified place which may be a handover place, an anchorage or alongside

deep sea:
pilot licenced to conduct vessels over extensive sea areas

harbour:
pilot who is licenced to conduct vessels from a specified place, such as a handover area or anchorage into a harbour

bar:
pilot licensed to conduct vessels over a bar to or from a handover with a river pilot (for example as used in USA)

river:
pilot licensed to conduct vessels from and to specified places, along the course of a river (for example as used in Rio Amazonas and Rio de La Plata)

channel:
pilot licensed to conduct vessels from and to specified places, along the course of a channel. (for example as used in Rio Amazonas and Rio de La Plata)

lake:
pilot licensed to conduct vessels from and to specified places on a great lake. (for example as used in the Lago de Maracaibo in Venezuela)

Remarks:
No remarks.

catrgy

NEW
Attribute: Category of vessel registry

Acronym: catrgy

Camel case: categoryRegistry

Attribute type: E

Expected input:

ID	Meaning
1	domestic registry
2	foreign registry
3	both domestic and foreign *(is this item needed?)*

Definitions:

domestic registry
The vessel is registered or enrolled under the same national flag as the port, harbour, territorial sea, exclusive economic zone, or administrative area in which the object that possesses this attribute applies or is located.

foreign registry
The vessel is registered or enrolled under a national flag different from the port, harbour, territorial sea, exclusive economic zone, or other administrative area which the object that possesses this attribute applies or is located.

both domestic and foreign
The vessel is registered or enrolled under more than one flag, one of which is the same as that of the port, harbour, territorial sea, exclusive economic zone, or other administrative area which the object that possesses this attribute applies or is located.

catrxn

Attribute: Category of regulation / restriction / recommendation   Acronym: catrxn

Camel Case: categoryOfRxN   Attribute type: L

Definition: The broad category or semantic group to which the information, regulation, restriction, or recommendation pertains. These broad categories may correspond to subdivision titles in sailing directions.

Expected input
ID   Meaning

        Regulation/restriction/recommendation pertaining to…
1   pilotage
2   traffic separation, recommended routes, and navigation and collision avoidance, for example, overtaking and head-on situations, navigation in fairways or channels, COLREGS
3   use of anchorages
4   requirements and permissions for the use of port services and facilities, such as tug assistance
5   nature reserves, protected species, environmental protection and pollution
6   security and customs
7   offshore and coastal activities dangerous to shipping such as drilling platforms, military exercises, dumping grounds (merge with 18?)
8   required filings and reports for VTS and ship reporting systems
8   required filings and reports other than VTS and ship reporting systems
10   hazards and obstructions
11   operation of vessels in severe weather or other special meteorological conditions
12   signalling and ship-to-ship communications
13   small craft operations
14   commercial cargo operations
15   aids to navigation
16   miscellaneous port and waterways safety
17   regulated navigation areas and limited access areas
18   danger zones and restricted area regulations
 (others?)

Definitions
(should be obvious from the Meanings in the list above)

References:
M-3 Chapters C 2.2, C 2.8; BSH new-format Sailing Directions[1] ; US Coast Pilot Chapter 2, Navigation Regulations (multiple volumes)

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[1] To be reviewed: Admiralty sailing directions and NGA sailing directions. Other suggestions?

gmllcn

NEW
Attribute: Location Name   Acronym: gmllcn

Camel case: gmlLocationName   Attribute type: S

Definition:
A verbal designation or description of the location of a feature.

References: GML 3.2

Indication
Text string designating a location, e.g., "on a line between X and Y"; "1 mile E of Sandy Hook Light"; "North mole bearing 211° ", "offshore").

Remarks
This attribute is derived from the "locationName" element in GML. It is intended for designating locations in language a human reader can understand, for designating imprecise locations, or for designating locations which may not have corresponding spatial objects defined in the data set.
This attribute must not be used for encoding the official name of a feature.

limtyp

NEW
Attribute: Limitation type   Acronym: limtyp

Camel case: limitationType   Attribute type: E

Expected input:

ID	Meaning
1	use of facility (boarding place, etc.) by vessels satisfying the conditions is prohibited
2	use of facility (boarding place, etc.) by vessels satisfying the conditions is required
3	use of facility (boarding place, etc.) by vessels satisfying the conditions is permitted but not required
4	use of facility (boarding place, etc.) by vessels satisfying the conditions is recommended
10	information object targeted by the chalim object applies to vessels satisfying the conditions
11	information object targeted by the chalim object does not apply to vessels satisfying the conditions

Remarks:
This attribute describes the interpretation of a "chalim" information object in the context of the object(s) with which it is associated. The conditions referred to in the definitions are those expressed by the "chalim" object.

ntchrs

NEW
Attribute: Notice time in hours

Acronym: ntchrs

Camel case: noticeTimeHours

Attribute type: I

Definition: The time in hours, prior to the time the service is needed, when notice must be provided to the service provider.

References:

Indication:
Unit: Hours
Resolution: 1

Example:
24 for 24 hours notice

ntctim

Attribute: Notice time   Acronym: ntctim

Camel case: noticeTime   Attribute type: Complex

Definition:
Span of time, prior to the time the service is needed, for preparations to be made to fulfill the requirement.

References: ?

		CamelCode Identifier	Cardinality	sequential
ntchrs	SubAttribute	noticeTimeHours	1	n/a
ntctxt	SubAttribute	noticeTimeText	0..1	n/a

ntctxt

NEW
Attribute: Notice time text   Acronym: ntctxt

Camel case: noticeTimeText   Attribute type: S

Definition: Text qualifying the notice time requirement.

Indication
Text string qualifying the notice time specified in ntchrs. This may explain the time specification in ntchrs (e.g., "3 working days" for a ntchrs value of "72") or consist of other language qualifying the time, e.g., "on leaving previous port" or "on passing reporting line XY").

pltqfc

Attribute: Pilot qualification

Acronym: pltqfc

Camel Case: pilotQualification

Attribute type: L

Expected Input

ID	Meaning
1	government pilot
2	pilot approved by government
3	state pilot
4	federal pilot
5	company pilot
6	local pilot
7	citizen with sufficient local knowledge
8	citizen with doubtful local knowledge

Definitions:
government pilot:
A pilot service carried out by government pilots.

pilot approved by government:
A pilot service carried out by pilots who are approved by government.

state pilot:
A pilot that is licensed by the State (USA) and/or their respective pilot association, required for all foreign vessels and all American vessels under registry, bound for a port with compulsory State pilotage. A federal licence is not sufficient to pilot such vessels into the port.

federal pilot:
A pilot who carries a Federal endorsement, offering services to vessels that are not required to obtain compulsory State pilotage. Services are usually contracted for in advance.

company pilot:
A pilot provided by a commercial company

local pilot:
A pilot with local knowledge but who does not hold a qualification as a pilot

citizen with sufficient local knowledge:
A pilot service carried out by a citizen with sufficient local knowledge

citizen with doubtful local knowledge:
A pilot service carried out by a citizen whose local knowledge is uncertain

Remarks:
No remarks.

rxncod

Attribute: Regulation / restriction / recommendation code   Acronym: rxncod

Camel Case: rxnCode   Attribute type: L

Expected Input

ID	Meaning
1	Pilotage is compulsory
2	Pertaining to the qualifications of pilot (details described in INFORM attribute or TXTDSC file)
3	Passage prohibited
4	Passage prohibited under certain weather conditions (details in INFORM or TXTDSC file)
5	Overtaking prohibited
6	Overtaking permitted only under certain conditions (stated in INFORM/TXTDSC file)
7	Pertaining to head-on situations in restricted passages or fairways (details in INFORM or TXTDSC file)
8	Tug assistance compulsory
9	Quarantine and health
10	Customs
11	Loading and unloading cargo
12	Drawbridge operations
13	Navigation prohibited
14	Right of way
15	Traffic permission required
16	Applicable only to vessels exceeding specified dimensions (associated chalim will specify limits)

(others?)

Definitions:
(should be obvious from the list above)

Remarks:
This attribute is an attempt to encode the most common types of regulations (recommendations, restrictions) in a form that software (e.g., ECDIS) can use to do at least some subject-specific processing. Since the details are in natural language (i.e., as text in INFORM), this will not be much, but (a) it should be possible to use this in conjunction with "chalim" in some cases to provide enhancements like automatic indicators in the ECDIS/ECS that passage is forbidden for vessels of certain size; (b) provide hints, such as a hint that pilotage is *probably* compulsory, etc.

Note: It remains to be seen whether it is possible to create a list of codes that is reasonably comprehensive, useful, and also reasonably short.

wkdywk

Attribute: Working days of week

Acronym: wkdywk

Camel case: workingDaysOfWeek

Attribute type: L

Expected input:
ID	Meaning
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday
7	Sunday

Definitions:
Monday
the day of the week before Tuesday and following Sunday
Tuesday
the day of the week before Wednesday and following Monday
Wednesday
the day of the week before Thursday and following Tuesday
Thursday
the day of the week before Friday and following Wednesday
Friday
the day of the week before Saturday and following Thursday
Saturday
the day of the week before Sunday and following Friday (together with Sunday forming part of the weekend)
Sunday
the day of the week before Monday and following Saturday (together with Saturday forms part of the weekend)

Examples:
1/5, 6 for the range Monday-Friday, followed by Saturday;
1, 3, 5 for Monday, Wednesday, and Friday

Remarks:
The number of items in this list must match the number of entries in the corresponding wkhrdy attribute, if present[2].
Ranges may be denoted in X/X notation, e.g., 1/5 for Monday through Friday (inclusive).

---

[2] NATSUR/NATQUA have a similar constraint in S-57.

wkhrdy

Attribute: Working hours of day   Acronym: wkhrdy

Camel case: workingHoursOfDay   Attribute type: Complex

Definition:
The working hours of the day for the port or service.

		CamelCode Identifier	cardinality	sequential
timref	SubAttribute	timeReference	1	n/a
timstw	SubAttribute	timeOfStartOfWork	1..*	True
timenw	SubAttribute	timeOfEndOfWork	1..*	True

Remarks:
No remarks.

Comment:
The Product Specification should show that this attribute could be repeated if there are a number of working time periods in a day (e.g. 0800-1200, 1400-2000). It may also be necessary to define separators so that it is possible to distinguish multiple work periods in a single day from work periods corresponding to different days (perhaps by using different separators)[3].

---

[3] Note: wkdywk/wkhrdy should work as defined, if we are careful to define the encoding rules so that there is no ambiguity between multiple work periods for the same day and work periods corresponding to different days. (At worst, we can use different separator characters to distinguish the two, e.g., commas and semicolons; at best, an XML-based encoding could repeat elements in the proper sequence.)