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Title	**MEDIN data guideline for tidal elevation data**
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Summary	This guideline defines the format of data and information produced from the observation and recording of tidal elevation data and corrections to specified bathymetry chart datum in support of Marine Hydrographic and Geophysical Survey. Used correctly the guideline facilitates easy use and reuse of the data. An Excel template is also provided if required.
Keywords	Hydrography, Geology, Tides, Tidal Height

Change history		
Version	**Date**	**Change**
1.0	19/01/2012	First draft of document
1.1	25/01/2012	QC release
1.2	02/02/2012	INSPIRE assessment finalised
1.3	12/02/2012	Changes incorporated following QC process; Draft for MEDIN review release

1.4	29/03/2012	Changes incorporated following review process; final release

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1.1 Scope and Data Format for Submission to DAC (Data Archive Centre)

This guideline covers the observed/recorded tidal elevation data and corrections to specified bathymetry chart datum for the reduction of soundings acquired during hydrographic and geophysical survey, and as a compliment of tidal stream and current observations. It covers the raw data, methodologies used and the derived processed data.

The guideline does not cover the derived data products from the acquisition of bathymetry; these are covered in the following guidelines:

- MEDIN data guideline for multibeam echosounder (MBES) data
- MEDIN data guideline for single beam echosounder (SBES) data

Note: the information provided in this guideline could also be relevant for reducing bathymetric data processed from seismic data acquisition.

This guideline does not specify methodological principles and standards for tidal reduction, however the following operational guidelines and discussion are recommended:

Title	Link
IHO S-44 Standards for Hydrographic Surveys	http://www.iho.int/iho_pubs/standard/S-44_5E.pdf
IHO Manual on Hydrography Chapter 5 - Water Levels and Flow	http://www.iho.int/iho_pubs/CB/C-13/english/C-13_Chapter_5.pdf

Tidal data utilised for the reduction of soundings falls into three categories:

- Prediction of elevations and application of co-tidal and meteorological (barometric pressure corrections). In North West Europe predicted tides are formulated for a defined port and co-tidal and co-range charts used to correct the tides at the offshore location for reduced tidal range and time lead/lag. Predicted tides are often generated using software applications.
- Observed data from shore-based tide gauge or from seabed-mounted water level recorder (WLR), corrections for meteorological effects, separation of “surge” interpolation or other modelling and derivation of chart datum. Where observed data are used for the reduction of bathymetry there is either a single point or multipoint co-tidal model used to provide what is in effect a time series of depth corrections at the instant vessel positions.
- GNSS measurements of elevation of the vessel and transducer above ellipsoid, correction to geoid and to chart datum. Typically Real Time Kinematic (RTK) methods are used to obtain precise geodetic heights over the duration of the survey. Work has been undertaken to observe and compute accurate mean tidal surfaces globally, such as mean sea level or geoid models, and the height variations can be measured against these

datum models. Other corrections are applied post processing such as heave, pitch and roll for the vessel.

The guideline builds upon previous data specification work undertaken by BODC and ICES, SAIC GSF and also refers to industry formats.

MEDIN has a network of Data Archive Centres (DAC) where data can be submitted for archiving by organisations wishing to share data, but do not retain long term archive facilities themselves.

Where tidal data are supplied to a DAC as part of the survey data package it is recommended that the data are incorporated within a standard documented folder structure as this reduces data archiving costs. For an example folder structure refer to the BGS Offshore Acquisition Folder Structure at http://www.bgs.ac.uk/downloads/start.cfm?id=2256.

An inventory of files and their respective sizes, and supply formats and media should be provided to the DAC. This can also be incorporated within the folder structure if necessary e.g. as part of the data processing log.

Tidal data can take the form of raw observed tides and processed tides ready for application of tidal reduction to soundings. Tide files normally take the form of summary files with date, time and tidal correction, or tide heights supplied as part of a set of oceanographic observations, or are logged within an acquired bathymetry data using GNSS navigation information. With all tidal data it is important that the time zone for the tidal data are recorded in order to ensure that the data are applied in the correct time frame.

The preferred format for the supply of tidal data should be provided in ASCII format. This guideline specifies tables most suitable for tidal data exchange by comma or tab delimited ASCII text file i.e. *.csv, *.txt, *.asc, *.dat. This is essentially a system independent file format which renders the data more readily reusable by MEDIN stakeholders and is the preferred exchange format for DAC. The sample data tables provided in section 2.6, 2.7 and 2.8 document the content of summary tides, observed tides and GNSS tide files.

BODC Ocean Data View (ODV) format provides a suitable standard for providing tide data in ASCII format; ODV is a flexible format which can be adapted to replicate the download file format for oceanographic instruments. See https://www.bodc.ac.uk/data/codes_and_formats/odv_format/.

The SAIC Generic Sensor Format (GSF) standard demonstrates the incorporation of GNSS tidal data into the file record. See http://www.saic.com/maritime/gsf/

Processed tidal data may be provided in GIS formats compliant with the following geometries/ data types:

- Point geometry for location of the tidal station utilised, or for storage of tidal observations along a route.

In some GIS formats the Z value of the point can be stored with the point geometry. This can be used to store elevation levels or tidal values where applicable.

Where data are submitted using industry and GIS formats the information specified in 2.1, 2.2, 2.3 (optional), 2.4 and 2.5 should be provided to accompany the data.

1.2 Background to Data Guidelines

The Marine Environmental Data and Information Network (MEDIN) is working towards creating a framework of consistent standards covering the major types of data collection undertaken in the marine environment around the UK. The principle benefits of this suite of standards are:

- Allows contracting organisation to easily specify a format that data should be returned in that can be readily used and includes all relevant attributes
- Provides a consistent format for contractors to work to (rather than a different format for each contract)
- Data can be readily exported to Data Archiving Centres and other users
- Instils good practice amongst users

Each standard defines the data and information that must be stored with a particular data type to ensure it can be readily used and reused. As this type of information is specific for different data types, guidelines are developed for each type. This document describes one such format. Other standards can be accessed through www.oceannet.org.

1.3 Using this Data Guideline

This guideline is split into sections that refer to information that can be collated at different levels as shown below:

Project - a collection of surveys that have been completed for a common purpose
Survey - a uniquely identifiable programme of data collection such as a research cruise, moored instrument deployment or survey event
Fixed Station – a target location used as the basis for replicate sample events and for repeat monitoring surveys
Sample Event – a sample specific event of data collection
Sampling Methodology (Data Production Tools) – Details of any method or instruments used to collect the data
Sample Data – the data

Where geophysical data are documented the terminology for the MEDIN guidelines sections differs slightly: Sample Event is termed '**Line Event**', Sampling Methodology is termed '**Acquisition Methodology**' and Sample Data are termed '**Processed Data**'. Processed data will most commonly be documented in the Processed Data section as the data volumes concerned with geophysical data normally require that raw data be provided in industry logged formats designed to store large volumes of data efficiently.

The Project and Survey Data tables are common to all Data Guidelines and so only need to be completed once for a survey even if a number of different techniques and data guidelines are used. The Sample/Line Event is specific to a technique of data collection (e.g. trawl, grab etc); the Sample/Processed Data and Sampling/Acquisition Methodology tables are specific to each Data Guideline. The fixed station table should only be used if a fixed point, transect or area is used as the basis for replicate sample events and for repeat monitoring surveys. See the document 'DG_structure' in the zip file to identify how some of these tables only need to be completed once for a single survey.

The tables below outline the data fields, a description and where available a term list and/or format given at the end of each field which should be used to store the data. Each field is either mandatory, conditional or optional as indicated by M, C, or O respectively. Conditional means that the field must be completed if a value is known. In the absence of an existing spreadsheet or database to hold the below information, it is recommended that the template available to download from the MEDIN website is used. Instructions are provided in the template.

In the event that historical data which does not have all the necessary mandatory fields is being configured into this guideline, then it is permissible to use the following entry terms:

Term	Description
unknown	The correct value is not known to and not computable by the creator of this information. However a correct value probably exists.
inapplicable	There is no appropriate value. To be used in cases where metadata elements cannot be set null due to schema constraints.

In some cases it may be necessary to extend this guideline for a specific purpose such as a specific exchange of data between applications or to fulfil the needs of a specific project. This is permissible however we advise that the broad structure and format is maintained and that where possible controlled vocabularies are used. As any extension to the structure and format may be useful for other organisations please inform MEDIN of further agreements.

1.4 Further information on the SeaDataNet, ICES and EPSG term lists

The available catalogues of term lists used for this MEDIN data guideline are provided primarily by SeaDataNet, the International Council for the Sea (ICES) and EPSG. If a term is not available in a recommended list then please contact MEDIN to arrange for the term to be added.

The SeaDataNet list may be viewed at http://seadatanet.maris2.nl/v_bodc_vocab/welcome.aspx . By clicking on the list any term may be searched for by using the drop-down menus or all terms viewed by clicking search. The terms may be viewed in groups of 15 or may be downloaded into an excel file.

The ICES term lists are available at http://www.ices.dk/datacentre/reco/ Select which list you require from the 'Reference Code List' drop-down box. The results are shown for the selected list and may be downloaded into MS Excel by selecting the inverted green arrow.

There are a number of ways of describing a spatial dataset. Common horizontal coordinate reference systems include WGS84 and British National Grid. Common vertical coordinate reference systems include Highest Astronomical Tide and Ordnance Datum Newlyn (ODN). It is important that which coordinate reference system used for a data set is recorded so conversions can be carried out between reference systems. The EPSG database of coordinate reference systems (http://www.epsg.org/Geodetic.html) provides a dictionary of reference systems. In brief, to find a code click on the OGP Online Registry and if you know the title (e.g. WGS84) then type this in the 'Name' field and click search. The name, code and further information is displayed. If you are looking for a specific type of reference system such as 'vertical' then click in the 'Type' box, hover over coordinate reference system and click on vertical and then click the search button and all recorded vertical reference systems are shown. If you want to search for a reference system in a particular part of the world (e.g. Northern Ireland Grid) the you may do so by submitting a term to the 'Area' box or fill out the lat and longs then click search. The website also provides a database of the reference systems and web services to access the information.

1.5 Relationship between MEDIN data guidelines and MEDIN discovery metadata

The MEDIN discovery metadata format is aimed at allowing the non-informed user to discover data sets and it is likely that one 'discovery' data set record will contain a large range of data types that are in turn covered by a range of data guidelines. To enable individuals to reuse data of a specific nature (e.g. benthic invertebrate data) then related information must be collected (e.g. data owner, reference systems used etc). Some of the information which is collected at the Survey Level in a data guideline is also required to create a discovery metadata record. Who creates the MEDIN discovery record for a dataset is case specific and dependant on the organisation, and the relationship it has with a Data Archive Centre. However it is intended that the information collected at the 'Survey Information' level is reused for creating a MEDIN discovery metadata record. Further details are available on the MEDIN website which demonstrate clearly which fields in the MEDIN Data Guidelines can be reused for which elements in the MEDIN Discovery Metadata Standard.

1.6 Updates and Feedback

If you have any comments or feedback on this guidelines please contact enquiries@oceannet.org . Standards develop over time and it is likely that this standard will change in the future. We advise that you return to the oceannet website to identify new versions and that you sign up to the MEDIN Standards e-mail listing (e-mail mecha@bodc.ac.uk) and Marine Data News to be kept informed of developments.

2.1 Project Information

If your collection of data forms part of a wider project or time series then the below details must be recorded. If the work is a small survey then the details below may not be required. A project is a collection of surveys that have been completed for a common purpose. For example: an environmental impact assessment composed of a number of separate surveys; scientific research composed of a number of different research cruises; a legislative monitoring programme which is conducted each year over several years. A project is usually funded by the same organisation(s) for its lifetime. These fields are common throughout all other MEDIN data guidelines and only need to be given once and referenced if your data set is composed of one or many surveys and therefore conforms to a number of MEDIN Data Guidelines.

M, C, O indicate which fields are M - mandatory (must be filled in), C - conditional (must be filled in if exists in data resource), or O - optional respectively.

Heading	M, C, O	Description	Recommended Term List or Format
Project name	M	The nationally/internationally accepted version of the project name.	Free text; e.g. North Hoyle Windfarm EIA Rapid Climate Change; Dogger Bank pSAC Monitoring Programme; EA Bathing Water Monitoring Programme 1989-2010
Project website	C	If a project website exists give the address. This should be the web address of the environmental surveys and not in the case of impact assessments the engineering development.	e.g. http://www.noc.soton.ac.uk/rapid/rapid.php
Project start date	M	The date that the project started which is from when the funding was in place to start. Use the 1st of the month if the exact date is not known.	Date; yyyy-mm-dd; e.g. 2001-01-24; 1973-01-01
Project end date	C	The date that the project finished or is due to finish. Use the 1st of the month if the	Date; yyyy-mm-dd; e.g.

		exact date is not known.	2007-01-24; 1976-01-01
Project code	M	Provide a code to uniquely identify the project and allow links to be made between the tables. To ensure uniqueness, it is recommended that the website of organisation responsible for the work is used followed by a unique code designated by the responsible organisation which should reflect the code used by the funding organisation where possible.	Free text; e.g. http://www.dassh.ac.uk/ME102; http://www.bodc.ac.uk/RCC; http://www.environment-agency.gov.uk/78949

2.2 Survey Information (Data Activity).

The survey information is a uniquely identifiable programme of data collection such as a research cruise, moored instrument deployment or survey event. This information is likely to be the same for all sample events (e.g. stations) and subsamples in a given data set such as a cruise. Note that in the event that these are not common to all sample events then they should be specified for each one. These fields are common throughout all other MEDIN data guidelines and only need to be given once and referenced if your data set is composed of many data types and therefore conforms to a number of MEDIN Data Guidelines. Where data collection is undertaken on research vessels the data below can often be sourced in the Cruise Summary Report.

M, C, O indicate which fields are M - mandatory (must be filled in), C - conditional (must be filled in if exists in data resource), or O - optional respectively.

Heading	M, C, O	Description	Recommended Term List or Format
Survey name	M	Title of the survey	Free text; e.g. 2004 CCW Menai Strait benthic monitoring survey
Survey category	M	Category of survey for use in subsequent searching for certain types of seabed and other surveys.	Recommended Term List; OGP SSDM WORK_CATEGORY Domain; e.g. Geophysical and Hi-Res Seismic (Analogue and Digital Survey) **Or** Free text; e.g. Oceanographic; benthic biology; fish stock
Survey abstract	M	Brief description of the purpose of the survey and other types of measurements that were made for the survey.	Free Text e.g. Survey was the first in a series of 3 in 2010 whose specific aim beyond that stated in the project was to identify sites suitable for

			further monitoring. As such it geophysical techniques were using in combination with grabs and cores to assess seabed type.
Survey code	M	A unique code for the survey to allow links to be built between this and sample event data, (the cruise identifier code could be used). To ensure uniqueness, it is recommended that the website of organisation responsible for the work is used followed by a unique code designated by the responsible organisation.	Free text; e.g. http://www.noc.ac.uk/JCR3022; http://www.bennett.ac.uk/RIBJULY_03_01)
Originator	M	The organisation who has created the data set. If the organisation is not in EDMO please contact enquiries@oceannet.org to add it. If a person who is not associated with any organisation generated the data then please provide the name in the sample event table.	Term List; European Directory of Marine Organisations e.g. 28: Centre for Environment, Fisheries and Aquaculture Science, Lowestoft Laboratory 2588: ABP Marine Environmental Services Ltd
Owner	M	Organisation that owns the data set. If the organisation is not in EDMO please contact enquiries@oceannet.org to add it.	Term List; European Directory of Marine Organisations e.g. 78: Department of Environment Fisheries and Rural Affairs 53: BP Exploration and Production
Survey start date	M	The date and time that the survey started.	Date or DateTime; yyyy-mm-dd or yyyy-mm-dd hh:mm:ss e.g. 2009-01-24 12:33:00
Survey end date	C	The date and time that the survey ended. May be left null if the survey is ongoing.	Date or DateTime; yyyy-mm-dd or yyyy-mm-dd hh:mm:ss

			e.g. 2009-02-16 16:33:00
Time Zone*	M	Give the time zone in which the date and time of the data acquisition is made (preferably Coordinated Universal Time (UTC))	Free Text; e.g. UTC
Spatial coordinate reference system*	M	Describes the system of spatial referencing. I.e. the datum used to provide details of latitude and longitude. (See section 1.4 on accessing term lists).	Term List; http://www.epsg.org/Geodetic.html e.g. **WGS84** code: EPSG::7030; **British National Grid** (projected) code: EPSG::27700; **ETRS89 / UTM zone 28N** code: EPSG::25828; **ETRS89 / UTM zone 29N** code: EPSG::25829; **ED50** code: EPSG::4230; **UTM31N** code: EPSG::23031
Coordinate Transformation*	C	Detail any coordinate transformation applied to the data.	Controlled vocabulary; use EPSG Coordinate Reference System Geodetic Parameter Register http://www.epsg.org/ or other defined coordinate reference system register; e.g. ED50 to WGS84 seven parameter transformation 18 = EPSG::1311 **Or** Free text; Where new transformation is defined
Position fix method and source*	M	Give the method and source of the position fix instrument.	Free Text; e.g. Differential GPS taken from the ships navigation equipment.

			4 point satellite fix achieved
Horizontal positional accuracy*	M	How accurate the spatial positions are likely to be.	Number; units = meters e.g. 15
Depth coordinate reference system*	C	Give the reference to which the depth has been calculated e.g. Ordnance Datum Newlyn; Highest Astronomical Tide. Mandatory if seabed depths are given for each sample. See section 1.4 on accessing term lists.	Term List http://www.epsg.org/Geodetic.html e.g. **Ordnance Datum Newlyn** code: EPSG::5701 **Malin Head height** code: EPSG::5731
Vertical positional accuracy*	C	How accurate the vertical resolution is. Must be provided if seabed depths are given.	Number; units = meters e.g. 0.5
Platform type*	O	The platform type (e.g. Research Vessel) from which the sampling device was deployed.	Term list; SeadataNet Platform Classes (L061) e.g. 31: Research Vessel; 13: beach/intertidal zone structure; 48: mooring; 71: human
Ship name*	M	The name of the ship from which the sampling device was deployed. If your ship is not on the list please contact accessions@ices.dk	Term list; SeaDataNet C174 at SeadataNet Cruise Summary Support Ship Metadata e.g. 74E9: Cefas Endeavour 74E0: Ocean Endeavour AA36: Unspecified Fishing Vessel AA33: Unspecified Self-Propelled Small Boat Use semi-colon delimited list where more than one vessel is used e.g. for 3D seismic configurations.
Report	O	Cruise reports, boat log, survey results,	Free text; in reference format; use semi

reference*		processing and/or technical report references if applicable.	colon delimited list where more than one volume is provided. e.g. Litt, E.J. 2009. PHiXT 4. 30 July to 2 August 2009 *RV Prince Madog* POL Coastal Observatory Liverpool Bay Survey Results Report. POL Coastal Observatory, Liverpool.
Project code	C	If the survey forms part of a wider project then state the code of the project given in the project table to allow links to be made between the tables.	Free text; e.g. RCC

*Fields marked are unlikely to be required for the collection of leisure and recreation data

2.3 Fixed (Target) Station Information

You should only use this table if you are returning to the same fixed point/transect/area on several occasions to form a time series – i.e. there is a target location for your sample event. When returning to a target station, the actual sample event may not be in exactly the same location each time due to ship movements or sampling strategy, however it is useful to record both the position which is intended to be sampled (fixed) and the actual sampling position (sample). Therefore, the information below must be included if a fixed point, transect or area is used as the basis for replicate sample events and for repeat monitoring surveys. Actual coordinates should be placed in the sample event table. A fixed station may be a point, transect, or an area. If the fixed station is a transect or an area then the secondary latitude and longitude fields must be completed. As an alternative, the fixed station extent can be provided in an ASCII, GIS or CAD format as detailed in the MEDIN product guideline for survey extents or MEDIN product guideline for survey line plans, and this replaces the fields below marked '*'.

M, C, O indicate which fields are M - mandatory (must be filled in), C - conditional (must be filled in if exists in data resource), or O - optional respectively.

Heading	M, C, O	Description	Recommended Term List or Format
Fixed station identifier	M	A unique identifier for the station.	Free text. e.g. Stanton_Bank_station_4 (point) EastChan_Innerdover_se04 Liverpool_Dublin_ferry_route1 (transect) Lagan_Estuary (area)
Primary latitude (decimal degrees)*	M	The primary WGS84 latitude of the fixed station given in decimal degrees. For a point this field is set to the point latitude; for a transect it is set to the latitude of the start of the transect; for an area it is set to the southern edge of the box. Units are positive North.	Decimal degrees; at least six decimal places. e.g. 54.583736
Primary longitude (decimal degrees)*	M	The primary WGS84 longitude of the sample given in decimal degrees. For a point this field is set to the point longitude; for a transect it is set to the longitude of the start of the transect; for an area it	Decimal degrees; at least six decimal places. e.g. -5.583736

Heading	M, C, O	Description	Recommended Term List or Format
		is set to the western edge of the box. Units are positive east (West is negative, East is positive).	
Secondary latitude (decimal degrees)*	C	The secondary WGS84 latitude of the fixed station given in decimal degrees. For a point this field is not required; for a transect it is set to the latitude of the end of the transect; for an area it is set to the northern edge of the box. Units are positive North.	Decimal degrees; at least six decimal places. e.g. 55.739336
Secondary longitude (decimal degrees)*	C	The secondary WGS84 longitude of the sample given in decimal degrees. For a point this field is not required; for a transect it is set to the longitude of the end of the transect; for an area it is set to the eastern edge of the box. Units are positive east (West is negative, East is positive).	Decimal degrees; at least six decimal places. e.g. -3.739436
Original co ordinates and coordinate transformation technique*	C	If coordinates were transformed from a different reference system into WGS84 decimal degrees then the original coordinate and original coordinate reference system should be given, the method used to transform stated and any differences in the relative (significant figures) of the original transformation explained.	Free text; e.g. SX498476, Coordinates were transformed from British National Grid using in house software 'BODC_transform'. The number of significant figures was reduced to 4 decimal degrees in line with the accuracy of the coordinate and transformation technique.
Position fix method and source	M	Give the method and source of the position fix instrument.	Free Text; e.g. Differential GPS taken from the ships navigation equipment. 4 point satellite fix achieved)
Description of fixed station	M	Describe if the fixed station is a point, transect (curve) or an area (surface).	Term list; SeadataNet Geospatial Feature Type (L021):

Heading	M, C, O	Description	Recommended Term List or Format
spatial form*			004: Point 003: Curve 005: Surface

2.4 Sample Event (Tides)

This table holds information on the location/extents, time and local conditions for the tidal observation. The observation is either taken at a single location, or as an underway logging through GNSS data. Where underway data are provided sample events can be depicted by track files and detailed in the MEDIN data guideline for navigation and positioning data (track). Use of geometric representations will replace the coordinate and spatial elements marked'*'.

M, C, O indicate which fields are M - mandatory (must be filled in), C - conditional (must be filled in if exists in data resource), or O - optional respectively.

Heading	M, C, O	Description	Recommended Term List or Format
Survey code	M	The survey code must be stated to allow links to be built between this table and the survey table (the cruise identifier code could be used).	Free text; e.g. http://www.noc.ac.uk/JCR3022; http://www.bennett.ac.uk/RIBJULY_03_01)
Sample Event Identifier	M	A unique identifier for the line or transect under consideration. Replicate identifiers should be suffixed to the end of a sample identifier using an underscore such as _1 or _a	Free text; e.g. E5, CTD1234 SV0001_1 SV0001_3
Fixed station identifier	C	If you are returning to the same fixed point/transect/area on several occasions to form a time series – i.e. there is a target location for your sample event, then put the identifier specified in the fixed station table in here.	Free text; e.g. Stanton Bank site 4 PS74926
Method identifier	M	Provide the identifier for the methods used as stated in the Sampling Method (Data Production Tool) table. If multiple methods were used separate codes using a comma.	Free text; e.g. TIDE4376 02465, 02896
Depth datum	M	Indicate the chart datum or reference for the	Controlled vocabulary; use EPSG

Heading	M, C, O	Description	Recommended Term List or Format
		water levels. Normally defined as Mean Sea Level = EPSG::5100.	Coordinate Reference System Geodetic Parameter Register http://www.epsg.org/ or other defined coordinate reference system e.g. Mean Sea Level = EPSG::5100 **OR** Free text; e.g. Chart Datum Ramsgate (UK)
Start Date and Time	M	The start date and time of the sample	yyyy-mm-dd or yyyy-mm-dd hh:mm:ss e.g. 2009-01-24 13:33:00
Start KP/ Distance along*	O	Start chainage according to kilometre post (KP) scheme or length and direction of programmed line/ transect. May be negative value if data logging commences before start of line is reached. This can be used if relevant i.e. tidal predictions or observations are made or taken to cover certain KP ranges or GNSS tides are used.	Decimal kilometres for KP scheme e.g. 0.001 Decimal metres for distance scheme e.g. -1.005
(Start) X Coordinate*	M	The start or station X coordinate for the sample, longitude or easting as per the defined coordinate reference system for the survey. For longitude, east is positive and west is negative.	Decimal degrees; minimum of six decimal places. e.g. -3.476363 **Or** Decimal Number; Units = metres e.g. 234865.55
(Start) Y Coordinate*	M	The start or station Y coordinate for the sample, latitude or easting as per the defined coordinate reference system for the survey. For latitude, north is positive and south is negative.	Decimal degrees; minimum of decimal places. e.g. 54.583736 **Or** Decimal Number; Units = metres

Heading	M, C, O	Description	Recommended Term List or Format
			e.g. 5963487.00
End Date and Time	M	The end date/time of the sample	yyyy-mm-dd or yyyy-mm-dd hh:mm:ss e.g. 2009-01-24 13:33:00
End KP/ Distance along*	O	End chainage according to kilometre post (KP) scheme or length and direction of programmed line/ transect. May be greater than programmed line length when logging finishes after end of line. This can be used if relevant i.e. tidal observations are taken to cover certain KP ranges or GNSS tides are used.	Decimal kilometres for KP scheme e.g. 125.023 Decimal metres for distance scheme e.g. 1010.005
End X Coordinate*	C	The end X coordinate of the sample, longitude or easting as per the defined coordinate reference system for the survey. For longitude, east is positive and west is negative. This can be used if relevant i.e. tidal observations are taken to cover certain KP ranges or GNSS tides are used	Decimal degrees; minimum of six decimal places. e.g. -3.476363 **Or** Decimal Number; Units = metres e.g. 234865.55
End Y Coordinate*	C	The end Y coordinate of the sample, latitude or easting as per the defined coordinate reference system for the survey. For latitude, north is positive and south is negative.	Decimal degrees; minimum of six decimal places. e.g. 54.583736 **Or** Decimal Number; Units = metres e.g. 5963487.00
Time Zone	C	Give the time zone in which the date and time of the sample/ file is made if different to that of survey	Free Text; e.g. UTC
Track Data	C	Link to method identifier for track data; relevant for GNSS data	Free text; separated by semi-colon if more than one track file is relevant; e.g. POS1234

Heading	M, C, O	Description	Recommended Term List or Format
Profile Data	C	Link to method identifier for speed of sound correction where required	Free text; separated by semi-colon if more than one profile file is relevant; e.g. CTD1234
Water Depth	C	Mean water depth at location, or water depth range, and how this was derived	Free text; e.g. 80m taken from Admiralty Chart e.g. 100-120m from survey MBES
Sample Rate	C	Sampling rate set for the sample when using observed tides	Free text; e.g. 5 minutes
Local Gravity	C	Local gravity considerations, applicable to some tide gauges	Free Text; e.g. 9.812 m/s^2
Magnetic Variation	C	Local magnetic considerations, applicable to some tide gauges	Free Text; e.g. 1° 24'W
Sampling personnel	O	Names or the personnel who were involved in collecting and processing the data	Free text; full personnel names separated by semi-colon if a team collated the data; e.g. Joe Bloggs; Brian Begger online surveyors
Sample notes	O	Any further notes on the sample collection that may be of relevance to data acquisition	Free text; e.g. Some turbidity due to sea state.
Remarks	O	Any other remarks required	Free text; Settling period to 2009-01-24 14:43:00

2.5 Sampling Method (Data Production Tools)

In many cases the information in this table is consistent for a whole survey in which case it should only have to be completed once. Where necessary the information in this table should be completed for each parameter under consideration. Information in this table may also be used to complete fields in the discovery metadata. The field 'Method Identifier' provides the link between this table and the sample event table.

M, C, O indicate which fields are M - mandatory (must be filled in), C - conditional (must be filled in if exists in data resource), or O - optional respectively.

Where a survey and/or data processing report has been provided with the data the information detailed in this table will be included within the reports. Where reports are provided detailing this information only the mandatory and conditional fields should be considered for completion here.

Heading	M, C, O	Description	Recommended Term List or Format
Method Identifier	M	A unique code for the methods to allow links to be built between this and sample event data.	Free text; e.g. TIDE1234
Tidal Adjustment Type	M	State the type of tide adjustment	Free text; e.g. Observed tides at port gauge Observed tides at site Tides deduced from GNSS Predicted tides
Instrument Details	C	State the name of the sensor used if applicable	Term List; SeaDataNet L221 SeaVOX Device Catalogue e.g. Munro tide gauge
Installation details	M	Describe installation details, if predicted tides are used give details of port used	Free text; e.g. Predicted at Standard Port Aberdeen e.g. Bubbler Gauge deployed at survey site e.g. Tide pole at Great Yarmouth
Processing	C	The Organisation(s) that processed the data	Term List; European Directory of Marine

Heading	M, C, O	Description	Recommended Term List or Format
organisation		if different from the collector identified in 2.2 Originator. Contact MEDIN to add an Organisation to this list	Organisations http://www.seadatanet.org/Metadata/EDMO e.g. 2588 ABP Marine Environmental Services Ltd
Range Factor	C	Range factor applied	Decimal Number; e.g. 0.45 (zero if not required)
High water difference	C	High water time lag/ projection used	Time +/-hh:mm: e.g. +00:45 (00:00 if not required)
Low water difference	C	Low water time lag/ projection used	Time hh:mm: e.g. -00:30 (00:00 if not required)
Reduction Level	C	Indicate the vertical datum or reference for any tidal variation computations, if different to that defined in survey information	Controlled vocabulary; use EPSG Coordinate Reference System Geodetic Parameter Register http://www.epsg.org/ or other defined coordinate reference system register **or free text;** e.g. Chart Datum Ramsgate (UK) Mean Sea Level = EPSG::5100 VORF LAT
Serial Number	O	Serial Number of tide gauge if known	Free text; e.g. s/n 1234
Calibration Details	O	Provide calibration details for sensor	Free text; e.g. Calibrated in laboratory 29-01-2011
Quoted Accuracy	O	State the quoted accuracy for the sensor	Free text; e.g. +/- 0.01m
Operating Ranges	O	State operating ranges for the system e.g. temperature and depths. If more than one use semi-colon separated list	Free text; e.g. 10-50 Celsius; 1375m/s to 1900m/s
Processing	O	State extraction/processing software used	Free text;

Heading	M, C, O	Description	Recommended Term List or Format
Software			e.g. Nortek SeaReport
Processing Software Version	O	State extraction/processing software version	Free text; e.g. v1.1
Procedures used	O	Any written methodology used should be referenced and linked. If the methodology is not referenced then provide a full description here.	Free text; e.g. Methodology follows <survey company> internal procedures from quality management system
Processing personnel	O	Names of the personnel who were involved in processing the tidal data	Free text; personnel name(s) separated by semi-colon if more than one personnel involved; indicate organisation name in brackets if more than one organisation involved. e.g. Joe Bloggs (MarConsulting) Tide data generation
Processing notes	O	Any further notes on data processing that may be of relevance.	Free text; e.g. This tide file was used KP 0-1 along route
Processing QC notes	O	Any further notes on data processing that may be of relevance.	Free text; e.g. QC procedure applied using Integrated Management System procedures

2.6 Summary or Predicted Tidal Data (Processed Data)

When providing the tidal data it must be clearly linked to the sample event information for a given file set and replicate. Summary or predicted tide files are normally generated as a simple ASCII file of date, time and water level. This format is also used in summarising observed data to apply tidal reduction in software.

M, C, O indicate which fields are M - mandatory (must be filled in), C - conditional (must be filled in if exists in data resource), or O - optional respectively.

Heading	M, C, O	Description	Recommended Term List or Format
Sample Event Identifier	O	Unique identifier/ code/ number for tidal data acquisition; may not be possible for some software applications; can be incorporated into the file name as an alternative.	Free text; e.g. TIDE1234
Date and time	M	Date and time of observation/ prediction	yyyy-mm-dd or yyyy-mm-dd hh:mm:ss e.g. 2009-01-24 13:33:00
Water Level	C	Observed/ predicted water level	Decimal Number; Units = metres e.g. 1.2
Tidal Variation	C	Reduced water level to a defined datum if column Water Level used to store the mean sea level	Decimal Number; Units = metres e.g. 1.2

2.7 Observed Water Level/ Tidal Data (Processed Data)

When providing observed water level/tidal data it must be clearly linked to the sample event information for a given file set and replicate. Observed water level/ tidal data are normally downloaded in the instrument manufacturer's format using the instrument manufacturer's software suite; these can include header information similar to that defined in sections 2.1 – 2.4. ODV format provided by BODC at https://www.bodc.ac.uk/data/codes_and_formats/odv_format/ provides a configurable format which also encompasses metadata columns storing data found in sections 2.1 – 2.4. The format below is provided for completeness to document the typical content logged by tide gauges/water level recorders.

M, C, O indicate which fields are M - mandatory (must be filled in), C - conditional (must be filled in if exists in data resource), or O - optional respectively.

Heading	M, C, O	Description	Recommended Term List or Format
Sample Event Identifier	O	Unique identifier/ code/ number for tidal data acquisition; may not be possible for some software applications	Free text; e.g. TIDE1234
Date and time	M	Date and time of observation	yyyy-mm-dd or yyyy-mm-dd hh:mm:ss e.g. 2009-01-24 13:33:00
Depth	M	Measured depth	Decimal number Units = metres
Atmospheric Pressure	C	Atmospheric pressure where logged	Decimal number Units = hectoPascal
Adjusted depth	C	Depth adjusted for atmospheric pressure (Depth – Atmospheric Pressure)	Decimal number Units = metres
QC Adjusted Depth	C	Depth adjusted after QC procedures to provide correction	Decimal number Units = metres
Datum Adjusted Depth	C	Depth adjusted according to a tidal datum where known	Decimal number Units = metres
Temperature	C	Water temperature if logged	Decimal number;

Heading	M, C, O	Description	Recommended Term List or Format
			Units = degrees
Heading	C	Heading of gauge if applicable	Decimal number; Units = degrees
Pitch	C	Pitch of gauge if applicable	Decimal number; Units = degrees
Roll	C	Roll of gauge if applicable	Decimal number; Units = degrees
Computed Tide	M	Calculated sea level variation about mean sea level calculated from adjusted observations or modelled surface representing a vertical datum	Decimal number Units = metres

2.8 GNSS Tidal Data (Processed Data)

When providing observed tidal data it must be clearly linked to the sample event information for a given file set and replicate. GNSS navigation data are normally output in NMEA format (see http://www.nmea.org/content/nmea_standards/nmea_083_v_400.asp) and tidal correction deduced and logged with the data i.e. within the processed MBES files. The GNSS navigation data will provide the height information for processing against the selected datum; the tidal reduction data are essentially incorporated into the track/sensor file. The output information may be similar to the formats discussed in 2.6 & 2.7, or encompass the following in a logged data file (based on SAIC GSF, see http://www.saic.com/maritime/gsf/):

M, C, O indicate which fields are M - mandatory (must be filled in), C - conditional (must be filled in if exists in data resource), or O - optional respectively.

Heading	M, C, O	Description	Recommended Term List or Format
Sample Event Identifier	O	Unique identifier/ code/ number for tidal data acquisition; may not be possible for some software applications	Free text; e.g. TIDE1234
Date and time	M	yyyy-mm-dd or yyyy-mm-dd hh:mm:ss	e.g. 2009-01-24 13:33:00
X Coordinate	M	The X coordinate of sampling, longitude or easting as per the defined coordinate reference system for the survey. For longitude, east is positive and west is negative.	Decimal degrees; minimum of six decimal places. e.g. -3.476363 **Or** Decimal Number; Units = metres e.g. 234865.55
Y Coordinate	M	The Y coordinate of sampling, latitude or easting as per the defined coordinate reference system for the survey. For latitude, north is positive and south is negative.	Decimal degrees; minimum of six decimal places. e.g. 54.583736 **Or** Decimal Number; Units = metres

Heading	M, C, O	Description	Recommended Term List or Format
			e.g. 5963487.00
Ellipsoidal Height	C	Height above reference ellipsoid/ spheroid such as WGS84 logged by GNSS antenna	Decimal Number; Units = metres e.g. 168.23
Height of Selected Vessel Waterline Above Ellipsoid	C	Height of vessel water line reference point above reference ellipsoid/ spheroid such as WGS84; corrected for offset	Decimal Number; Units = metres e.g. 164.23
Ellipsoidal Height and Selected Datum Separation	C	Theoretical ellipsoid to tidal surface datum separation at given location	Decimal Number; Units = metres e.g. 57.63
Heave Correction	C	Correction for heave	Decimal Number; Units = metres e.g. 0.26
Pitch Correction	C	Correction for pitch, if not included in heave	Decimal Number; Units = metres e.g. 0.15
Roll Correction	C	Correction for roll, if not included in heave	Decimal Number; Units = metres e.g. 0.20
Heave direction	C	Heave direction when logged	Decimal Number; Units = degrees e.g. 128.3
Computed Tide	M	Calculated tidal variation at given location based on modelled sea level or vertical datum and height of waterline	Decimal Number; Units = metres e.g. -0.103

APPENDIX - INSPIRE Compatibility Analysis

MEDIN is registered as a Spatial Data Interest Community with INSPIRE and complies with the requirements of INSPIRE metadata implementing rules. MEDIN is also working towards compliance with web service and data implementing rules. This section of the guideline provides an assessment of compliance for this data type with Annex I, II & III data themes and data model implementing rules.

The INSPIRE data model is built on the foundation schemas ISO/TC211 Geographic Information/ Geomatics (includes metadata), EarthResourceML and GeoSciML. These schemas are designed for encoding data within XML (GML) data services and data transport formats. The data structure is hierarchical/object-oriented in nature. A base or main application schema defines the common spatial object types, data types and union data types (which provide a choice of data structure for the same element). Reusable application schemas are then linked to the main schema according to the type of data.

Water level and tidal data could be considered in terms of two application schemas INSPIRE Annex II Theme Elevation and INSPIRE Annex III Theme Oceanographic Geographical Features. This is because water levels could be considered both elevations and observations, particularly in the case of GNSS techniques.

However, because observations from tide gauges, water level recorders and GNSS techniques represent a certain situation in time, the Oceanographic Geographical Features, with its links to Climate Science Modelling Language (CMSL) and ISO 19156 Observations and Measurements schema, provides more flexibility in its object definitions for the storage of tidal/ water level observations.

It is not recommended that predicted tides are included within the INSPIRE framework as conceptually they are theoretical and are not actual observations. Even if considered in terms of elevation they do not represent a real world observation.

The Ocean Geographic Features application schema contains the following spatial object types of use:

- Point Series Observation for the time series of measurements at a fixed or deployed tide gauge/ water level recorder
- Point Observation and Point Observation Collection which can be used to store observations taken underway represented as multiple points i.e. GNSS tides

The primary application schema for Oceanographic Geographical Features makes provision for the storage of observations based on ISO 19156 schema for Observations and Measurements.

Spatial data object (abstract) SF_SamplingFeature defines the station, at which the sample is taken. A point location, PointObservation (SF_SamplingPoint) representing an installed tide gauge or deployed water level recorder will be defined. For observations taken for the ship's path this will be represented by several PointObservations in a PointObservationCollection. Both approaches will form a PointSeries observation for which a TM_Period time period will be assigned; each PointObservation is assigned a TM_Instant time instant attribution to record the time of the observation.

The above feature types/ spatial object types are children/ sub types of SamplingCoverageObervation and OM_DescreteCoverageObservation, which in turn are children/ sub types of the base feature type OM_Observation, which has attributes:

- phenomenon time (for storage of sample times, both instantaneous and periodical)
- resultTime
- validTime
- resultQuality
- parameter (observed)

In turn, OM_Observation has the following relevant requirement classes for definitions of what is measured:

- geometryObservation – links to ISO schema for definition of the spatial aspects such as PointObservation
- temporalObservation – links to ISO schema for the definition of temporal storage
- timeSeriesObservation – links to ISO schema for definition of temporal coverage
- measurement – links to ISO schema and feature type for measurement, stores value and units

OM_Process is also defined as an abstract class which links to OM_Observation allows the attribution of the device propagating the measurement e.g. tide gauge.

Observations and Measurements application schema provides a flexible framework to define objects and store certain parameters and measurements in space and time, namely the water level/ ellipsoidal height recorded and the reduced water level (tidal variation). However, linking to the Observation: procedure application schema is also recommended to provide information about what is being measured i.e. background information about the tide gauge as

stored in the data production tools table can be incorporated, and possibly survey details. There is scope to link to the Geophysics Extension Application Schema through the Observations and Measurements schema, whereby project and campaign definitions provided by the Geophysics Extension Application Schema can be utilised to store project and survey information.

The Observations and Measurements package is designed to be linked to an INSPIRE Environmental Monitoring Facility, which can be defined for mobile methods. The following spatial object types and data types are attributable to EnviromentalMontoringFacility:

- Spatial Object Type: representativePoint
- Data Type measurementRegime
- Data Type mediaMonitored (environmental medium monitored)
- Data Type MobileValue to indicate if the facility is mobile; in this case it is
- Result Acquisition Source value: in-situ

All candidate data for inclusion within the INSPIRE framework require defined processes to transform the data from a flat file or GIS format to the spatial data model specified with the INSPIRE Annex themes specifications. The information provided here is intended as verification of the data against the INSPIRE data specification in readiness for inclusion.