EMFF Operational Programme 2014-2020

Blue Growth & Marine Spatial Planning Scheme

Data Discovery, Collation and Gap Analysis for Spatial Representation – Final Report

February 2019

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Partners: Marine Institute

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Spatial Data and Evidence Projects

Project 1 – Data Discovery, Collation and Gap Analysis for Spatial Representation – Final Report

February 2019

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Spatial Data and Evidence Projects

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Notice

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Executive Summary

ABPmer and its project partners have been appointed by the Marine Institute to deliver Spatial Data and Evidence Projects to support the development of Ireland's first marine spatial plan. The projects are funded through the European Maritime and Fisheries Fund (EMFF). This report relates to Project 1 Data Discovery, Collation and Gap Analysis for Spatial Representation. The specific objectives for the project comprise:

- Review and identification of existing spatial, environmental, socio-economic data, from Ireland's Marine Atlas, the Digital Ocean, national agencies, ISDE, European databases, ICES, OSPAR data sources and national data sets from other countries;
- Collation and assessment of existing data in terms of validity and quality of the data and metadata and its usefulness for MSP; and
- Comprehensive data gap analysis based on international best practice in MSP.

This report summarises the data review and assessment of its quality and usefulness for MSP; and the gap analysis and identification of options for filling data gaps.

The project carried out a review of data availability from various sources against a list of MSP themes and topics. The Gap Analysis established generic MSP data requirements and compared the data layers currently available on Ireland's Marine Atlas against those data requirements, to determine existing Marine Atlas MSP data gaps. Options for filling them drew on the data sources identified through the Data Review.

A total of 2,068 data sets have been identified as being of potential use within marine spatial planning. This includes 403 data sets already held within the Marine Atlas and a further 1,666 data sets identified through this Data Review phase. Some of the data set sub-categories contain a high number of relatively good quality data, e.g. marine mammals, fisheries & shellfisheries; others contain low numbers of data sets, e.g. telecommunications and marine aggregates. Other datasets hold a high number of data sets but of relatively low quality e.g. tourism and recreation. The number of data sets that met the quality assurance threshold (>50% overall score) was 1,794 and 593 datasets had INSPIRE compliant metadata.

The Gap Analysis identified that only two (out of thirty-two) topics (administrative and physical boundaries, and other marine infrastructure) had data on the Marine Atlas that were broadly complete and sufficient. For the other topics, the data on the Marine Atlas were either severely lacking, or some information was available but further improvements were desirable.

The next steps are to prioritise the data gaps and develop individual roadmaps for the higher priority gaps that set out data sources and processing steps required to fill the gaps, alongside continuing to source datasets required.

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1 Introduction

1.1 Background

ABPmer and its project partners have been appointed by the Marine Institute to deliver Spatial Data and Evidence Projects to support the development of Ireland's first marine spatial plan. The projects are funded through the European Maritime and Fisheries Fund (EMFF).

Marine Spatial Planning (MSP) has been identified as an important process for supporting the sustainable development of Ireland's seas. The development of an overarching national marine spatial plan is identified as a Government policy objective in Ireland's Integrated Marine Plan as set out in Harnessing Our Ocean Wealth (HOOW) (Inter-Departmental Marine Coordination Group, 2012). The Maritime Spatial Planning Directive (2014/89/EU) also requires Member States to develop and implement marine spatial plans covering marine water under their jurisdiction by 2021. Ireland has transposed the directive through the European Union (Framework for Maritime Spatial Planning) Regulations 2016.

Under the Regulations, The Minister for Housing, Planning and Local Government (DHPLG) is responsible for preparing Ireland's first marine spatial plan. In December 2017, the Department published a roadmap for the development of the Plan (DHPLG, 2017). It is intended that the Plan is developed in four broad stages:

- Stage 1 – Activation Stage: establishing the MSP function within DHPLG and initial engagement with stakeholders (to end of 2017);
- Stage 2 – Development Stage: development of evidence base, publication of evidence and issues report for public consultation, development and testing of plan options and publication of a draft Plan (to end of September 2019);
- Stage 3 – Finalisation Stage: consideration, approval and publication of Plan (to end September 2020); and
- Stage 4 – Plan Implementation Stage: implementation, review and iterative development of the Plan (end of 2020 onwards).

A high-level Inter-Departmental Group (IDG) has been established to lead and oversee the development of the Plan. An Advisory Group has also been established to ensure participation of relevant non-governmental organisations, professional bodies and technical experts in the process. The Marine Institute has a key support role in relation to technical and scientific input into the development of the Plan, supporting the proposed organisational structures and supporting the process of preparing the Plan.

This report is prepared under one of a number of Spatial Data and Evidence Projects supporting the development of the Plan:

1. Data Discovery, Collation and Gap Analysis for Spatial Representation;
2. Data Prioritisation and Collection for Spatial Representation;
3. Assess and Map Marine Ecosystems Services;
4. Mapping the Potential Impacts of Climate Change; and
5. Best Practice on Modelling and Support Tools for Integrating Marine Spatial Data for Scientific and Technical Advisory Services.

This report relates to Project 1 Data Discovery, Collation and Gap Analysis for Spatial Representation.

1.2 Project 1 objectives

Project 1 entails data discovery, collation, gap analysis and, where feasible, data collection for use in support of MSP. The specific objectives for the project comprise:

- Review and identification of existing spatial, environmental, socio-economic data, from Ireland's Marine Atlas, the Digital Ocean, national agencies, ISDE, European databases, ICES, OSPAR data sources and national data sets from other countries;
- Collation and assessment of existing data in terms of validity and quality of the data and metadata and its usefulness for MSP; and
- Comprehensive data gap analysis based on international best practice in MSP.

This report summarises:

- the data review and assessment of its quality and usefulness for MSP, which was undertaken in the period April to June 2018; and
- the gap analysis and identification of options for filling data gaps, which was undertaken during the period July to September 2018.

1.3 Project oversight

The project is overseen by an advisory group comprising Marine Institute and DHPLG.

2 Methodology

2.1 Introduction

MSP requires a wide range of evidence to support plan development. MSP is an explicitly spatial process and therefore requires spatial data at an appropriate spatial resolution. MSP is also an integrative process and therefore also requires environmental, social and economic data including data on all human activities occurring in the marine environment. Information is also required across the Land Sea Interface (LSI) recognising that activities on or near the coast can influence or be influenced by the sea. The open nature of the marine environment also means that transboundary data may also be required.

An overview of the approach is set out in Figure 1. Firstly, the project carried out a review of data availability from various sources against a list of MSP themes and topics (section 2.2, 'Data review'). Secondly, the Gap Analysis established generic MSP data requirements and compared the data layers currently available on Ireland's Marine Atlas against those data requirements, to determine existing Marine Atlas MSP data gaps and options for filling them, drawing on the data sources identified through the Data Review (section 2.3, 'Gap analysis'). In a later project (Project 2: Data Prioritisation and Collection), the data gaps were prioritised, and a series of Roadmaps were created for how to fill those gaps.

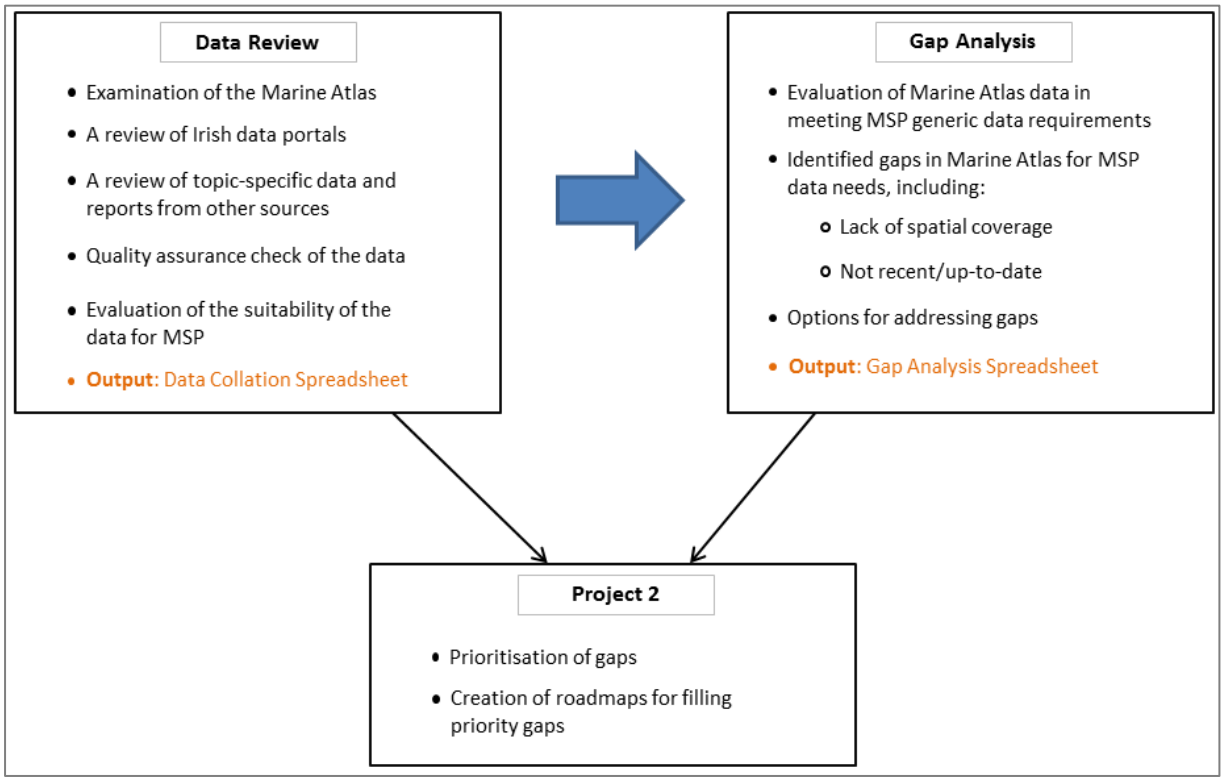


Figure 1. Overview of Methodology for the Data Review and Gap Analysis

There is no absolute list of information requirements for MSP but different national MSP processes generally use similar types of information (European Commission, 2016). Information requirements will also be dictated by the level of detail that MSP is seeking to achieve. For example, plans that are seeking to promote more prescriptive spatial policies are likely to require greater levels of evidence to underpin such policies and achieve stakeholder support (MSPP Consortium, 2006).

In the absence of an absolute list of data requirements, the project team has taken forward the task drawing on its experience of spatial data and evidence processes for other marine plans and the generic checklist provided in European Commission (2016) (see section 2.2.1).

2.2 Data review

The Data Review was progressed in three main stages, described in more detail below:

- Task 1 – Identification and collation of data;
- Task 2 – Quality assurance of data sets; and
- Task 3 – Evaluation of suitability of data for MSP.

This is summarised in Figure 2.

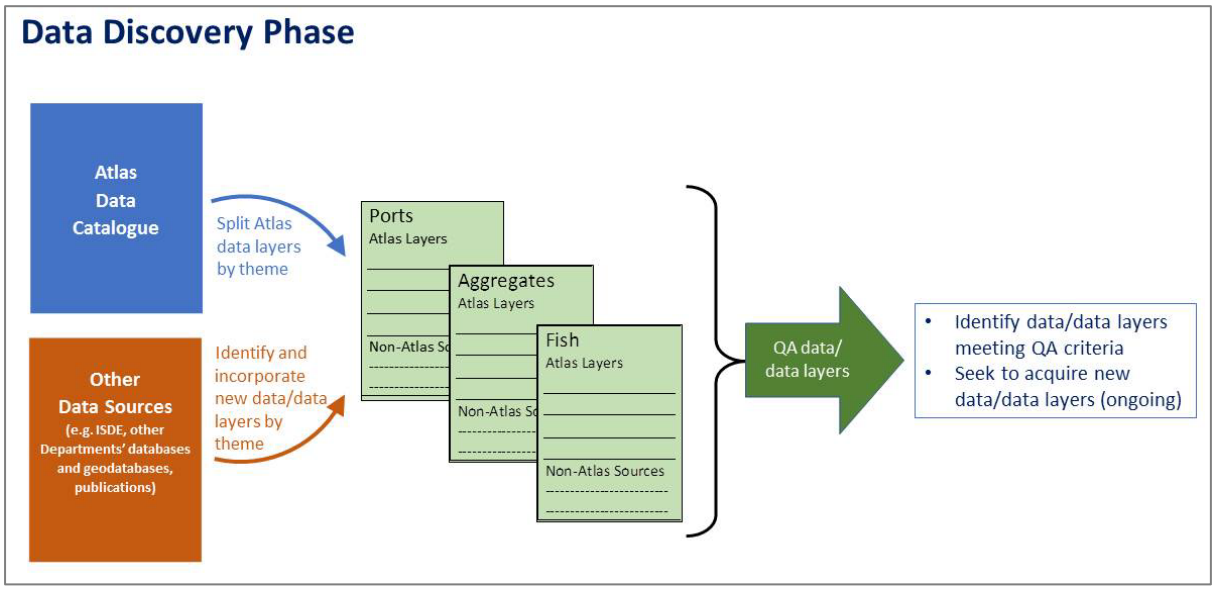


Figure 2. Data discovery, review and quality assurance

2.2.1 Identification and collation of data

Available data were identified across the full range of MSP topics encompassing:

- Administrative and physical boundaries:
  - Marine Plan Area;
  - Political (e.g. Terrestrial administrative boundaries);
  - Coastal;
  - Directives (e.g. EC Directives reporting units);
  - Territorial, maritime limits and international maritime limits (6 NM, 12 NM, 200 NM, Exclusive Economic Zone);
  - Marine Regions;
  - Rivers and Lakes.
- Physical environment:
  - Geology;
  - Ocean features;
  - Seabed sediments.

- Biological environment:
  - Benthic habitats and species;
  - Fish & shellfish;
  - Marine mammals;
  - Birds;
  - Reptiles;
  - Terrestrial habitats;
  - Natural capital and ecosystem services;
  - Protected sites.
- Environmental Quality:
  - Water quality;
  - Marine litter;
  - Other human pressures.
- Human environment:
  - Aquaculture;
  - Aviation;
  - Coast and flood defences;
  - Cultural heritage and assets;
  - Defence and national security;
  - Energy – petroleum, renewables, transmission systems, carbon capture and storage;
  - Fisheries and shellfisheries;
  - Infrastructure – Land-side (roads, rail, urban development, utilities);
  - Infrastructure – Other marine;
  - Marine aggregates;
  - Ports, harbours and shipping;
  - Seascape;
  - Social and economic factors;
  - Telecommunications;
  - Tourism;
  - Seaweed harvesting;
  - Sport and recreation;
  - Waste water treatment and disposal.

The review drew upon a number of key on-line data sources, together with a wider on-line search, including:

- Ireland's Marine Atlas http://atlas.marine.ie/
- Irish Spatial Data Exchange (ISDE) http://www.isde.ie/#/
- Ireland's Digital Ocean https://www.digitalocean.ie/
- EPA Portal http://gis.epa.ie/
- NPWS Maps and Data https://www.npws.ie/maps-and-data
- Heritage Maps https://heritagemaps.ie/WebApps/HeritageMaps/index.html
- GeoHive https://geohive.ie/
- DublinDashboard http://www.dublindashboard.ie/pages/index
- Ireland's Open Data Portal https://data.gov.ie/

Informal contact was undertaken with a wide range of organisations to clarify data sources and availability, and potential data sets from online sources and reports were identified from a wide range of organisations (N.B. this is an ongoing process and contacts will continue with these and other organisations), including:

- ABPmer;
- Afloat Ireland;
- An Taisce;
- Angling Council of Ireland;
- Birdwatch Ireland;
- Boatlaunch;
- Bord Iascaigh Mhara (BIM);
- British Geological Survey;
- Canoeing Ireland;
- Central Statistics Office (CSO);
- Centre for Environment, Fisheries and Aquaculture Science (Cefas) (UK);
- Centre for Marine and Renewable Energy (MaREI);
- Coastal and Marine Resources Centre (CMRC);
- Coastwatch Ireland;
- Commissioners of Irish Lights;
- County Councils;
- Cycling Ireland;
- Department of Agriculture, Food and the Marine (DAFM);
- Department of Communications, Climate Action and Environment (DCCAE);
- Department of Culture, Heritage and the Gaeltacht (DCHG);
- Department of Defence;
- Department of Housing, Planning & Local Government (DHPLG);
- Digital Ocean;
- Discover Ireland;
- Dublin Bay Birds Project;
- EirGrid;
- EMODnet;
- Environmental Protection Agency (EPA);
- EU Joint Research Centre;
- EU Social, Technical and Economic Committee on Fisheries (STECF);
- European Environment Agency;
- Extreme Sports Ireland;
- Failte Ireland;
- Fishing in Ireland (.com);
- FlyRyte Drone Academy;
- Flyte;
- Fred Olsen Renewables & Hazel Shore Ltd. (via Natural Power);
- Galway-Mayo Institute of Technology;
- Gas Networks Ireland;
- Geological Survey of Ireland (GSI);
- GMIT;
- Greenlink Interconnector;
- Greenwire Interconnector;
- Heritage Council;
- INFOMAR;
- Inland Fisheries Ireland;
- International Council for the Exploration of the Sea (ICES);
- International Maritime Organization (IMO);
- Ireland-France Subsea Cable;
- Irish Aviation Authority (IAA);
- Irish Climbing Online;
- Irish Coast Guard;
- Irish Kitesurfing Association;
- Irish Maritime Development Office (IMDO);
- Irish Sailing;
- Irish Surfing Association;
- Irish Underwater Council;
- Irish Waterski and Wakeboard Federation;
- Irish Whale and Dolphin Group (IWDG);
- Irish Windsurfing Association;
- Irish Wrecks Database;
- JNCC;
- Kingfisher (Seafish);
- Kitesurf Ireland;
- Local Kite Spots (.com);
- Louth Nature Trust;
- Magic Seaweed;
- Making the European Fisheries Ecosystem Plan Operational (MEFEPO) project, University of Liverpool;
- Maps.ie;
- Marine Institute;
- Marine Scotland;
- Marine Traffic;
- Maritimemaps / Claymoreclan Design;
- National Biodiversity Data Centre;
- National Monuments Service;
- National Museum of Ireland;
- National Parks and Wildlife Service (NPWS);
- National Trails Office;
- National University of Ireland – Galway;
- NERC;
- Ordnance Survey Ireland (OSI);
- Oslo-Paris Agreement (OSPAR);
- Parkwind & Oriel Windfarm Ltd.;
- Petroleum Affairs Division (PAD);
- Pobal Programmes and Initiatives throughout Ireland;
- Queens University Belfast;
- Royal National Lifeboat Institution (RNLI);
- Royal Society for the Protection of Birds;

- Saorgus Energy & Innogy SE;
- Sea Angling Ireland;
- SeaDataNet
- Sea-Fisheries Protection Authority (SFPA);
- Socio-economic Marine Research Unit (SEMRU);
- SSE Renewables;
- Sustainable Energy Authority Ireland (SEAI);
- The Ireland Walking Guide;
- The Office of Public Works (OPW);
- Tourism Ireland;
- Transport Infrastructure Ireland;
- UK Climbing;
- UK Hydrographic Office;
- UK Met Office;
- University College Cork;
- University of Glasgow;
- University of St Andrews;
- Waterford Institute of Technology;
- Wild Atlantic Way;
- Wildscope.

Information on relevant data sets and information sources was collated within a Data Collation Excel spreadsheet containing a number of fields (see accompanying workbook). This serves as a catalogue of the various data sets identified, and the institution or organisation that holds the data, together with a contact where available.

Contacts are being pursued with many of these organisations to obtain relevant datasets for inclusion on the Marine Atlas (i.e. in particular those where a gap in the Marine Atlas has been identified, and the organisations hold data that are expected to be useful in filling priority gaps). Further detail on the contacts, data sources being requested, and progress in obtaining data is provided in Appendix A.

2.2.2 Quality assurance

Evidence quality assurance is important both to ensure accuracy of information used within MSP and to promote stakeholder confidence in the data being used. All data identified through Task 1 has therefore been subject to a quality assurance assessment. The Marine Institute has quality assurance requirements as a part of the Marine Institute Data Strategy (2017 – 2020) objectives. Objective 3 of 6 in the data strategy is assigned to ensuring the quality of data that MI holds. This is summarised in the Data Policy document as: 'Quality – Defining process to ensure the Marine Institute delivers high-quality, reproducible data'. The quality assurance method used in this project has taken account of these quality assurance requirements of the Marine Institute, and broadly follows an evidence quality assurance process used by the Marine Management Organisation, the marine planning body for English marine plans (MMO, undated). The elements of the quality assurance process are documented in Table 1 and described in more detail below.

Table 1. Data quality assurance elements

QA Category	Description
Appropriateness	To ensure that a piece of evidence is appropriate for its intended use and can be used to inform the question that has been posed.
Methodology	The method used to produce or collect the evidence is recognised standard practice.
Timeliness	Age of the evidence is an important consideration. Depending on the nature of the evidence, out of date evidence has the potential to affect the user confidence.
Accuracy	Is the resolution sufficient for what the data are representing? For evidence that relies on modelled data an unbiased statistical accuracy assessment can provide assurance and confidence.
Production Quality Standards	Ensure that any evidence used has been collected, processed and published with rigour and that appropriate quality assurance processes are in place, and embedded, within the organisations that collected or produced such evidence.
Metadata INSPIRE Compliant	Is the metadata INSPIRE compliant?

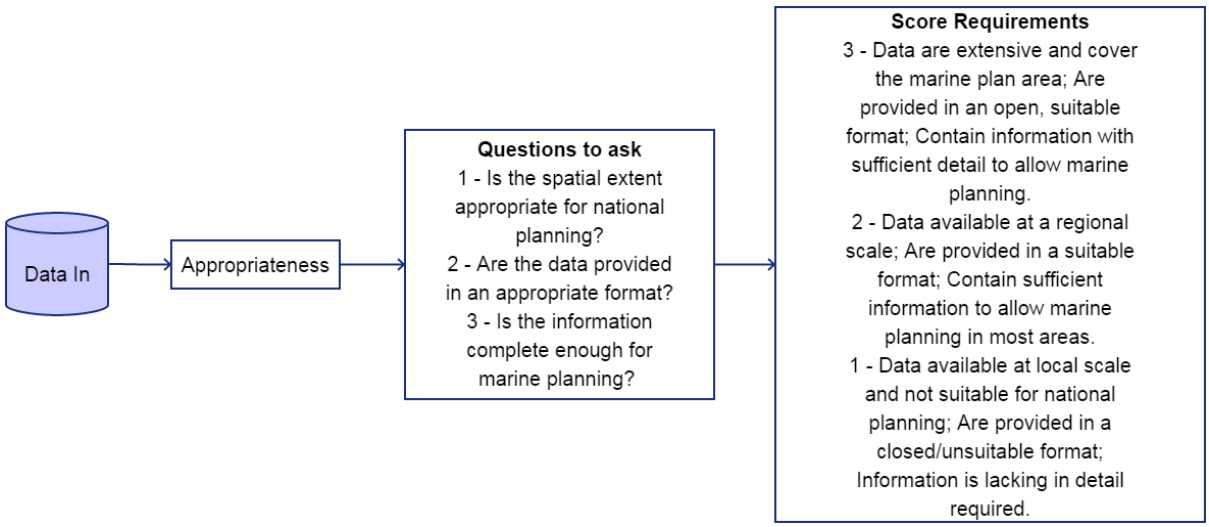
For each of these categories a score has been assigned based on how the dataset meets the criteria set out below. The score is between 1 and 3 or zero (N/A) where the category is not applicable to that particular dataset:

- 0 – N/A;
- 1 – Low/Unknown;
- 2 – Medium; and
- 3 – High.

The scores for each relevant category were then summed and calculated as a percentage to give an overall indication of the quality of the data. Relevant questions that were considered about the data, and indicative score requirements, for each quality assurance element, are provided in more detail below.

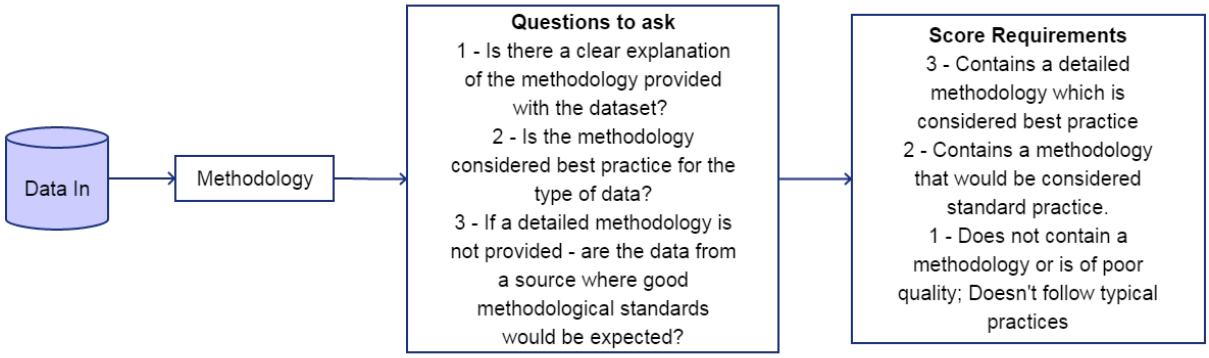
Appropriateness

How relevant are the data to marine spatial planning?



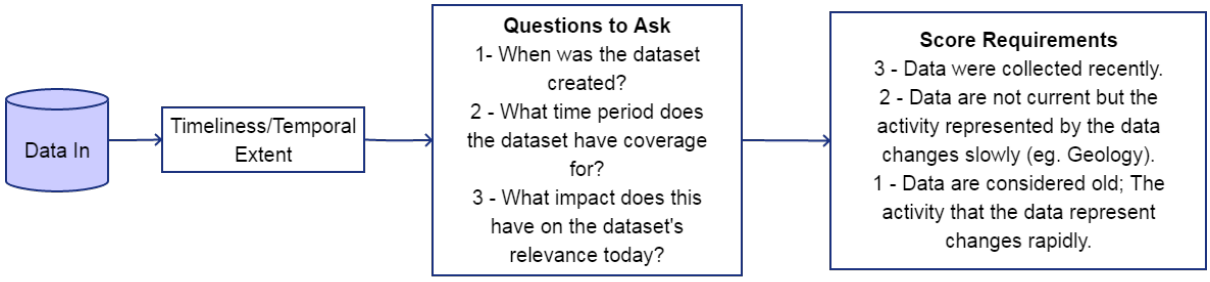
Methodology

Is there a clear explanation of the methodology used, and was it robust enough?



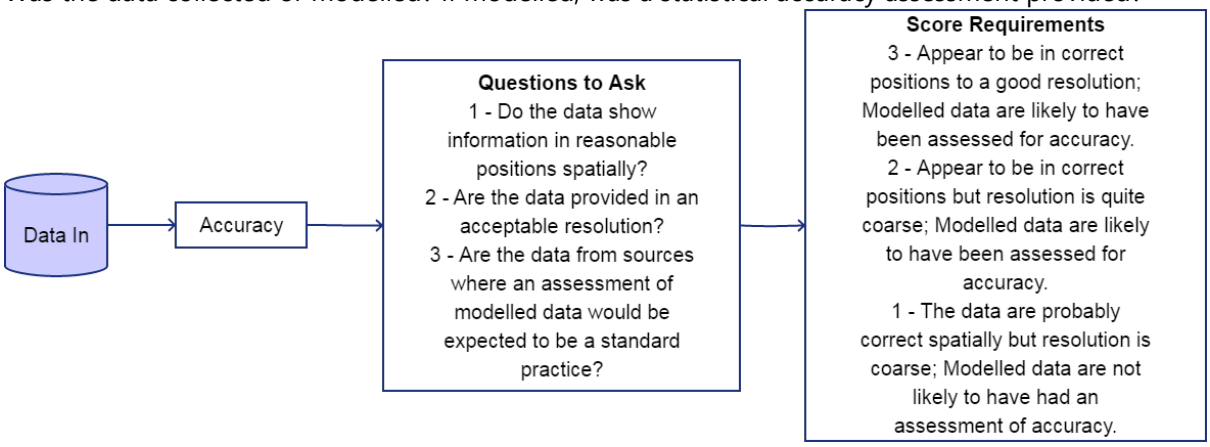
Timeliness/Temporal extent

What period of time does the data represent? How old is the dataset and how much of an effect could this have on its accuracy today? For example, habitat datasets may become out of date within a few years however geology datasets will have a much longer lifespan.



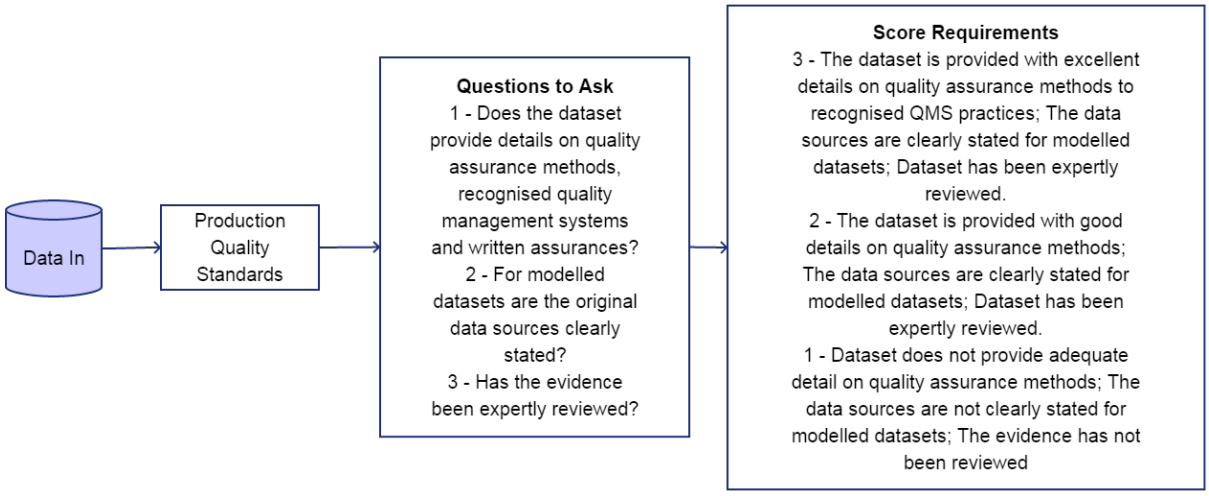
Accuracy

Was the data collected or modelled? If modelled, was a statistical accuracy assessment provided?



Production quality standards

Is there sufficient information provided on QA checks of the dataset? Does it state the data sources?



Metadata INSPIRE compliant

According to Article 5 of the INSPIRE Directive 2007/2/EC, Member States shall ensure that metadata are created for the spatial data sets and services corresponding to the themes listed in Annexes I, II and III, (Table 2) and that those metadata are kept up to date. Commission Regulation (EC) No 1205/2008 sets out the requirements for the creation and maintenance of this metadata. This includes the mandatory metadata elements for spatial datasets and spatial dataset series (Table 3).

Table 2. Spatial data themes referred to in the INSPIRE Directive

Annex I	Annex II	Annex III
Coordinate reference systems	Elevation	Statistical units
Geographical grid systems	Land cover	Buildings
Geographical names	Orthoimagery	Soil
Administrative units	Geology	Land use
Addresses		Human health and safety
Cadastral parcels		Utility and governmental services
Transport networks		Environmental monitoring facilities
Hydrography		Production and industrial facilities
Protected sites		Agricultural and aquaculture facilities
		Population distribution — demography
		Area management/restriction/regulation zones and reporting units
		Natural risk zones
		Atmospheric conditions
		Meteorological geographical features
		Oceanographic geographical features
		Sea regions
		Bio-geographical regions
		Habitats and biotopes
		Species distribution
		Energy resources
		Mineral resources

Table 3. Mandatory metadata requirements for spatial data sets and spatial data set series

QA Category	Description
Resource title	Mandatory
Resource abstract	Mandatory
Resource type	Mandatory
Resource locator	Mandatory if a URL is available to obtain more information on the resource, and/or access related services
Unique resource identifier	Mandatory
Resource language	Mandatory if the resource includes textual information
Topic category	Mandatory
Keyword	Mandatory
Geographic bounding box	Mandatory
Temporal reference	Mandatory
Lineage	Mandatory
Spatial resolution	Mandatory for data sets and data set series if an equivalent scale or a resolution distance can be specified
Conformity	Mandatory
Conditions for access and use	Mandatory
Limitations on public access	Mandatory
Responsible organisation	Mandatory
Metadata point of contact	Mandatory
Metadata date	Mandatory
Metadata language	Mandatory

All data were assessed for compliance with INSPIRE metadata standards (Figure 3). Where metadata files were lacking, or where metadata failed the INSPIRE compliance check, this was flagged in the Data Collation spreadsheet (INSPIRE Compliant: Yes / No)[1].

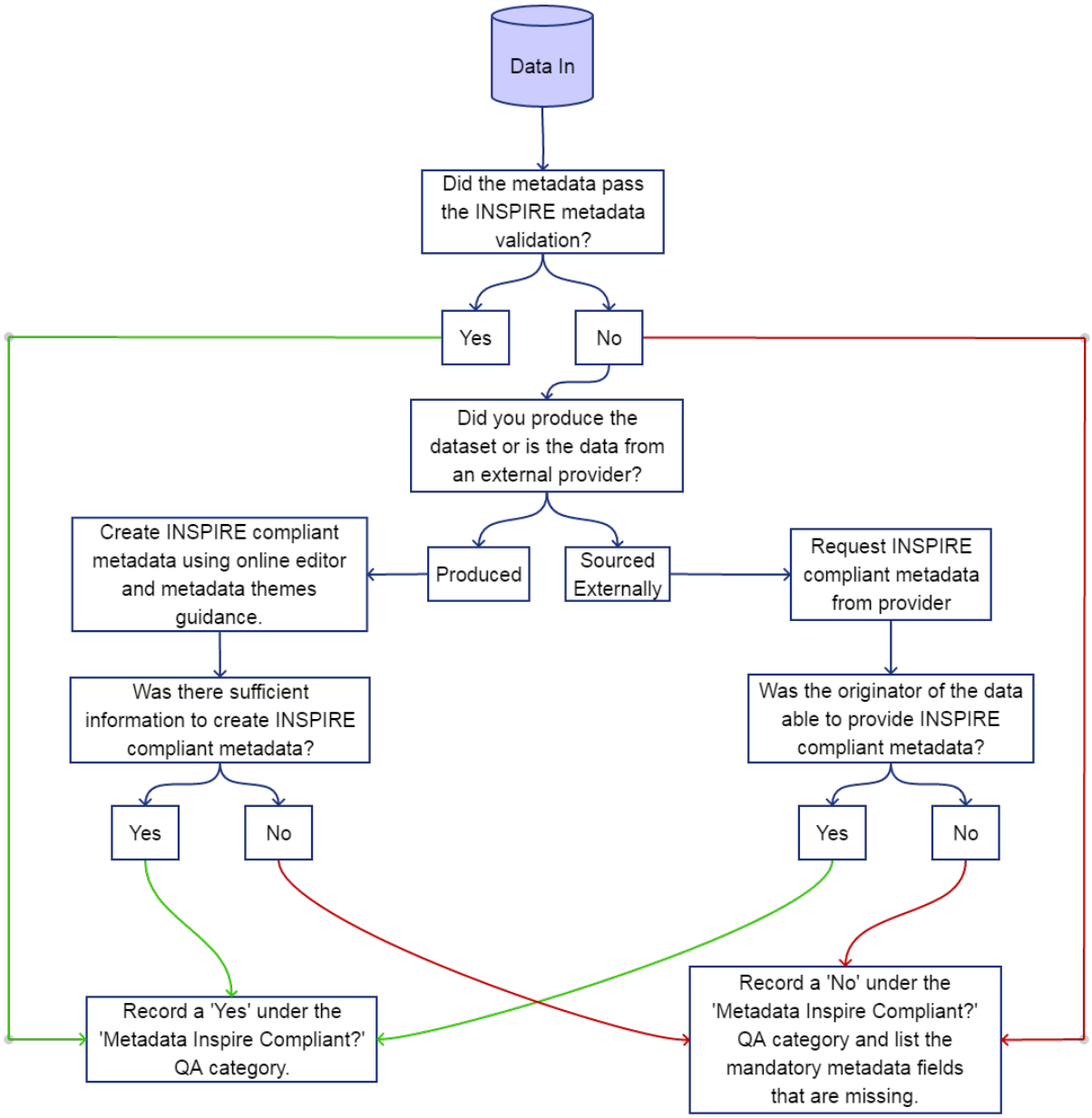


Figure 3. INSPIRE-compliant metadata check flow chart

[1] If a dataset that lacks INSPIRE-compliant metadata is later identified as being of use to MSP, we will look to create INSPIRE-compliant metadata if possible, to enable its use.

2.2.3 Evaluation of suitability for use within MSP

The evaluation of suitability has been based on the judgement of the study team. This judgement has been informed by the quality of the data, the extent to which similar data has found to be useful in other national MSP processes and specific interest in particular activities in Ireland.

The suitability of the data has been categorised (and colour-coded) as follows:

- Not suitable for use/not required;
- Requires major revision/improvement;
- Suitable for use with minor modification; and
- Suitable for use in current form.

Further commentary has been provided in the spreadsheet on the relative usefulness of the data sets to MSP and what further activity might be required to make it suitable for use. This information will be used to inform the gap analysis.

Summaries of the Data Review phase for each topic are provided in Appendix A.

2.3 Gap analysis

The identification of data gaps built on the Data Review. The gap analysis was based on:

- Definition of data products/data layers required for MSP;
- Existence of those data products/data layers on Ireland's Marine Atlas.

Data gaps were then identified where existing Marine Atlas layers were not available for specific generic MSP data requirements. The identified gaps were prioritised for filling through a later project (Project 2: Data prioritisation). An overview of the gap analysis process is shown in Figure 4.

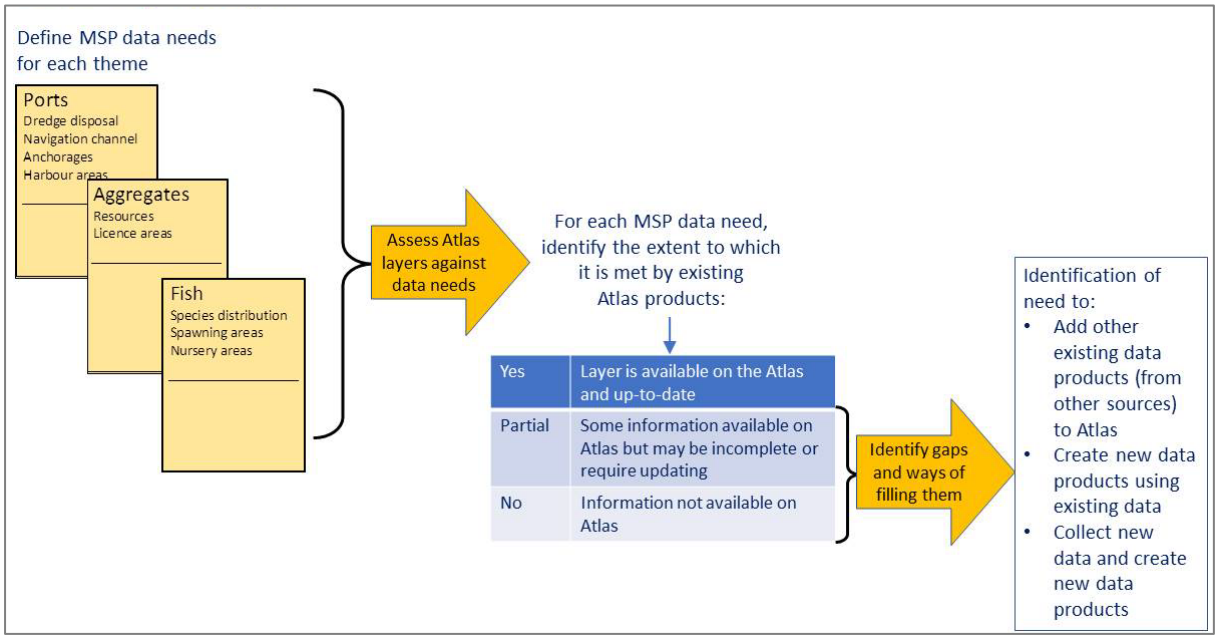


Figure 4. Generic MSP data needs, identification of gaps in Marine Atlas and options for filling them

The identification of specific data and information gaps for MSP depends, to some extent, on what Ireland is seeking to achieve through its MSP process and the tools that it proposes to use. At this stage in the process, the focus is on gaps in relation to broad generic data product/data layer requirements (Table 4) to support MSP, recognising that additional evidence can be collected through the course of the MSP process where this is necessary to address newly-identified gaps. The relevant data requirements vary by the topic type (e.g. whether relating to biological or environmental aspects, or human activities), and are modified according to the specifics of each topic.

Table 4. Generic MSP Data Requirements for Data Products/Data Layers

Data Category	Generic Data Requirement
Administrative and Physical Boundaries	▪ Spatial representation of relevant boundary/unit
Physical environment	▪ Current spatial distribution and characteristics of physical feature (e.g. wave height, contaminant concentration etc) ▪ Potential future spatial distribution and characteristics of physical features (where relevant) 2
Biological Environment	▪ Historic spatial distribution of feature ▪ Current spatial distribution and/or abundance/intensity of feature ▪ Spatial information on current ecological function (e.g. foraging, nursery, breeding, migration route etc)) – relevant to mobile features (fish, birds, mammals, reptiles) ▪ Potential future spatial distribution of feature ▪ Administrative boundary for biological feature
Environmental Quality	▪ Administrative or management boundary ▪ Historic quality status ▪ Current quality status ▪ Potential future quality status
Human Environment	▪ Historic spatial distribution/location and/or intensity of activity (last 10 years) ▪ Current spatial distribution of resource ▪ Current spatial distribution/location and intensity of activity ▪ Potential future spatial distribution of resource (next 20 years) ▪ Potential future spatial distribution/location and intensity of activity (next 20 years) ▪ Activity specific administrative boundary (e.g. fishing closed areas) ▪ Data/spatial data on historic value of activity (last 10 years) ▪ Data/spatial data on current value of activity ▪ Data/spatial data on potential future value of activity (next 20 years)

A Gap Analysis Spreadsheet was set up and pre-populated with information on MSP Category, INSPIRE Theme, Sub-Theme, Feature name, and Indicative MSP Requirement. For each topic, the spreadsheet was populated with information on:

- Current availability of suitable data product/ data layer on Marine Atlas;
- Extent of gap;
- Options for addressing gap;
- Estimated cost; and
- Notes.

[2] Physical features are unlikely to change significantly over the time period of a marine plan. The value of seeking to create data products/data layers for future time periods is considered to be very limited and thus likely to score low in any prioritisation process. However, this element has been included in the gap analysis for the majority of physical environment features for completeness.

The pre-population of each topic spreadsheet with 'Feature name' and 'Indicative MSP Requirement' essentially define the data products/data layers required. These were populated based on expert judgement and knowledge of each topic and likely MSP requirements based on experience from previous MSP processes.

Each of the above fields was populated as detailed below.

2.3.1 Current availability of suitable data product / data layer

An indication of whether information is **currently available on the Marine Atlas** and suitable for use in its current form was based on the Data Collation Spreadsheet (which documented layers available on the Marine Atlas as well as data from other sources), classified as:

- Yes;
- Partial;
- No.

'Partial' was used where data are available on the Marine Atlas but are spatially incomplete or are out-of-date and require updating. For example, if data are between 5 and 10 years old they have generally been classed as 'partial' if they are being used to represent **current** distribution or activity. However, for some topics, older data may be acceptable for features that are unlikely to change over time (e.g. geomorphology).

2.3.2 Extent of gap

This field describes the extent of the gap on the Marine Atlas, and where data or data products might be available to fill the gap (from the Data Review).

By way of an example, there are maps describing the spatial distribution of different species of cetacean on the Marine tlas. These are quite old and incomplete. These may provide a sufficient representation of historical distribution of the relevant marine mammals but they do not provide a sufficient representation of current distribution/abundance of marine mammals. Thus, in terms of the availability of spatial data layers on the Marine Atlas describing the current distribution of species of cetacean, there is a gap.

2.3.3 Options for addressing gap

For each gap (where current availability of data was 'partial' or 'no'), brief text was added describing options for addressing the gap together with information on any significant limitations. We sought to follow a hierarchy of options:

- Where data products/data layers exist but are not yet on the Marine Atlas, the first option should be to seek to agree permission with data owner to use data within MSP and host on the Marine Atlas;
- Where data exist but are not in a suitable form (i.e. not processed to provide the appropriate data layer or data product), one or more options for processing data to create suitable data products /data layers should be presented;
- Where data do not exist options should be identified to collect new data and process it to create suitable data products/data layers.

2.3.4 Estimated cost

An estimate of the indicative cost of obtaining or producing suitable data products/data layers, using best judgement, is provided according to the following categories:

- <€5k: this category would apply where a suitable data product exists as open source data but is not currently on the Marine Atlas;
- €5k–10k: this category would apply if suitable open source data exist but require some minor processing to generate a useful data product;
- €10k–100k: this category would apply if data exist but require significant effort to acquire or process to generate a useful data product;
- >€100k: this category would apply if primary data need to be collected or a major effort is required to collate and process existing data to create a useful data product.

In the subsequent prioritisation phase under Project 2, more detailed descriptions of the work and costs to develop suitable data layers/data products will be developed for those data gaps that are considered to be of higher priority.

2.3.5 Notes

This field was used to note the name of existing layers on the Marine Atlas, where a requirement is assessed as 'Yes' or 'Partial', and to note any other pertinent information.

3 Data Review Findings

3.1 Identification of data sets

A total of 2,068 data sets have been identified as being of potential use within marine spatial planning. These are summarised in Table 5. This includes 403 data sets already held within the Marine Atlas and a further 1,666 data sets identified through this Data Review phase.

The full details of the data review are provided in the accompanying Data Collation Excel Spreadsheet. A summary by topic is provided in Appendix A 'Summary of Data Review by Topic' on page 25.

3.2 Quality assurance of data sets

Of the four principal data categories, the administrative and physical boundaries category contains 57 data sets, the physical environment category contains 195 data sets, the marine environment and nature conservation category contains 1,386 data sets, the environmental quality category contains 29 data sets, and the human environment category contains 401 data sets. This gives a total of 2,068 data sets and includes the duplication of a number of data items across themes.

While some of the data set sub-categories contain a high number of relatively good quality data, e.g. marine mammals, fisheries & shellfisheries; others contain low numbers of data sets, e.g. telecommunications and marine aggregates. Other datasets hold a high number of data sets but of relatively low quality e.g. tourism and recreation.

The number of data sets that met the quality assurance threshold (>50% overall score) was 1,794 and 593 datasets had INSPIRE compliant metadata.

3.3 Evaluation of suitability

The administrative and physical boundaries category contains 39 data sets considered immediately suitable for use in marine spatial planning, up to a total of 40 data sets suitable with revision. The physical environment, marine environment and nature conservation,, environmental quality and human environment category values were 35 (101 with revision), 101 (1,167 with revision), 9 (1 with revision) and 86 (187 with revision) respectively.

Note that some data have not yet been accessed and some recently-acquired datasets have not yet been assessed therefore quality assurance and MSP suitability assessment is not yet complete for those layers.

Table 5. Data Review Summary

MSP Topic	Number of Data Sets in MI Atlas	Number of Additional Data Sets Identified	Number of Data Sets Meeting QA Threshold (50%)	Number of Data Sets Meeting INSPIRE Standards	Number of Data Sets Considered Immediately Suitable for Use in MSP	Number of Data Sets Considered Suitable for Use in MSP with Revision	Number of Data Sets Considered Unsuitable for Use in MSP
Administrative Boundaries	**56**	**1**	**53**	**45**	**39**	**1**	**17**
Land boundaries	8	1	5	3	5	1	3
National and international maritime limits	25	0	25	21	16	0	9
EC Directive reporting units	6	0	6	6	6	0	0
Fisheries units/boundaries	11	0	11	9	10	0	1
River and catchment boundaries	6	0	6	6	2	0	4
Physical Environment	**64**	**131**	**186**	**62**	**35**	**101**	**59**
Geology	18	90	103	18	25	73	10
Ocean features	43	22	62	41	3	15	47
Seabed sediments	3	19	21	3	7	13	2
Marine Environment and Nature Conservation	**167**	**1219**	**1281**	**381**	**101**	**1167**	**27**
Benthic habitats and species	14	29	43	15	12	31	0
Fish and shellfish	63	16	73	64	53	18	8
Marine mammals	70	1058*	1078	289	20	1058	0
Birds	0	103*	60	0	3	45	14
Reptiles	0	9*	4	0	0	4	4
Terrestrial habitats	10	0	10	8	3	7	0
Natural capital and ecosystem services	0	3	3	0	0	3	0
Protected Area Boundaries (Designated nature conservation sites)	10	1	10	5	9	1	1
Environmental Quality	**8**	**21**	**15**	**7**	**9**	**1**	**6**
Water Quality	3	14*	5	3	4	1	1
Marine litter	0	5	5	0	5	0	0
Other human pressures	5	2*	5	4	0	0	5
Human Environment	**107**	**294**	**259**	**98**	**86**	**187**	**83**
Aquaculture	6	5	11	6	9	2	0
Aviation	0	3	1	0	0	3	0
Coast and flood defences	0	26*	6	0	0	5	1
Cultural heritage and assets	1	11	11	0	4	2	6
Defence and national security	0	3	1	0	0	3	0
Energy (Petroleum, renewables, transmission systems)	61	17*	61	58	20	15	27
Energy – Carbon capture and storage	0	1	1	0	0	0	1
Fisheries and shellfisheries	12	54	56	12	17	43	6
Infrastructure – Land-side (Roads, rail, urban development, utilities)	0	7*	2	0	0	7	0
Infrastructure – Other marine	6	0	6	4	4	0	2
Marine aggregates	3	0	3	3	0	2	1
Ports, harbours and shipping	13	17*	18	12	14	6	3
Seascape	0	0	n/a	n/a	n/a	n/a	n/a
Seaweed harvesting	0	18	17	0	0	16	2
Social and economic factors	0	44*	32	0	8	27	7
Telecommunications	1	1	1	1	1	0	1
Tourism, sport and recreation	0	86	28	0	8	54	24
Wastewater treatment and disposal	4	1	4	2	1	2	2

* Examination of some of the data and metadata items will need to be completed, as data are either held by MI, another data provider, or have been obtained recently.

4 Gap Analysis Findings

The full gap analysis is provided in a separate Gap Analysis Excel Spreadsheet. A summary narrative for each topic is provided in Appendix C 'Summary of Gap Analysis by Topic' on page 54.

A summary of the gap analysis findings by topic is provided in Table 6. Each topic has been given a colour rating (green, amber, red), based on a qualitative assessment of the balance of availability of data requirements for MSP on the Marine Atlas, according to the following categories:

	Data on the Marine Atlas are broadly complete and sufficient
	Marine Atlas has some information, but further improvements and additions are desirable
	Data severely lacking from the Marine Atlas

This is intended as a quick visual indication of where the main issues lie. The summaries of each topic in Appendix C, and the full gap analysis in the accompanying spreadsheet, should be referred to for details.

Table 6. Summary of gap analysis findings by topic

MSP Topic	Number of MSP requirements for which layers exist on the Marine Atlas			Comment
	Yes	Partial	No	
Administrative Boundaries				
Administrative and physical boundaries	59		2	Data on Atlas almost complete. Gaps can be readily filled.
Physical Environment				
Geology		13		Incomplete coverage of Irish waters. Filling gaps entails significant costs.
Seabed sediments		2		Only partial coverage and coarse resolution. Can be improved with processing of existing data.
Ocean process features	8	20		Atlas has some data on spatial distribution of some features, but other features require significant investment to fill gaps.
Biological Environment				
Benthic habitats and species	5	36	19	Some data on Atlas but gaps entail significant costs to fill through field-based surveys and processing of existing data.
Fish and shellfish	5	46	30	Existing data on administrative boundaries. Atlas data are incomplete for most species. Most can be updated from existing sources.
Marine mammals	1	44	53	Existing Atlas data is incomplete, should be updated with existing data from other sources/surveys.
Birds	1	1	21	Significant gaps exist, but much relevant data is held by other agencies.
Reptiles			16	No data on the Atlas, layers can be created from NPWS data at relatively low cost.
Terrestrial habitats	1	8		Data exist on land cover classification; gaps can be addressed at relatively low cost.

MSP Topic	Number of MSP requirements for which layers exist on the Marine Atlas			Comment
	Yes	Partial	No	
Natural capital and ecosystem services	9	16	24	Some data exist on distribution of habitats, energy resources and some infrastructure. Significant gaps exist, can be addressed through project 3.
Environmental Quality				
Water quality	7		17	Data exist on boundaries and WFD quality status. Additional data could be sourced from other agencies
Marine litter			6	Data can be sourced from Coastwatch or MI/OSPAR, but further investment in surveys to fill gaps is needed.
Other human pressures			31	No data on Atlas on pressures, but many could be sourced from existing data with some processing required.
Human Environment				
Aquaculture	4		21	Atlas contains information on boundaries and current spatial distribution. Gaps on resource, historic and future distribution and value.
Aviation			4	Information can be sourced from IAA.
Coast and flood defences			6	No data on Atlas, some can be sourced from OPW. Information on coastal defence assets would need significant effort.
Cultural heritage and assets		1	21	Data on Atlas relate to wrecks. Additional data can be sourced, new data on palaeolandscapes needed. Other aspects better addressed through tourism/recreation.
Defence and national security			5	No data on the Atlas, spatial data can be filled from other sources, information on value would require more processing.
Energy (Petroleum, renewables, transmission systems)	9	20	36	Some layers exist, most gaps can be filled from data from other sources at relatively low cost.
Energy – Carbon capture and storage			3	Spatial information can be sourced from SEIA 2008 study. Value would require assumptions.
Fisheries and shellfisheries	9	4	38	Existing layers relate to admin boundaries. Layers on activity need updating; some gaps can be filled from processing existing data, others would require new data collection.
Infrastructure – Land-side (Roads, rail, urban development, utilities)		2	28	Significant data gaps but most can be filled from existing sources, albeit with some processing required.
Infrastructure – Other marine	4			Layers available for current distribution.
Marine aggregates		2	4	Filling the data gap on distribution of marine aggregate resource is likely to entail significant effort.
Ports, harbours and shipping	2	8	15	Need for updating and improving some existing layers, additional layers needed on various topics by processing existing sources.

MSP Topic	Number of MSP requirements for which layers exist on the Marine Atlas			Comment
	Yes	Partial	No	
Seascape			2	No layers on Atlas but seascape/landscape character assessments available from county councils. National assessment needed.
Seaweed harvesting			8	Some gaps can be readily filled from existing data, information on current distribution of resource, and future activity would cost more.
Social and economic factors			6	No layers currently on Atlas but could be created from existing sources. Future layers would require assumptions.
Telecommunications		3	3	Need to refine existing layers, could create layers on value (replacement cost).
Tourism, sport and recreation		2	178	Some gaps can be filled from existing sources, but significant primary data collection required for others.
Wastewater treatment and disposal	3	6	9	Layers exist on current distribution of facilities, and could be created for historic, future and value.

5 Next Steps

Based on the identification of data gaps and the brief options identified for filling those gaps, and drawing on existing data identified in the Data Review, the next steps that will be carried out are:

- Prioritisation of data gaps into high, medium and low categories;
- For high and medium priority data gaps, to develop individual roadmaps that set out what data sources should be used, any additional data to be collected, and data processing steps required to fill the gap, along with an estimate of costs, time and specialist expertise required. These will form the basis for further work by ABPmer under the SDE projects to develop data products, as well as providing a clear specification for work that can be taken forward by the Marine Institute or other agencies through separate projects;
- To contact holders of the data identified in the Data Review and required for the implementation of the Roadmaps, and obtain the data and associated licences;
- To agree on the Roadmaps that will be taken forward by ABPmer under the SDE projects to fill the data gaps identified.

The steps above will be taken forward under SDE Project 2 on Data Prioritisation and Collection.

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7 Abbreviations and Acronyms

AIS	Automatic Identification System
ASI	Annual Services Inquiry
BGS	British Geological Survey
BIM	Bord Iascaigh Mhara
BRITICE	British-Irish Ice Sheet - Glacial Mapping Project
CCS	Carbon Capture and Storage
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CFRAM	Catchment Flood Risk Assessment and Management
CMRC	Coastal and Marine Research Centre
CODA	Cetacean Offshore Distribution & Abundance in the European Atlantic
CORINE	Coordination of Information on the Environment
COTF	Cetaceans on the Frontier
CSO	Central Statistics Office
CTD	Conductivity, Temperature and Density
DCHG	Department of Culture, Heritage and the Gaeltacht
DHPLG	Department of Housing, Planning and Local Government
DNA	Deoxyribonucleic acid
EC	European Commission
EEZ	Exclusive Economic Zone
EirGrid	EirGrid Group
EMFF	European Maritime and Fisheries Fund
EMODnet	European Marine Observation and Data Network
EPA	Environmental Protection Agency
ESAS	European Seabirds At Sea
ESB	Electricity Supply Board
EU	European Union
EUNIS	European Nature Information System
FAME	Future of the Atlantic Marine Environment
FEE	Foundation for Environmental Education
GeoHive	Spatial Data Service (OS Ireland)
GIS	Geographic Information System
GSI	Geological Survey of Ireland
GT	Gross Tonnage
GVA	Gross Value Added
HAB	Harmful Algal Bloom
HOOW	Harnessing our Ocean Wealth
IAA	Irish Aviation Authority
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
ICPSS	Irish Coastal Protection Strategy Study
IDG	Inter-Departmental Group
IMAGIN	Irish Sea Marine Aggregates Initiative
IMDO	Irish Maritime Development Office
IMO	International Maritime Organization
INFOMAR	INtegrated Mapping FOr the Sustainable Development of Ireland's MArine Resource
INSPIRE	Infrastructure for Spatial Information in Europe
IPPC	Integrated pollution prevention and control
ISDE	Irish Spatial Data Exchange

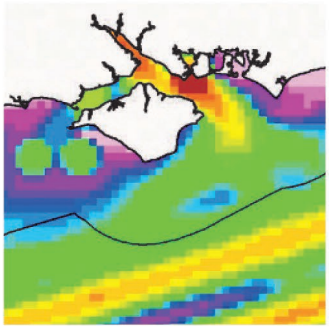
iVMS	inshore Vessel Monitoring System
IWDG	Irish Whale and Dolphin Group
I-WeBS	Irish Wetland Bird Survey
JNCC	Joint Nature Conservation Committee
KIS-ORCA	The Kingfisher Information Service - Offshore Renewable Cable Awareness
LiDAR	Light Detection and Ranging
LSI	Land–Sea Interface
MaREI	Centre for Marine and Renewable Energy Ireland
MCA	Maritime and Coastguard Agency
MIDA	Marine Irish Digital Atlas
MISE	Mammals in a Sustainable Environment
MMO	Marine Management Organisation
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
MSPP	Marine Spatial Planning Pilot
N/A	Not Applicable
NACE	Statistical classification of economic activities in the European Community
NBDC	National Biodiversity Data Centre
NEWS	Non-Estuarine Coastal Waterbird Survey
NPWS	National Parks and Wildlife Service
ObSERVE	Programme of targeted acoustic and aerial surveys of Cetaceans and Seabirds in the Irish offshore
OE	Ocean Energy
OPW	Office of Public Works
OS	Ordnance Survey
OSI	Ordnance Survey Ireland
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAD	Petroleum Affairs Division
PAM	Passive Acoustic Monitoring
PCI	Projects of Community Importance
PDF	Portable Document Format
PoP	Platforms of Opportunity
PReCAST	Policy for Recommendations for Cetacean Acoustic Surveys and Tracking
QA	Quality Assurance
Ramsar	Wetlands of international importance, designated under The Convention on Wetlands (Ramsar, Iran, 1971)
RNLI	Royal National Lifeboat Institute
RSPB	Royal Society for the Protection of Birds
RV	Research Vessel
SAC	Special Area of Conservation
SAM	Static Acoustic Monitoring
SAR	Search and Rescue
SCANS II	Small Cetaceans in European Atlantic and North Sea
SEAI	Sustainable Energy Authority Ireland
SEMRU	Socio-economic Marine Research Unit
SFPA	Sea-Fisheries Protection Authority
SMR	Sites and Monuments Record
SOTW	Song of the Whale (Vessel)
SPA	Special Protection Areas
STECF	Scientific, Technical and Economic Committee on Fisheries
TSS	Traffic Separation Schemes

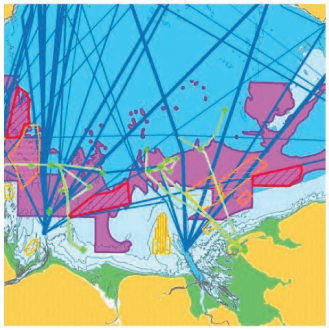
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UNESCO	United Nations Educational, Scientific and Cultural Organization
VMS	Vessel Monitoring System
WESPAS	Western European Pelagic and Acoustic Survey
WFD	Water Framework Directive
WHS	World Heritage Sites
WMS	Web Map Service

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices




Innovative Thinking - Sustainable Solutions

ABP mer

A Data being Requested from Other Organisations

Table A1. Data being requested from other organisations

Data Provider	Data
An Taisce	Beaches - Blue Flag, Beaches - Green Coast datasets (Tourism & Recreation theme)
BIM	Spatial data from seed mussel survey reports 2012-2017 (Aquaculture) Spatial data from Shellfish Stocks and Fisheries Reviews (shellfish beds) Spatial data from scallop habitat survey Clarification of annual aquaculture survey methodology
Climbing Ireland	Coastal climbing/coasteering locations
Coastal and Marine Resources Centre	Grey seal and harbour seal habitat
Coastwatch	Coastwatch Survey 2012-2017 (marine litter)
Commissioners of Irish Lights	Commercial shipping spatial data (AIS)
Cycling Ireland	Cycling clubs
DAFM	Aquaculture data layers
DCCAE	ObSERVE data (seabirds and marine mammals)
Department of Defence	Spatial data for danger areas, military ports
Deep Sea Fibre Rockabill	Proposed telecom cable route
DHPLG	Foreshore licensing database data
Digital Ocean	Dive sites and Wild Atlantic Way
Discover Ireland	Datasets 'On the Water', 'Sea Angling Operators', 'Beaches'
EirGrid	Route corridor for planned Celtic interconnector; existing land-side grid and N-S interconnector
EPA	Nutrient sensitive areas; dredge disposal licences
Failte Ireland	Location of tourism related businesses/activities
Gas Networks Ireland	Spatial data on gas network (terrestrial and marine)
Greenlink	Proposed power interconnector route
GSI/PAD	Latest available oil and gas data including licensing rounds/awards
Heritage Maps	Blue Flag beaches, Green Coast
Inland Fisheries Ireland	Article 17 maps for migratory fish; sea angling. Boat angling and bait collection locations; Wild Atlantic Way shore fishing locations
Ireland France Subsea Cable Ltd	Proposed telecom cable route
Irish Aviation Authority	Airport restriction zones (Airport Control Zones, Airport Control Areas), Helicopter Main Routes.
Irish Kitesurfing Association	Location of kitesurfing schools
Irish Sailing	ICC Sailing Directions
Irish Surfing Association	Location of surfing clubs/schools
Irish Underwater Council	Dive clubs

Data Provider	Data
Irish Waterski and Wakeboard Federation	Waterskiing and wakeboarding locations
Irish Windsurfing Association	Windsurfing schools and centres; windsurfing locations
Irish Wrecks	Wreck locations
KIS-ORCA	Power and telecom cable spatial data
Magic Seaweed	Surfing locations
Mammals in a Sustainable Environment (MISE) Project	Otter commuting
Maps Ireland	Surfing locations
Marine Traffic	Maps of recreational vessel density
MI	Commercial fisheries data layers; Fish data layers, Shellfish waters and shellfish hygiene classification data
MIDA	Seaweed species distributions
National Monuments Service	Wreck locations; World Heritage Sites
National Trails Office	Datasets on Off-Road Cycling, Walking/Hiking Trails, Sli na Slainte Walking Routes, Looped walks, Waymarked Ways, On-Road Cycling
NBDC	Chondrichthyans of Ireland spatial data
NPWS	Sand dunes, shingle and vegetated seacliffs; Article 17 data layers, OSPAR threatened and declining habitats
OPW	CFRAM and IPCSS data
OSPAR	Munitions historic dumpsites; Threatened and declining habitats and species
OSI	OSI PRIME 2 data sets
SEAI	Potential CCS storage locations
SFPA	Shellfish Waters and Shellfish Hygiene classification data
Tourism Ireland	Datasets on Angling schools/tuition, Boat tours, Bus tours
UK Climbing	Climbing locations
UKHO	IMO routeing measures, statutory harbour areas, maintained navigation channels, anchorages
Wild Atlantic Way	Walking Wild Atlantic Way datasets
Wicklow County Council	Bray Head Special Area shapefile

B Summary of Data Review by Topic

B.1 Administrative and Physical Boundaries

The Atlas contains more than 60 Administrative and Physical Boundary data layers including:

- Land boundaries (Mean High water Mark, Mean Low Water Mark);
- National and international maritime limits (6 nm, 12 nm, 200 nm, Exclusive Economic Zone (EEZ);
- EU Directive Reporting Boundaries;
- Protected Area Boundaries (designated nature conservation sites);
- Terrestrial administrative boundaries; and
- River and Catchment Boundaries.

There are also a range of administrative and management boundaries that relate to particular marine activities. These data sets are better organised as part of the relevant MSP theme.

Most of the Administrative and Physical Boundary data layers are suitable for use in MSP without further modification. Around twenty of the layers are considered relatively unimportant for marine planning, for example some of the detailed layers for rivers and catchments. No additional relevant boundaries were identified, other than a better source of data for Ireland's Ramsar sites.

B.2 Physical Environment

B.2.1 Geology

The most recent and useful information on this theme principally comprised of geophysics data in the form of bathymetric, backscatter, LiDAR, gravity, magnetics and geology, which are available at varying extents and resolution. The datasets provide information on the seabed depth and type and the solid geology and were obtained for a large extent of Irish waters, with the bathymetry data providing the widest coverage at varying resolutions. These datasets are available from the INFOMAR WMS service as well as the Geological Survey Ireland (GSI) Geophysical Archive Data Delivery system.

Generally these datasets are only available as surveys over an area. They have not been interpreted to identify features on the seabed including marine process features, such as tidal banks or glacial process features, such as moraine fields over the entire dataset. Therefore, there is scope for the interpretation of these datasets to identify marine, glacial and geological process features at a national scale. There are, however, examples of a few local studies which obtain and use the high resolution bathymetry for their area of interest to identify and interpret geological process features on the seabed and make the interpreted information publicly available. Identified examples include the "*Bedforms on the northwest Irish Shelf: indication of modern active sediment transport and over printing of paleo-glacial sedimentary deposits*" and "*Glacial and glacially-related features on the continental margin of northwest Ireland mapped from marine geophysical data*" study reports and outputs from the BRITICE Glacial Mapping Project. Such studies have a limited coverage, but provide useful interpreted data of marine, glacial and geological process features that are not widely available.

More widespread interpretation of features on the seabed and geological structures is available in British Geological Survey (BGS) charts. These are however much older and do not completely cover Irish waters. Data from the Petroleum Affairs Division (PAD) includes information on the offshore geology and the extent of geological units, as well as information on some geological structures. The information

on geological structures is limited to fault and ridge lines as well as outcrops of igneous rock and intrusive bodies. The data covers all Irish waters, extending out to Ireland's exclusive economic zone (EEZ) limit. Further information on the seabed geology, including substrate, lithology and stratigraphy types are available from the EMODnet project. This sets out the extents of geological units, but again does not include any information on features on the seabed, such as the occurrence of marine or glacial process features.

Bathymetry, geology and seabed classification maps are also available from EMODnet. However, these tend to be at a much coarser scale than the INFOMAR data introduced above, which should be used in the first instance.

B.2.2 Sediments

Data on seabed sediments is quite limited, with the most extensive dataset available from INFOMAR and GSI, resulting from the analysis of backscatter data as described in Section B.2.1. The interpretations from the backscatter have been ground-truthed by obtained sediment samples which are also available for use. These datasets provide the widest coverage at the highest resolution, covering Irish waters.

Other sources of sediment data are from EMODnet and the Mapping European Seabed Habitats (MESH) Atlantic projects. These outputs are mainly aimed at identifying and classifying seabed habitats and therefore do not directly inform on sediment type and distribution. Nonetheless, information on the seabed sediment type can still be interpreted from seabed habitat data.

Sediment charts from the BGS are another source of data providing information on the sediment type and distribution, similar to the geological data. However, this data is again much older and does not completely cover Irish waters.

B.2.3 Ocean process features

These data are categorised under the INSPIRE oceanographic geographic features theme. It includes properties of oceanographic and meteorological processes such as tides, currents, waves, sea water density, salinity and temperature, wind, pressure, ocean frontal systems and sea level change.

The most extensive repository of data and information on this theme is from the Marine Institute. This data is available in its raw form, with data records at regular intervals over the deployment period. However, there are limited examples of interpreted and derived static maps of the process parameters across a wider area, e.g. the distribution of significant wave heights across Irish waters. Nonetheless, the potential is there to derive such static representations.

Long term deployments of tide gauges, wave and weather buoys are available for a number of locations around Ireland. The tide gauges are mostly located at the coast and form part of the Irish tide gauge network, whereas the wave and weather buoys are deployed further offshore. The deployment locations are available to view on the Marine Institute's Marine Atlas, while the recorded data is available from the Marine Institute. The data from each monitoring site is limited in spatial coverage, but provides a long-term view of the processes. Assessment of multiple sites provides additional information on the spatial variation within Irish waters. The data from across the different monitoring sites have been combined to provide static maps of tidal levels, currents, waves, salinity, and temperature across Irish waters for certain time periods.

Local surveys of the conductivity, temperature and density (CTD) of the water column are also available from the Marine Institute, but these tend to be over a shorter time range and smaller area. Additional data on sea temperature is continually obtained from instruments permanently mounted on the Marine

Institute's research vessels which collect data in transit. This provides data from a wider area, but is limited in time.

The EMODnet Physical Parameters data portal provides information on archived and near real-time data on oceanographic conditions in Europe's seas and oceans, including information on sea levels, currents, waves, wind, sea water salinity and temperature and wind. Although the associated data is not readily available through the portal, there is direction to the relevant data holders.

B.3 Biological Environment

B.3.1 Benthic habitats and species

Broad-scale habitat maps

For the purposes of the data review, identification of broad-scale habitat maps was made using several data catalogues: the European Marine Observation and Data Network (www.emodnet.eu), the Irish Spatial Data Exchange (www.isde.ie), the Marine Institute data catalogue (www.marine.ie) and the International Council for the Exploration of the Sea (ICES) data catalogue (http://gis.ices.dk/geonetwork/srv/eng/catalog.search#/home).

Table B1. Broad scale habitat data sets

Name/Location	Data Source	Spatial Extent
Collated EUNIS Habitats	Marine Institute	National
EMODnet Collated Substrate	Geological Survey of Ireland	National
MSFD Predominant Habitat Confidence	Marine Institute	National
MSFD Predominant Habitat Type	Marine Institute	National
Celtic Sea offshore habitats	Marine Institute	Regional
Valentia Island habitat	Marine Institute	Inshore
Cork Coastal Rocky Habitat	Marine Institute	Inshore
South Irish Sea Habitats	Marine Institute	Regional
Irish Sea Pilot Project Habitats	Marine Institute	Regional
Kenmare River Habitats	Marine Institute	Inshore
Celtic Sea Nearshore habitat	Marine Institute	Regional
Southwest Ireland Marine habitats	Marine Institute	Regional
Belmullet marine habitats	Marine Institute	Inshore
IMAGIN Irish Sea habitats	Marine Institute	Regional
Blacksod Bay Seabed habitat	Bord Iascaigh Mhara (BIM)	Inshore
Broadhaven Bay Seabed habitat data IE000113	BIM	Inshore
East Malin Head habitat map IE000979	BIM	Regional
West Malin Head habitat map (Area A) IE000980	BIM	Inshore
West Malin Head habitat map (Area B) IE000981	BIM	Inshore
Clew Bay Marine Habitats IE001000	Marine Institute	Inshore
Kilkieran Bay Marine Habitats IE001001	Marine Institute	Inshore
Kenmare River SAC EUNIS Habitat Map IE001014	Marine Institute	Inshore
National – data extends out to offshore limit of marine plan area or beyond Regional – covers all or part of a regional sea area Inshore – limited survey area confined to inshore (<6nm from baseline)		

Twenty-two broad-scale data sets were identified dating from 2001 to 2011. The majority of the datasets use the European Nature Information System (EUNIS) for habitat classification (the classification for the data sets sourced from Bord Iascaigh Mhara are unknown). The age of some datasets may limit their use.

Article 17 habitats

Published spatial data sets for the marine/coastal habitats under Article 17 of the Habitats Directive were identified from the National Parks and Wildlife Service data catalogue (https://www.npws.ie/maps-and-data/habitat-and-species-data/article-17/habitats). Ten habitat datasets were identified to be of relevance to this data review.

Marine/coastal Habitats for which relevant datasets were identified are:

- Coastal lagoons;
- Estuaries;
- Large shallow inlets and bays;
- Reefs;
- Salt marsh;
- Sand banks slightly covered by the sea;
- Sand dunes;
- Tidal mudflats; and
- Vegetated sea cliffs.

Where these habitats occur nationally there is continuous monitoring. Article 17 reporting occurs every 6 years. The most recent reports were created in 2013.

OSPAR threatened and declining habitats and species

Published spatial data sets for the OSPAR list of threatened and/or declining species and habitats in Ireland are limited.

OSPAR threatened and/or declining habitats are:

- Carbonate mounds;
- Coral gardens;
- Deep sea sponge aggregations;
- Intertidal *Mytilus edulis* beds on mixed and sandy sediments;
- Intertidal mudflats;
- *Lophelia pertusa* reefs;
- Maerl beds;
- *Modiiolus modiolus* beds;
- Oceanic Ridges with hydrothermal vents;
- *Ostrea edulis* beds;
- *Sabellaria spinulosa* reefs;
- Sea Pen and burrowing megafauna communities; and
- *Zostera* beds.

Where these habitats are present nationally, they are available as point or polygon data in the OSPAR habitats 2015 map (http://www.emodnet-seabedhabitats.eu/access-data/download-data/). The low mobility species (OSPAR regions III and V) are not represented in these data sets. A brief examination of a sample of the point data revealed that data set age may be an issue – data from the beginning of

the 1990s, and potentially earlier, was included. More recent and representative data is certainly available for certain habitats on the OSPAR list through NPWS.

Deegan (2004) identified all available data sources for the locations of the cold water coral species, *Lophelia pertusa,* in Irish waters. The relevance of this data, given its age, could not be quantified. However, it appears likely that many of the organisations identified as capturing relevant spatial data continue to do so.

Table B2. OSPAR threatened and/or declining habitats data sets

Name	Data Type	Area
OSPAR habitats 2015	Polygon	National
OSPAR habitats 2015	Point	National

Seaweed distribution

Published spatial data sets for the distribution of seaweeds nationally are limited. One dataset was identified to be of relevance – the seaweed dataset found on the Marine Irish Digital Atlas (www.mida.ucc.ie/contents.ie). This data set is point data, with national coverage. The data identifies the species recorded at the site and the date records were made. Examination of several points within the dataset show records going back to the 1960s, other records within the data set may be older, whether these older records remain accurate was not possible to assess.

B.3.2 Fish

This theme focused on species distribution for shellfish and fish species including accessing available data on key migratory fish. The review focused on species distributions as opposed to data related to fisheries or aquaculture; these were sourced separately and are discussed in more detail in Section B.4.8

The following species, among others, are covered by this review:

- Atlantic cod;
- Atlantic salmon;
- Blue whiting;
- Brook lamprey;
- Sea lamprey;
- Haddock;
- Hake;
- Herring;
- Horse mackerel;
- Kilarney shad;
- Mackerel;
- Megrim;
- Monkfish;
- Nephrops;
- Pollan;
- River lamprey;
- Scallops;
- Twaite shad; and
- Whiting.

A number of data portals were identified. Online portals include Ireland's Marine Atlas, http://atlas.marine.ie/, [30/04/2018], Cefas https://www.cefas.co.uk/cefas-data-hub/ [29/05/2018], and species data used for Article 17 reporting from the National Parks and Wildlife Service (https://www.npws.ie/maps-and-data/habitat-and-species-data/article-17/species/fish).

Spawning and nursery habitats

Data on the location of spawning and nursery habitats of haddock, hake, blue whiting, cod, herring, horse mackerel, mackerel, megrim and whiting are included on the Marine Atlas. These layers may be useful for marine spatial planning as they provide an indication of feature distribution.

Data for spawning and nursery habitats are also available from Cefas. This data provides more specific location data from species sampled providing a finer spatial resolution which may provide a more useful indication of feature distribution for use in spatial planning. The data included within the Cefas data also includes a wider range of species providing location data for spurdog, tope shark, ling, monkfish, anglerfish, plaice, sandeel, spotted ray, common skate, sole, thornback ray and undulate ray in addition to those included on the Atlas.

Migratory species

Few data are currently available for migratory species in Irish waters, layers for the distribution of sea lamprey, brook lamprey, river lamprey, twaite shad and Atlantic Salmon are identified as being in preparation (NPWS website). Information is available on those Special Areas of Conservation designated for migratory fish species.

Nephrops

The prawn (*Nephrops norvegicus*) is common around the Irish coast occurring in sandy/muddy areas were the sediment is suitable for them to construct their burrows. The *Nephrops* underwater television survey has assessed the spatial location of *Nephrops* in the Aran Grounds, the Irish Sea and the Celtic Sea annually since 2002. Burrows were counted to support the calculation of the abundance and distribution of *Nephrops* in the areas identified for populations.

The *Nephrops* ground map identifies key *Nephrops* grounds in Irish waters.

Data Layers not included in the Atlas

Two additional sources of data have been identified that are not represented in the Atlas, but which might be accessible:

- *Chondrichthyans of Ireland* (National Biodiversity Data Centre) – Data are collated from a variety of data sources and provide an indication of the distribution of Elasmobranchs in the Irish EEZ and adjacent waters. Data include information on the distribution of multiple species of sharks, skate and rays surveyed between 1985 and 2014. The layer provides fine resolution point data for species locations which might be important from a conservation perspective.
- *Scallop habitats* (created by MI for BIM) – Data provides an indication of feature distribution for potential use in marine spatial planning. The layer consists of multibeam echosounder data and seabed sampling data acquired during the INFOMAR national seabed mapping programme used to generate a habitat map for the Inshore Fisheries section of Bord Iascaigh Mhara.

B.3.3 Marine mammals

The marine mammal review encompassed cetaceans, seals and otters. The review has focused on data collected since 2001 as this was the start of the data listed in Ireland's Marine Atlas, http://atlas.marine.ie/ , [30/04/2018]. Data from 2001 to 2017 was accessed. For seals, the data discovery dated back to 1991 and for otters to 1980, to maximise data available.

Cetaceans

For the purposes of the data discovery element of this project, a number of data sources were identified. Online portals include Ireland's Marine Atlas, http://atlas.marine.ie/ , [30/04/2018] and from the National Parks and Wildlife Service (https://www.npws.ie/maps-and-data/habitat-and-species-data/article-17/species/mammals), species data used for Article 17 reporting. Under the NPWS Article 17 data, relevant cetacean datasets prior to 2001 were included and therefore supports the period selected. Cetacean data sources originate from dedicated and opportunistic visual surveys, with additional coverage from long and short term Passive Acoustic Monitoring (PAM) and Static Acoustic Monitoring (SAM). Passive Acoustic Monitoring datasets are often simultaneous to visual observations and can have high spatial but low temporal coverage. Static Acoustic Monitoring contribute long-term datasets which have low spatial but high temporal coverage and have a significant contribution to Marine Spatial Planning (MSP). However, consideration needs to be given as to how this data should be gathered and presented in order to maximise its efficacy. The following species are covered by the review:

- Harbour Porpoise;
- Atlantic White-sided Dolphin;
- Risso's Dolphin;
- Common Dolphin;
- Striped Dolphin;
- Bottlenose Dolphin;
- White-beaked Dolphin;
- Beaked Whale;
- Minke Whale;
- Blue Whale;
- Killer Whale;
- Sperm Whale;
- Pilot Whale;
- Humpback Whale;
- Fin Whale;
- Sei Whale;
- Sowerby's Beaked Whale;
- Cuvier's Beaked Whale;
- Long finned Pilot Whale; and
- Northern Bottlenose Whale.

Visual datasets

A number of key visual datasets were accessed (Table B3). The IWDG Ship Survey data used in the current Marine Atlas was updated from 2005 (the last year of current in the Atlas). Broad-scale EU-funded dedicated cetacean surveys (SCANS II, Cetacean Offshore Distribution and Abundance in the European Atlantic – CODA) which included Irish waters, and the most recent dedicated surveys (ObSERVE – Aerial and ObSERVE – Acoustic), were also accessed. The latter two important surveys were presented as best available knowledge as the final reports will not published until June 2018. Marine mammals are recorded opportunistically during surveys targeting other groups. Marine mammal observations were systematically collected concurrently on a number of Marine Institute fisheries acoustic surveys including the Celtic Sea Herring (2004-2017) and Blue Whiting surveys. Marine mammal data is also collected during the new WESPAS surveys with 2016-2017 data accessed.

Site surveys of Special Areas of Conservation for Article 17 monitoring were also accessed. These include harbour porpoise surveys of the Blasket Islands SAC, Roaringwater Bay and Islands SAC and Rockabill to Dalkey Islands SAC as well as the series of NPWS funded Nearshore Surveys.

Although there are a number of important datasets available for MSP especially where recording effort is quantified, including sea-state (wave conditions), which is an important variable when stratifying marine mammal observation data, there are considerable gaps in the data. Broad-scale surveys dedicated marine mammal data (CODA, SCANS II) are only undertaken during summer months, typically July. Fisheries surveys, although annual, only cover discrete areas, though the new WESPAS survey does have a large spatial coverage but is a summer survey. Platforms of Opportunity (PoPs) ObSERVE Aerial provides a unique insight into winter distribution and abundance of marine mammals in the entire EEZ and should be repeated at regular intervals.

Table B3. Visual observational datasets identified as suitable for MSP

No	Name	Duration	Years	Reference
1	IWDG Ship Survey		2005-2017	IWDG Unpublished data
2	Heritage Council Ships of Opportunity		2004	Wall *et al.* 2006; Wall *et al.* 2013a
3	SCANS II	30 days	2005	Hammond *et al.* 2013
4	CODA	30 days	2007	Hammond *et al.* 2011
5	SOTW Beaked whale survey	27 days	2010	Boisseau *et al.* 2011
6	Celtic Sea Herring		2004-2017	Ciaran O'Donnell reports, Marine Institute
7	Blue whiting	60 days	2015-2017	IWDG, Blue whiting reports (Meade *et al.*, 2016; O'Donnell *et al.*, 2015; O'Donnell *et al.*, 2017)
8	MMO data from Seismic			Baines *et al.* 2017
9	ObSERVE Aerial			Rogan *et al.* 2018
10	ObSERVE Acoustic	37 days	2015-2016	Berrow *et al.* 2018
11	Harbour Porpoise Surveys		2007-2016	
12	Nearshore Surveys		2010-2012	

Passive Acoustic Monitoring (PAM) datasets

A total of 8 PAM datasets have been identified since 2001, some of which are multi-annual and were collected using national and international funding sources. These are presented in Table B4. All PAM datasets have extensive coverage in offshore Irish waters and thus are very suitable for MSP purposes. However, the difficulty in using this type of data is the level of analyses which has been carried out on such datasets and in what format they can be supplied in. In order to maximise public funded datasets for MSP, future attention needs to be given to devising a protocol to standardise archiving, analysing and release of PAM data to maximise their potential.

Table B4. PAM datasets identified as suitable for MSP

No	Name	Duration	Years	Reference
1	SCANS II	30 days	2005	Hammond *et al.* 2013
2	CODA	30 days	2007	Hammond *et al.* 2011
3	SOTW Beaked whale survey	27 days	2010	Boisseau *et al.* 2011
4	PReCAST PAM	79 days	2009-2011	O'Brien *et al.* 2013
5	Blue whiting	60	2015-2017	IWDG, Blue whiting reports
6	COTF 1-6	62	2009-2011	O'Brien *et al.* 2016
7	ObSERVE Acoustic PAM	37	2015-2016	Berrow *et al.* 2018

Of all the PAM datasets documented, none were targeted at year-round coverage. SCANS II and CODA were restricted to the months of July and August. The SOTW beaked whale survey was carried out in September and October (Boisseau *et al* 2010), while PReCAST (Policy for recommendations for cetacean acoustic surveys and tracking) PAM was carried out across a number of months between 2009 and 2011 (O'Brien *et al.* 2013), and the Blue Whiting surveys were restricted to the months of March and April. More recently (various, see Table B4), the ObSERVE Acoustic PAM datasets are available for the months May to October. Winter is one the times when little coverage is received offshore, most likely restricted due to weather constraints.

Static Acoustic Monitoring (SAM) datasets

A total of 5 long-term SAM datasets since 2001 have been identified which are likely to have a significant contribution to MSP. However, as with PAM, the format and level of data analyses completed raise concerns. SAM datasets have low spatial coverage but provide continuous datasets on trends within localised areas over a long period and therefore their contribution to planning cannot be ignored. Most of the SAM datasets identified are multi-annual surveys and some were obtained using national and international funding sources. SAM datasets are presented in Table B5. Some SAM datasets have extensive coverage in offshore Irish waters (ObSERVE-Acoustic), while others are limited to regional areas such as the Shannon Estuary. But given the estuary is a Special Area of Conservation (SAC) for bottlenose dolphins, a long-term SAM dataset may prove critical to MSP in the area. In order to maximise publicly-funded datasets for MSP, future attention needs to devise a protocol to standardise archiving, analysing and release of SAM data to maximise their potential.

Table B5. SAM datasets identified as suitable for MSP

No	Name	Duration	Years	Reference
1	ObSERVE Acoustic SAM	443 days	2015-2016	Berrow *et al.* 2018
2	Shannon SAM	>1000 days	2011-2017	O'Brien and Berrow, 2017
3	OE Site Spiddal	936 days	2005-2017	Benhemma le Galle and O'Brien 2018
4	PReCAST SAM	>1000 days	2009-2011	O'Brien *et al.* 2013
5	Beaked whale pilot study	204 days	2011	Wall *et al.* 2013b

Of all the SAM datasets documented, all but two were targeted at year-round coverage. Shannon Estuary SAM, OE Test site and PReCAST SAM are three powerful datasets with regards to temporal coverage but give low spatial resolution. ObSERVE SAM provides coverage from May to November 2015 and 2016, while Beaked whale Pilot study cover over 6 months in offshore waters. SAM data has an important contribution to MSP given it is one of the means we have to gather offshore data in times of adverse conditions so has a significant contribution to make to MSP and should not be ignored due to its restricted spatial coverage.

Seals

For the purposes of the data discovery element of this project, a number of data sources were identified. Online portals include Ireland's Marine Atlas, http://atlas.marine.ie/, [30/04/2018] and from the National Parks and Wildlife Service (https://www.npws.ie/maps-and-data/habitat-and-species-data/article-17/species/mammals), habitat and species data used for Article 17 reporting. Under the NPWS Article 17 data, all seal datasets were included. Seal data sources originate from standard terrestrial surveys, thermal and visual aerial surveys, at sea visual surveys, opportunistic sightings and additional coverage from telemetry data; three of these seal datasets are presented in Table B6. The telemetry data provides valuable information on grey and harbour seal behaviour and distributions at sea, which will prove significant in contributing to Marine Spatial Planning (MSP).

A total of 18 seal datasets were identified, of these two are long-term datasets which have extensive coverage of Irish coastal areas and offshore waters. The focus of one of these long-term datasets is restricted to the distribution and terrestrial/intertidal abundance associated with grey and harbour seal at breeding and moulting areas during the summer months (NPWS, 2013). As seals spend most of their time at sea and are a highly mobile marine species that shows seasonal and annual movements, this data can only give minimum population estimates as some of the population will go unrecorded at the time of the count.

The second long-term dataset uses a combination of terrestrial count data and telemetry data collected over 20 years to model the predicted distribution for both species. This type of data is likely to be of significant contribution to MSP. There have also been 13 datasets identified from visual ship-based surveys, as both species of seal are not easily detected and identified at sea except at close range, therefore sighting records obtained during ship-based surveys may not be a true assessment of distribution. Information on seal distribution and habitat use is best ascertained from a combination of telemetry data and terrestrial surveys, enabling better understanding which will in turn give the best information for broad-scale MSP.

Table B6. Seal datasets (long-term and telemetry) identified as suitable for MSP

No	Name	Years	Reference
1	Article 17 Reporting 2007-2012 (Species)	2001-2012	NPWS (2013)
2	Estimated at-sea Distribution of Grey and Harbour Seals - updated maps 2017	1991-2016	Jones *et al.* (2015)
3	Seal Track	2006-2009	Cronin *et al.* (2010) (2011)

Telemetry data collected from tagged harbour seals off the south-west of Ireland show at-sea movements and habitat use that suggests they have a limited range of within 20 km of their haul-out site (Cronin *et al.* 2010). In contrast, telemetry data collected from tagged grey seals off the southwest of Ireland showed a maximum distance of 511 km travelled from their haul out site although mean distance recorded was 50.85 km but significant variation was recorded between individual grey seals (Cronin *et al.* 2011). The differences in the way the two species use the marine environment will hold important implications for MSP, both the grey and harbour seal spend the majority of their time at sea up to 50 km from the coast therefore future public funded studies would be advantageous to be focused in this zone to maximise public funded datasets for MSP.

Otter

For the purposes of the data discovery element of this project, a number of data sources were identified. Online portals include Ireland's Marine Atlas, http://atlas.marine.ie/, [30/04/2018] and from the National Parks and Wildlife Service (https://www.npws.ie/maps-and-data/habitat-and-species-data/article-17/species/mammals), habitat and species data used for Article 17 reporting. Under the NPWS Article 17 data, all otter datasets were included. Other data sources originate from standard otter surveys and opportunistic sightings, some of which were complimented with DNA analysis, these datasets may prove useful to MSP. The otter datasets identified are shown below in Table B7.

Table B7. Otter datasets identified as suitable for MSP

No	Name	Years	Reference
1	National Otter Survey	2010-2011	Reid *et al.* 2013
2	National Otter Survey	2004-2005	Bailey & Rochford, 2006
3	National Otter Survey	1980-1981	Chapman & Chapman, 1982
4	Threat Response Plan – Otter	2009-2011	NPWS, 2009
5	MISE	2011-2015	Mammals in a Sustainable Environment (MISE) project
6	Atlas of Irelands Mammals	2010-2015	Lysaght *et al.* 2016
7	Mammals of Ireland	2016-2025	National Biodiversity Data Centre (2018)

A total of seven otter datasets have been identified, three of these are from national otter surveys (Chapman & Chapman, 1982; Bailey & Rochford, 2006; Reid *et al.* 2013) which have comprehensive temporal and spatial coverage of Irish coastal and catchment waters. The 2010/11 national otter survey (Reid *et al.*, 2013) specifically targeted coastal areas which had not previously received survey effort. Range was calculated via a range tool based on 2007-2012 distribution records from multiple sources, as otters are territorial the carrying capacity of suitable otter habitat for females was estimated to give data which is likely to be of significant contribution to MSP. The range reported in Reid *et al.* (2013) is significantly larger than that of Bailey & Rochford (2006) due to the increased survey effort of coastal areas. After a decline in population between the 1980/81 and 2004/05 a national threat response plan was issued for otters, rapid assessment survey sites for otter took place between 2007/09 and otter numbers appear to have recovered to their 1980 numbers. These datasets combined give long-term information on otters in Ireland which may prove advantageous for MSP.

The Atlas of Mammals in Ireland 2010-2015 and the ongoing Mammals of Ireland 2016–2025 have been identified as datasets which hold important information for MSP on otter road kill and other mortality events along with validated sightings, these type of datasets will maximise and augment publicly-funded datasets for MSP.

Management units

The Inter-Agency Marine Mammal Working Group (IAMMWG, 2015) identifies management units for a number of cetaceans including:

- Harbour Porpoise;
- White-sided Dolphin;
- Risso's Dolphin;
- Common Dolphin;
- White-beaked Dolphin;
- Minke Whale; and
- Bottlenose Dolphin.

B.3.4 Birds

Irish coasts and islands are renowned for their internationally-important breeding populations of seabirds and iconic headlands that are key bottlenecks where observations of a wide area of Atlantic species can made during the autumn migration period.

A range of data is available covering:

- Wetland birds;
- Breeding seabirds;
- Post-breeding seabird movements;
- Tern colonies; and
- Seabirds at sea.

There are a multitude of datasets for individual bird species, but for the purposes of MSP, a smaller number of layers representing a synthesised overview of the main areas of importance may be more appropriate. Many coastal areas are designated as Special Protection Areas (SPAs) for birds. These boundaries encompass the most important wetland bird interests, breeding seabirds and tern colonies. The SPA boundaries serve as a proxy for these interest features, and have generally been considered to provide adequate representation for these features in the context of other national marine planning processes.

Tern foraging areas and areas of importance to seabirds are less well represented by SPA networks and data on the distribution of these features at sea may help to ensure adequate representation.

The following sections provide more detail on the surveys and data available.

Wetland birds: winter waterbirds in the inshore marine environment

An annual monitoring programme, the Irish Wetland Bird Survey (I-WeBS) has been running since the winter of 1994/95. This covers virtually all the key estuaries and bays in the country including Dundalk Bay, Dublin Bay, Wexford Harbour, Dungarvan, Cork Harbour and Lough Swilly. The sheer size of the Shannon Estuary has prevented regular ground counts, but it is usually covered annually by aerial survey. Key I-WeBS publications include Crowe (2005) and Boland and Crowe (2012).

One of the key habitat gaps in the above surveys are open coasts (sandy and shingle beaches and non-cliff rocky shores), habitats that can support a significant proportion of the national populations of species such as Oystercatcher, Ringed Plover, Curlew, Purple Sandpiper and Turnstone. This gap has been plugged by a series of three single winter surveys at 9-year intervals (NEWS: Non-Estuarine Coastal Waterbird Survey) commencing in 1997/98 (Colhoun & Newton, 2000) and the most recent update was for 2015/16 (Lewis *et al*. 2017).

Overall, marine species with the poorest coverage by I-WeBS and NEWS include true seaduck (common scoter, eider, red-breasted merganser, long-tailed duck) and divers (particularly red-throated and great northern). The recent aerial surveys of the ObSERVE programme have probably improved our knowledge in this regard though the results are not yet publicly available.

Breeding seabirds

Irish coastal cliffs, islands and brackish lagoons and coastal marshes support 24 species of seabird plus three species that mostly nest inland but spend the majority of the year in salt water environments (red-throated diver, common scoter, red-necked phalarope). Breeding seabirds have been monitored by a series of national surveys at approximately 15-year intervals: 1969-70 (Cramp *et al*. 1974), 1985-87 (Lloyd *et al*. 1991) and 1998-2002 (Mitchell *et al*. 2004). The fourth in the series is presently underway and nearing completion (2014-2019) with some published data available from the earlier years covering gannet colonies (Newton *et al*. 2015a) and the major cliff-nesting colonies (Newton *et al*. 2015b). The first two surveys were quantitative for diurnal species, with order of magnitude/qualitative assessments made for the three nocturnal burrow/crevice nesting shearwater and petrel species. The 1998-2002 survey, known by the name "Seabird 2000" was the first to include quantitative population size estimates for the nocturnal trio. In addition, two national assessments of breeding terns Sternidae have been made: the first in 1984 (Whilde, 1984) and the second in 1995 (Hannon *et al*., 1997).

Mapping of foraging areas of breeding seabirds

Over the last 8-10 years the miniaturisation of tracking devices has permitted the deployment of data loggers on large and medium sized seabirds. Three teams of researchers have operated in Ireland in recent years: one from Exeter, Leeds and Plymouth Universities focussing on Gannets; one from BirdWatch Ireland, with UK-based partners from the RSPB and Queen's University Belfast, focussing on Shags, Kittiwakes, Guillemots and Razorbills and more recently large gulls; finally, a team from University College Cork have tracked breeding Manx Shearwaters, Razorbills and Puffins. In many cases, not only 2-D locational data are gathered but additional tags such as Time Depth Recorders have been simultaneously deployed to study dive depths and underwater behaviour.

Monitoring post-breeding seabird movements in autumn

The autumn (usually August through to October) 'seawatching' tradition documents the southerly movements of Arctic and Sub-Arctic breeding seabirds and these birds are often joined by Southern Hemisphere species that range in the Austral winter in to the North Atlantic (e.g. Great and Sooty Shearwaters). The key sites for this monitoring are bottleneck headlands including Kilcummin Head and Annagh Head in County Mayo, The Bridges of Ross on the Loop Head Peninsula in County Clare, Cape Clear in County Cork and Carnsore Point in County Wexford. The best conditions for recording intense movements along the west coast are often strong northwesterly winds but this is not necessarily the case for the south coast. In the period 2010-2013, the EU Interreg-funded FAME Project (Future of the Atlantic Marine Environment) ran a coordinated network of simultaneous seawatches under the flag "Seatrack – seabird migration survey". Three hour surveys were conducted at 8 pre-selected days with near complete data gathered for nine sites along the east, south and west coasts (Keogh *et al*. 2014) and less complete data for a further 11 sites.

Year-round seabirds at sea surveys

The distribution of seabirds in offshore waters has been monitored in an *ad hoc* manner using the ESAS methodology developed by the UK Joint Nature Conservation Committee Seabirds at Sea Team. Vessels of opportunity were often used so coverage of Irish EEZ waters was far from systematic. All available data were compiled for the period 1980-1987 in to an 'Atlas' entitled "The Distribution of Seabirds and Cetaceans in the waters around Ireland" (Pollock *et al*. 1997). From 2009 onwards, seabird observers have been present on the seven Cetaceans on the Frontier surveys using the RV Celtic Explorer and also on many acoustic fisheries surveys since 2012. The analysis of this combined dataset is the basis of a PhD study by Niall Keogh at the Galway-Mayo Institute of Technology due to be completed in early 2019.

For the Irish Sea in particular, there are a series of seabirds at sea studies conducted during the environmental assessments of offshore windfarm developments on the east coast sandbanks. These usually comprise monthly surveys over 12 month periods. Data are available for the Oriel Wind Park (off Dundalk Bay, Louth)), the Kish and Bray Banks (Dublin and Wicklow), the Codling Bank (Wicklow) and the Arklow Bank (Wicklow). Off the west coast, there have been similar assessments related to Marine Renewable Energy Test sites in Galway Bay and off the Mullet Peninsula (Mayo).

The impending ObSERVE data sets are likely to provide the most comprehensive and up-to-date data for seabirds at sea and the data could be used to create useful spatial data products for marine planning, possibly supplemented with other sources of spatial data where appropriate.

B.3.5 Reptiles

The only reptiles encountered in Irish waters are marine turtles (Cheloniidae). Records exist for four species:

- Green Turtle;
- Hawksbill Turtle;
- Leathery Turtle; and
- Loggerhead Turtle.

Most marine turtles are only very occasionally observed in Irish waters with the great majority of records relating to Leathery Turtle (Leatherback Turtle). The National Biodiversity Data Centre (NBDC) publishes maps based on 10 km and 50 km gridded data. Owing to the infrequent sightings and sparsity of

records, the data is unlikely to be of specific value to marine planning, other than as providing an overview of distribution of Leathery Turtle and Loggerhead Turtle.

B.3.6 Environmental quality

Spatial data on environmental quality is available from EC Directive reporting (bathing waters, WFD transitional and coastal waters, nitrate sensitive areas and sensitive areas (eutrophic) and shellfish hygiene. This data is suitable to inform marine planning. Data continues to be collected and reported in relation to the former Shellfish Waters Directive (now subsumed within WFD) by MI, but data are now viewable. There is some additional data on WFD and bathing water pressures held by EPA which is not currently viewable.

Additional data is available on specific monitoring programmes (HABs, chemical point monitoring) but this is considered to be too fine-scale for national-level marine planning.

B.3.7 Terrestrial habitats

Spatial data on coastal margin habitats is available from CORINE data sets. Additional information on sand dunes and vegetated cliffs is available from Article 17 reports. The information is sufficient to support marine planning as it is largely contextual.

B.3.8 Natural capital and ecosystem services

Parker *et al.* (2016) prepared a number of spatial data layers representing the provision of marine ecosystem services (marine biodiversity, marine areas that provide food, marine carbon) which are freely available.

Further development of spatial data layers for marine natural capital and ecosystem services will be taken forward under Project 3.

B.4 Human Environment

B.4.1 Aquaculture

Six layers relating to aquaculture are available on the Marine Atlas, and a further five data sources have been identified (some of which are similar to or repeats of those on the Atlas). The layers available on the Atlas show the location of aquaculture production facilities (separately for finfish, seaweed and shellfish) as polygons, also showing type of production (extensive, intensive, land-based). The data are from 2016 and thus are fairly current, although these could be updated annually to show any changes to production areas.

Additional layers and information available include:

- Classified bivalve production areas;
- Seed mussel surveys (relating to harvest areas); and
- Production tonnage, value and volume, and employment, by species and county.

The latter provides useful information on the value and socio-economic importance of aquaculture. Although this does not relate to individual aquaculture sites, these data could be spatialised by county to reflect the relative importance of aquaculture around the coast of Ireland. Vega & Hynes (2017) provide an estimate of the economic value of the marine aquaculture industry (fish and shellfish).

B.4.2 Aviation

Irish Aviation Authority (IAA) holds information on Airport Control Areas and Control Zones which is published on Aeronautical Chart ICAO 1:500,000. The IAA website indicates that information on helicopter main routes is 'to be developed'. No spatial data available via IAA website.

B.4.3 Carbon capture and storage

There are currently no licensed carbon capture and storage (CCS) activities in Irish waters. Some information on potential storage locations is available from an SEAI project. There is a proposal for a CCS facility using the Kinsale Gas Field off Cork to store CO_2 from two gas-fired power stations at Whitegate and Aghada.

There is currently no economic value obtained from carbon capture and storage activities in Irish waters.

B.4.4 Coast and flood defences

Spatial data are available on areas at risk from coastal flooding from the Irish Coastal Protection Strategy Study (ICPSS). The information will need to be sourced from OPW. These data have been incorporated within the National Catchment Flood Risk Assessment and Management (CFRAM) project outputs.

No central source of data on coast protection and flood defence assets has been identified. Such information will need to be sought from OPW.

There is currently no information on the economic value of the coast protection and flood defence sector, but it may be possible to source information on capital works and maintenance expenditure from OPW.

B.4.5 Cultural heritage

There are a number of spatial datasets which record information on historic sites and assets in Ireland. While a number of these are specific to the marine environment, most apply principally to terrestrial areas, including the coastline:

- The Archaeological Survey of Ireland – Sites and Monuments Record (SMR) is compiled by the Archaeological Survey of Ireland and covers terrestrial heritage assets. It covers the littoral zone with a small number of intertidal records. It appears to include currently protected, candidate and non-designated assets, though this is not immediately apparent from the symbology applied to records. This appears to be good quality information, though sources are uncertain.
- Record of Monuments and Places data are held by the National Monuments Service – it is assumed that this data is included in the SMR though this requires confirmation.
- The National Inventory of Architectural Heritage is compiled by the Archaeological Survey of Ireland and provides information about historic buildings across Ireland. Historic buildings in coastal locations can be extracted from this dataset.
- Architectural Conservation Areas comprise information on terrestrial, urban area based designations and will apply to some historic coastal settlements. The data is held by County Councils.
- The National Monument Service Wreck Inventory of Ireland maps the location of wrecks off the Irish coastline. The level of detail varies, but there is a consistent classification and information on the year of loss. There is more information for better-understood wrecks (particularly

wartime ones). It should be noted that historical shipwreck data can be inaccurate unless confirmed by modern methods (e.g. diving or sonar survey).

- INFOMAR Surveyed Shipwreck data, held by the National Monuments Service, provides confirmed position of wrecks. It could be used to cross-reference Wreck Inventory data if this has not already been done.
- National Museum of Ireland Finds Database provides information on material culture findspots. This is potentially useful context for the asset-focused data but perhaps should not be used in main analysis.
- Archaeological Excavation Reports, held by Transport Infrastructure Ireland, comprise grey literature records relating to transport infrastructure schemes. This is likely to be specific to locations where transport infrastructure projects have been implemented in coastal locations but will not provide a consistent picture along the coastline.
- World Heritage Sites (WHS) — centrepoints are available for World Heritage Site Properties, though it is assumed that polygons for the full extent of WHS (including buffers where appropriate) are also available given UNESCO management plan requirements. There is only one coastal WHS in Ireland.
- National Monument Zones are notification zones for planning purposes. The zones do not depict precise asset extents, although the monuments are assumed to sit within the Record of Monuments and Places.

B.4.6 Defence

The Department of Defence holds spatial data on military practice and exercise areas. This information will need to be sought from the Department of Defence. No spatial data on Ireland's naval bases has been sourced, but there is only one main facility at Haulbowline, Cork.

There is currently no data on the economic value of naval activity in Irish waters.

B.4.7 Energy

Coastal power stations

Spatial data on the location of existing coastal power stations is available from MIDA. The quality of the spatial data is acceptable for MSP. There is no central source of information on proposed new coastal power stations but the number is expected to be very small.

There is a lack of information on the economic value of coastal power stations, although it is possible to estimate electricity output based on power station capacity.

Electricity interconnectors

Spatial data on the location of existing electricity interconnectors is available from KIS-ORCA under licence. The quality of the spatial data is acceptable for MSP. ESB hold information on the Irish electricity transmission network which is likely to include information on estuary cable crossings and cable connections to islands. This source is being pursued. There are two planned electricity interconnectors identified on the list of Projects of Community Importance (PCI), the Celtic Interconnector (EirGrid) linking Ireland and France, and Greenlink (Element Power) linking Ireland and Wales. Both projects are in planning and precise routes are therefore not yet defined. It may be possible to obtain shapefiles of indicative cable corridors through direct approach to EirGrid and Element Power.

There is no specific information on the economic value of electricity interconnectors in Vega & Hynes (2017) and it is likely to be challenging to identify the discrete economic value of electricity interconnectors and marine elements of the transmission network from the value of the network as a whole.

Oil and gas

Spatial data on the location of offshore oil and gas infrastructure, commercial oil fields, historic wells and current licensing rounds is available from PAD. Information on current authorisations and Licensing Rounds is also available from PAD. The quality of the spatial data is acceptable for MSP. There is a relative lack of information to support understanding of potential future activity as information on possible resource areas is commercially sensitive. Information on lease awards provides some indication of areas of potential interest in the short-term.

Vega & Hynes (2017) provide estimates of the economic value of offshore oil and gas activity based on the Census of Industrial Production[3] (Oil and Gas NACE Four Digit Codes: 06.10, 06.20, 09.10). However, because of the small number of companies operating in the sector, commercial confidentiality issues limited the availability of data on oil and gas exploration even at national level. Data are provided for a range of economic variables including turnover, GVA and employment. As for the Annual Services Inquiry (ASI), the CSO's online databases provide national data at broad sector level only; more specific datasets at NACE 4 digit level would need to be obtained through an enquiry to CSO. Commercial confidentiality would likely limit the degree to which data could be broken down below national level.

Offshore wind

Spatial data on the location of existing offshore wind infrastructure is available. This is currently limited to the Arklow Bank demonstration offshore wind turbine and export cable. The quality of the spatial data is acceptable for MSP. There are a number of possible offshore wind developments in Irish waters but there is no central source of data on the array locations or export cable routes. This information will need to be sought and acquired. Information on offshore wind resources is available from SEAI. Offshore wind resources are generally suitable for offshore wind power generation and the location of arrays is generally determined by constraints other than the availability of offshore wind resources.

There is limited information on the economic value of offshore wind. Vega & Hynes (2017) provide an estimate of the economic value of the marine renewable energy sector as a whole.

Tidal energy

There is currently no tidal energy infrastructure in Irish waters. Information on tidal energy resources is available from SEAI which can be used to identify areas of tidal energy potential based on assumptions about the required tidal energy characteristics for project viability. The quality of the spatial data is acceptable for MSP.

There is limited information on the economic value of tidal energy. Vega & Hynes (2017) provide an estimate of the economic value of the marine renewable energy sector as a whole.

Wave energy

Spatial data on the location of existing wave energy infrastructure is available. This is currently limited to test and demonstration sites. Information on wave energy resources is available from SEAI which can

[3] http://www.cso.ie/en/methods/industry/censusofindustrialproduction/

be used to identify areas of wave energy potential based on assumptions about the required wave characteristics for project viability. The quality of the spatial data is acceptable for MSP.

There is limited information on the economic value of wave energy. Vega & Hynes (2017) provide an estimate of the economic value of the marine renewable energy sector as a whole.

B.4.8 Fisheries and shellfisheries

A range of spatial data on fisheries and shellfisheries have been identified through the data review. The Marine Institute's Atlas includes 12 layers that relate to: inshore (non-vessel monitoring system, VMS) activity by different gear types; VMS-based data by gear type for vessels over 15 m length; and periwinkle harvesting areas. However, the layers are all substantially out-of-date (2008-2012) and require updating.

A further 53 'new' layers have been identified (some of which represent multiple 'sub' layers such as for individual gear types or species), therefore there will be a requirement to select the layers that are most robust, recent and relevant to marine spatial planning.

For larger vessels (over 15 m, and more recently over 12 m in length), spatial data are available from VMS transmissions, which provide the location, speed and bearing of a vessel at least every two hours. This can be used to represent both spatial distribution and intensity of activity, and can be linked to logbook returns to provide information on value. Such layers are available from several sources: the Marine Institute's Atlas (out-of-date); and in the Atlas of Commercial Fisheries around Ireland, 2nd Edition (Marine Institute, 2014) (out-of-date). However, Marine Institute fisheries staff have indicated that they are in the process of updating these layers during 2018. Coordination and communication between fisheries and marine spatial planning will help facilitate the production of layers that are appropriate for MSP needs.

For smaller vessels (under 12 m), there is information available on the spatial distribution of some fisheries, but consistent information on intensity is lacking. Layers available on the Atlas are substantially out-of-date, as are layers that were prepared for WFD assessments in 2008 (available in 'An Atlas of Fishing and Some Related Activities in Ireland's Territorial Sea and Internal Marine Waters with Observations Concerning their Spatial Planning', Fahy *et al.*, 2008). However, more recent layers have been produced in the Shellfish Atlas (Marine Institute, 2017) on the geographical distribution of a range of shellfisheries, using VMS (where available), questionnaires, expert knowledge and survey data (e.g. of shellfish beds). These provide a good indication of the distribution of smaller vessels' activity, as around 90% of the inshore fleet target shellfish. Some under-12 m vessels are required to use inshore VMS (iVMS), principally those involved in the razor clam fishery, and iVMS is expected to be extended to incorporate more under-12 m vessels over the next few years, which will improve the data availability (a number of potting vessels on the south coast are expected to introduce iVMS this year).

The Common Fisheries Policy provides access to all Member States' vessels across EU waters outside 12 nm, and to fleets with historical access rights to certain areas between 6 and 12 nm. It is therefore relevant to also consider the fishing activity of other countries. Several data sources include the activity of both Irish and other nationalities' vessels, including data at ICES rectangle resolution (more coarse resolution than that available from VMS data) from the Scientific, Technical and Economic Committee on Fisheries (STECF). These data are available for spatial distribution of activity and intensity (effort and landings tonnage), but not value.

Fishing ports, and data on landings to ports, are also available, which provide a useful linkage between the activity at sea and where the potential benefits on land (from ancillary activities, processing etc.), are derived.

B.4.9 Land-side infrastructure (roads, rail, urban development, utilities)

OSI hold spatial data on roads, rail and urban developed areas, and the data is available subject to licence restrictions. EirGrid holds spatial data on the terrestrial electricity transmission network and Gas Networks Ireland holds spatial data on the terrestrial gas distribution network. These data holders need to be approached to explore access to relevant data sets and any conditions of use.

There are a number of proposed electricity interconnectors with landfalls in Ireland. Information on these landfall locations and associated converter stations and links to the national electricity distribution network could be sought from the relevant project promoters.

B.4.10 Marine aggregates

There are currently no licensed marine aggregate activities in Irish waters. Some information on potential marine aggregate resources off the east coast of Ireland is available from the IMAGIN project[4]. Information on potential marine aggregate resources elsewhere in Irish waters could be generated through interpretation of existing geotechnical, geophysical and surficial sediment data. There is currently no economic value obtained from marine aggregate resources in Irish waters.

B.4.11 Marine litter

There are a number of sources of spatial data on marine litter. These include formal Government programmes to collect information for MSFD reporting as well as wider national surveys such as Coastwatch. The latter provides the most comprehensive view of marine litter around Ireland's coastline.

B.4.12 Ports and shipping

Navigation channels

The Commissioners of Irish Lights hold records on Lighthouse and navigation buoy locations. This data can be made available subject to agreement from the Commissioners. From this dataset, it will be possible to derive navigational channels, using the lateral (Port and Starboard) channel buoy locations. Through comparison with charted information using UK Hydrographic Office (UKHO) publications, it will be subsequently possible to derive maintained channels where buoyed channel coincide with areas identified as maintained through dredging. This will provide a 'maintained navigation channel' data layer.

IMO routeing

The International Maritime Organization (IMO) publish ships' routeing measures to improve the safety of navigation in areas with high traffic density, converging traffic or crossing traffic. These may be traffic separation schemes (TSS), inshore traffic zones or deep-water routes. Precautionary areas are also published to defined limited areas where vessels should navigate with caution. Around Ireland, there

[4] The Irish Sea Marine Aggregates Initiative (IMAGIN) was a collaborative project between Ireland and Wales focused on the sustainable management of marine aggregate resources. It ran from 2006 – 2008, largely funded through the INTERREG IIIA programme. The project sought to facilitate the evolution of a strategic framework within which the exploitation of marine aggregate resources from the Irish Sea could be sustainably managed with minimum risk of impact on marine and coastal environments, ecosystems and other marine users. The project mapped some marine aggregate resources in the Irish Sea, including off the east coast of Ireland.

are two IMO adopted schemes (Off Fastnet Rock and Off Tuskar Rock) plus a non-IMO routeing measure termed 'Approaches to Dublin'. A data layer is available for these without licence.

Automatic Identification System (AIS) Data

Automatic Identification System (AIS) data is transmitted by marine vessel traffic and can be compiled into point datasets from which transit lines can be created. AIS signals are broadly classified as 'Class A' and 'Class B', where AIS-A is carried by international voyaging ships with gross tonnage (GT) of 300 or more tonnes, and all passenger ships regardless of size. AIS-B is carried by smaller vessels and is aimed at smaller commercial vessels, the fishing sector and recreational vessel users; however, the use of AIS-B is non-compulsory. AIS data is typically broken down into the following vessel categories which are taken directly from the AIS data transmissions:

- Non-Port service craft;
- Port service craft;
- Vessels engaged in dredging or underwater operations;
- High speed craft;
- Military or law enforcement vessels;
- Passenger vessels;
- Cargo vessels;
- Tankers;
- Fishing; and
- Recreational.

It is known that the Irish Coast Guard has an AIS dataset for 2015. There is limited metadata associated with this dataset, use of this data under licence has not been (to date) established. In addition, for the Irish Sea with coverage over a most of the East Coast of Ireland, data provided by the UK Marine Management Organisation (MMO) is available for 2015. This data product has been decoded by ABPmer to create a geodatabase of anonymised vessel transits. The data was collected by the UK Maritime and Coastguard Agency (MCA) using their network of AIS receivers. The data represents a composite of 84 days of AIS data collected in 2015. The following periods of time form the dataset:

- 1 to 7 from each of the following: January, February, March, April, May, June, July, August, and November 2015;
- 8 to 14 of October 2015;
- 29 August to 4 September 2015; and
- 3 to 9 December 2015.

Ports, harbours and slipways

The data investigation has not identified an authoritative listing of all ports, harbours and slipways in Ireland. However, various listings are available, which can be combined to create this data layer. MIDA hold ports, classified as Ferry, Commercial, Fishing and Marine. The Central Statistics Office collates ports, measured by tonnages handled with data from 1995 to 2016 presented as annualised data. This dataset provides carriage of goods and passengers in all ports and harbours in Ireland. The information collated includes: type of cargo, port of loading/unloading, gross weight of goods in tonnes, number of passengers, nationality of registration of the vessel, number of vessels by type and size, deadweight of vessels and gross tonnage of vessels. To augment this listing, The Irish Maritime Development Office (IMDO) has produced further information in the Irish Maritime Transport Economist, providing sector information with tonnage data for individual ports. The locations of ports and harbours can be extracted from Ordnance Survey information, into point data. This will be a manual digitisation exercise, using OS and Aerial photo data sources. A comprehensive listing of boat launch points (slipways) is available

and freely downloadable from the website boat-launch (www.boatlaunch.co.uk). This will require manual download, but may be extracted with assistance from the website owner. The data is contributed by users of the website, so has inherent data uncertainty. Spot-checks of integrity for known sites suggests that the information is comprehensive and has sufficient associated metadata.

Search and Rescue (SAR)

A number of sources of information exist under this topic. The locations of Royal National Lifeboat Institute (RNLI) resources including stations, boats and beach rescues can be provided on direct request to the RNLI. This dataset can be added to with Irish Coastguard information on SAR resources. The RNLI provide a 10 year history of all call out information, which is a spatial dataset available on payment of a data extraction fee. This data could be worked up into a heat-map view of marine accident/incident call outs at a National scale.

Anchorages and statutory harbour authority areas

The spatial extent and location of defined areas such as anchorages and harbour areas are represented on UKHO charts. This information is not available as a downloadable data layer. The UKHO do not make this available as a payment service. However, UKHO charts for Irish Waters can be purchased and layers of information created through digitisation.

Dumping at sea boundary

Dumping at sea (disposal sites) boundaries are available from the Environmental Protection Agency (EPA) as a download which will provide information between 1989 and present. This data layer may be used under licence.

Vega & Hynes (2017) provide an estimate of the economic value of the shipping and maritime sector as a whole. They also provide a separate estimate for the cruise sector. CSO statistics web pages provide data by port, including Ro/Ro traffic, Lo/Lo traffic, tonnage of goods, numbers of passengers disembarking, and numbers of cruise ships and passengers. These are all available by port, and more detailed than summary statistics in the Irish Maritime Transport Economist publication. While economic data are lacking, these data provide a good indication of the spatial distribution of ports and maritime transport activity.

B.4.13 Seascape

There is currently no seascape character assessment for Ireland, and only partial coverage of landscape character assessment at County level.

B.4.14 Social factors

Spatial data is available on demographics, socio-economic status, housing and overall levels of deprivation for coastal electoral districts. Some contextual information on social values in relation to the marine environment is also available. The information is suitable to support marine planning.

B.4.15 Surface water/wastewater management

Spatial data layers are available for the location of integrated pollution prevention and control (IPPC) facilities, waste facilities and urban wastewater treatment discharges. This information is considered to be suitable for national scale marine planning as it identifies the location of the main point source

discharges to the marine environment. No central source of information on surface water outfalls or storm outfalls has been identified but this is not considered important for national-scale marine planning.

There is no central source of information on the economic value of coastal surface water/wastewater treatment.

B.4.16 Telecommunications

Spatial data on existing telecommunications cables in Irish waters is available from KIS-ORCA under licence. This information is considered suitable for MSP but is not downloadable due to licence restrictions.

There is no central source of information on planned telecommunications cables. One planned telecommunications cable has been identified (Cork–Lannion (IFC-1)) for which details are being sought.

There is no central source of information on the economic value of telecommunications cables in Irish waters treatment.

B.4.17 Tourism and recreation

There is no comprehensive survey showing the spatial intensity and breakdown of marine recreation activities around the Irish coastline. There are a number of datasets which show the location of recreation assets (e.g. beaches or coastal paths) but which provide no indication of their relative or absolute levels of use. There are some surveys that provide more detailed information for specific activities or locations. Taken together, the data do not provide a comprehensive or consistent picture of tourism and recreation activity.

Beach Leisure

Beaches provide the location for a wide variety of informal recreation activities including games, swimming, beachcombing, rockpooling, walking and sunbathing. Depending on their characteristics, they can provide a location for more specialist activities such as surfing, windsurfing, kitesurfing, sand yachting and launch locations for canoes, kayaks and other small craft.

Key datasets relating to beaches include:

- Blue Flag Beaches – up-to-date spatial data showing the location of 88 Irish beaches that were awarded Blue Flag status. Blue Flag beaches must be identified bathing waters and are judged against a total of 32 criteria covering environmental education and information, water quality, environmental management, and safety and services. This dataset provides a good indication of those beaches that are judged to be managed most sustainably. The Blue Flag is administered in Ireland by An Taisce on behalf of the Foundation for Environmental Education (FEE).

- Green Coast – up-to-date spatial data showing the location of 59 Irish beaches that have been awarded Green Coast status. To achieve the award, beaches must have excellent water quality and have effective and appropriate management to ensure the protection of the natural environment. These beaches may not have the suite of facilities required for Blue Flag status but they are exceptional places to visit.
- Clean Coast Beaches – up-to-date spatial data showing beaches that have been awarded the Green Coast Award and which also operate the Clean Coasts Volunteering scheme.

- Bathing Water Locations – this dataset can be downloaded from the Irish Spatial Data Exchange, providing information about the quality of bathing waters (excellent, good, poor and unknown).
- Discover Ireland has a very comprehensive dataset which identifies Blue Flag, Clean Coasts and other beaches. It also identifies beaches that are not awarded Blue Flag or Green Coast status. Approximately 177 sites are identified in the dataset although it is unlikely that the shapefile will have been updated the since the award of 2018 Blue Flag and Green Coast beaches.
- Strava – the activity app can provide spatial information about places visited by people recording their activity on smartphones or smartwatches. It would be possible to identify which of these locations are along the coastline or on specific beaches. At present the dataset is relatively sparse, providing information about the most intensively visited locations rather than a more representative and comprehensive picture. There is also a significant cost associated with obtaining the data. It is possible that the data may be more useful in the future when large numbers of participants have generated more spatial data over a longer period.

It is evident that there is good information on the location of beaches in Ireland, particularly those that have been awarded Blue Flag and Green Coast status. It is possible that smaller and more remote beaches are under-represented. There is little information to indicate which of these beaches are most visited.

Cycling

Cycling is an activity which, while not specifically marine in nature, can take place along the coastline. It includes on-road cycling (including touring) and off-road cycling. Information is partial, indicating the location of cycling clubs and providing incomplete information about on- and off-road cycling opportunities.

Key datasets relating to cycling include:

- Cycling clubs – a dataset maintained by Cycling Ireland showing the location of cycling clubs. It does not provide information on the routes used by the clubs.
- On-road cycling routes – the National Trails Office holds information about on-road cycle routes, but it does not provide complete coverage for Ireland.
- Off-road cycling routes – the National Trails Office holds information about off-road cycle routes, but it does not provide complete coverage for Ireland.
- Strava – the activity app can provide spatial information about routes used by cyclists recording their activity on smartphones or smartwatches. It would be possible to identify which of these routes are located along the coastline, but not whether the coast was a specific or incidental destination as part of a longer ride. The dataset does not distinguish between on- and off-road cycling. At present the dataset is relatively sparse, providing information about the most intensively visited locations rather than a more representative and comprehensive picture. There is also a significant cost associated with obtaining the data. It is possible that the data may be more useful in the future when large numbers of participants have generated more spatial data over a longer period.

It is evident that there is some information about cycling routes on the coast in Ireland, although this is not comprehensive. There is little information to indicate which of these routes are most heavily used by cyclists.

Walking

Walking is an activity which, while not specifically marine in nature, can take place along the coastline. It includes short walks and use of longer distance trails.

Key datasets relating to cycling include:

- The Heritage Council maintains information on the location Pilgrim Paths, although it only provides information on the starting point for each trail within the Pilgrim Paths group and does not show the route in question (held within the National Trails Office's Looped Walk dataset). It does not provide information on the numbers of people using the paths.
- The National Trails Office's Looped Walk dataset provides information on the routes of National Loop Walks and Pilgrim Paths, including those in coastal locations. It does not provide information on the numbers of people using the paths.
- The National Trails Office also maintains a Waymarked Ways dataset, including those in coastal locations. It does not provide information on the numbers of people using the paths.
- Information on the starting points of Sli na Slainte Walking Routes (not the routes themselves) are held by the National Trails Office. It does not provide information on the numbers of people using the paths.
- The National Trails Office's Walking/Hiking Trails dataset identifies walking and hiking routes around Ireland. Some routes are mapped but others only have their starting points identified as point data. There is no information about the numbers of people using these trails.
- The Irish Walking Guide identifies the starting point of walking routes from a variety of sources e.g. Lonely Planet Publications, Irish Coastal Walks guidebook, The Mountains of Ireland guidebook, Hiking in Ireland guidebook, Best Irish Walks guidebook, The Irish Coast to Coast Walks, etc. There is no information about the actual routes followed or the numbers of people using these routes.
- The Wild Atlantic Way dataset provides the route of the entire Wild Atlantic Way walking and cycling route. It does not include information on the number of people using the route.
- Discover Scotland has information on Coastal and Looped Walks. It identifies the starting point for 17 coastal and looped walks including some routes that are not in the National Looped Route dataset.
- Strava – the activity app can provide spatial information about routes used by walkers recording their activity on smartphones or smartwatches. It would be possible to identify which of these routes are located along the coastline, but not whether the coast was a specific or incidental destination as part of a longer walk. At present the dataset is relatively sparse, providing information about the most intensively visited locations rather than a more representative and comprehensive picture. There is also a significant cost associated with obtaining the data. It is possible that the data may be more useful in the future when large numbers of participants have generated more spatial data over a longer period.

It is evident that there is good information on the location of coastal trails. There is little information to indicate which routes are most popular amongst walkers.

Angling

Activities included under the angling heading include bait digging, shoreline angling and angling from a boat.

Key datasets relating to angling include:

- The Fishing in Ireland website which includes hand-drawn maps showing the location of fishing hotspots and associated bait digging locations along the coastline. The maps are dated 1980 so may not be up-to-date.
- Sea Angling Ireland hand-drawn maps showing shore marks where shore angling takes place based on information from anglers. The map shows known shore marks and suspected shore marks where angling could take place. The date of this information is not known.

- Sea Angling Ireland has published a directory of angling boat operators – these are listed and not located spatially.
- Fishing in Ireland has published a directory of charter boats – these are listed and not located spatially.
- Inland Fisheries Ireland has published the Wild Atlantic Way Shore Fishing dataset which identifies all shore angling locations along the Wild Atlantic Way.
- Inland Fisheries Ireland has published the shore angling, boat angling centres and bait collection dataset which identifies locations for shore angling, bait collection and boat angling centres around Ireland. Maps are in PDF but appear to have been created in GIS so the point data should be available.
- Discover Ireland's Sea angling operators dataset includes 133 operators, though only some of these relate to sea angling.
- Discover Ireland's Angling Clubs dataset details only 4 angling clubs across Ireland so is not comprehensive.
- Tourism Ireland's Angling Clubs dataset details only 8 angling clubs across Ireland, mostly focused in the north.
- Tourism Ireland's Angling operators and guides dataset provides a dataset of angling operators and guides across Ireland. It is the same dataset as Discover Ireland detailed above (133 records).
- Tourism Ireland's Angling schools/tuition dataset provides information on a limited number of angling schools across Ireland. It is likely to overlap with other angling datasets and would need to be clipped to only include schools along the coast.

It is evident that there is reasonably good information on locations where shoreline angling and angling from a boat, together with bait digging takes place. Information is best along the west coast. Some is dated and not available in digital form. There is some information on angling operators and guides, though this is not spatial. There is no information on the popularity or intensity of angling activity along different parts of the coastline.

Kite surfing

A number of data sources provide information on locations used for kite surfing and on the location of kite surfing schools:

- Kite Surf Ireland's information on kitesurfing locations shows the location of five surfing clinics.
- The Local Kite Spots dataset records user generated information on locations for kite surfing.
- The Irish Kite Surfing Association holds information for eight kite surfing schools but not the locations used for kite surfing.

It is evident that there is some user-generated information on where people undertake kite surfing and on the location of surfing schools/clinics. There is no information on the intensity of activity in different locations.

Windsurfing

A number of data sources provide information on locations used for windsurfing and on the location of windsurfing schools:

- The Irish Windsurfing Association's windsurfing location data shows user generated information on locations for windsurfing.
- Map.ie also identifies locations used for windsurfing, though this is not as comprehensive as, and overlaps with, the Irish Windsurfing Association's data.

- Discover Ireland maintains a dataset identifying windsurfing schools, clubs and adventure centres that offer windsurfing. The location of these clubs is likely to overlap with other activities e.g. surfing, kitesurfing.
- The Irish Windsurfing Association also identifies the location of approved training centres for windsurfing.
- Tourism Ireland provides some limited information on the location of windsurfing schools and centres, but all four sites listed are in Northern Ireland and most are inland rather than on the coast.

It is evident that there is some user generated information on where people undertake windsurfing and on the location of windsurfing schools/centres. There is no information on the intensity of activity in different locations.

Surfing

A number of data sources provide information on locations used for wind surfing and on the location of wind surfing schools:

- Discover Ireland identifies around 77 surf schools, clubs and adventure centres that offer surfing. The location of these clubs is likely to overlap with other activities e.g. windsurfing, kitesurfing.
- The Magic Seaweed website identifies 44 surf locations based on information provided by surfers.
- The Irish Surfing Association identifies the location of surf clubs and schools.
- Map.ie identifies popular beaches for surfing though these do not generally overlap with those identified on the Magic Seaweed website.

It is evident that there is some user generated information on where people undertake surfing and on the location of surfing schools. There is no information on the intensity of activity in different locations.

Climbing, bouldering and coasteering

Recently, coasteering and bouldering have become increasingly important activities, alongside more traditional climbing. Information on locations used for climbing, bouldering and coasteering comes from a number of different sources:

- Extreme Sports identifies four adventure centres that provide coasteering activities.
- Discover Scotland also identifies activity operators that offer coasteering. Data will overlap with other activities that these adventure centres provide.
- Climbing.ie provides a list of popular areas for coasteering (the website includes a broken link to a map showing climbing locations).
- UK Climbing identifies climbing locations along the coastline.

It is concluded that there is partial information on locations where climbing, bouldering and coasteering activities take place and centres providing these activities. There is however no user-generated data and no indication on the relative intensity of use at these and other locations.

Diving

A number of data sources provide information on dive locations, diving clubs and centres providing training and opportunities for diving:

- Tourism Ireland's diving dataset identifies diving schools and diving centres, but only one is outside Northern Ireland, in Cork.
- Discover Ireland diving and snorkelling dataset identifies diving schools and diving centres and watersports centres that offer diving.
- Digital Ocean dive sites data identifies diving sites around the Irish coastline.
- The Irish Underwater Council holds information on registered dive clubs.
- IrishWrecks.com identifies locations of shipwrecks, however the exact position of shipwrecks varies (classified into two categories – position estimated or position approximate).

There is partial information on dive locations, clubs and diving centres. There is, however, no user-generated data and no indication on the relative intensity of use at these and other locations.

Vega & Hynes (2017) provide an estimate of the economic value of the marine tourism and leisure sector as a whole. The report uses data on coastal accommodation occupancy to estimate coastal share of tourism economy. Fáilte Ireland publishes a range of statistics on the volume and value of tourism and accommodation capacity and occupancy.

B.4.18 Wild seaweed harvesting

Limited commercial-scale wild seaweed harvesting occurs in Irish waters. A number of licences and applications have been identified covering areas of Co. Sligo, Co. Mayo, Galway Bay and Bantry Bay but it is unclear whether all of these licences are current. Information on these licences is available from DHPLG. Vega & Hynes (2017) note that 'Seaweed harvesting takes place around the coast of Ireland, with particular concentrations in Co. Galway, Co. Donegal, Co. Sligo, Co. Kerry and Co. Cork'.

There is little specific information on the economic value of commercial seaweed harvesting. Vega & Hynes (2017) note that it contributes to the Seafood Processing and Marine Biotechnology and Bio-products sectors.

C Summary of Gap Analysis by Topic

C.1 Administrative and Physical Boundaries

Data gaps for Administrative and Physical Boundaries against the generic MSP data requirements are shown in Table C1. The features that have been identified as relevant for administrative and physical boundaries are a variety of boundaries such as baselines, Exclusive Economic Zone (EEZ) limits, local authority boundaries, areas relating to different directives and marine protected area boundaries.

Table C1. Summary of gaps for Administrative and Physical Boundaries on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Spatial representation of relevant boundary/unit	59		2

Against the generic MSP data requirements, **data for Administrative and Physical Boundaries exist on the Atlas** for virtually all significant administrative boundaries.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Ramsar sites;
    - An alternative layer can be used at low cost (<€5k).

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- Wexford Coastal Zone Management areas;
    - Data layer can be sought from Wexford County Council at low cost (<€5k).

C.2 Physical Environment

C.2.1 Geology

Data gaps for geology against the generic MSP data requirements are shown in Table C2. The general features that have been identified as relevant for physical environment are as follows:

- Marine process features - Morphology and morphological features;
- Quarternary geology - Glacial process features;
- Geological process features - Offshore Fault;
- Geological process features - Offshore Ridge;
- Geological process features – Igneous;
- Geological process features - Intrusive Bodies;
- Geological process features - Tectonic Elements;
- Geological process features - Marine Basin;
- Geological process features - Continental Margin;
- Bathymetry;
- Seabed geology.

Table C2. Summary of gaps for geology on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution and characteristics of physical features		11	
Potential future spatial distribution and characteristics of physical features		2	

Against the generic MSP data requirements, **data for geology exist on the Atlas** for:

- There are no features for which complete dataset exists as they only provide partial coverage over Irish Waters, although many of the data layers cover the main areas of interest.

There are **partial data g**aps (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Distribution of marine process features. The available data is fairly recent but does not provide complete coverage for all Irish waters;
  - This gap can be filled by collating data outputs from the INFOMAR, Geological Survey Ireland (GSI) Joint Irish Bathymetric Survey (JIBS) and the British Geological Survey (BGS) at relatively low cost (€5-10k).
- Current spatial distribution and characteristics of physical features with respect to the seabed geology, Quaternary geology and geological process features. That is limited on the Atlas and has an incomplete coverage in Irish waters;
  - This gap can be filled by collating data outputs from the Petroleum Affairs Division (PAD) and the GSI. Data from the GSI is mainly available in a paper format and would require digitisation. Estimated costs are in relation to each feature is about €5k, but cumulatively is likely to be around €50k.
- Current and potential future spatial distribution and characteristics of physical features with respect to bathymetry. The available data does not provide complete coverage for all Irish waters;
  - This gap can be filled by collating regional outputs from INFOMAR, JIBS and GSI. However these datasets in combination do not provide complete coverage and additional survey may be required at significant cost(>€100k);
  - The current properties can provide a good representation of future conditions, however, to prepare predictions of future distribution, would involve a relatively high cost (€10 - 100k).

C.2.2 Seabed sediments

Data gaps for seabed sediments against the generic MSP data requirements are shown in Table C3. Only one feature has been identified as relevant for seabed sediments:

- Seabed sediments.

Table C3. Summary of gaps for seabed sediments on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution and characteristics of physical features		1	
Potential future spatial distribution and characteristics of physical features		1	

Against the generic MSP data requirements, **data for seabed sediments exist on the Atlas** for:

- There are no features for which complete dataset exists as they only provide partial coverage over Irish Waters.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Current and potential future spatial distribution and characteristics of physical features with respect to seabed sediment. Data on the Atlas is at a coarse resolution in the form of sample points, with limited information on the wider distribution of sediment, it therefore does not provide complete coverage for all Irish waters;
    - Data exists for current conditions and can be compiled from multiple sources including outputs from INFOMAR and the GSI and BGS seabed sediment maps. This can be achieved at relatively low cost at less than €5k;
    - The degree to which seabed sediment would change in the future would be limited, however modelling could be undertaken to indicate locations and extent of change €10-100k.

C.2.3 Ocean process features

Data gaps for ocean process features against the generic MSP data requirements are shown in Table C4. The general features/sub-themes that have been identified as relevant for ocean process features are as follows:

- General Near Surface Current;
- Irish Coastal Current;
- Irish Slope Current;
- Mean Annual Distribution of Wave Height (m);
- Mean Annual Distribution of Wave Period (sec);
- Mean Tidal Amplitude;
- Mixed layer depth;
- Ocean Fronts;
- Sea salinity;
- Sea surface currents;
- Sea temperature;
- Seasonal Density Driven Transport;
- Upper Water Mass Movement;
- Western Irish Sea Gyre.

Table C4. Summary of gaps for ocean process features on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution and characteristics of physical features	4	10	
Potential future spatial distribution and characteristics of physical features	4	10	

Against the generic MSP data requirements, **data for ocean process features exist on the Atlas** for:

- Current spatial distribution and characteristics of physical features with respect to mixed layers and salinity. The present status also provides a good representation of the future conditions; and
- Current spatial distribution and characteristics of physical features with respect to sea surface and the Western Irish Sea gyre currents. The present status also provides a good representation of the future conditions.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Current and potential future spatial distribution and characteristics of physical features with respect to near surface currents as the data available on the Atlas has limited coverage.
    - Data is available locally and would require further survey and associated modelling to obtain a wider distribution over Irish waters, associated costs are on the order of €5-10k; and
    - The present status will be a good representation of future conditions, therefore if modelling is completed for the present status to provide a wider distribution (€10 - 100k); this would be directly applicable to the future and would have no cost. However, if surveys are carried out again these would have costs of over €100k.
- Current and potential future spatial distribution and characteristics of physical features with respect to Irish coastal and slope currents, which has limited coverage over Irish waters;
    - Data is available locally and would require further survey and associated modelling to obtain a wider distribution over Irish waters, associated costs are on the order of €5-10k; and
    - The present status will be a good representation of future conditions, therefore if modelling is completed for the present status to provide a wider distribution; this would be directly applicable to the future and would have no cost. However, if surveys are carried out again these would have costs of over €100k.
- Current and potential future spatial distribution and characteristics of physical features with respect to mean annual distribution of wave height and period. Data on the Atlas are from wave buoys around the coast, but is not available over all Irish waters.
    - The available data is from observations at disparate sites, however if data is required over a wider area regional modelling would be required at a cost of over €10k; and
    - The degree to which the wave height and period would change in the future would be limited and the current status is a good representation of future conditions. If modelling is completed for the present status to provide a wider distribution, this would be directly applicable to the future and would have no cost. However, if surveys are carried out again these would have costs of over €100k.
- Current and potential future spatial distribution and characteristics of physical features with respect to the mean tidal amplitude. Data on the Atlas are from tide gauges around the coast, but is not available over all Irish waters.
    - The available data is from observations at tide gauges, however if data is required over a wider area regional modelling would be required at a cost of over €10k;
    - The degree to which the tidal amplitude would change in the future would be limited and the current status is a good representation of future conditions. If modelling is completed for the present status to provide a wider distribution, this would be directly applicable to the future and would have no cost. However, if surveys are carried out again these would have costs of over €100k.

- Current and potential future spatial distribution and characteristics of physical features with respect to ocean fronts and the data available on the Atlas has limited coverage.
    - Data is available locally and would require further survey and associated modelling to obtain a wider distribution over Irish waters, associated costs are on the order of €5-10k; and
    - The present status will be a good representation of future conditions, therefore if modelling is completed for the present status to provide a wider distribution; this would be directly applicable to the future and would have no cost. However if surveys are carried out again these would have costs of over €100k.
- Current and potential future spatial distribution and characteristics of physical features with respect to sea temperature and the data available on the Atlas has limited coverage.
    - Data is available locally and would require further survey and associated modelling to obtain a wider distribution over Irish waters, associated costs are on the order of €5-10k; and
    - The present status will be a good representation of future conditions, therefore if modelling is completed for the present status to provide a wider distribution; this would be directly applicable to the future and would have no cost. However if surveys are carried out again these would have costs of over €100k.
- Current and potential future spatial distribution and characteristics of physical features with respect to seasonal density driven transport and the data available on the Atlas has limited coverage.
    - Data is available locally and would require further survey and associated modelling to obtain a wider distribution over Irish waters, associated costs are on the order of €5-10k; and
    - The present status will be a good representation of future conditions, therefore if modelling is completed for the present status to provide a wider distribution; this would be directly applicable to the future and would have no cost. However, if surveys are carried out again these would have costs of over €100k.
- Current and potential future spatial distribution and characteristics of physical features with respect to upper water mass movement and the data available on the Atlas has limited coverage.
    - Data is available locally and would require further survey and associated modelling to obtain a wider distribution over Irish waters, associated costs are on the order of €5-10k; and
    - The present status will be a good representation of future conditions, therefore if modelling is completed for the present status to provide a wider distribution; this would be directly applicable to the future and would have no cost. However, if surveys are carried out again these would have costs of over €100k.

C.3 Biological Environment

C.3.1 Benthic habitats and species

Data gaps for benthic habitats and species against the generic MSP data requirements are shown in Table C5. The general features/sub-themes that have been identified as relevant for benthic habitats and species are 20 individual habitats and species as follows:

- Coastal Lagoon;
- Estuaries;
- Large Shallow Inlets Bays;
- Mediterranean Salt meadows;
- Reefs;
- Atlantic Salt meadows;
- Sand Banks slightly covered by sea water at all times;
- Seabed Substrate;
- Seaweed distribution;
- Tidal Mudflats Sandflats;
- Sea caves;
- OSPAR habitats: Maerl beds;
- OSPAR habitats: Sea-Pen & Burrowing Megafauna Communities;
- OSPAR habitats: Sea-Pen & Burrowing Megafauna Communities;
- OSPAR habitats: Zostera Beds;
- OSPAR r habitats: Intertidal Mytilus edulis beds on Mixed & Sandy Sediments;
- OSPAR habitats: Carbonate mounds;
- OSPAR: Coral gardens;
- OSPAR: Lophelia pertusa reefs;
- OSPAR: Sabellaria spinulosa reefs; and
- Invasive Alien Species.

The MSP requirements of 'historic spatial distribution of feature', 'current spatial distribution and/or abundance/intensity of feature' and 'potential future spatial distribution of feature' apply to all the features.

Table C5. Summary of gaps for benthic habitats and species on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic spatial distribution of feature		14	6
Current spatial distribution and/or abundance/intensity of feature	5	10	5
Potential future spatial distribution of feature		12	8

Against the generic MSP data requirements, **data for benthic habitats and species exist on the Atlas** for:

- Current distribution of the following habitats listed on Annex I of the EU Habitats Directive: Coastal lagoons, Estuaries, Large shallow inlets and bays and Salt marsh.
- Current and historic distribution of OSPAR threatened habitats which occur within SAC areas (Maërl beds, *Zostera* beds, Sea-Pen & Burrowing Megafauna Communities, Intertidal *Mytilus edulis* beds on Mixed & Sandy Sediments and *Sabellaria spinulosa* reefs).

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Current distribution of the Annex I habitats; Reefs (biogenic and geogenic), outside of SACs and Seacaves both within and outside SACs;
    - These gaps can only be addressed by field-based surveys to acquire the relevant baseline information and monitor future changes in its extent. This is likely to have considerable associated costs, estimated to be in the region of >€100k.

- Current distribution of the Annex I habitats; Tidal Mudflats and Sandflats and Sand Banks slightly covered by sea water at all times outside of SACs;
    - These gaps can only be addressed by a combination of desk-based surveys of the historic and current aerial imagery in the case of tidal mudflats and sandflats and field-based surveys in the case of sandbanks to acquire the relevant baseline information and monitor future changes in its extent. This is likely to have considerable associated costs, estimated to be in the region of >€100k.

- Current and future distribution of the OSPAR habitats; Maërl beds, *Zostera* beds, Sea-Pen & Burrowing Megafauna Communities, Intertidal *Mytilus edulis* Beds on Mixed & Sandy Sediments and *Sabellaria spinulosa* Reefs outside of SACs;
    - These gaps can only be addressed by field-based surveys to acquire the relevant baseline information and monitor future change in its extent. This is likely to have considerable associated costs, estimated to be in the region of >€100k.

There are data gaps on the Atlas, but **partial data available from other agencies** that could be sourced and/or processed, for the following:

- Seabed substrate;
    - This could be sourced from existing MI WFD data and NPWS Article 17 monitoring data for inshore areas. However, surveys would be required to update offshore areas. This is likely to have considerable associated costs, estimated to be in the region of >€100k.

There are **no data on the Atlas** for the current and historic distribution of:

- The OSPAR habitats; Carbonate mounds, Coral gardens and *Lophelia pertusa* reefs;
    - Current ongoing surveys under the jointly-funded Irish Government/EU European Maritime and Fisheries Fund (EMFF) as part of the Marine Institute's implementation of the Marine Biodiversity scheme will significantly address this gap under its current funding scheme. However, future assessment of the distribution of these habitats would require significant future funding well in excess of €100K.

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require **new data collection programmes** to collect the required data, for the following:

- Marine Alien Invasive Species (IAS);
    - While limited *Ad hoc* data on the current distribution of some marine IAS exists, few targeted surveys have been conducted. This represent a major data gap for the future assessment and control of marine IAS in Ireland. To address this gap targeted surveys to include the production of inventories, spatial distribution and temporal occurrence of IAS is required. Estimated cost €10k–100k.

C.3.2 Fish

Data gaps for fish against the generic MSP data requirements are shown in Table C6. The general features/sub-themes that have been identified as relevant for fish are as follows (including top ten commercial species, migratory species and elasmobranchs):

- Atlantic cod;
- Atlantic salmon;
- Blue whiting;
- Brook lamprey;
- Cockle;
- Biologically Sensitive Area;
- Haddock;
- Hake;
- Herring;
- Horse mackerel;
- Mackerel;
- Megrim;
- Black belly angler monk Nursery;
- Monkfish;
- White belly angler monk Nursery;
- Nephrops;
- Oyster;
- River lamprey;
- Scallop habitat;
- Sea lamprey;
- Twaite shad;
- Whiting;
- Elasmobranch.

Table C6. Summary of gaps for fish on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Administrative boundary for biological feature	3		
Historic spatial distribution of feature	1	11	8
Current spatial distribution and/or abundance/intensity of feature		12	8
Potential future spatial distribution of feature		12	8
Spatial information on current ecological function	1	11	6

Against the generic MSP data requirements, **data for fish exist on the Atlas** for:

- Administrative boundary for the Biologically Sensitive Area, the Greencastle Codling Protected Area, White Belly Angler Monk Nursery area, Nephrops functional units and historical distribution of Nephrops from underwater TV surveys.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Past, present and potential future distribution and current ecological function for commercial fish populations and Atlantic Salmon;
    - It may be possible to fill this gap using information from other sources at relatively low cost (€5-10k per data product);

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on, Brook Lamprey, River Lamprey, Sea Lamprey or Twaite Shad, but data could be sourced from NPWS;
    - It is anticipated that this information can be sourced from NPWS, subject to licensing agreements at low cost (<€5k per data product);
- There are no data on current spatial distribution and/or abundance of cockle, oyster and scallop available on the Atlas.
    - It may be possible to fill this gap using information from other sources, such as NBN, at relatively low cost (€5-10k per data product);
- No available data on elsamobranch distributions and/ or abundance on the Atlas;
    - It may be possible to fill this gap using information from other sources, such as Chondrichthyans of Ireland or NBN. Significant processing of data likely to be required (€10-100k);

C.3.3 Marine mammals

Data gaps for marine mammals against the generic MSP data requirements are shown in Table C7. The features for marine mammals are the 20 individual species, as well as habitats, sites and management units for relevant species.

Table C7. Summary of gaps for marine mammals on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Administrative boundary for biological feature			11
Historic spatial distribution of feature		21	
Current spatial distribution and/or abundance/intensity of feature	1	23	
Potential future spatial distribution of feature			21
Spatial information on current ecological function			21

Against the generic MSP data requirements, **data for marine mammals exist on the Atlas** for:

- Atlantic white-sided dolphin
- Beaked whale
- Harbour porpoise
- Risso's dolphin
- Common dolphin
- Striped dolphin
- White-beaked dolphin
- Minke whale
- Pilot whale
- Blue whale
- Killer whale
- Sperm whale
- Humpback whale
- Fin whale
- Bottlenose dolphin
- Sei whale
- Otter

Data for all marine mammal species are currently only very partially compiled on the Marine Atlas, drawing almost exclusively on one atlas (Wall *et al*. 2013). Currently the **Marine Atlas is incomplete for all marine mammal species**. Gaps should be filled by gathering further data from the sources identified in the spreadsheet:

- Update this Historic spatial distribution with coverage from SCANS I and II, CODA, and DCCAE.
- Update Current spatial distribution and/or abundance/intensity of feature with data from IWDG (2012-2017), SMRU (SCANS III), NPWS Harbour Porpoise and Nearshore Surveys and MI fisheries surveys and DCCAE ObSERVE programme.
- Update Current Spatial information on current ecological function with data from IWDG (2012-2017), NPWS and MI fisheries surveys and DCCAE - ObSERVE programme. Appropriate analyses should then be performed on the updated data to assess ecological function (i.e. areas with evidence of foraging, presence of calves, migration routes).
- Update existing data with those datasets identified to future spatial distribution of feature is complete (from IWDG (2012-2017), SMRU (SCANS III), NPWS and MI fisheries surveys and DCCAE - Observe programme).
- For beaked whales, additionally using DCCAE funded surveys (Boisseau *et al*. 2010 and Wall *et al*. 2012).
- Additional for Baleen whale data, access Baines *et al*. (2017) survey.
- Coastal datasets for bottlenose dolphin, harbour porpoise and common dolphin, NPWS SAC surveys, small site investigations and nearshore surveys.
- Harbour seal; update with NPWS funded survey data for Harbour Seal to address current spatial distribution and/or abundance/intensity of feature using data from surveys 2007-2012, 2013, Cronin *et al*., 2010.
- Grey seal, NPWS Article 17 reporting 2007-2017, IWDG funded marine mammal observations, Cronin *et al* (2011) Tracking grey seals on Irelands' continental shelf. Unpublished Reports NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Jones *et al* (2015) Patterns of space use in sympatric marine colonial predators reveals scales of spatial partitioning and DCCAE - Observe programme.
- Otter, missing historical data such as Chapman and Chapman (1982), Bailey and Rochford (2006), and various NPWS surveys and data from the MISE project to be input in order to have a more complete dataset.

Data are not available for:

- Potential future distribution and spatial information on current ecological function.
    - Existing data on distribution should be updated with those datasets identified to ensure potential future spatial distribution of features is complete (€10–100k per species).
    - Some information exists ecological function for some species (e.g. where animals have been recorded foraging), but for other is lacking. Existing distribution evidence could be used with additional data and knowledge on ecological function and behaviour to develop layers on spatial function (€10–100k per species).

C.3.4 Birds

Data gaps for birds against the generic MSP data requirements are shown in Table C8. The general features that have been identified as relevant for birds are as follows:

- Location of seabird colonies (by key species) - cliff-nesting species (Fulmar, Kittiwake, Guillemot, Razorbill);
- Location of seabird colonies (by key species) - cliff-nesting species (Cormorant, Shag);
- Location of seabird colonies (by key species) - cliff-nesting species (Gannet);
- Location of seabird colonies (by key species) - diurnal burrowing nester (Puffin);
- Location of seabird colonies (by key species) - nocturnal burrow nesters (Manx Shearwater);
- Location of seabird colonies (by key species) - nocturnal burrow nesters (European Storm-petrel);
- Location of seabird colonies (by key species) - nocturnal burrow nesters (Leach's Storm-petrel);
- Location of seabird colonies (by key species) - large gulls (Lesser Black-backed, Herring, Great Black-backed);
- Location of seabird colonies (by key species) - small gulls (Black-headed, Common, Mediterranean);
- Location of seabird colonies (by key species) - small gulls (Great Skua);
- Location of seabird colonies (by key species) - dispersed crevice nester (Black Guillemot);
- Location of seabird colonies (by key species) - terns (Sandwich, Roseate, Common, Arctic, Little);
- Overall winter seabird density (total) (and by key species) - all species;
- Overall summer seabird density (total) (and by key species) - all species;
- Special Protection Areas;
- Tern foraging areas (based on ranges from tern colonies).

Table C8. Summary of gaps for birds on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Administrative boundary for biological feature	1		
Historic spatial distribution of feature			3
Current spatial distribution and/or abundance/intensity of feature		1	3
Potential future spatial distribution of feature			3
Spatial information on current ecological function			12

Against the generic MSP data requirements, **data for birds exist on the Atlas** for:

- Boundary definitions for Special Protection Areas only and these are biased towards the nearshore coastal zone and intertidal habitats;
- Estuarine winter waterbird numbers and distribution.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- The ObSERVE seabird dataset needs to be uploaded to the Atlas at the earliest opportunity.

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on Seabird colony location and breeding numbers, but data could be sourced from National Parks & Wildlife Service for most recent national dataset (2015-2018) or from BirdWatch Ireland for 1998-2002.
- There are no data on Seabirds at Sea, but historical data are available on the European SaS database managed by JNCC and a more up-to-date dataset for Irish Atlantic EEZ and Celtic Sea from GMIT/Niall Keogh.

- A further, year-round, dataset of seabird data has been collected by the offshore renewables industry for the east coast sandbanks
    - As a first step in producing a Sensitivity Map for offshore areas, BirdWatch Ireland have recently opened dialogue with Irish Sea wind energy operators.
- There are no data on foraging ranges of breeding seabirds; these data have been collected for some species by researchers at UCC (BEES) and BirdWatch Ireland (INTERREG-Atlantic FAME dataset)
    - Meta-data sets are available for other species in the UK and other neighbouring EU countries.

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require new data collection programmes to collect the required data, for the following:

- There are no data relating to nearshore (approx. 1-10 nm), autumn/winter seabirds and seaduck distributions at sea.
    - Resources required to fill this are a programme of commissioned seabirds at sea surveys in bays or high definition aerial videography.
- There are no data relating to breeding success/productivity of seabirds apart from a few Irish Sea sites supporting important tern colonies and Downpatrick Head, Mayo (annual but Kittiwakes only). Some data are available from NPWS for 2006/2007 and BirdWatch Ireland (FAME) for 2010/2011;
    - Resources required to fill this are a programme of commissioned seabird productivity plots in a representative suite of internationally important colonies e.g. Horn Head (Donegal), Cliffs of Moher (Clare), Skellig Michael (Kerry), Great Saltee (Wexford) and Lambay/Ireland's Eye (Dublin).

C.3.5 Reptiles

Data gaps for reptiles against the generic MSP data requirements are shown in Table C9. The general features/sub-themes that have been identified as relevant for reptiles are as follows:

- Green Turtle;
- Hawksbill Turtle;
- Leathery Turtle;
- Loggerhead Turtle.

Table C9. Summary of gaps for reptiles on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic spatial distribution of feature			4
Current spatial distribution and/or abundance/intensity of feature			4
Potential future spatial distribution of feature			4
Spatial information on current ecological function			4

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- Some data is available for four species of turtle (Green, Hawksbill, Leathery, Loggerhead) from National Biodiversity Data Centre;

- Historic/current data layers could be created for all four species based on available data at relatively low cost (<€5k per data product). This information could be used to project possible future distribution.

There is **no specific data** on ecological function, but for all species the use of Irish waters is understood to primarily relate to foraging.

C.3.6 Terrestrial habitats

Data gaps for terrestrial habitats against the generic MSP data requirements are shown in Table C10. The general features/sub-themes that have been identified as relevant for terrestrial habitats are as follows:

- Land Cover Classification;
- Sand Dune;
- Vegetated Sea Cliff.

Table C10. Summary of gaps for terrestrial habitats on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic spatial distribution of feature	1	2	
Current spatial distribution and/or abundance/intensity of feature		3	
Potential future spatial distribution of feature		3	

Against the generic MSP data requirements, **data for terrestrial habitats exist on the Atlas** for:

- Historic land cover classification.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Current and future distribution of terrestrial habitats:
  - It is assumed that the current gap will be addressed by future land cover classification map updates (at minimal cost); future distribution could be projected based on historic trends, but products likely to be low confidence (€5-10k);
- Historic, current and future distribution of sand dune and vegetated sea cliff:
  - It would be possible to seek to address the historic and current gaps through literature review and to project future distribution based on historic trends, but products likely to be of low confidence (€5-10k per product).

C.3.7 Natural capital and ecosystem services

Data gaps for natural capital and ecosystem services against the generic MSP data requirements are shown in Table C11. There are 47 general features that have been identified as relevant for natural capital and ecosystem services, as follows:

- Habitats: Seabed habitats, Sand dunes, Beaches, Saltmarsh, Seagrass, Mudflat, Reef, Pelagic, Water surface, Seawater;
- Species: Fish and cephalopods, Shellfish, Macroalgae, Cetaceans, Seals, Seabirds;

- Activities/sectors: Marine aggregates, Oil and gas reserves, Offshore wind, Wave energy, Tidal stream energy, Tidal range energy, Wild capture fisheries, Algae/ Seaweed Harvesting, Aquaculture – finfish, Aquaculture – shellfish, Transport, Recreation and tourism
- Infrastructure: Coastal footpaths, Coastal open space, Slipways and marinas, Aquaculture installations, Ports and harbours, Vessels; Cultural heritage;
- Resources: Fuel/ Energy, Materials: fibre, ornamental, biochemical, Genetic resources, Water for non-drinking purposes;
- Services: Climate regulation and carbon sequestration, Mediation of wastes/ water purification, Natural Hazard Protection/ Mediation of flows, Lifecycle maintenance, habitat and gene pool protection;
- Scientific and educational, Aesthetic, Spiritual and emblematic, Existence and bequest.

Table C11. Summary of gaps for natural capital and ecosystem services on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution and/or abundance/intensity of feature	5	12	1
Current spatial distribution of resource	4	4	23

Against the generic MSP data requirements, **data for natural capital and ecosystem services exist** on the Atlas for:

- Current spatial distribution of seabed habitats, saltmarsh, mudflats, offshore wind, wave and tidal stream energy resources, sea surface and aquaculture installations.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Current spatial distribution of sand dunes, seagrass, reef, pelagic, fish and cephalopods, beaches, shellfish, macroalgae, cetaceans, seals, seabirds, marine aggregates, oil and gas reserves, seawater, slipways and marinas, ports and harbours;
    - Development of improved data is likely to occur under other MSP themes in Project 1 and/or Project 3.

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- Current distribution of shipping activity;
    - Development of comprehensive data layers for shipping density would entail a significant effort in processing AIS data (see Ports & Shipping);
- Current distribution of tidal range energy resources, coastal footpaths, coastal open space;
    - Development of data layers could be progressed using modelling (tidal range) or accessing other data sets (footpaths, coastal open space) – see Energy and Tourism and Recreation.

There are **major data gaps at an Ireland level** for the mapping of marine ecosystem services. These will be addressed through Project 3.

C.4 Environmental Quality

C.4.1 Water Quality

Data gaps for environmental quality against the generic MSP data requirements are shown in Table C12. The general features/sub-themes that have been identified as relevant for water quality are as follows:

- Bathing Water Compliance;
- Coastal Water Quality;
- Shellfish classified areas (shellfish hygiene);
- Shellfish waters classification;
- Transitional Water Quality;
- WFD Register of Protected Areas Nutrient Sensitive Areas.

Table C12. Summary of gaps for water quality on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Administrative boundary	5		1
Historic quality status			6
Current quality status	2		4
Potential future quality status			6

Against the generic MSP data requirements, **data for water quality exist on the Atlas** for:

- Administrative boundaries for bathing waters, shellfish waters, shellfish harvesting and WFD transitional and coastal waters
- Current quality status for transitional and coastal waters

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- The location of nutrient sensitive areas;
  - Data are likely to be available from EPA (<€5k per data product).
- Historic status of bathing waters, transitional and coastal waters, shellfish waters, shellfish harvesting areas and nutrient sensitive areas;
  - Data are likely to be available from EPA (<€5k per data product).
- Current status of bathing waters, shellfish waters, shellfish harvesting areas and nutrient sensitive areas;
  - Data are likely to be available from EPA (<€5k per data product).
- Potential future status of bathing waters, transitional and coastal waters, shellfish waters, shellfish harvesting areas and nutrient sensitive areas;
  - Data are likely to be available from EPA (<€5k per data product).

C.4.2 Marine Litter

Data gaps for marine litter against the generic MSP data requirements are shown in Table C13. The general features/sub-themes that have been identified as relevant for marine litter are as follows:

- Coastal litter;
- Seabed litter.

Table C13. Summary of gaps for marine litter on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic quality status			2
Current quality status			2
Potential future quality status			2

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on historic or current coastal or seabed litter, but some data could be sourced from Coastwatch (coastal) or MI/OSPAR (IGFS, OSPAR Fishing for Litter);
    - Maps of litter distribution/intensity could be prepared using the existing data at relatively low cost (<€5k or €5-10k per data product) but spatial coverage would be incomplete and there are some methodological issues with Coastwatch data
- There are no data on potential future coastal or seabed litter, but some data on existing litter distribution/intensity could be sourced from Coastwatch (coastal) or MI/OSPAR (IGFS, OSPAR Fishing for Litter);
    - Maps of potential future litter distribution/intensity could be prepared using the existing data and assumptions on trends at relatively low cost (€5 - 10k per data product) but spatial coverage would be incomplete and there are some methodological issues with Coastwatch data. In order to address current limitations of both coastal and seabed litter surveys, additional investment in surveys would be required (€10-100k per annum for extra survey effort)

C.4.3 Other Human Pressures

Data gaps for other human pressures against the generic MSP data requirements are shown in Table C14. Thirty-one features have been identified as relevant for other human pressures, as follows:

- Physical: Temperature changes – local, Salinity changes – local, Water flow (tidal current) changes - local, including sediment transport considerations, Emergence regime changes - local, including tidal level change, Wave exposure changes – local, Physical loss (to land or freshwater habitat), Physical change (to another seabed type), Habitat structure changes - removal of substratum (extraction), Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion;
- Contamination/substances: Transition elements and organo-metal contamination, Hydrocarbon and PAH contamination, Synthetic compound contamination, Introduction of other substances, Radionuclide contamination;
- Nutrients/eutrophication: Nutrient enrichment, Organic enrichment, Deoxygenation;
- Changes in suspended solids (water clarity);
- Siltation rate changes, including smothering (depth of vertical sediment accretion);
- Marine litter;
- Energy: Electromagnetic changes, Introduction of light;
- Sound: Underwater noise changes;
- Biological: Genetic modification and translocation of indigenous species, Introduction or spread of non-indigenous species, Introduction of microbial pathogens, Removal of target species, Removal of non-target species, Barrier to species movement; Death or injury by collision; Visual disturbance.

Table C14. Summary of gaps for other human pressures on the Atlas

Data Requirement*	Number of Sub-themes		
	Yes	Partial	No
Historic quality status			
Current quality status			31
Potential future quality status			

* Historic and potential future quality status could be relevant for marine planning, but these have not been included on the spreadsheet.

None of the possible pressure data layers is available on the Atlas, but WFD data layers could be seen as covering seven of the chemical pressures (Transition elements and organo-metal contamination, Hydrocarbon and PAH contamination, Synthetic compound contamination, Introduction of other substances, Nutrient enrichment, Organic enrichment and Deoxygenation).

For a further seven pressures (Temperature changes – local, Salinity changes – local; Water flow (tidal current) changes – local, including sediment transport considerations; Emergence regime changes - local, including tidal level change; Wave exposure changes – local; Introduction of light and Barrier to species movement), the level of pressure is not considered to be significant at plan scale and therefore do not merit further consideration.

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following possible pressure layers:

- Physical loss (to land or freshwater habitat);
- Physical change (to another seabed type);
- Habitat structure changes - removal of substratum (extraction);
- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion;
- Siltation rate changes, including smothering (depth of vertical sediment accretion);
- Marine litter;
- Electromagnetic changes;
- Underwater noise changes;
- Genetic modification and translocation of indigenous species;
- Introduction or spread of non-indigenous species;
- Introduction of microbial pathogens;
- Removal of target species.

Maps of current pressure could be prepared using available data and assumptions at a cost of <€5k to €10 - 100k per data product, although confidence in some of the data layers is likely to be low.

For the other possible pressure layers, the relative lack of data is likely to confound attempts to create a meaningful data product and new data collection would probably be necessary.

C.5 Human Environment

C.5.1 Aquaculture

Data gaps for aquaculture against the generic MSP data requirements are shown in Table C15. The general features that have been identified as relevant for aquaculture are:

- Finfish;
- Seaweed; and
- Shellfish.

Table C15. Summary of gaps for aquaculture on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Activity-specific administrative boundary	1		
Current spatial distribution of **resource**			3
Potential **future** spatial distribution of **resource** (next 20 years)			3
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)			3
Current spatial distribution/location and intensity of **activity**	3		
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			3
Data/spatial data on **historic value** of activity (last 10 years)			3
Data/spatial data on **current value** of activity			3
Data/spatial data on potential **future value** of activity (next 20 years)			3

Against the generic MSP data requirements, **data for aquaculture exist on the Atlas** for:

- Administrative boundaries for shellfish production;
- Current spatial distribution/location of activity (finfish, seaweed, shellfish).

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- Historic spatial distribution/location and/or intensity of activity (last 10 years) (finfish, shellfish only – seaweed is an emerging sector therefore historic data unlikely);
  - This could be filled relatively easily by mapping the location of historic licensed sites using data from licensing body (DAFM) (€5–10k per aquaculture type);
- Data/spatial data on current value of activity (finfish, seaweed, shellfish);
  - BIM annual aquaculture survey includes value of production by county, this could be spatialised by county. Alternatively, value per species per county could be assigned across relevant production units (€5–10k per aquaculture type).
- Data/spatial data on historic value of activity (finfish, shellfish only – seaweed is an emerging sector therefore historic data unlikely);
  - As above, create spatial layer using historic value data by county from BIM, could also be combined with historic location of activity to produce average value per production unit (€5-10k per aquaculture type).

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require **new data collection programmes** to collect the required data, for the following:

- Potential future spatial distribution of resource (next 20 years);
  - Model areas of aquaculture potential based on areas where suitable physical and environmental parameters occur. Model can include constraints based on the distribution, location and intensity of other marine sector activities (€10–100k per aquaculture type);

- Potential future spatial distribution/location and intensity of activity (next 20 years);
  - Using model of areas of aquaculture potential (above), identify most suitable areas for growth and develop scenarios of sector growth (trends, growth in existing production units vs establishment of new production units) (€10–100k per aquaculture type);
- Data/spatial data on potential future value of activity (next 20 years);
  - Potential future projections of value based on trends, assumptions (production levels, markets and prices) (€10–100k per aquaculture type).

C.5.2 Aviation

Data gaps for aviation against the generic MSP data requirements are shown in Table C16. The general features that have been identified as relevant for aviation are:

- Airport Control Zones;
- Helicopter Main Routes.

Table C16. Summary of gaps for aviation on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Activity-specific administrative boundary			2
Current spatial distribution/location and intensity of **activity**			1
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			1

There are **data gaps on the Atlas, but data is available from other agencies** that could be sourced and/or processed, for the following:

- Airport control areas and helicopter main routes data are not available on the Marine Atlas;
  - Spatial data is available from the Irish Aviation Authority. The cost would likely be <€5k.

C.5.3 Carbon capture and storage

Data gaps for carbon capture and storage against the generic MSP data requirements are shown in Table C17. The general features that have been identified as relevant for carbon capture and storage are:

- Assessment of the Potential for Geological Storage of CO2 for the Island of Ireland.

Table C17. Summary of gaps for carbon capture and storage on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Potential **future** spatial distribution of **resource** (next 20 years)			1
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			1
Data/spatial data on potential **future value** of activity (next 20 years)			1

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on existing or potential future areas for CCS storage or where future infrastructure might be located, but data could be sourced from a previous SEIA study;
    - Some information on potential resource areas could be collated from SEIA 2008[5] (<€5k per data product).

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require new data collection programmes to collect the required data, for the following:

- There are no data relating to potential economic value of future CCS projects in Ireland;
    - It may be possible to develop some indicative information on CCs project costs and benefits from experience in other administrations (<€5k per data product) but confidence would be low.

C.5.4 Coast and flood defences

Data gaps for coast and flood defences against the generic MSP data requirements are shown in Table C18. The general features/sub-themes that have been identified as relevant for coastal and flood defences are as follows:

- Coastal erosion;
- Flood risk;
- Flood and coastal defence structures.

Table C18. Summary of gaps for coast and flood defences on the Atlas

Data requirement	Number of sub-themes		
	Yes	Partial	No
Current spatial distribution/location and intensity of **activity**			3
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			3

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on coastal flood risk, but data could be sourced from OPW;
    - It should be possible to fill this gap using OPW ICPSS data at low cost (<€5k);
- There are no data on coastal erosion, but data for future erosion hazard (set back lines) could be sourced from OPW at low cost (<€5k).

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require new data collection programmes to collect the required data, for the following:

- There are no data relating to current coastal erosion or the location/nature of flood protection/coast defence assets;
    - Addressing these data gaps is likely to be challenging and require a significant attempt to collate data from local authorities and other sources (<€10-100k). It may not be possible to adequately address the gaps without implementing additional surveys.

[5] Assessment of the Potential for Geological Storage of CO2 for the Island of Ireland, SEIA 2008.

C.5.5 Cultural heritage

Data gaps for cultural heritage against the generic MSP data requirements are shown in Table C19. The general features/sub-themes that have been identified as relevant for cultural heritage are as follows:

- Terrestrial heritage assets;
- Historic buildings;
- World Heritage Sites;
- Wrecks.

Table C19. Summary of gaps for cultural heritage on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution of **resource**		1	3
Current spatial distribution/location and intensity of **activity**			4
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			4
Data/spatial data on **historic value** of activity (last 10 years)			2
Data/spatial data on **current value** of activity			4
Data/spatial data on potential **future value** of activity (next 20 years)			4

There are **currently no data on the Atlas** for cultural heritage, apart from the distribution of wrecks.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Current spatial distribution of wrecks (INFOMAR-surveyed wrecks);
    - Data is available as points only; standard buffers could be applied to ensure full area of asset is protected, with this data added to the Atlas (Costs <€5k).

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- Current (cultural) value of shipwrecks is unclear and is not recorded in available datasets;
    - Engagement with NMS required to understand whether information on potential cultural value is available and approaches that could be taken (Costs <€5k);
    - Application of an assumptions-based approach to dataset, e.g. assigning a higher level of importance to WWI/II wrecks and those with established provenance (Costs <€5k);
- Current spatial distribution of World Heritage Sites;
    - Polygon data available and could be added to Marine Atlas (Costs <€5k);
- Current spatial distribution of terrestrial heritage assets and historic buildings in the coastal zone is available in the form of the Archaeological Survey of Ireland Sites and Monuments Record and the National Inventory of Architectural Heritage point data. This could be added to the Marine Atlas (Costs <€5k).

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require new data collection programmes to collect the required data, for the following:

- There are no data at the Ireland level relating to non-wreck marine heritage assets;
    - The ongoing submerged palaeolandscapes project ('Europe's Lost Frontiers') and surveys, in which MI is a partner, will partially address this in the offshore area – but data for the intertidal and inshore zone will be missing. It is unlikely that this could be collected within the scope of this project. While it is understood that piecemeal surveys of the coastal zone have been undertaken (e.g. by University College Cork Coastal and Marine Resources Centre), the data arising does not appear to have been incorporated in the national SMR. It is anticipated that engagement with MI staff involved in this process would help determine data availability schedules (costs <€5k);
    - If no data is available, proxy analysis of existing bathymetric data – based on depth / sea level regression, topography type and sediment cover – could be used to define broad areas with potential for preservation of palaeolandscapes (costs €10k-€100k).

No data are available for the following, relating to any sub-theme / dataset:

- Historic spatial distribution/location and/or intensity of activity (last 10 years) – cultural heritage assets are a fixed, finite resource. Historic distributions would depict patterns of research and discovery, not the actual distribution of assets;
- Current spatial distribution/location and intensity of activity – cultural heritage data maps fixed assets rather than activities. This would be more effectively analysed through visitor data under the Tourism and Recreation theme;
- Potential future spatial distribution of resource (next 20 years) – cultural heritage assets are a fixed, finite resource. Future understanding of distribution is reliant on patterns of research and discovery, not the actual distribution of assets;
- Potential future spatial distribution/location and intensity of activity (next 20 years) – cultural heritage data maps fixed assets rather than activities. This would more effectively analysed through visitor data under the Tourism and Recreation theme;
- Data/spatial data on historic value of activity (last 10 years): in relation to cultural value, this would not be an appropriate measure. For social and economic values, this would be better captured under Tourism and Recreation;
- Data/spatial data on potential future value of activity (next 20 years): in relation to cultural value, this would not be an appropriate measure. For social and economic values, this would be better captured under Tourism and Recreation.

C.5.6 Defence

Data gaps for defence against the generic MSP data requirements are shown in Table C20. The general features identified as relevant for Defence are:

- Danger Areas;
- Naval bases.

Table C20. Summary of gaps for defence on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Activity-specific administrative boundary			1
Current spatial distribution/location and intensity of **activity**			1
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			1
Data/spatial data on **current value** of activity			1
Data/spatial data on potential **future value** of activity (next 20 years)			1

There are **data gaps on the Atlas, but data is available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on activity specific boundary or spatial (current or future) distribution;
    - Data could be sourced from the Naval Services and the Department of Defence (cost estimate <€5k).

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require new data collection programmes to collect the required data, for the following:

- There are no data relating to value of naval defence. The data only exist either in relation to ship investments or contribution of overall defence forces to GDP;
    - Data could be extracted from the mid-term review of the 2016-2021 Capital Plan and contribution to GDP (cost estimate €10-100k).

C.5.7 Energy

Data gaps for energy against the generic MSP data requirements are shown in Table C21. The general features/sub-themes that have been identified as relevant for energy are as follows:

- Coastal power stations;
- Electricity distribution network;
- Electricity interconnectors;
- Gas distribution network;
- Gas interconnectors;
- Ireland Block Grid;
- Ireland Quad Grid;
- Offshore wind infrastructure;
- Offshore wind development areas;
- Offshore wind resources;
- Oil and gas fields;
- Oil and gas infrastructure;
- Oil and gas development licences;
- Tidal stream energy resource;
- Tidal range energy resource;
- Tidal energy infrastructure;
- Wave energy infrastructure;
- Wave energy resources.

Table C21. Summary of gaps for energy on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Activity-specific administrative boundary	2		
Current spatial distribution of **resource**	3	1	1
Potential **future** spatial distribution of **resource** (next 20 years)			
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)		5	4
Current spatial distribution/location and intensity of **activity**	4	1	4
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)		5	4
Data/spatial data on **historic value** of activity (last 10 years)		4	5
Data/spatial data on **current value** of activity		4	5
Data/spatial data on potential **future value** of activity (next 20 years)			9

Against the generic MSP data requirements, **data for energy exist on the Atlas** for:

- Administrative boundaries for oil and gas licensing;
- Spatial distribution of offshore wind, wave and tidal stream energy;
- Current spatial distribution of power and gas interconnectors, oil and gas infrastructure and offshore wave infrastructure.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Oil and gas resources:
  - It may be possible to fill this gap using information from other sources at relatively low cost (€5-10k);
- Historic location and intensity of electricity interconnectors, gas interconnectors, oil and gas, offshore wind and offshore wave infrastructure:
  - It is anticipated that this information can be derived from existing information on the Atlas or from other data providers, subject to licensing agreements at low cost (<€5k per data product);
- Location and intensity of existing offshore wind infrastructure:
  - It is anticipated that this information can be derived from MIDA, subject to licensing agreements at low cost (<€5k);
- Location and intensity of future electricity and gas interconnectors, offshore wind and wave infrastructure and oil and gas infrastructure:
  - It is anticipated that this information can be derived from existing information on the Atlas or from other data providers, subject to licensing agreements at relatively low cost (<€5k or €5-10k per data product);
- Historic and current value of oil and gas, offshore wind, wave and tidal energy:
  - It is anticipated that this information can be derived from a combination of existing information on the Atlas and from other data providers, subject to licensing agreements at relatively low cost (<€5k per data product);

There are **data gaps on the Atlas, but data are available from other agencies** that could be sourced and/or processed, for the following:

- Tidal range energy potential;
  - This could be sourced from existing MI hydrodynamic models at low cost (<€5k);

- Historic distribution of coastal power stations, electricity and gas distribution networks[6];
    - It is anticipated that this information can be sourced from other data providers, subject to licensing agreements at low cost (<€5k per data product);
- Current distribution and intensity of coastal power stations, electricity and gas distribution networks;
    - It is anticipated that this information can be sourced from other data providers, subject to licensing agreements at low cost (<€5k per data product);
- Future distribution and intensity of coastal power stations and electricity and gas distribution networks:
    - It is anticipated that this information can be derived from existing information from other data providers, subject to licensing agreements at relatively low cost (<€5k or €5-10k per data product);
- Historic and current value of coastal power stations, electricity and gas distribution networks and electricity and gas interconnectors:
    - It is anticipated that this information can be derived from other data providers, subject to licensing agreements at relatively low cost (<€5k per data product);
- Potential future value of all energy activities:
    - It is anticipated that this information can be derived from other data providers, subject to licensing agreements at relatively low cost (<€5k per data product);

C.5.8 Fisheries and shellfisheries

Data gaps for fisheries and shellfisheries against the generic MSP data requirements are shown in Table C22. The general features that have been identified as relevant for fisheries and shellfisheries are:

- Landings by port (broken down by deepwater/demersal/pelagic/shellfish);
- Vessel numbers by port (can show number of vessels by length group);
- Vessel steaming routes to fishing grounds;
- Inshore (<12m) fishing, layers by gear type;
- Salmon fisheries (commercial salmon catch, salmon drift nets);
- Offshore (>12m) (Irish vessels) fishing, layers by gear type;
- Offshore (>12m) (non-Irish vessels) fishing, layers by gear type.

Not all indicative MSP requirements will apply to all features (e.g. requirements on value are not relevant to vessel numbers by port, but are relevant to landings by port).

Table C22. Summary of gaps for fisheries and shellfisheries on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Activity-specific administrative boundary	9		2
Current spatial distribution of **resource**			2
Potential **future** spatial distribution of **resource** (next 20 years)			2
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)		2	5
Current spatial distribution/location and intensity of **activity**		2	5
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			7
Data/spatial data on **historic value** of activity (last 10 years)			5
Data/spatial data on **current value** of activity			5
Data/spatial data on potential **future value** of activity (next 20 years)			5

[6] There is also no data on historic (or current) tidal stream infrastructure as none has yet been installed in Irish waters

Against the generic MSP data requirements, **data for fisheries and shellfisheries exist on the Atlas** for:

- A number of activity-specific administrative boundaries.

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Historic distribution and intensity of activity for inshore and offshore fisheries;
  - For inshore, layers are available on the Atlas (2010-2013) but need to be checked for completeness against the Atlas of commercial shellfisheries in Ireland;
  - For offshore, layers available show CPUE which is an indicator of abundance of the resource rather than intensity of activity. Layers of effort by gear type (2008-2012) could be incorporated from the Atlas of Commercial Fisheries in Ireland 2nd Edition at low cost (<€5k);
- Current distribution and intensity of activity for inshore and offshore fisheries;
  - Existing inshore layers are out-of-date. Updating data on inshore fishing will be resource-intensive (>€100k) as data collection, mapping, and processing will be required. The existing layers could be combined with the layers in the Atlas of commercial shellfisheries in Ireland (€5-10k) and new layers could be created over time as vessel monitoring systems are extended across the fleet;
  - Existing offshore layers are out-of-date (2011 or earlier) and require updating. Marine Institute is currently processing new layers from VMS data. It is recommended to have layers for each gear type, plus amalgamated layers for e.g. demersal mobile, static and pelagic gears. Effort and/or volume of landings should be used – effort would more clearly reflect distribution of activity (rather than a reflection of resource abundance);

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on Administrative boundaries relating to closed areas/management areas, and historic access rights in the 6-12nm area;
  - Data could be sourced from BIM at low cost (<€5k);
- Vessel numbers by port, broken down by vessel size;
  - Fleet register could be obtained from DAFM(?) and spatialized (€5-10k);
- Landings by port (broken down by demersal/pelagic/shellfish/deepwater species), for historic and current spatial distribution (volume) and value;
  - These data should be obtainable from DAFM/SFPA, and would require processing and spatialising (€5-10k);
- Fishing grounds (shellfish beds and other species);
  - Maps of shellfish beds and fishing grounds can be combined from the Commercial fisheries for shellfish around Ireland and Atlas of Commercial Fisheries around Ireland, 2nd edition (<€5k, €5-10k);
- Historic and current spatial distribution of offshore fishing by non-Irish vessels;
  - A map of historic activity is available in Commercial Fisheries Atlas 2nd Edition (international effort from VMS) that could be obtained for <€5k;
  - More recent VMS data could be processed to produce a layer for current activity (€5-10k);
- Historic and current salmon fisheries (commercial salmon catch, salmon drift nets);
  - Landings statistics from Inland Fisheries Ireland could be spatialized (€5-10k);
- Vessel steaming routes to fishing grounds (historic, current and future);
  - Historic and current VMS data could be processed to show steaming routes (pings where speed >6knots), for €5-10k.

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require new data collection programmes to collect the required data, for the following:

- Layers on value of activity for inshore, salmon, offshore (Irish) and offshore (non-Irish) vessels, for historic and current data;
  - For inshore fishing, ICES rectangle data on value could be spatialized across the fishing areas (€10-100k);
  - For salmon fishing, assumptions on value (price per salmon) could be used to attribute a value to the spatialized catch data (€10-100k);
  - For offshore Irish vessels, VMS data can be linked to logbook returns to generate layers showing value of landings (historic and current), €10-100k;
  - For offshore non-Irish vessels, VMS pings could be linked to STECF landings data and converted to value using Irish landings prices (€10-100k);
- Future projections on resource distribution, activity distribution and value of activity;
  - Filling these gaps would require modelling of future species distributions based on stock and climate change models, combined with projections on fleet development and levels of effort, and projected future values, with increasing assumptions at each stage. Multiple layers, varying from €10-100k and >€100k.

C.5.9 Land-side infrastructure (roads, rail, urban development, utilities)

Data gaps for land-side infrastructure (roads, rail, urban development, utilities) against the generic MSP data requirements are shown in Table C23. The general features identified as relevant for land-side infrastructure are:

- Eirgrid Transmission Network;
- Gas Pipeline Network;
- Interconnector;
- Rail Network;
- Road Network.

Table C23. Summary of gaps for land-side infrastructure on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)			5
Current spatial distribution/location and intensity of **activity**		2	3
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			5
Data/spatial data on **historic value** of activity (last 10 years)			5
Data/spatial data on **current value** of activity			5
Data/spatial data on potential **future value** of activity (next 20 years)			5

There are **partial data gaps** on the Atlas for:

- Current spatial distribution of the road network (motorways and national roads only shown);
  - A new basemap sourced from OSI could address the issue of the current spatial distribution of rail and road. The recommended basemap is the Discovery Series, the same used on myplan.ie. Cost <€5k.

- Current spatial distribution of the gas pipeline network (no data for onshore network);
    - The polyline shown on https://www.gasnetworks.ie/corporate/gas-regulation/transparency-and-publicat/dashboard-reporting/ could be used, estimated cost <€5k.

There are **data gaps on the Atlas, but data is available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on any of **the onshore Transmission Network** layers, but data could be sourced from Eirgrid;
    - Most data are in the public domain but requires processing. It would cost €10k - €100k to process.
- There are no data on any of the **onshore gas pipeline network** layers, but data could be sourced from Gas Network Ireland (GNI);
    - Most data is in the public domain but requires processing. It would cost €10k - €100k to process.
- There are no data on any of the **onshore interconnector** layers, but data could be sourced from Eirgrid. There is no historic or current data on onshore interconnector as no onshore interconnector has been built to date. The only data available regards the future / potential;
    - Most data is in the public domain but requires processing. It would cost €5k - €10k to process.
- There are no data on any of the **rail network** layers, but data could be sourced from Irish Rail and Transport Infrastructure Ireland and OSI;
    - Most data are in the public domain but requires processing. It would cost €5k - €10k to process.

C.5.10 Marine aggregates

Data gaps for marine aggregates against the generic MSP data requirements are shown in Table C24. The general features/sub-themes that have been identified as relevant for marine aggregates are as follows:

- Marine aggregate resource;
- Marine aggregate extraction.

Table C24. Summary of gaps for marine aggregates on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution of **resource**		1	
Potential **future** spatial distribution of **resource** (next 20 years)		1	
Current spatial distribution/location and intensity of **activity**			1
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			1
Data/spatial data on **current value** of activity			1
Data/spatial data on potential **future value** of activity (next 20 years)			1

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Current and potential future distribution of marine aggregate resources;
    - Development of a comprehensive data layer of existing marine aggregate resources is likely to entail a significant effort in analysing INFOMAR seabed sediment data and IGS borehole data. Future data layer likely to be similar if not identical to current data layer as resource distribution is unlikely to change significantly over time

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on the Atlas in relation to existing marine aggregate extraction activities, but data could be sourced from DHPLG for the Drogheda maintenance dredging licence (from which dredged sand is being used for other purposes);
    - It should be possible to create data layers on the location/intensity of existing marine aggregate extraction activity (and value) at low cost (<€5k).

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require new data collection programmes to collect the required data, for the following:

- Location and intensity and value of potential future marine aggregate activity:
    - It is currently unclear to what extent a significant marine aggregate industry might develop.

C.5.11 Other marine infrastructure

Data gaps for other marine infrastructure against the generic MSP data requirements are shown in Table C25. The general features/sub-themes that have been identified as relevant for other marine infrastructure are as follows:

- Commissioners of Irish Lights Buoy;
- Irish National Tide Gauge Network;
- Weather Buoy Network;
- Weather Station.

Table C25. Summary of gaps for other marine infrastructure on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution/location and intensity of **activity**	4		

Against the generic MSP data requirements, data for other marine infrastructure exist on the Atlas for:

- Commissioners of Irish Lights Buoy;
- Irish National Tide Gauge Network;
- Weather Buoy Network; and
- Weather Station.

This is considered sufficient for the purposes of MSP. While the location of other marine infrastructure may change slightly over time, this can be reflected in regular (annual) update of the data layers.

C.5.12 Ports and shipping

Data gaps for ports and shipping against the generic MSP data requirements are shown in Table C26. The general features identified as relevant for ports and shipping are:

- Lighthouse;
- Navigation Buoy;
- Shipping density;
- Ports;
- Ferry Route;
- Point locations of piers and quays;
- Particularly Sensitive Sea Areas;
- Sulphur Emission Control Areas;
- Dumping at Sea Boundary;
- IMO Routeing;
- Search & Rescue - RNLI Stations;
- Search & Rescue - Accident & Incident Stats;
- Search & Rescue - Irish Coast Guard resources;
- Statutory Harbour Areas;
- Maintained navigation channels;
- Commercial anchorages;
- Slipways.

Table C26. Summary of gaps for ports and shipping on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Activity-specific administrative boundary		2	4
Current spatial distribution of **resource**	2	1	3
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)		1	2
Current spatial distribution/location and intensity of **activity**		3	2
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)		1	1
Data/spatial data on **historic value** of activity (last 10 years)			1
Data/spatial data on **current value** of activity			1
Data/spatial data on potential **future value** of activity (next 20 years)			1

Against the generic MSP data requirements, data for ports and shipping exist on the Atlas for:

- Lighthouse;
- Point locations of piers, quays.

There are **partial data gaps** (i.e. data is available on the Atlas but may be spatially incomplete or requires updating). The following notes against each data type/layer are presented:

- Location and intensity of past present and potential future port activity – information available on Atlas for port location/type but not intensity
    - Could create data layer(s) indicating intensity of activity based on throughput/passenger numbers etc (<€5K per data product)

- Particularly Sensitive Sea Areas (an area which needs special protection as defined by the International Maritime Organization (IMO)), is suitable for use with minor modification, data is displayed as a blank area covering defined sea area as a whole (limited Meta data).
    - IMO data outlines the limits of PSSAs <€5K.
- Sulphur Emission Control Areas, is suitable for use with minor modification, the data layer defines existing area but does not include future control areas;
    - MARPOL (Maritime Pollution) and IMO regulations can be source to fill the gaps for future enforcements<€5k.
- Coastguard collected Automatic Identification System (AIS) traffic frequency is displays as AIS point data. Transit line data nor vessel derived density is not presented;
    - Process Coastguard AIS data into transit lines and density grid. €10k-100k.
- Navigation Buoys are identified, but with limited Meta-data regarding buoy type or fitted navigational equipment (transponders, lights etc);
    - Information collected from Commissioner of Irish Lights<€5k.

There are **data gaps on the Atlas, but data available from other agencies**/organisations that could be sourced and/or processed, for the following:

- MMO distributed (MCA) AIS Data:
    - Data sourced from Irish Coastguard AIS data, €10k-€100k;
    - Or, data sourced from MMO (MCA) via ABPmer (will only cover the Irish Sea and partially cover Southern Irish Coastline) €5k-€10k.
- Past, present and potential future value of port activity – information available on Atlas for port location/type but not value
    - Could create data layer(s) indicating value based on throughput/passenger numbers etc and national data on value of port sector (<€5K per data product)
- IMO Routeing:
    - Data can be collected from IMO routeing charts and presented as a data layer, <€5K.
- Search & Rescue - RNLI Stations, but data could be sourced from RNLI:
    - Can be acquired from RNLI websites and/or enquire directly to RNLI identifying point locations of resources (stations, fixed assets, mobile assets) <€5k.
- Search & Rescue - Accident & Incident Stats, but data could be sourced from RNLI:
    - RNLI incidents data can be acquired from RNLI for a £250 search and extract fee. The data can be worked up into point data and head maps of incident occurrence intensity, <€5k.
- Search & Rescue - Irish Coach Guard Resources, but data could be sourced from Irish Coastguard:
    - Data sourced from Irish Coastguards identifying point locations of resources (stations, fixed assets, mobile assets) <€5k.
- Statutory Harbour Areas:
    - Data can be sourced from UKHO Chart and digitised which will require the purchase and processing of charts for the entire Irish coast €10-100k.
- Maintained navigation channels:
    - Data can be sourced from UKHO Chart and digitised which will require the purchase and processing of charts for the entire Irish coast (see above item) €10-100k.
- Commercial anchorages:
    - Data can be sourced from UKHO Chart and digitised which will require the purchase and processing of charts for the entire Irish coast (see above items) €10-100k.
- Slipways:
    - Data can be sourced from www.boatlaunch.co.uk and created into a data layer, automatic extract may be possible through negotiation with the data holder<€5k.

C.5.13 Seascape

Data gaps for seascape against the generic MSP data requirements are shown in Table C27. The feature that has been identified as relevant for seascape is:

- Seascape character areas/types;

Table C27. Summary of gaps for seascape on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution of **resource**			1
Potential **future** spatial distribution of **resource** (next 20 years)			1

No data is available on the Atlas relating to seascapes, but there is **partial information available from other sources**:

- Donegal and Clare county councils' Seascape Character Assessments;
- Leitrim, Mayo, Galway, Limerick, Cork, Wexford, Wicklow, Kilkenny, Dublin, Meath and Louth county councils' Landscape Character Assessments which identify seascape character areas;
- Strategic Environmental Assessment (SEA) of the Offshore Renewable Energy Development Plan in the Republic of Ireland (Sustainable Energy Authority of Ireland, 2010). The seascape assessment part of this SEA was undertaken by desk study only.

There is a **data gap at an Ireland level** for a comprehensive seascape character assessment. At minimum, a desk based assessment of seascape character based on analysis of spatial data layers would generate draft character areas which would be mapped and key characteristics described. It would not be informed by site survey and might therefore be open to challenge.

A more comprehensive approach, as recommended by the Marine Institute (2001) would be to carry out a desk and field based analysis of seascape character based on analysis of spatial data layers, sea and land based survey. This would generate definitive seascape character areas which would be mapped and key characteristics described. Cost €10k–100k.

C.5.14 Socio-economic factors

Data gaps for social factors against the generic MSP data requirements are shown in Table C28. The general features identified as relevant for socio-economic factors are:

- Deprivation Index;
- Population distribution;
- Level of Education;
- Housing;
- Male Unemployment;
- Female Unemployment;
- Overall unemployment;
- Employment by Industrial Sector e.g. farming.

Table C28. Summary of gaps for social factors on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)			6
Current spatial distribution/location and intensity of **activity**			6
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			6

There are **data gaps on the Atlas, but data available from other agencies** (that could be sourced and/or processed, for historic and current deprivation index, population, level of education, housing and unemployment.

- There are no data for historic and current deprivation index, population, level of education, housing, unemployment and industry, but data could be sourced from Pobal Maps and Central Statistics Office (CSO);
    - Relevant maps could be prepared at relatively low cost (€<5k per data product). CSO data is available under Creative Commons licence and thus outputs could be made readily available. Pobal data would be viewable but due to data restrictions may not be downloadable other than as a static map.
- There are no data for potential future deprivation index, population, level of education, housing, unemployment and industry, but existing data could be sourced from Pobal Maps and Central Statistics Office (CSO) and future trend assumptions applied;
    - Relevant maps could be prepared at relatively low cost (€5-10k per data product). CSO data is available under Creative Commons licence and thus outputs could be made readily available. Pobal data would be viewable but due to data restrictions may not be downloadable other than as a static map.

C.5.15 Surface water/wastewater management

Data gaps for surface water/wastewater management (integrated pollution control) against the generic MSP data requirements are shown in Table C29. The general features identified as relevant for surface water/wastewater management are:

- Integrated Pollution Control;
- Licensed Waste Facility;
- Urban Waste Water Treatment.

Table C29. Summary of gaps for surface water/wastewater management on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)		3	
Current spatial distribution/location and intensity of **activity**	3		
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)		3	
Data/spatial data on **historic value** of activity (last 10 years)			3
Data/spatial data on **current value** of activity			3
Data/spatial data on potential **future value** of activity (next 20 years)			3

Against the generic MSP data requirements, **data exists on the Atlas** for the current spatial distribution of:

- Licenced facilities for Integrated pollution control;
- Urban waste water treatment plant, including their population equivalent;
- Licensed waste facilities.

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- Historic and future distribution of the above-mentioned category is not available but could be modelled using EPA data;
    - Other data may need to be processed. Cost: €10-100k.
- Historic and current value of the above-mentioned categories could be modelled using EPA data;
    - Other data may need to be processed. Cost: €10-100k.

C.5.16 Telecommunications

Data gaps for telecommunications against the generic MSP data requirements are shown in Table C30. The feature that has been identified as relevant for telecommunications is:

- Subsea Cables.

Table C30. Summary of gaps for telecommunications on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)		1	
Current spatial distribution/location and intensity of **activity**		1	
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)		1	
Data/spatial data on **historic value** of activity (last 10 years)			1
Data/spatial data on **current value** of activity			1
Data/spatial data on potential **future value** of activity (next 20 years)			1

There are **partial data gaps** (i.e. data are available on the Atlas but may be spatially incomplete or are dated and require updating) for the following:

- Historic, current and potential future distribution and intensity of activity;
    - Some refinement of the data product on the Atlas is required to create distinct historic, current and potential future telecom cable data layers (<€5k per data product).

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- There are no data on historic, current or potential future economic value of telecom cables, but data could be sourced from other administrations;
    - It may be possible to create a data product indicating replacement cost for telecom cables drawing on information from other administrations (<€5k per data product), although there is no agreed method for estimating economic value of telecom cables.

C.5.17 Tourism and recreation

Data gaps for tourism and recreation against the generic MSP data requirements are shown in Table C31. The general features that have been identified as relevant for tourism and recreation relate to various types of activity as follows:

- Angling (shore, boat and bait collection);
- Kitesurfing;
- Windsurfing;
- Surfing;
- Coasteering/bouldering at coast;
- Diving/snorkelling;
- Recreational drone use at coast;
- General Beach Leisure - Beach combing, beach games, sun bathing, rock pooling, sea swimming;
- General Coastal Tourism Activities;
- Hovercraft;
- Cycling along the coast;
- Quad bikes, scramble bikes or cars on foreshore;
- Sand-yachting/land-sailing/land-yachting;
- Kite buggying;
- Kite landboarding;
- Light aircraft (motorised and un-motorised);
- Motorboats;
- Motorised sail boats;
- Wakeboarding and Waterskiing;
- Parascending;
- Un-motorised sail boats;
- Kayaking;
- Canadian canoeing;
- Stand Up Paddleboarding (SUP);
- Rowing/sculling;
- Dinghies, day boats or other small keelboats;
- Personal watercraft;
- Visit to attractions;
- Walking;
- Wildlife/bird watching/wildfowling.

Table C31. Summary of gaps for tourism and recreation on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)			30
Current spatial distribution/location and intensity of **activity**		2	28
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			30
Data/spatial data on **historic value** of activity (last 10 years)			30
Data/spatial data on **current value** of activity			30
Data/spatial data on potential **future value** of activity (next 20 years)			30

Against the generic MSP data requirements, **partial data for tourism and recreation exist on the Atlas** for:

- Bathing Water Quality;
- INFOMAR Surveyed Shipwreck.

No data is available on the Atlas relating to tourism and recreation, but there is data available from other agencies that could be sourced and/or processed, for the following data layers. However, it should be noted that data relating to activity clubs, centres, schools and operators provides a proxy measure since it does not accurately record where an activity takes place, nor the number of people undertaking the activity in each of these locations.

- Density map for pleasure crafts (yachts, sailing vessels and other pleasure crafts) around Ireland available to purchase from Marine Traffic.
- Clubs, centres, schools and operators for the following data layers – Angling; Kitesurfing; Windsurfing; Surfing; Coasteering/Bouldering at coast; Diving/Snorkelling; Hovercrafting; Cycling; Quadbiking; Sand-yachting/land-sailing/land-yachting; Kite buggying; Light aircraft; Motorboats; Motorised sail boats; Wakeboarding/water skiing; Un-motorised sail boats; Kayaking; Canadian canoeing; Stand-up paddleboarding; Rowing/sculling; Dinghy sailing; Personal watercraft users; and, Wildlife/bird watching/wildfowling.
- Location of scenic drives, walking and cycling routes/trails.
- Attractions along the coast.
- Beaches and good quality bathing water locations where general beach leisure and recreation activities may take place.

There are **data gaps at an Ireland level** (no data available, either on the Atlas or from other sources), that would require new data collection programmes to collect the required data for the following data layers. It is recommended that a new survey is carried out to gather spatial information on where different activities take place and the value of activities to the economy. This could most efficiently be undertaken if a single survey covers all marine recreation and tourism activities of interest, using interactive mapping to capture spatial information and linked questionnaires to gather a range of other relevant information.

- Angling – New primary data on location, intensity and value of activity (€5k-€10k).
- Kitesurfing – New primary data on location, intensity and value of activity (€5k-€10k).
- Windsurfing – New primary data on intensity and value of activity (€5k-€10k).
- Surfing – New primary data on intensity and value of activity (€5k-€10k).
- Coasteering/Bouldering at coast – New primary data on location, intensity and value of activity (€5k-€10k).
- Diving/snorkelling – New primary data on intensity and value of activity (€5k-€10k).
- Recreational drone use at coast – New primary data on location, intensity and value of activity (€5k-€10k).
- General beach leisure – New primary data on intensity and value of activity (€5k-€10k).
- General coastal tourism activities – New primary data on location, intensity and value of activity (€5k-€10k).
- Hovercrafting – New primary data on location, intensity and value of activity (€5k-€10k).
- Cycling along the coast – New primary data on intensity and value of activity (€5k-€10k).
- Quadbikes, scramble bikes or cars on foreshore – New primary data on location, intensity and value of activity (€5k-€10k).
- Sand-yachting/land-sailing/land-yachting – New primary data on location, intensity and value of activity (€5k-€10k).
- Kite buggying – New primary data on location, intensity and value of activity (€5k-€10k).
- Kite landboarding – New primary data on location, intensity and value of activity (€5k-€10k).

- Light aircraft – New primary data on location, intensity and value of activity (€5k-€10k).
- Motorboats – New primary data on intensity and value of activity (€10k-€100k).
- Motorised sail boats – New primary data on intensity and value of activity (€10k-€100k).
- Wakeboarding/water skiing – New primary data on location, intensity and value of activity (€5k-€10k).
- Parascending – New primary data on location, intensity and value of activity (€5k-€10k).
- Un-motorised sail boats – New primary data on location, intensity and value of activity (€5k-€10k).
- Kayaking – New primary data on location, intensity and value of activity (€5k-€10k).
- Canadian canoeing – New primary data on location, intensity and value of activity (€5k-€10k).
- Stand-up paddleboarding – New primary data on location, intensity and value of activity (€5k-€10k).
- Rowing/sculling – New primary data on location, intensity and value of activity (€5k-€10k).
- Dinghy, day boat and keelboat sailing – New primary data on location, intensity and value of activity (€5k-€10k).
- Personal watercraft users – New primary data on location, intensity and value of activity (€5k-€10k).
- Visits to attractions – New primary data on intensity and value of activity (€5k-€10k).
- Walking – New primary data on intensity and value of activity (€5k-€10k).
- Wildlife/bird watching/wild fowling – New primary data on location, intensity and value of activity (€5k-10k).

C.5.18 Wild seaweed harvesting

Data gaps for wild seaweed harvesting against the generic MSP data requirements are shown in Table C32. Only one feature is identified as relevant for wild seaweed harvesting:

- Seaweed harvesting.

Table C32. Summary of gaps for wild seaweed harvesting on the Atlas

Data Requirement	Number of Sub-themes		
	Yes	Partial	No
Current spatial distribution of **resource**			1
Potential **future** spatial distribution of **resource** (next 20 years)			1
Historic spatial distribution/location and/or intensity of **activity** (last 10 years)			1
Current spatial distribution/location and intensity of **activity**			1
Potential **future** spatial distribution/location and intensity of **activity** (next 20 years)			1
Data/spatial data on **historic value** of activity (last 10 years)			1
Data/spatial data on **current value** of activity			1
Data/spatial data on potential **future value** of activity (next 20 years)			1

There are **data gaps on the Atlas, but data available from other agencies** that could be sourced and/or processed, for the following:

- Historic and current spatial distribution/location and/or intensity of activity (last 10 years);
    - Shapefile for licences permitted over last ten years could be requested from DHPLG (<€5k). Use DHPLG website to determine which licences are still current. For intensity, review MLVC's report on all granted license to identify quantity harvested (in tonnes). Cost €10-100k.

- Current spatial distribution of resource;
    - There are various options for filling this gap: collate existing information on distribution of commercial species (€10-100k); commission survey of distribution/abundance of commercial species (>€100k); and undertake modelling of key commercial species such as kelp (€10-100k).
- Historic, current, and future value of activity;
    - Data on the value of activity (historic and current) could be sourced from Bord Iascaigh Mhara (BIM) and combined with licence data from the Department of Housing Planning and Local Government (DHPLG) (<€5k). Data on future value will require projections combined with potential distribution of activity. Cost €10k-100k.

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